

The effect of equipping ambulances with rapid communication mechanisms in responding quickly to the injured in emergency situations

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ABSTRACT

The current study aimed to identify the impact of equipping ambulances with rapid communication mechanisms on the response time for injured individuals in emergency situations. This was achieved by employing a descriptive analytical approach through the distribution of a questionnaire consisting of 500 emergency medical technicians to assess their opinions regarding the equipping of ambulances and rapid communication mechanisms. The study's results indicated that there was no statistical significance attributed to professional and occupational experiences or the number of years of service concerning the responses of the sample on the questionnaire. The study presented several findings, including that technological advancements have facilitated the provision of higher quality communication means in ambulances, ensuring various solutions for rapid access to victims in emergencies. Furthermore, the implementation of precise location identification technology has enhanced response speed and helped avoid traffic congestion. The study's results also indicated that the quicker the access to the accident scene, the greater the chances of survival for the injured, and that there is an effect of delayed response on rescue opportunities.

Keywords: Technique, technology, response speed, communication methods, rapid access methods.

INTRODUCTION

Ambulances are the first responders in medical emergencies, playing a vital role in saving lives and minimizing the effects of accidents and sudden injuries. One of the key factors contributing to the efficiency of ambulance operations and improving response times is equipping them with the latest rapid communication technologies.^{1,15,8}

The importance of rapid communication in ambulances lies in effective coordination. Fast communication allows paramedics to instantly connect with hospital operations centers and other emergency response teams, facilitating effective coordination and determining the best route to the accident site, as well as transporting the patient to the nearest hospital equipped to handle their condition. Additionally, paramedics can transmit accurate and timely medical information about the patient's condition to the receiving hospital, enabling the hospital staff to prepare for the patient's arrival and provide necessary medical care upon arrival.^{8,15,5}

In cases requiring additional support, such as major accidents or disasters, paramedics can swiftly request assistance from fire, police, or other rescue teams. Furthermore, GPS systems allow for tracking the movements of ambulances and identifying the nearest available ambulance to the location, thereby reducing response times. Rapid communication aids paramedics in making critical decisions regarding the actions to be taken during patient transport, such as choosing the shortest routes or changing the hospital destination. All calls and information related to the patient's medical condition can be recorded, which helps improve the quality of emergency services and assess paramedic performance. Thus, equipping ambulances with rapid communication technologies offers numerous benefits.^{14,1,4}

Increased response speed is facilitated by rapid communication mechanisms, which contribute to reducing response times in emergency situations. These mechanisms enhance the quality of medical care provided to patients, improve the efficiency of ambulance teams, and bolster community trust in emergency services. One of the rapid communication methods utilized in ambulances is the use of radio devices to communicate with the operations center and coordinate with other ambulance teams, along with mobile phones for communication with hospitals and sending medical reports. Additionally, portable computers are employed to record medical information about the patient and transmit it to the hospital. GPS systems assist paramedics in locating the incident and determining the quickest routes to the hospital. Video communication systems for paramedics allow for interaction with hospital doctors and presenting the patient's condition to them.^{1,9}

Thus, equipping ambulances with the latest rapid communication mechanisms significantly enhances the efficiency of emergency services and provides better medical care for patients in emergencies. Rapid communication mechanisms are fundamental elements in improving the quality of emergency services and the speed of response to emergencies. By ensuring effective communication between ambulance teams and hospitals, the chances of survival for the injured can be improved, and the consequences of accidents and injuries can be minimized.^{10,2}

DISCUSSION

Ambulances and Response Speed

Ambulances play a crucial role in saving lives and providing urgent medical care in emergencies. One of the key factors that significantly affects the effectiveness of this service is the speed of response. Here, the role of rapid communication devices equipped in ambulances comes into play, which greatly contribute to reducing response time and improving the quality of service provided. The importance of response speed in emergencies lies in its contribution to saving lives, as every minute is critical in medical emergencies. Quick intervention and immediate first aid can make the difference between life and death, as well as alleviate suffering. Rapid access to the injured and the provision of necessary medical care reduce the pain and suffering they experience. The earlier first aid is administered, the lower the likelihood of serious complications from injuries.^{1,14}

Technology plays an important role in response speed through the use of Geographic Information Systems (GPS), which aid in precise navigation to identify the fastest routes to the accident site and avoid traffic congestion. It also enables medical centers to track the location of the ambulance in real-time. Furthermore, advanced communication devices facilitate instant communication between the ambulance and the hospital, allowing for the transmission of vital medical information about the patient and data transfer. Radiology images and medical test results can be sent online to facilitate diagnosis and treatment. Additionally, remote monitoring devices enable medical staff to monitor vital signs such as heart rate and blood pressure during transport, allowing for necessary actions to be taken in case of deterioration. Smart applications also allow citizens to report accidents more quickly.^{5,11}

-Types of Ambulances

Ambulances vary in design and equipment to meet the diverse needs in the field of emergency medical services. Each type of ambulance is designed to perform a specific function and provide a certain level of medical care during transport. Ambulances can be classified into several types based on various criteria, including :

Traditional ambulances, which are the most common and widespread, are characterized by their distinctive design that makes them easily recognizable. They contain a patient compartment equipped with basic resuscitation devices and a compartment for the driver and paramedics. These ambulances are used to transport patients from the scene of an accident to the hospital and provide basic first aid during transport.^{1,6}

Advanced ambulances are distinguished by more sophisticated medical equipment, such as ventilators and cardiac monitors. They may also include an isolation compartment for infectious patients and are used in critical medical situations that require advanced medical care during transport, such as severe burns or heart attacks.^{2,4} Specialized ambulances include pediatric ambulances, air ambulances, and those equipped to handle hazardous materials. Each type is specifically designed to meet certain needs, such as transporting sick children, accessing remote areas, or dealing with incidents involving hazardous materials.^{3,8}

Small ambulances are smaller and more flexible than traditional ambulances and are used in narrow or congested areas. They are utilized for short-distance patient transport or in locations that are difficult to access with larger ambulances.^{5,2}

Air ambulances are used to transport patients over long distances or to remote areas that are difficult to reach by road. They are equipped with the latest medical devices and provide intensive medical care during the flight. Marine ambulances are used in critical cases that require rapid transport to specialized medical centers. They are used to provide emergency services in marine areas such as ships and boats. They are equipped to deal with injuries and medical conditions that occur at sea. They are used in marine rescue operations and emergencies that occur on board ships. The factors affecting the choice of the type of ambulance are the patient's condition, the severity of the injury or illness, the distance between the accident site and the hospital, the availability of the necessary medical equipment, the condition of the road, and the weather conditions.^{1,5}

Ambulances play a crucial role in saving lives and providing urgent medical care to patients. To maximize the benefits of this service, ambulances must be equipped with the latest technologies, and paramedics should be trained to use all medical equipment available in the ambulance. Additionally, regular maintenance of ambulances is essential to ensure their safety and efficiency.^{4,2}

Components of an Ambulance

An ambulance serves as a mobile medical unit designed to provide primary medical care in emergencies and transport patients to hospitals. These vehicles include a wide range of medical equipment and devices that enable paramedics to handle various emergency situations. The most important components of an ambulance are the patient compartment, which contains a medical stretcher used for safe and comfortable patient transport, and securing devices used to stabilize the patient and prevent movement during transport, especially in cases of severe injuries. Vital signs monitoring devices, such as blood pressure monitors, pulse oximeters, and thermometers, are used to continuously track the patient's condition. Additionally, ventilators are employed in cases of respiratory arrest or difficulty breathing, and cardiac resuscitation devices are utilized in cases of cardiac arrest. A first aid kit contains a variety of medical tools and supplies, such as bandages, splints, medications, and more. The paramedic compartment includes a control panel with switches for lighting and other electrical devices in the vehicle, a medication cabinet containing necessary medications for various emergency situations, communication devices such as radios and mobile phones for contact with operations centers and hospitals, and an oxygen tank that provides essential oxygen to the patient when needed, along with protective equipment.^{1,12,9}

It provides the energy needed to operate electrical appliances in the event of a power outage and the air conditioning system, as it helps maintain a suitable temperature inside the patient's cabin. Accordingly, ambulances equipped with the latest technologies and medical tools work to provide the best possible medical care to patients in emergency situations. These components are vital to ensure the provision of effective medical care to patients in emergency situations.^{1,14,15}

Ambulance Speed

The speed of ambulances is a critically important topic where the urgent need to save lives intersects with traffic laws that ensure the safety of all road users. Every second is crucial in medical emergencies; however, ambulances face challenges regarding speed. In most countries, ambulances are granted the right to exceed the speed limit when their lights and sirens are activated, ensuring they reach the scene of an incident as quickly as possible. With this privilege, ambulance drivers bear the responsibility of driving cautiously and responsibly, considering the safety of others on the road. Nonetheless, there are speed limits for ambulances to ensure the safety of paramedics, patients, and pedestrians.^{2,5}

Ambulances also encounter challenges such as traffic congestion, which is one of the largest obstacles they face, limiting their ability to move quickly. Additionally, poor road conditions can delay ambulance arrival. The failure of some drivers to respect the rights of ambulances can further impede their movement. It is the responsibility of ambulance drivers to drive carefully, even when in a hurry, and to adhere to traffic laws as much as possible while considering emergency circumstances. They should use lights and sirens only when necessary and avoid disturbing others.^{4,1}

Furthermore, ambulance drivers must maintain continuous communication with the operations center to update information regarding their location and the patient's condition. The community also plays a role in assisting ambulances by distinguishing them from other vehicles. Drivers and pedestrians should recognize ambulances and facilitate their passage by yielding the right of way.^{5,7}

The speed of an ambulance is a complex issue that requires a balance between the need to save lives and ensuring the safety of everyone on the road. Through collaboration among stakeholders, infrastructure development, and community awareness, the performance of ambulances can be improved, ensuring they reach the accident site as quickly as possible and provide the necessary medical care to patients and the injured.

Rapid Transport Methods for Casualties in Emergencies

The speed of transporting casualties in emergencies is a crucial factor in saving lives and reducing health complications. Several methods are used to transport the injured, each with its own advantages and disadvantages depending on the nature of the injury and the surrounding circumstances. Among these methods, ambulances are the most commonly used, serving as the primary means of transporting casualties in most cases. They are equipped with the latest medical devices to assist the injured and provide first aid during transport. Advantages include their availability in most areas, ability to reach various locations, and the presence of trained medical personnel to care for the injured. However, they may face challenges in accessing narrow or congested areas and may take longer to reach distant locations. Another method is medical helicopters, which are used in emergencies requiring rapid transport over long distances or in areas difficult to access by ambulance. Their advantages include quick arrival at the accident site and the ability to transport the injured to the nearest

equipped hospital, as well as access to remote and mountainous regions. Disadvantages include high costs, susceptibility to weather conditions, and the need for advanced flying skills. Additionally, rescue boats are a method of transporting casualties, used in coastal areas or regions that are difficult to access.^{2,9}

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In this regard, the speed of transporting injured individuals in emergency situations is key to saving lives and improving quality of life. By investing in technology, training medical personnel, and collaborating with all relevant parties, it is possible to ensure that patients receive the medical care they need as quickly as possible.^{3,8}

METHODS

The current research paper relies on a descriptive analytical approach to measure the impact of equipping ambulances with rapid communication mechanisms and the speed of response to injured individuals in emergency situations. This is achieved through the use of an electronic questionnaire distributed to a sample of 500 paramedics to assess the effect of equipping ambulances with rapid communication systems. The study considers the variable of professional experience to compare the responses of those with greater experience in the paramedic profession to those with less experience, and to determine whether there are any statistical differences attributed to professional experience in measuring the effect of the equipment on the ambulance's response speed to injured individuals in emergency cases.

Design

Statistical analysis: frequencies and percentages of class variables were calculated and averages and standard deviations of continuous variables were calculated. Statistical analysis was conducted using the SPSS v 16 program (Social Science Statistical Package) using non-standard metric analysis. Trust periods were set at 95%, and the $p \leq 0.05$ value was considered statistically significant.

Study setting

Analytical descriptive study was conducted based on a questionnaire form and distributed to a sample of paramedics in emergency departments in the burns unit during the period June-2024 to August-2024

RESULTS

Characteristics of study participants:

A total of 500 participants answered the questionnaire, with professional experience ranging from less than five years to more than 20 years in the Red Crescent ambulance profession.

Table 1.0 : Professional Experience

| Professional Experience | percentage | Repetitions |
|-------------------------|------------|-------------|
| Less than 5 years | 20% | 100 |
| 6-10years | 30% | 150 |
| 11-15years | 13% | 70 |
| 16-20years | 20% | 100 |
| More than 20 years | 17% | 80 |
| total | 100% | 500 |

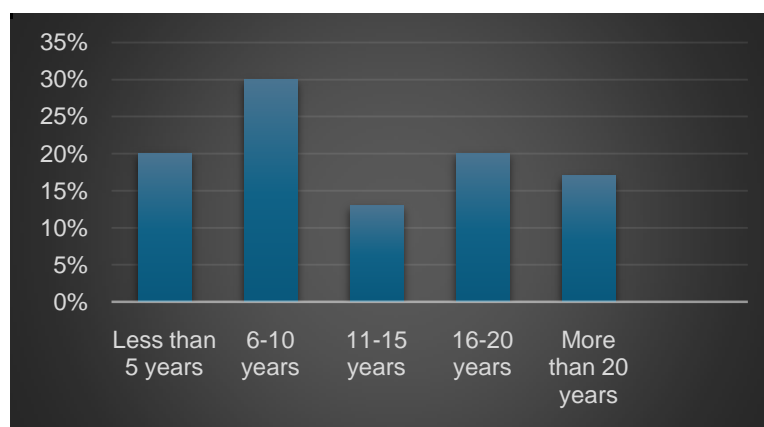


Figure 1.0: Professional Experience

The figure illustrates the results of the study related to the questionnaire and the responses to it, showing that the majority of the sample consists of individuals with professional experience ranging from 6 to 10 years, followed by those with less than 5 years, and also those with experience between 16 to 20 years.

Table 2.0: Technological development has helped provide higher quality communication methods in ambulances

| Technological development has helped provide higher quality communication methods in ambulances | percentage | Repetitions |
|---|------------|-------------|
| Strongly agree | 30% | 150 |
| Agree | 30% | 150 |
| Neutral | 20% | 100 |
| Disagree | 10% | 50 |
| Strongly Disagree | 10% | 50 |
| total | 100% | 500 |

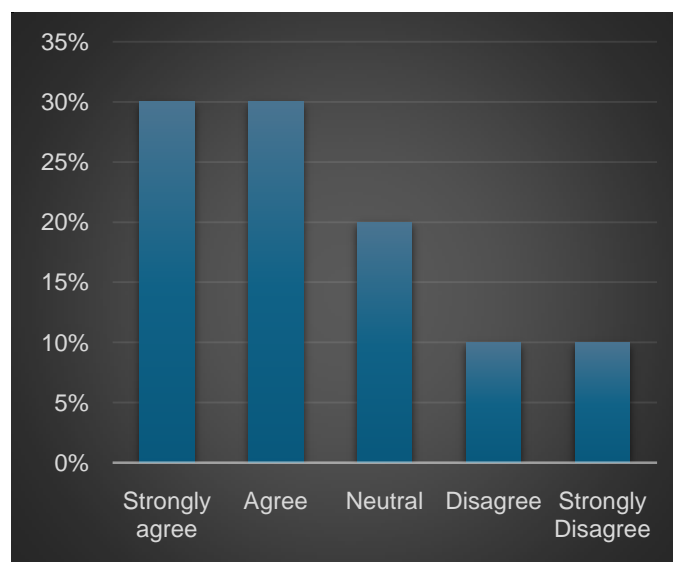
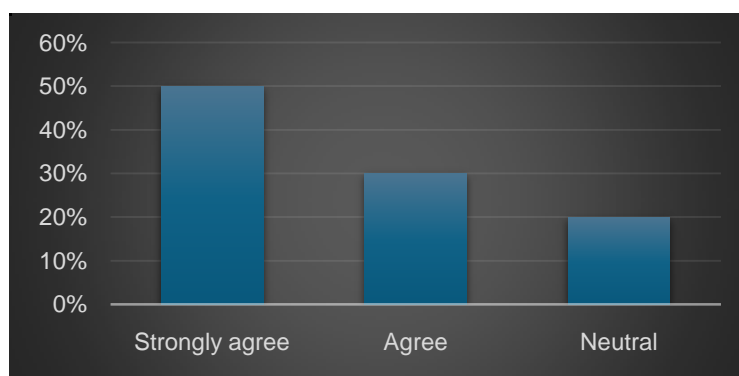


Figure 2.0: Technological development has helped provide higher quality communication methods in ambulances

The figure illustrates the sample's responses regarding the item that technological advancement has contributed to providing higher quality communication means in ambulances, resulting in very high response rates and agreement that technological development aids in offering numerous high-quality communication tools in ambulances. This enables the vehicles to receive calls quickly and to provide services rapidly at incident locations.

Table 3.0: There are solutions in ambulances that ensure quick access to the injured in emergency situations

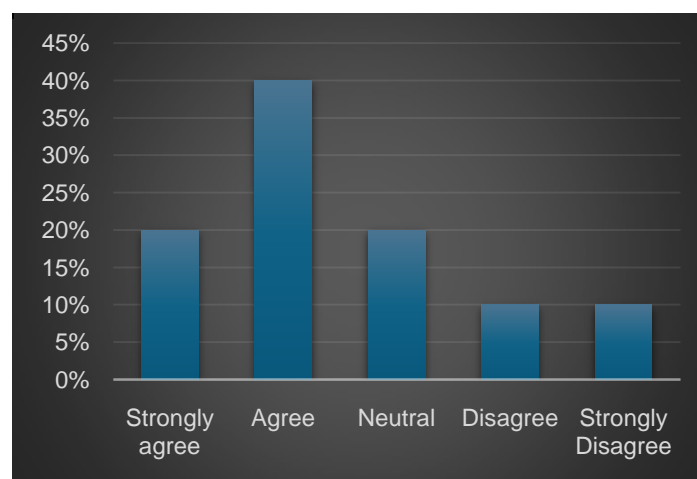
| There are solutions in ambulances that ensure quick access to the injured in emergency situations | percentage | Repetitions |
|---|------------|-------------|
| Strongly agree | 50% | 250 |
| Agree | 30% | 150 |
| Neutral | 20% | 100 |
| Disagree | 0% | 0 |
| Strongly Disagree | 0% | 0 |
| total | 100% | 500 |

**Figure 3.0:** There are solutions in ambulances that ensure quick access to the injured in emergency situations

The figure illustrates the sample responses regarding a provision present in current ambulances that ensures rapid access to victims in emergency situations, resulting in very high response rates. It is agreed that technological advancements aid in providing numerous high-quality communication tools in ambulances, enabling them to receive calls quickly and deliver services promptly at incident sites. This finding aligns with previous studies that indicated that communication helps in the development and improvement of the quality of ambulance services.

Table 4.0: Accurate location identification technology has helped speed up access and avoid traffic congestion

| Accurate location identification technology has helped speed up access and avoid traffic congestion | percentage | Repetitions |
|---|------------|-------------|
| Strongly agree | 20% | 100 |
| Agree | 40% | 200 |
| Neutral | 20% | 100 |
| Disagree | 10% | 50 |
| Strongly Disagree | 10% | 50 |
| total | 100% | 500 |

**Figure 4.0:** Accurate location identification technology has helped speed up access and avoid traffic congestion

The figure illustrates the sample responses regarding how precise location identification technology aids in rapid access and avoids traffic congestion in emergency situations, resulting in very high response rates. There is a consensus that technological advancements contribute to providing various high-quality communication means in ambulances, enabling them to receive calls quickly and deliver services promptly at incident sites. This finding aligns with previous studies that indicated that accurate geographic location identification facilitates faster access for ambulances, thereby assisting in the immediate and urgent provision of help to those in need.

Table 5.0: The faster the arrival to the accident site, the greater the chances of survival for the injured

| The faster the arrival to the accident site, the greater the chances of survival for the injured | percentage | Repetitions |
|--|------------|-------------|
| Strongly agree | 50% | 250 |
| Agree | 30% | 150 |
| Neutral | 20% | 100 |
| Disagree | 0% | 0 |
| Strongly Disagree | 0% | 0 |
| total | 100% | 500 |

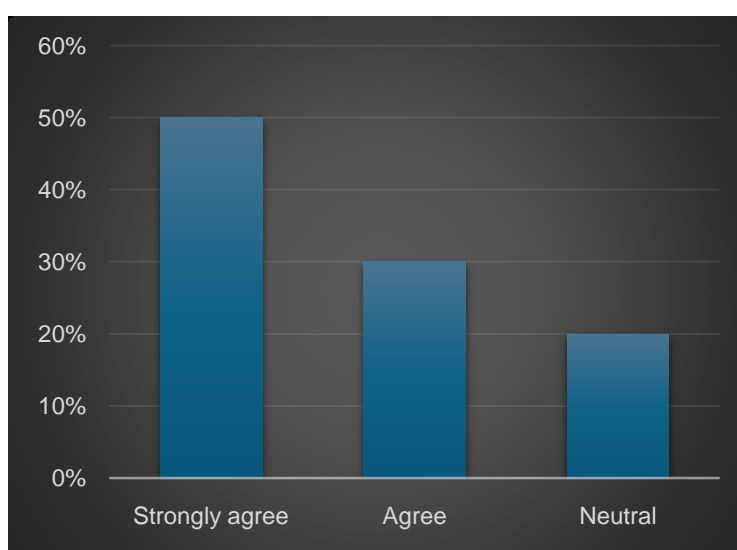


Figure 5.0: The faster the arrival to the accident site, the greater the chances of survival for the injured

The figure illustrates the sample responses regarding the item that the faster the access to the accident site, the greater the chances of survival for the injured in emergency situations. This reflects very high response rates and agreement that technological advancements assist in providing many high-quality communication means in ambulances, enabling vehicles to receive calls quickly and deliver services promptly at incident locations. This result aligns with previous studies that indicated that accurately determining geographic location aids in the faster arrival of ambulances, thereby facilitating immediate and urgent assistance to those in need

Table 6.0: Delayed response affects rescue opportunities

| Delayed response affects rescue opportunities | percentage | Repetitions |
|---|------------|-------------|
| Strongly agree | 30% | 150 |
| Agree | 30% | 150 |
| Neutral | 20% | 100 |
| Disagree | 10% | 50 |
| Strongly Disagree | 10% | 50 |
| total | 100% | 500 |

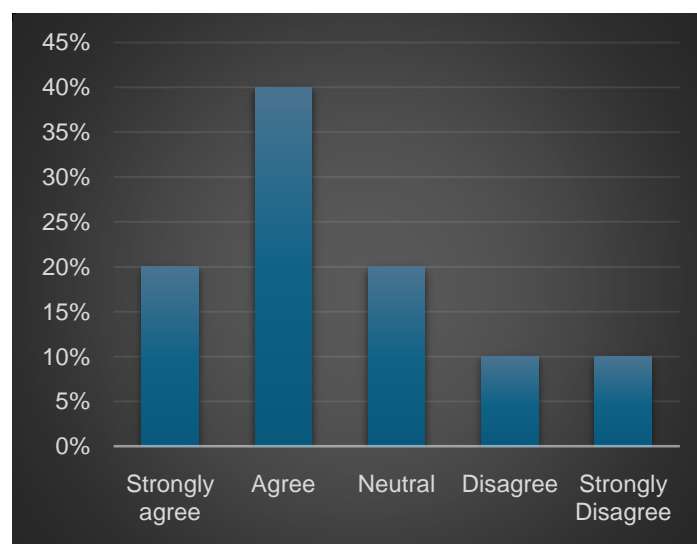


Figure 6.0 :Delayed response affects rescue opportunities

The figure illustrates the sample responses regarding the item of whether a delay in response affects rescue opportunities more in emergency situations, indicating very high response rates and agreement that response speed impacts the ability to provide services quickly at the incident sites. This result is consistent with previous studies which indicated that accurately determining the geographical location aids in the faster arrival of ambulances, thereby facilitating immediate and urgent assistance to those in need.

Table 7.0: The presence of dedicated paths and roads for ambulances is one of the things that helps increase the chances of survival

| The presence of dedicated paths and roads for ambulances is one of the things that helps increase the chances of survival | percentage | Repetitions |
|---|------------|-------------|
| Strongly agree | 30% | 150 |
| Agree | 30% | 150 |
| Neutral | 40% | 200 |
| Disagree | 0% | 0 |
| Strongly Disagree | 0% | 0 |
| total | 100% | 500 |

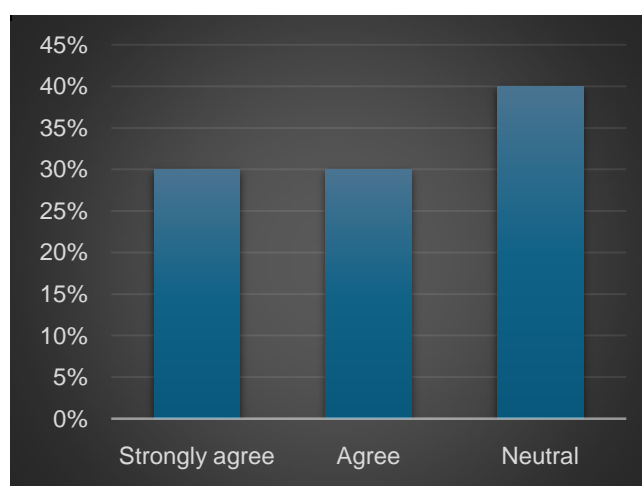


Figure 7.0 : The presence of dedicated paths and roads for ambulances is one of the things that helps increase the chances of survival

The figure illustrates the sample responses regarding the availability of dedicated routes and pathways for ambulances, which are factors that significantly enhance survival chances in emergency situations. This results in very high response rates and confirms that the speed of response has an impact on the ability to provide

services quickly at incident sites. This finding aligns with previous studies that indicated that accurately determining geographic locations aids in the faster arrival of ambulances, thereby facilitating immediate and urgent assistance to those in need.

Table 8: the mean, standard deviation, and relative importance of sample responses

| The item | The mean | Standard deviation | relative |
|---|----------|--------------------|----------|
| Technological development has helped provide higher quality communication methods in ambulances | 3.96 | 1.023 | %59.24 |
| There are solutions in ambulances that ensure quick access to the injured in emergency situations | 3.67 | 1.398 | %53.31 |
| Accurate location identification technology has helped speed up access and avoid traffic congestion | 2.96 | 1.363 | %59.24 |
| The faster the arrival to the accident site, the greater the chances of survival for the injured | 3.46 | 0.668 | %49.11 |
| Delayed response affects rescue opportunities | 3.54 | 0.922 | %70.89 |
| The presence of dedicated paths and roads for ambulances is one of the things that helps increase the chances of survival | 3.46 | 0.668 | %49.11 |

The analysis of the study results regarding the mean, average, and standard deviation indicates that there are high rates of agreement that technological advancements in communication methods have significantly aided in the rapid response to emergency situations .

The results analysis also pointed out that there are numerous solutions that involve quick access to victims in emergencies, suggesting that reliance on geographic location technologies can facilitate rapid arrival at the accident site, thereby increasing survival chances .

Furthermore, the analysis of the study results indicated that delays in response reduce survival opportunities, as there are various specialized routes for ambulances, which also enable ambulances to reach victims swiftly and provide timely services .

The study results also clarified that there are no statistically significant differences attributed to years of experience, as responses varied regarding the agreement on the importance of integrating technology as communication tools in ambulances for speeding up access to victims in emergency situations.

CONCLUSION

With the significant technological advancements contributing to the rapid response of ambulances, there are still numerous challenges facing this vital service. These challenges require solutions to ensure medical assistance reaches patients as quickly as possible. Among these challenges is traffic congestion, which is considered the primary barrier preventing ambulances from reaching the accident site swiftly. Congestion delays the arrival of medical teams, potentially affecting the survival chances of the injured .

Another issue is the shortage of ambulances; in some areas, the number of ambulances does not match the increasing demand for service, leading to delayed responses. Additionally, the distribution of ambulances may be uneven across regions, impacting response times in certain areas .

The difficulty in pinpointing the exact location also poses a challenge. In some cases, individuals reporting incidents may struggle to provide precise locations, resulting in wasted time searching for the accident site. In remote areas or those with difficult terrain, reaching the accident location can be particularly challenging, especially under adverse weather conditions .

Moreover, a lack of community awareness contributes to the problem. Some drivers may not recognize the importance of yielding to ambulances, hindering their access to the scene. Delays in requesting medical assistance can also diminish the survival chances of the injured. Furthermore, there may be inadequate coordination between emergency centers, ambulances, and hospitals, adversely affecting response times .

Finally, infrastructure issues play a significant role; poor road conditions or the absence of suitable routes in certain areas can obstruct ambulance movement. Traffic signals may be ineffective or nonexistent in some locations, exacerbating congestion. Additionally, the lack of emergency lanes on streets complicates the navigation of ambulances

To overcome these challenges, it is essential to develop road networks, improve road infrastructure, provide dedicated lanes and routes for ambulances, increase the number of ambulances, ensure an adequate distribution of these vehicles, train drivers to navigate difficult conditions and manage traffic congestion, and organize awareness campaigns to encourage the public to yield to ambulances and seek medical assistance as quickly as

possible. Additionally, it is important to develop applications that enable citizens to accurately report incidents and pinpoint their geographic locations, as well as to enhance cooperation among relevant entities such as police, fire services, and emergency services to facilitate rescue operations. Therefore, addressing the challenges of ambulance response times necessitates a collaborative effort from all stakeholders, including the government, healthcare institutions, and the citizens themselves. By working together, we can improve ambulance services and ensure timely medical assistance to save lives.

Consequently, the speed of ambulance response is a critical factor in saving lives. By investing in technology, enhancing infrastructure, and training personnel, the quality of emergency services can be improved and the time taken to reach the injured can be reduced.

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