

# The Role Of Drones In Accelerating The Arrival Of Medical Support Before The Arrival Of Ambulances In The Kingdom Of Saudi Arabia

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## Abstract:

This study aimed to identify the role of drones in accelerating the delivery of medical support before ambulances arrive in the Kingdom of Saudi Arabia, given the challenges field teams may face, such as traffic congestion or geographical distance from accident sites. The study relied on the descriptive analytical approach due to its suitability to the nature of the research, where the questionnaire was used as the main tool to collect data from a sample of 30 individuals working in the Saudi Red Crescent Authority. The results showed a general trend among sample members toward agreeing that drones contribute to improving the speed of medical response and help deliver essential supplies such as medicines and resuscitation equipment faster than ambulances in some cases. Participants also indicated that the use of drones contributes to improving the chances of saving lives in remote or crowded areas and provides field teams with accurate and immediate information about the accident site, enhancing decision-making efficiency and speeding up intervention. The study recommended expanding the use of drones as part of the Saudi Red Crescent's future development plans, while also providing specialized training programs for paramedics to enhance their proficiency in using this technology. It also recommended conducting broader studies with larger samples to measure the long-term impact of these applications on the quality of emergency medical services.

**Keywords:** Drones; Medical Support; Emergency Medical Services; Ambulance Response; Saudi Red Crescent; Response Time; Healthcare Technology; Saudi Arabia

## INTRODUCTION

Drones are, in their simplest definition, remotely operated or autonomous aerial vehicles (have evolved from mere military uses to widespread civilian applications). The basic concept of drones is that they fly without a human pilot on board. They are also known as unmanned aerial vehicles (UAVs). These aircraft are divided into two main categories: remotely operated drones, which are directly controlled by a ground operator using controllers, and autonomous drones, which operate autonomously based on built-in software and navigation systems. Drones are equipped with a variety of sensors and cameras, allowing

them to perform various tasks such as photography, surveillance, mapping, and even delivering goods 1,5.

The history of drones dates back to the early twentieth century, when they were initially used as aerial targets for military training. These aircraft were very simple and operated via simple radio signals. However, the real development began with World War II and continued at a rapid pace, especially in the military aspect. The technical development of drones can be explained as follows:

In control and navigation systems, initially, operators relied on direct vision and simple radio signals for control. However, with the advent of the Global Positioning System (GPS) drones have the ability to fly, with high accuracy, follow pre-defined paths, and return to the take-off point automatically. With the development of artificial intelligence technologies, drones now use artificial intelligence algorithms to process data received from sensors, enabling them to automatically avoid obstacles. They can now monitor trees, buildings, and wires and avoid them independently during flight, as well as make decisions through which the best flight or landing path is determined in emergency situations. Like low battery levels, advanced drones can perform complex missions from take-off to landing without any human intervention. Drones have also seen improvements in batteries and power sources, as limited flight time was a major obstacle. But the development of lithium polymer batteries has made them lighter and more capable of storing energy, which has greatly increased the flight time of drones and led to a significant improvement in performance. Advanced software has emerged that allows users to plan flight paths automatically and manage complex tasks. Drones use cloud computing to process and analyze the huge amounts of data they collect, such as aerial survey images, which allows for the creation of accurate digital models. All of these developments have contributed to the transformation of Drones have evolved from a simple military tool to a versatile technology that impacts many civilian fields such as agriculture, logistics, photography, and public safety 15,12.

## DISCUSSION:

Drones are classified into different types based on their design and method of movement, which determines their multiple civilian uses. They can be divided mainly into three basic categories: rotary-wing drone (Multi-rotor Drones) are one of the most common and widespread types. Especially in civilian uses, it is characterized by its ability to take off and land vertically (VTOL) and to fly at a fixed point, (Hovering) making it ideal for tasks that require high precision and control. Among its types are the quad-rotor, which is the most common and smallest type. It is suitable for amateur aerial photography, monitoring, and simple inspections. The second type is the hexagonal and octagonal which are larger and more stable and have the ability to carry heavier loads such as professional cameras or advanced surveying devices. Among its field uses are aerial photography and film production. It is widely used in the film industry and advertisements. It covers events and is also used for monitoring such as inspecting power lines, oil pipelines, buildings, bridges, and solar farms to look for any defects or damage. It is also used to search for missing persons in difficult areas or disaster zones, as it can reach places that are difficult for humans to reach 5,8,12.

the fixed-wing drone. Its design and shape resembles traditional aircraft. It relies on wings to generate lift. It does not have the ability to take off or land vertically and requires a take-off and landing path. It is also characterized by the ability to fly long distances, for longer periods, and at higher speeds. Its field uses include conducting geographical surveys and mapping. It is ideal for aerial surveys of large areas such as agricultural lands, huge construction projects, and complex geographical areas. It is also used to monitor borders and remote areas over long distances.

The third type of drone is the hybrid drone, which is a combination of the first and second types. It has fixed wings for flying long distances, in addition to propellers for vertical take-off and landing, which

gives it great flexibility. Among its field uses are logistics delivery operations, where it performs. Some companies, for example, Amazon, use it to deliver packages, combining the speed of long-distance flight with the ability to land in tight spaces. It is also used to deliver medicines and medical supplies. In remote or hard-to-reach areas, they are also used to extinguish fires. They identify the hotspots of large forest fires and help direct firefighting teams 2,6,8.

#### **- Support Medical in Cases Emergency**

Emergency medical support is a set of services and procedures that aim to provide rapid medical care to injured or critically ill people with the aim of saving lives and reducing complications. This type of support is an essential link in the health care chain and requires a rapid and organized response. The emergency medical support system includes several integrated elements to ensure the provision of the best care. The first responder is the first person to arrive at the accident site, whether police or firefighters. or a civilian person. Trainer, provides basic first aid such as stopping bleeding or cardiopulmonary resuscitation (CPR). Or fixing fractures while waiting for the arrival of specialized ambulance teams. The second element of ambulance and emergency services is the backbone of the system and consists of an art. Emergency Medical Technicians (EMTs) and paramedics are professionally trained to provide advanced medical care on-site such as administering medications. Or installing artificial respirators, and the third element is the emergency rooms in hospitals, which receive patients and the injured who are transferred from the accident site, where doctors and nurses quickly assess the case (Triage) to determine care priorities according to the severity of the case and then provide the necessary treatment, whether it is emergency surgery or intensive treatment before transferring the patient to other departments in the hospital. The importance of medical support in emergencies is due to its significant contribution to saving lives, as rapid intervention in cases of cardiac arrest or serious accidents increases the chances of the injured person surviving, as it works to reduce complications. Medical support aims to alleviate the pain of the injured and provide them with comfort as much as possible, and the system helps direct the patient to the most appropriate medical facility for his condition, ensuring that he receives the treatment designated for him 5,8,16.

Based on the above, emergency medical support faces several challenges, including limited resources, Difficulty in accessing some areas and work pressure, but technological development has contributed to its improvement and development. This is largely achieved through the use of smartphone applications to request emergency assistance and pinpoint locations, and the use of drones to deliver vital medical supplies to remote or hard-to-reach locations. These developments contribute to making emergency medical support more efficient and rapid, enhancing communities' ability to respond to health crises 11,10,5.

#### **- Identification Support Medical The first**

First aid is defined as the immediate and temporary care provided. First aid is given to a person who is suddenly injured or ill, before the arrival of specialized medical assistance or transportation to the hospital. One of the principles of providing first medical support is to preserve the life of the injured person by dealing with critical conditions such as respiratory arrest or severe bleeding. The aim of first medical support is to prevent the injury from worsening, such as stabilizing a fracture to prevent further damage or covering a burn to prevent infection. First medical support is not limited to doctors or paramedics, but can be provided by a person properly trained in the basics of first aid, whether at home, at work, or in any public place. Examples of first medical support include cardiopulmonary resuscitation (CPR) and stopping bleeding. By applying direct pressure to the wound and fixing fractures through Use a temporary splint and treat burns

initial medical support is the first step. Which can make a huge difference between life and death or between a minor injury and a permanent disability. It gives the injured person a chance to survive until specialized medical support reaches him 11,10.

#### **- Challenges in speed Response Ambulance**

Emergency medical services(EMS) face numerous challenges that directly impact response speed and are important and essential factors in saving lives and reducing complications. These challenges can be explained as follows:

Confronting traffic congestion and infrastructure : Large cities and densely populated areas are among the places where ambulances face the most difficulty in moving, as traffic congestion leads to delays in the arrival of paramedics to the accident site. Especially during rush hours , as well as poor infrastructure, where narrow streets or closed roads may hinder the movement of ambulances , determining the correct location of the injured person is a major challenge, especially if the caller is in a state of fear or unable to clearly describe his location, as addresses may be vague or not available in map systems. This leads to wasted time, as there may be some places that are difficult to access, such as remote rural areas or places inside large and complex buildings . Another challenge is the lack of resources and training, as many ambulance systems still suffer from a shortage of human and logistical resources , such as a shortage of paramedics , as the insufficient number of qualified paramedics leads to delays in dispatching ambulances, and limited funding, as sufficient funding may hinder the modernization of ambulance teams or the provision of advanced medical equipment 1,3,5.

Through the above clarification of the challenges facing the speed of emergency response, it is possible to present how to overcome them by using advanced geographic positioning systems(GPS) and smart phone applications to accurately determine the caller's location allocating special paths for ambulances in , crowded areas, providing intensive training on an ongoing basis for ambulance teams, and providing them with modern equipment. Providing intensive training courses for individuals on basic first aid 2,6,1.

#### **experiments International Pioneer**

have witnessed pioneering experiments in the use of drones in various civilian fields, which opens new horizons for improving services and saving time and effort. Examples of these experiments in providing emergency medical support include drones being an ideal solution for delivering vital medical supplies to places that are difficult to access quickly, such as rural areas or areas affected by natural disasters . In Rwanda , AfricaZip Line launchedA program to deliver blood bags, vaccines, and other medical supplies to rural areas using fixed-wing drones that fly at speeds of up to 100 kilometers per hour, then drop the package in a designated area by parachute. This program has contributed to significantly reducing deaths resulting from lack of blood supplies . In SwitzerlandMatternet uses drones to transport medical samples and tests between hospitals and laboratories . As this use speeds up the diagnostic process and reduces the need to transport samples through congested roads , these experiments demonstrate that drones are no longer just an imaging tool but have become an essential part of future civilian infrastructure 5,8,9.

#### **- Airplanes The march To transfer pharmaceutical and supplies**

Drones are a true revolution in the field of medical logistics , especially with regard to the transportation of medicines and vital supplies . This technology provides a fast and effective solution to overcome the challenges facing traditional transportation systems, such as traffic congestion and access to remote areas The importance of using drones may be due to The drone in the medical field contributes to the rapid . response in emergency situations, as the aircraft can Drones deliver blood bags vaccines, antitoxins, and essential first aid equipment to the site of an accident or hospital in record timesignificantly reducing mortality rates . Their importance also lies in their ability to reach remote areas and natural disaster sites.

Some areas lack good road infrastructure or are in areas that are difficult to reach due to natural disasters such as floods or earthquakes. Drones are the only means of delivering medical aid. They can transport essential medicines to isolated villages and communities, ensuring the continuity of healthcare . Drones are also the ideal solution for transporting shipments of medicines vaccines, and insulin, as they reduce transportation time and reduce the risk of damage to sensitive medicines 8,9,12.

#### **- Airplanes The march To transfer Devices Resuscitation Cardiac**

Drones delivering Automated External Defibrillators (AEDs) are a pioneering emergency medical initiative that aims to reduce response time in cardiac arrest cases . Cardiac arrest is a critical medical condition , as the heart stops pumping effectively, and every minute that passes without treatment reduces the chance of survival by 7-10%. They are used to transport AEDs because they are distinguished by their ability to fly directly to the site without being affected by traffic congestion or difficult terrain. They can also reach the injured person before the ambulance arrives, especially in crowded or remote areas Studies have shown that drones can reach those injured in cardiac arrest cases in a much shorter time compared to ambulances. Karolinska University in Sweden conducted a pioneering study that showed that drones carrying AEDs reached 11 cardiac arrest cases faster than ambulances, also in the United States Some companies, in collaboration with medical organizations, have begun testing the use of drones to deliver lifesaving equipment to specific areas, with a focus on densely populated areas . They also contribute to the chances of survival, as cardiopulmonary resuscitation(CPR) and the use of an AED within the first few minutes are critical. Drones allow non-specialists on the scene to provide immediate assistance, significantly increasing the chances of saving the life of the injured person before the arrival of medical personnel 1,8,7.

#### **- Challenges organizational And the wish**

face significant regulatory and security challenges, hindering their full deployment despite their technical and economic advantages . These challenges are critical to ensuring the safety of individuals, property, and airspace. The regulatory challenges can be explained as follows: Regulations and legislation are the greatest challenge to the integration of drones in terms of airspace safety. They pose a threat to commercial aviation and other aircraft, and therefore impose strict restrictions on flight altitudes and paths, as well as the need to obtain special permits for flying in urban areas. Drones equipped with cameras also raise significant privacy concerns. Some legislation is used to restrict flying over private property or in public areas without a permit to protect individuals from unwanted Commercial or professional use also requires registration, licensing, and operator training, which adds procedural complications that may slow the adoption of the technology 7,6,11.

Among the security challenges facing drones, They can be used for sabotage or criminal activities, which requires strict security controls, as they can be used to transport illegal materials or carry out terrorist attacks. Or spying on sensitive sites, as anti- drone systems have become(anti-drone systems)There is an increasing security need to protect vital facilities such as airports and prisons. Unauthorized control is also a security challenge. A drone 's control system can be hacked , data stolen, or its trajectory changed putting it at risk and potentially being used for criminal purposes 10,11,6.

These challenges therefore demonstrate that integrating drones into society requires a delicate balance between leveraging their advantages and providing the necessary legal and security framework to ensure they are not misused

#### **structure Infrastructure and capabilities Current**

The Kingdom of Saudi Arabia is showing great interest in modern technologies, and drones are one of these technologies that have wide application potential in various sectors, in line with the Kingdom's

Vision 2030 in the health field, as we find that hospitals and health centers in rural and remote areas face difficulty in obtaining medical supplies on a regular basis or in emergency situations , where drones can To establish a rapid delivery network for transporting medicines, vaccines and solutions Even blood bags, ensuring the continuity of healthcare in these areas. Transporting medical samples between hospitals and central laboratories often takes a long time due to traffic congestion . Drones can significantly reduce this time, increasing the speed of the diagnostic process and helping doctors make faster decisions about the patient's treatment plan . Therefore, drones can enhance the Kingdom's ability to provide modern and innovative healthcare. Especially in the fields of emergency and first aid, which contributes to achieving the goal of providing comprehensive and effective health care to all citizens 1,4,3

The Kingdom of Saudi Arabia also possesses a strong infrastructure and promising potential to integrate drone technology into various sectors, especially in the medical field, thanks to its massive investments in technology and digital transformation . The digital infrastructure in the Kingdom is a strong foundation for operating Drones help with this, as communications networks are spreading in major cities, providing connectivity. fast Reliable and reliable, which is crucial for controlling drones and transmitting data in real time , the Kingdom also relies on global positioning systems(GPS) and geographic information systems(GIS) which ensure accurate and safe navigation of drones . The Saudi government also shows , clear support for the adoption of modern and innovative technologies, as Saudi Arabia's Vision 2030 encourages economic diversification and reliance on modern technologies. Drones are part of this trend , and the General Authority of Civil Aviation(GACA) is working to develop regulations and systems to govern the use of drones, ensuring their safe and efficient operation 2,5,8.

Therefore, Saudi Arabia can benefit from this infrastructure and capabilities , positioning the Kingdom as a leader in using drones to enhance the efficiency of its healthcare system

#### **- Capabilities Crescent red Saudi in area ambulance Air**

It is considered The Saudi Red Crescent's air ambulance service is one of the main pillars of the emergency healthcare system in the Kingdom, which has developed significantly to become an advanced model in saving lives, especially in critical cases , as the service currently focuses on In densely populated areas and highways (such as Riyadh) with a plan for gradual expansion to include all regions of the Kingdom of Saudi Arabia and the services it works to provide, transferring critical cases between hospitals and rapid intervention in road accidents and regions , in addition to providing a dedicated service during the Hajj season in the holy sites, where equipped ambulance aircraft are deployed in cooperation with the Ministry of Defense and Security Aviation , and the speed of response, we find that the response time reaches 3-35 minutes depending on the location, as the service recorded more than 300 emergency operations annually with more than 1000 flight hours , as we find in November 2023, the air ambulance transported 89 emergency cases and 66 life-saving flights , as it contributes Air ambulance services reduce the death rate from accidents and increase response times and access to medical care , in line with the goals of Saudi Vision 2030

Accordingly, it is considered The Saudi Red Crescent's air ambulance capabilities are a successful model for integrating strategic planning with advanced technical implementation, directly contributing to saving lives and improving the quality of emergency healthcare services. With continued expansion and investment in this sector, the Kingdom is expected to become a regional leader in air ambulance services

#### **- Trends Governmental To support Technology And intelligence artificial**

Seeking Governments around the world are adopting ambitious strategies to support emerging technologies and artificial intelligence with the aim of enhancing digital transformation and building a knowledge-based economy. This is one of the most important government trends in the Kingdom of Saudi Arabia in this field , as the Kingdom launched the ( National Strategy for Data and Artificial Intelligence )

(SDAIA). With the goal of making the Kingdom among the top 15 countries in the field of artificial intelligence by 2030 , this strategy focuses on developing competencies, attracting investments and promoting scientific research and innovation 1,5,9.

The Kingdom also provides artificial intelligence technologies in the health and education sectors to improve services and preventive care , as government trends to support artificial intelligence technologies show a focus on... Strong , by building a knowledge-based economy, while adhering to standards of responsibility and inclusiveness , through national strategies and investment in infrastructure and talent , these countries seek to achieve global leadership in emerging technologies. Collaboration between governments, the private sector, and the research community will be a fundamental framework for achieving these visions 8,6,3.

#### **- Dimensions Economic and logistics**

Artificial intelligence is no longer just a future technology , but has become one of the main drivers of transformation in various sectors , with its role appearing particularly in the health sector in the Kingdom of Saudi Arabia, where it agrees... Its economic and logistical horizons align with the ambitious goals of Saudi Vision 2030. This technology offers innovative solutions to existing challenges. This enhances the efficiency of the health system and improves the quality of care provided to citizens and residents of the Kingdom. We find that artificial intelligence represents a huge economic opportunity for the Kingdom by transforming the health sector from a cost-based system to a smart investment as artificial intelligence can significantly reduce health care costs. For example, machine learning algorithms can help hospitals improve resource management. Predicting patient numbers and optimizing doctors' and nurses' work schedules . Using medical robots in delicate surgeries or routine tasks reduces human error, saving on subsequent treatment costs. AI also contributes to the creation of entirely new industries , such as the development of smart medical diagnostic software, the manufacture of AI-enabled medical devices, and the establishment of startups specializing in big health data analysis. These industries not only contribute to economic diversification but also provide high-value job opportunities for citizens . AI can also accelerate research in the field of genetic and chronic diseases by analyzing massive genetic data sets, which accelerates the discovery of new drugs and places the Kingdom at the forefront of advanced countries in the field of biomedical research 2,3,6.

Artificial intelligence technologies offer innovative logistical solutions that help overcome geographical and operational challenges in the Kingdom's healthcare sector. It contributes to improving medical supply chains. Artificial intelligence can predict demand for medicines and medical supplies in different regions, which helps manage inventory effectively and avoid shortages or waste . AI systems can also identify hospitals that need specific supplies based on seasonal patterns of diseases or epidemics . Drones are one of the most prominent AI-powered logistics applications , capable of quickly transporting medicines blood bags, and vaccines to remote or hard-to-reach areas, reducing emergency response times and helping save lives 9,11,16.

Based on the above, the economic and logistical dimensions of artificial intelligence in the healthcare sector in the Kingdom of Saudi Arabia represent a golden opportunity to achieve a qualitative leap in the quality of healthcare . With continued government support and investment in infrastructure, human resources, and scientific research, the Kingdom is on its way to establishing a sustainable healthcare system. Effective and able to meet future needs 15,12,10.

#### **methodology Search and its tools**

This study relied on a descriptive analytical approach, given its suitability to the nature of the research topic, which aims to identify the impact of using drone technology on improving the efficiency of emergency medical services among the Saudi Red Crescent Authority's ambulance teams. This approach

is based on describing the phenomenon as it is in reality, then analyzing the data and extracting indicators that support the interpretation of the results.

#### Study population and sample

The study population consists of members of the Saudi Red Crescent Authority's field ambulance teams. A sample of (30 individuals) was selected by simple random method to represent the target community.

#### Data Collection Tool:

A questionnaire was used as the primary data collection tool. It was designed to measure sample members' attitudes toward the use of drones in emergency response work. The questionnaire contained a set of statements related to the following aspects:

- 1 .The role of aircraft in accelerating the delivery of medical support.
- 2 .Its ability to transport essential medical supplies.
- 3 .Its contribution to improving the chances of saving lives in critical incidents.
- 4 .Its role in providing teams with accurate and immediate information.
- 5 .Contributing to improving coordination between the operations room and field teams.
- 6 .The extent to which it contributes to reducing the risks to which paramedics are exposed.
- 7 .Its effectiveness in managing medical resources during disasters and crises.
- 8 .The future of investment in drones as a service supporting the development of the Saudi Red Crescent.

The questionnaire items were formulated according to a three-point Likert scale (agree - neutral - disagree) in order to facilitate statistical data analysis.

### Analysis Results

**Table (1) Mean, Median and Standard Deviation**

Statement	Agree	Neutral	Disagree	Mean	Median	Standard Deviation
Drones help reduce the time required for medical support	21 (70%)	6 (20%)	3 (10%)	2.60	3.00	0.57
Drones can deliver essential medical supplies...	19 (63%)	7 (23%)	4 (14%)	2.49	3.00	0.64
The use of drones improves the chances of saving lives...	23 (77%)	5 (17%)	2 (6%)	2.71	3.00	0.52
Drones provide real-time, accurate information...	20 (67%)	7 (23%)	3 (10%)	2.57	3.00	0.58
Drones help overcome geographical obstacles...	21 (70%)	5 (17%)	4 (13%)	2.57	3.00	0.62
The use of drones increases coordination...	18 (60%)	8 (27%)	4 (13%)	2.47	2.00	0.66
Relying on drones reduces the risk to	19	6 (20%)	5 (17%)	2.47	3.00	0.68



paramedics...	(63%)					
The use of drones improves the efficiency of medical resource...	20 (67%)	7 (23%)	3 (10%)	2.57	3.00	0.58
Integrating drones into the ambulance system will enhance...	22 (73%)	5 (17%)	3 (10%)	2.63	3.00	0.56
I believe that future investment in drones is necessary...	24 (80%)	4 (13%)	2 (7%)	2.73	3.00	0.49

The study results showed that there was a general trend among the research sample (30 individuals from the Saudi Red Crescent) towards approving the role of drones in supporting emergency medical services. The arithmetic means of the statements ranged between (2.47 - 2.73) on the three-point Likert scale (agree = 3, neutral = 2, disagree = 1), which reflects a clear positive tendency towards using this technique.

The phrase "I believe that future investment in drones is a necessary step to develop the services of the Saudi Red Crescent" achieved the highest mean of (2.73) with a low standard deviation (0.49), indicating the presence of broad agreement among sample members about the importance of investing in this technology in the future. The phrase "The use of drones improves the chances of saving lives in remote or crowded accidents" came in second place with an average score of 2.71, which reflects participants' belief in the role of this technology in enhancing survival chances.

In contrast, the phrase "The use of drones contributes to increasing coordination between the operations room and field teams" had the lowest mean (2.47), which indicates a relative variance in the opinions of sample members on this aspect, although the general trend remained positive.

Overall, the results confirmed that respondents viewed drones as an effective means of improving response speed, information accuracy, and the distribution of medical resources in crises, with strong agreement on the need to invest in this technology in the future to enhance the quality of emergency services in the Kingdom.

#### - Recommendations

:Drones can revolutionize the speed and efficiency of emergency medical response in Saudi Arabia by

- Establish a clear legislative framework . The General Authority of Civil Aviation must develop flexible and updated regulations to govern the use of drones in the medical field, specifying . permitted and prohibited flight zones and specific altitudes
- Establishing strategic partnerships It encourages partnerships between government agencies (such as the Red Crescent Authority) and leading local and international technology companies in the . field of drones to exchange expertise and localize the technology
- Create dedicated launch centers In major hospitals and field ambulance points for drones , to .ensure that these drones are ready to fly at any time
- Developing centralized control systems by creating a central digital platform for the operations room that allows for the location of an emergency, automatic dispatch of the drone , and real-time . tracking of its flight
- Customize the types of drones by using two types of them Multi- rotor drone for crowded urban . areas, fixed-wing drone for remote areas
- Drones are equipped with different payloads depending on the need, such as AEDsfor public . places, or blood bags and medical samples for hospitals
- Developing and designing smart applications that allow citizens to request medical support, . accurately locate themselves, and receive instructions on how to handle a resuscitator

- Training of cadres Medical and paramedic training on how to handle and prepare drones for use.  
. Ensuring efficient operation
- Launching educational campaigns to raise citizens' awareness of the role of drones in supporting  
. ambulance services and how to handle them in emergency situations
- Allocating budgets for research and development in the field of medical drones with the aim of  
improving their capabilities. And increase its range  
Developing artificial intelligence systems to avoid obstacles more effectively

## CONCLUSION

Drones are a powerful tool that has the potential to transform the emergency response system in Saudi Arabia, by speeding up the delivery of essential medical support to injured people before ambulances arrive . International experience and the Kingdom's local capabilities have demonstrated clear results . confirming the vital role of this technology

Drones help reduce response time in critical situations, as time is the decisive factor in saving lives. Especially in cases of cardiac arrest or severe bleeding , Drones can bypass traffic congestion and fly directly to the scene of an accident , significantly reducing response time . In major cities in the Kingdom such as Riyadh and Jeddah, where traffic congestion can delay an ambulance, drones equipped with an , automated cardiopulmonary resuscitation(AED) device can arrive within minutes, allowing citizens on the scene to deliver an immediate shock to the injured person, significantly increasing their chances of . survival before paramedics arrive

Drones also contribute to reaching remote and difficult areas , as the Kingdom is distinguished by its vast geographical area with the presence of many remote areas and villages that lack nearby ambulance centers. Through drones, a bridge can be formed. Airlifting vital medical supplies (such as blood bags, antitoxins, and essential medicines) to these areas ensures that residents receive the necessary care in emergency situations . This capability enhances the efficiency of the Kingdom's healthcare system and . narrows the gap between urban and rural areas

Therefore, these results indicate and demonstrate that the integration of drones into the Saudi ambulance system is not just a technical addition, but rather a vital strategy to enhance response speed, reduce mortality rates, and achieve the goals of Saudi Arabia's Vision 2030 in building an advanced and sustainable healthcare sector.

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