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DRONES' USAGE IN MEDICAL EMERGENCY: META-ANALYSIS OF PRACTICAL AND LEGAL ASPECTS

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Abstract

Unmanned aircraft can play an essential role in medical care delivery. This paper conducted a literature review to determine (1) the various medical supplies delivered by drones, (2) the legal challenges, and (3) the potential benefits of medical drones. The implications for the United States, India, and other contexts are then discussed. We used systematic literature review methods and defined search strings to achieve this goal. A review protocol was used to search the databases PubMed, Scopus, and Web of Science for relevant literature. Other documents were also sought using the snowball method. According to the findings, medical supplies carried by drones include blood, AEDs, medications, vaccinations, laboratory test samples, and so on. Regulations, expenses, abuse (public safety), and psychological effects on individuals who have seen drones used to drop bombs are all potential challenges that might come from the use of technology to deliver medical supplies. Drones have the potential to save more lives by lowering reaction time in medical situations. Finally, drone technology has ushered in a new era in the health sector and will be a cutting-edge technology in the United States and India to support this advancement. Cutting-edge innovation is required to assure drone safety and acceptability. This can be accomplished by collaborating with regulators to develop the necessary policy frameworks and providing other health resources to supplement drone use, establishing a culture foundation for rural communities to raise awareness of the benefits of drones, and training health personnel to handle medical supplies via drone.

Keyword: Health; Medical Supplies; Transport; India; UAV

1. INTRODUCTION

India's government is the highest authority in implementing laws restricting the use of drones. It controls and regulates the use of these types of vehicles, commonly referred to as unmanned aerial vehicles (UAV). Unmanned aerial vehicles, or more specifically, unmanned aerial vehicles (UAVs) can be defined as small flying machines that are controlled by remote control devices. This definition is necessary because these are not aircraft but rather was used for conducting tasks in many fields and activities. In other words, they are essentially two-seater UAVs with engines. They usually carry two or four people on board; each with independent operation and control of the vehicle[1]. This is how these UAVs operate, with no one operating for themselves but instead receiving instructions from others. These UAVs are mostly used in a wide variety of fields, such as search and rescue, firefighting, surveillance duties, etcetera. Moreover, these types of UAVs are often used for conducting air traffic control and tracking airborne targets in various situations. Consequently, the use of these UAVs has grown exponentially over the past few years. However, there is only a limited number of people trained in UAVs compared to those trained as medical staff, which makes their deployment even more difficult when it respects to large-scale medical emergencies[2].

2. History

The development of drones is deeply rooted in military history. This has been made possible through several major events that have enabled it to become a formidable weapon of war in the contemporary period. Among those events include the invention and subsequent manufacture of a single-engine, highly maneuverable aircraft[3]. The technology used by early drone makers was

[*] B.A.LLB, LLM

[1] Nagarjuna, Kotha. "Design of Effective Landing Mechanism for a Fully Autonomous Unmanned Aerial Vehicle". International Conference on Signal Processing, 2015, pp. 1–6, doi:10.1109/ICSCN.2015.7219864.

[2] Ebeid, Emad. "A Survey on Open-Source Flight Control Platforms of Unmanned Aerial Vehicle". *Digital Systems Design*, 2017, pp. 396–402, doi:10.1109/DSD.2017.30.

[3] Rife J, Carlisle R. The sound of freedom. Dahlgren, VA: Naval Surface Warfare Center, Dahlgren Division; 2006.

derived from another project known as the 'flying boat' which had been commissioned during WWII, but this project failed to yield any substantial results. Since then, all that we have left remains are two different forms of flying boats. Both models were developed in order to tackle specific warfare objectives such as anti-submarine warfare (ASW), counter-terrorism operations, reconnaissance operations and the protection of warships. It is worth noting that these devices were also used during WW2 to carry out espionage against Japanese and French submarines and warships respectively. These devices carried out their respective missions as well. However, unlike other similar projects whose success was characterized by high costs, the first successful test flight was done by CIPRI (3) on March 12, 2004 using the RAPID M1.

During the Korean War, the Hellcat fighter was converted into a drone carrying 1,000 pounds of explosives. Then they were deployed to try to destroy nuclear power plants and railway lines in North Korea. In the 1950s, the United States Navy developed the first unmanned helicopter to fight the Soviet submarine threat. The QH-50 helicopter is controlled remotely from the destroyer's deck and is loaded with torpedoes, sonar devices, or nuclear charges. At the same time, Ryan Aeronautics has produced a non-manned jet-propelled aircraft called Firebee. In the 1960s, they were converted into a reconnaissance drone called Lightning Bugs with a range of 2500 miles[4]. After the 1973 Yom Kippur War, drones were more widely used. The Israeli Air Force deployed a drone to provide crucial images of the enemy's threats and targets in real time. As the U.S. and Israeli governments cooperated more closely, the U.S. Navy acquired an Israeli pioneer drone that was very effective during the Persian Gulf War. In the late 1990s, drones became a key component of the most important national troops[5].

3. Systematic Literature

I. Rosser, James C Jr et al. "Surgical and Medical Applications of Drones: A Comprehensive Review." *JSLS: Journal of the Society of Laparoendoscopic Surgeons* vol. 22,3 (2018): e2018.00018. doi:10.4293/JSLS.2018.00018- Drones

[4] Keane JF, Carr SS. A Brief History of Unmanned Aircraft. *Johns Hopkins APL Tech Dig*. 2013; 32:558–571

[5] 1970s & 1980s—UAV Universe Sites. Available at: https://sites.google.com/site/uavuni/1960s–the 1970s/ Accessed on 19Aug 2022.

can collect real-time data, deliver payloads, and have sparked the rapid evolution of many industrial, commercial, and recreational applications. Unfortunately, progress in the field of medicine has been slower. This study provides a thorough examination of current and future drone applications in medicine in the hopes of empowering and inspiring more aggressive research.

II. **Anna Konert, Jacek Smereka, Lukasz Szarpak, "The Use of Drones in Emergency Medicine: Practical and Legal Aspects", Emergency Medicine International, vol. 2019, Article ID 3589792, 5 pages, 2019.** https://doi.org/10.1155/2019/3589792- This paper will present real-world examples of how they can be used in rescue operations around the world. The paper concluded the research by observing that the existing regulations regarding drone flights have been identified globally as affecting aviation safety as the appearance of an unreported unmanned aircraft in controlled space.

III. **Abderahman Rejeb, Karim Rejeb, Steve Simske, Horst Treiblmaier, Humanitarian Drones: A Review and Research Agenda, Internet of Things, Volume 16, 2021, 100434, ISSN 2542-6605,** https://doi.org/10.1016/j.iot.2021.100434.- This study looks into the capabilities, performance outcomes, and challenges of drones used in humanitarian logistics (HL). It examines potential humanitarian applications for drones and presents a comprehensive agenda that structures and guides future research on the subject.

A systematic literature search was conducted to assess scientific research related to the current medical application of drones. For advanced research, sources of “drones”, “UAVs”, “unmanned aircraft”, “UAS” and “unmanned aircraft systems” were identified. The source is arranged in chronological order, the title is examined for relevance, and if necessary, selected. Sources include magazines, academic journals, articles, commercial publications and electronic resources.

Academic and non-academic sources have been accepted. The definition of academic sources is that they are published in academic journals and in the proceedings of national conferences. Non-academic sources have been included in efforts to capture the latest information in reports on the current use of drone technology. The same application was also included as a source.

The main topics of public health and disaster relief include catastrophic injury care, data collection, infectious diseases, disaster relief and emergency medicine. In emergencies, including in battlefields, drones are used as telemedical equipment. Medical supplies and transportation include some sub-sectors, including medical delivery, patient evacuation and commercial infrastructure applications.

4. Materials and Methods

The use of drones is a relatively new technology used for some time to come. Not only can this technology be used in medical practice and research, but it also can improve the quality of life of people worldwide. Medical science is always looking for ways to overcome the limitations posed by technological advancements and, as such, will invest in research to explore innovative means of treatment. One of these methods is the development of medical drones, which promises to help doctors perform surgeries with ease and efficiency. In any case, drones are not limited to just being used for medical purposes; they can often be employed in other areas as well and have various uses, both good and bad[6].

4.1 Types/Application Options

One of the most popular types of medical drones includes unmanned aerial systems (UASs) to provide medical services to clients remotely. These UASs do not require the assistance of humans to operate them. They can be operated from places like offices or private homes without human intervention, making them highly mobile. Such UAS consist of cameras, LiDAR sensors, radio frequency communication receivers, imaging processors, and other gadgets. Unlike regular drones, which are small enough to fit into hands, the ones manufactured by Dronebase usually have bigger bodies to handle heavier equipment. Thus, they require larger batteries for longer flight times and larger propellers instead of a normal drone with a single propeller. Drone-based medical applications range from the simple provision of diagnosis to even complex operations involving the placement of prosthetics as per the need of the patient. There are two main categories of UASs; small unmanned aerial systems (SUASs) and large-format Unmanned Aircraft System (UAS).

[6] Srivastava, Mashrin. "Automated Emergency Paramedical Response System". *Health Information Science*, vol. 6, no. 1, 2018, pp. 22–22, doi:10.1007/S13755-018-0061-1.

SUASs require smaller batteries and are therefore much smaller while providing high levels of autonomy[7]. compared to UASs, the size of SUAS is usually around 40 inches wide and 10 feet long, while large UASs are about 75 feet long and 100 feet in length. SUAS is more durable than UASs because of their lightweight design and can thus withstand harsh environments with little damage to their components. An example of a common SUAS is Sky-Droid, which can fly at a heights of up to 10,000 ft. However, since its inception, many other SUASs have emerged to serve specific applications such as agriculture and surveillance. While some of the latest models offer higher speeds of operation and better range, others are capable of flying to altitudes up to 20,000 ft and longer. It has also come to light that currently, there are three main classes of SUASs available in the market, with those designed for agricultural missions being classified as E0, S0, L0 and the newly designed R1[8].

The second class of medical drones to be discussed is the company known as Inspire Medical Systems (IMS), which offers a plethora of different types of medical drones. With more than 1,000 systems installed, IMS is one of the largest medical device manufacturers in the world and provides medical support, monitoring and tracking, and personal care products that are specifically designed to meet the needs of patients. Furthermore, the products are mostly custom-designed and tailored to suit the unique needs of individual consumers. Their devices are available directly through hospitals as opposed to third party retailers or online stores. Their drones are equipped with LiDAR and video camera systems to assist in viewing the surrounding environment and provide real-time tracking on the ground. IMS drones are very affordable and hence can easily cater for budgets for poor patients who cannot afford the expensive equipment for advanced treatments. Since the system relies heavily on machine vision and electronic processing of the data, there are no worries

[7] Hosseini, Nozhan. "UAV Command and Control, Navigation and Surveillance: A Review of Potential 5G and Satellite Systems". *IEEE Aerospace Conference*, 2019, pp. 1–10, doi:10.1109/AERO.2019.8741719.
[8] Darvishpoor, S. "Configurations, Flight Mechanisms, and Applications of Unmanned Aerial Systems: A Review". *Progress in Aerospace Sciences*, vol. 121, Feb. 2020, p. 0, doi:10.1016/J.PAEROSCI.2020.100694.

as far as data privacy is concerned as there is guaranteed anonymity over the whole process, unlike for most hospital-based treatment and treatment plans[9].

The next type of medical drone would be the Bokeh medical robot developed by the Microsoft Research Center and acquired by Boston Dynamics. Bokeh robots are controlled by powerful electric motors located on a motorised platform and can be programmed to act in a particular manner based on the user. By mimicking the movements of a person, this robotic system allows patients with spinal cord injuries or other impairments to walk or move around freely over land. According to studies, Bokeh bots can be deployed in the field of treating chronic back pain and arthritis. Due to their modular structure and ergonomic design, the Bokeh robots can be moved around and used across the globe due to its lightweight construction. Users can conduct simple procedures as they move around, such as cleaning, changing diapers, and checking the urine sample. Unlike most conventional robots where the users must wear special shoes, such robots are made of flexible material and thus can be worn on the feet without limiting their movement[10].

Lastly is a type known as a quadcopter. Unlike commercial drones, medical drones are completely autonomous and usually run-on battery backup with no onboard power source. To make matters worse, the control center often operates the quadcopters remotely, giving room for error in both the hardware and software. Despite this, the user doesn't need to worry about losing GPS, Wi-Fi or Bluetooth connection as the autonomous drones track of it automatically. Additionally, the fact that you don't need to own a traditional aircraft for these machines means that they are cost effective. They are also ideal for remote locations like cities, campuses, and government buildings. medical drones can carry payloads that can hold as much as 60 lbs on a single charge. Nevertheless,

[9] Awad, Atheer. "Connected Healthcare: Improving Patient Care Using Digital Health Technologies". *Advanced Drug Delivery Reviews*, vol. 178, Nov. 2021, p. 0, doi:10.1016/J.ADDR.2021.113958.
[10] Filho, Fernando Henrique Iost. "Drones: Innovative Technology for Use in Precision Pest Management". *Journal of Economic Entomology*, vol. 113, no. 1, Feb. 2020, pp. 1–25, doi:10.1093/JEE/TOZ268.

most payloads can take roughly 3 pounds of weight. A lot of the heavier payloads are suitable for patients with lower motor abilities, such as children and seniors[11].

4.2 Benefits of Using Medical Drones in Medicine

The benefits of working with drones have been well documented. As seen, the most popular ones include increased safety, increased flexibility, decreased costs, enhanced security, improved environmental protection, and greater accuracy. If only one benefit is more important than the other, then this one definitely stands out. Increased safety and security are some of the top reasons why most people want to get involved in the usage of health drones. Though there are still apprehensions surrounding whether there are any risks associated with getting a drone in your possession, it's easy to see the benefits of having such devices in your clinic and beyond[12].

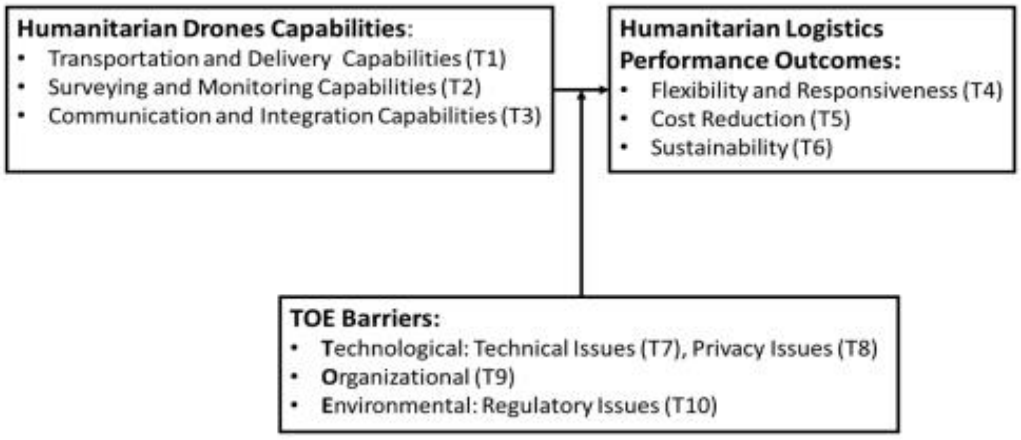

Fig: **A framework for analysing drones (Rejeb et al. 2021)**

Improved Accuracy – Through proper training and guidance, such medical devices can identify objects and their exact location within a space faster than ever before possible. This allows doctors to treat the medicine accurately and to prescribe appropriate doses when administered by a simple doctor. Improved Safety – When operating on tangible object, there is a chance of damage or

[11] Rohi, Godall. "Autonomous Monitoring, Analysis, and Countering of Air Pollution Using Environmental Drones". *Heliyon*, vol. 6, no. 1, Jan. 2020, doi:10.1016/J.HELIYON.2020.E03252.
[12] Sabra, Mohammed Nourr A. "Description of Security Impact of Drones Challenges and Opportunities". *National Computer Conference*, 2018, pp. 1–5, doi:10.1109/NCG.2018.8593136.

perhaps injury; however, when operating in a medical setting, accidents are considerably less likely. For example, using a drone, it is now easier for the doctors to identify and locate hazardous materials like lead, cadmium, and mercury. Better Environmental Protection – The sky is always full of pollution, so the probability of damaging the planet is almost instantaneously high. During the flights of medical drones, the debris that flies away after each of our final destinations is accounted for. Because of this, people may also save money with regard to air travel by simply landing their very own drones in a remote location once again instead of doing the same with trains or aeroplanes. Finally, the very best part of the entire scenario is that the entire procedure for collecting waste is generally much quicker and simpler. All in all, the medical drone is certainly well worth it.

5. **Results and Discussion**

The first question to be discussed involves the use of UAVs in health emergencies. Generally, the ability of these vehicles to perform lifesaving interventions and procedures should also make them an asset in emergency response efforts. For instance, using these vehicles can save lives when responding to a major accident involving humans. Likewise, saving them from a potentially deadly infection can also lead to significant number of life-saving measures. It is also important to bear in mind that these vehicles can be used to monitor and record data such as temperature and pulse, so that treatment recommendations can be made with absolute certainty. Such information is particularly important for medical staff that seek to provide accurate and effective care during emergencies.

The second question that needs to be addressed concerns the legal and ethical issues associated with this kind of transport. Some might argue that medical professionals need be able to rely on these vehicles once they arrive in a situation. Indeed, if they do not, all other measures must be taken, such as air ambulance transfers or establishing an additional field hospital, for example. Additionally, legal and ethical questions arise when considering the usage and disposal of a single-vehicle that operates both inside and outside the context of one's own home. Can another person use it? For the purposes of this paper, it would be preferable to not allow anyone to take advantage of such UAV. That being said, allowing individuals from outside the area to use these types of vehicles could eventually result in a conflict of interest or violation of the rights of someone who had already used them, thereby defeating any beneficial intentions that they might have set out.

Moreover, while considering the fact that these vehicles are equipped with special components designed specifically for the task at hand, it seems plausible that one party may decide to use them, without permission, in circumstances that might unfit within one's jurisdiction[13].

Furthermore, much debate exists about exactly what those conditions might be. According to the US Food Safety Administration (FSA) determines "emergency preparedness situation" as "any event that leads an individual to act or to suffer harm; either by death or serious injury or by deprivation of liberty; whether the harm results from a natural disaster, human error, or deliberate acts of terrorism". While the application of the term seems appropriate here, it is not an exhaustive list. Thus, there is a range of factors that could trigger a situation that warrants the action and response of personnel involved in medical intervention.

The United States has experienced some success concerning the use of these machines. One notable example is when the U.S. Army used small aircraft during the 2003 invasion of Iraq. Many of them were unmanned and equipped with anti-tank, chemical and/or biological agents. Their speed and agility enabled soldiers to move quickly through the dangerous terrain where armoured fighting vehicles could not easily adapt to their speed. During the war, many members of both the military and civilian population were injured and numerous people lost their lives. Such outcomes highlight the importance of having rapid response mechanisms in place[14].

The same principle applies to modern times. When responding to public health emergencies, governments have employed massive aerial platforms such as those used by the World Health Organization, which uses helicopters to deliver drugs and other resources to vulnerable communities in areas affected by communicable diseases and epidemics. Because of their superior capability for transport and storage, these large platforms can efficiently deliver the needed supplies to far-flung parts of the planet within hours[15]. For instance, on March 11th, 2004, when Hurricane Katrina struck New Orleans, France's Ministry of National Defense deployed a similar

[13] Lopez-Fuentes, Laura. "Review of Computer Vision Techniques in emergencies". *Multimedia Tools and Applications*, vol. 77, no. 13, July 2018, pp. 17069–107, doi:10.1007/S11042-017-5276-7.

[14] Lyall, Jason. "Rage Against the Machines: Explaining Outcomes in Counterinsurgency Wars". *International Organization*, vol. 63, no. 1, Jan. 2009, pp. 67–106, doi:10.1017/S0020818309090031.

[15] Laksham, Karthik Balajee. "Unmanned Aerial Vehicle (Drones) in Public Health: A SWOT Analysis". *Journal of Family Medicine and Primary Care*, vol. 8, no. 2, Feb. 2019, pp. 342–46, doi:10.4103/JFMPC.JFMPC_413_18.

system called Sentinel II to support relief efforts. It was designed specifically for large groups, and included four large-twin-engine biplane blades arranged vertically behind each wing. At the wingtips, there were six small engines capable of supplying up to 16,000 pounds of cargo and 200 tonnes of fuel. Moreover, because of their size, they also had a range of 6,000 miles above sea level, enabling effective air ambulance flights over vast distances. Because of their size, these wing tanks also contained heavy equipment for treatment and rehabilitation; therefore, helping save lives when victims of major injuries, accidents, or natural disasters are rescued from inaccessible locations[16].

Additionally, if a person was to die on land, the American Red Cross does not have access to standard hospital equipment and medical personnel. Consequently, time and resources are likely to be needed to determine exactly what has happened and to respond appropriately. Therefore, a drone is an ideal means to reach the wounded and diseased populations. First, they can be used as scouts and for reconnaissance. Second, while conducting rescue and fire operations, the automated systems in the vehicles can gather information about the whereabouts of casualties and aid responders to arrive at the scene sooner than the standard ambulance and other specialised medical vehicles do. Thus, the system can keep track of available resources and supplies so that no additional personnel are required to respond to incidents. Lastly, they are used for search, rescue, and recovery missions[17].

These systems have many reasons; One reason is that these machines allow for faster response times than vehicles and helicopters., Another aspect is that drones can be programmed to respond to specific conditions, while a pilot cannot always predict every situation and must make decisions based on various variables that may not be readily available in a human-powered aircraft. However, the biggest advantage is that these machines are very accurate, and thus, are much better at delivering results. Although some organisations have voiced concerns over the impact of these machines on jobs and environmental safety, other advantages outweigh these fears. Researchers note that "…the value of the use of aviation could well be estimated at $5 billion or even more

[16] Yin, Weihao. "Risk Reduction Impact of Connected Vehicle Technology on Regional Hurricane Evacuations: A Simulation Study". *International Journal of Disaster Risk Reduction*, vol. 31, Oct. 2018, pp. 1245–53, doi: 10.1016/J.IJDRR.2018.01.013.

[17] Braun, Jonathan. "The Promising Future of Drones in Prehospital Medical Care and Its Application to Battlefield Medicine". *Journal of Trauma-Injury Infection and Critical Care*, vol. 87, July 2019, doi:10.1097/TA.0000000000002221.

than $12 billion annually". Furthermore, the increased availability of medical equipment, as well, has contributed to ensuring that "…more people in need can receive medical care". Similarly, more people are dying from lack of access to basic medical care[18].

Although the above points out clearly difference between some areas of practice, this may indicate obvious differences., including public health and medical resources, there also exist a difference between how these resources should be used and how they are used. Therefore, a better approach to understand cases related to the utilisation of resources requires acknowledging the distinct differences between the principles behind public health and the development of medical equipment. There is therefore little consensus on how to best use both elements.

The third issue concerns the ethics and legality surrounding the use of UAVs. To begin with, the Federal Aviation Administration (FAA) was created in 1920 as a body tasked by Congress when it became clear that these machines would improve air travel and thus reduce the time spent waiting to land or taking off from airports. Today, these machines have become increasingly popular in our everyday activities, and are now a common aspect of modern society. But the question of law and ethics arises regarding ensuring that nobody can take advantage of the advantages afforded by these technologies and uses them unethically, especially when dealing with medical patients. Especially, if the goal of medical responders was to save lives, then why risk letting others take advantage of them? Furthermore, to some degree, the idea that using these UAVs can help the environment seems absurd. If something like water is saved by using these vehicles, it does not make sense that using them to deliver food and supplies might affect its quality. If one relies solely on these vehicles to get food, then why not fly? Why would one rely on a plane to get medication? These are just some of the many questions that arise when considering the concept of corrective action and environmental protection from pollution. When thinking of safety in this case, one must not leave any of these points out – not only is there a legitimate case for doing everything possible to ensure the protection of human life but also the protection of the environment[19].

[18] Khan, Md. Nafiz Hasan. "An Exploratory Study of the Use of Drones for Assisting Firefighters During emergencies". *Human Factors in Computing Systems*, 2019, p. 0, doi:10.1145/3290605.3300502.

[19] Mohamed, Nader. "Unmanned Aerial Vehicle Applications in Future Smart Cities". *Technological Forecasting and Social Change*, vol. 153, Apr. 2020, p. 0, doi:10.1016/J.TECHFORE.2018.05.004.

For example, a recent report suggests that drone companies such as Amazon, Google, or Blue Origin have successfully managed to sell hundreds of thousands of personal protective equipment (PPE) respirators and masks, which is hardly reassuring for those in healthcare facilities. Not only will these medical workers be risking their life when performing these crucial jobs, but it is also unlikely that they would be able to afford the same level of PPE required of non-medical workers. A similar argument could apply to the use of these vehicles for delivering vaccinations. Since medical personnel would be unable to afford similar quantities of vaccines, then they might not necessarily be prioritised in the supply of vaccines currently available with sufficient efficacy levels to protect the population, even though it has increased the likelihood of developing side effects such as pain and discomfort[20].

The Fourth Amendment to the United States Constitution also plays a key role in the discussion of these vehicles. This amendment prohibits unlawful searches and seizures, as well as excessive force and seizure. It can also prevent a person's constitutional rights such as due process, liberty, and due process rights in a criminal court, as well as his or her rights from the denial of freedom of speech and conscience. Nevertheless, it should also be noted that these regulations also include exceptions, which means that there are plenty of reasons for the government to go against these laws. One can imagine instances where this clause might not apply since the government and other agencies that have authority over the delivery of goods and services can be justified in breaking various rules that these vehicles can follow. Nevertheless, the presence of these exceptions means that when a request for these vehicles is submitted, they must be given the benefit for whatever reason. Even if these exceptions are applied to both medical personnel and other entities, the Fourth Amendment itself still stands in the best interests of medical responders and their victims[21].

6. Legal Mechanism of Drones in around world

The idea of the legal mechanism to govern the use of personal drones is not new for anyone who comes across this type of technology from time to time. However, the legality and how the law can actually regulate it made it a little more difficult than we expected. Such paper will attempt to

[20] Sacramento, David. "An Adaptive Large Neighborhood Search Metaheuristic for the Vehicle Routing Problem with Drones". *Transportation Research Part C-Emerging Technologies*, vol. 102, May 2019, pp. 289–315, doi:10.1016/J.TRC.2019.02.018.

[21] Matthew, Dayna Bowen. "Two Threats to Precision Medicine Equity". *Ethnicity & Disease*, vol. 29, Dec. 2019, pp. 629–40, doi:10.18865/ED.29.S3.629.

explain the laws that were set by various governments worldwide and present legal mechanisms that are designed to ensure the safety of human beings within the air. It would be likewise to attempt to provide examples of some of these types of laws, which may be utilised to regulation the manufacture and usage of personal aircraft by people in the modern-day United States[22].

Governments can choose many laws to regulate personal artificial devices, such as the creation of regulations to regulate their production and usage. First, there are different types of regulations that have been put into place in most countries. Such include both top quality and industrial regulations. Each type of regulation can be associated with something that an individual or business needs to consider. Top quality regulations can be used with companies that require certain standards to be met to obtain approval to operate or if they encounter any problem in terms of a violation of these limitations (Rosenberg), they must comply with them. With industry regulations, the government regulates many areas, including the manufacturing process, testing and inspection, distribution, sales and marketing and even pricing. Some regulations can generally be imposed on AI, but the most important one is definitely the Aviation Safety Take action, which is the first line of defence against terrorism. Under the Federal Aviation Administration, the agency has been creating rules and regulations to try to keep the American skies safe. One example would is the FAA's rule on "Self-Taught UAV Systems" that prohibits self-taught vehicles from being installed in the nation's airports except following specified guidelines. Self-taught vehicles often contain more than 100 pounds weight and must be at least 12 years old. According to the FAA, these machines can be equipped with commercial units by third-party providers., using specific specifications and do not violate their own terms. The other common restrictions that can be placed on self-pilots are that these vehicles must be able to be carried by themselves or be moved by another vehicle not manufactured by them or possibly a third party (Daniels).

The next law that could be considered legal in many countries is perhaps the Human Rights Condition. This is because most individuals believe they can exercise much rights that they cannot. For instance, they might think that as long as someone else is driving them to where they are operating, for instance, they really should be allowed to drive, not only while they are operating. Because of this, there are no minimum requirements that prevent individuals from obtaining

[22] Alwateer, Majed. "Emerging Drone Services: Challenges and Societal Issues". *IEEE Technology and Society Magazine*, vol. 39, no. 3, Sept. 2020, pp. 47–51, doi:10.1109/MTS.2020.3012325.

adequate protection through police arrests., the security at work, and many other concerns. Many countries throughout Western Europe declare that all humans have the same worth, is defined by the Universal Declaration of Your independence, which states; "All men and women being equal are entitled to acquire and hold in marriage and enjoy each other's lives the privileges they have been granted and to acquire and maintain the property, property rights and responsibilities. However, if this does happen, then you must then pay for your freedom while defending it. If you can't afford it, then the person responsible for your freedom could also be held liable. Additionally, you must also pay to have your liberty or perhaps your property removed in the event the person in charge of it is guilty of abuse or injury to you in doing so. Lastly, there needs to be just no violence or abuse of power. Although laws define the actions that will be legal and the actions that could be illegal, the particular ones that the federal constitution was founded upon are ones declared legal by your court. When the court makes a ruling, it is done without looking at the evidence in which case the judge made that fact known. Even though the courts may have many options in determining whether a case is legal or illegal, as well as what actions to penalise, the fundamental point that is usually taken from this information is that a case that happens is a criminal one[23].

Because of the number of issues regarding how exactly legal system function regarding technological devices like robots, the laws about them am less obvious. As stated previously, there are more than forty different types of laws that can be created by simply different governments. Nevertheless, the best-known top-quality laws about robot machines are the FAA Regulations and the ANPR. The main purpose behind such policies is to permit persons to use robotic technology. Additionally, they are meant to allow for a greater degree of safety for employees and passengers inside the air. Another type of legislation that may be created to protect people from becoming hurt in the event they have a problem with these artificial devices, for instance, certainly one law says that the only thing that will stop someone from falling is gravity. Therefore, there needs to be an area to limit the fall of everyone in the plane to limit injuries, or perhaps injuries to other people who might arise. Furthermore, the FAA may also offer rules to prevent the machine, in the event it drops out of control, it makes it possible for the person behind it to take responsibility for that.

[23] Rogan, Mary. "Human Rights Approaches to Suicide in Prison: Implications for Policy, Practice and Research". *Health & Justice*, vol. 6, no. 1, Sept. 2018, pp. 15–15, doi:10.1186/S40352-018-0075-4.

Finally, yet again, when the computer crashes. Regardless of when a similar device fails, the person responsible can end up being found liable for the tragedy[24].

6.1 Drone laws in India

India's government is the highest authority in implementing laws restricting the use of drones. They control and regulate the use of these types of vehicles, commonly referred to as unmanned aerial vehicles (UAVs). This technology uses low altitude satellites – commonly known as "satellites" – to transmit data in a way that can be followed by an aircraft whose sensor and computer are specially designed for its operations. The main objectives and benefits of UAVs include reducing traffic congestion and saving fuel consumption, which is critical in developing nations like India and China. India has successfully developed applications, such as those targeting air pollution and disaster management, which have brought much confidence back into its country. In fact, according to some experts, several countries that previously faced challenges related to disasters could now thrive because of the application of UAVs. Despite this, the United States – although it is an industrial power with large mineral resources – fears the potential of drone warfare because its economy relies heavily on military spending (as most states in Asia do). The US believes that using drones will be unsafe and has already begun working on a system for regulating their operation[25].

According to the DGCA, drone use is allowed in India, subject to DGCA regulations. The first person who tried the concept was an engineer named John H. Walker, Jr. in 1942. He developed a capable machine of transporting men and women to far regions and became known as the Wright brothers. It wasn't until 1947 when Dr. Vikram Shukla, Chairman Department of Civil Aviation and Space Development, approved the idea of making this craft an air travel option for people. Therefore, with the help of the then Prime Minister Jawaharlal Nehru, they started building their own prototype vehicle. Although there were no aircraft and helicopters, they managed to make up for it by creating a series of small satellites and using them to carry people from one place to

[24] Porras-Vazquez, Alberto. "A New Methodology for Facilitating the Design of Safety-Related Parts of Control Systems in Machines According to ISO 13849:2006 Standard". *Reliability Engineering & System Safety*, vol. 174, June 2018, pp. 60–70, doi:10.1016/J.RESS.2018.02.018.
[25] Rothe, Julian. "A Concept for Catching Drones with a Net Carried by Cooperative UAVs". *International Symposium on Safety, Security, and Rescue Robotics*, 2019, pp. 126–32, doi:10.1109/SSRR.2019.8848973.

another as fast as possible. This concept was soon made available to the public. The success of Dr. Vikram's invention made him the official inventor of the term "Droner", and he was given the title of Airports Engineer. These two inventions led the way to other innovations, which created many smaller aerial vehicles, which were later added to other parts of our everyday lives. Today, these modern flying machines are now used for the delivery of packages, transporting goods, moving supplies and even conducting maintenance tasks on buildings[26].

In recent times, many countries have used small unmanned vehicles, also called drones, as a means of conducting various activities. These include emergency services such as search and rescue missions, surveillance, meteorological observation, military reconnaissance, surveillance, and other applications. In the United States of America, the Federal Aviation Administration has developed guidelines for conducting searches for drugs, weapons, or explosives in all airports. Also, the FAA has defined a set of rules which are used to regulate the flying, landing, and takeoff in any airport. The Federal Aviation Administration's regulation provides overall control to the Department of Agriculture (DA) over access to aerial intelligence. Furthermore, it protects the safety of aircraft by regulating their movements without interference from external sources, namely the government, law enforcement agencies, and airports by regulating their operations, including those that require the use of robots, unmanned vehicles, and artificial intelligence. Currently, there are no legal prohibitions on the use of these tools for performing critical public and governmental functions[27].

The main difference between the regulations of commercial aviation and military air coverage is that they do not allow the operation of robotic or other small drones as a weapon. Thus, the federal laws protect both civilian and military users of these tools. Although most people believe that the concept of 'drone zone' can exist only in developed countries like the US or Israel, more attention must be given to developing nations like Africa where drone applications are already used. First, because the military planes do have to operate independently, these pilots must be able to perform complex manoeuvres and take turns. On the one hand, this requirement may seem very complicated but this is actually quite simple. However, some military pilots will have to fly

[26] Cotton, William B. "Airborne Trajectory Management for Urban Air Mobility". *AIAA/CEAS Aeroacoustics Conference*, 2018, doi:10.2514/6.2018–3674.

[27] Alladi, Tejasvi. "Applications of Blockchain in Unmanned Aerial Vehicles: A Review". *Vehicular Communications*, vol. 23, June 2020, p. 0, doi:10.1016/J.VEHCOM.2020.100249.

alongside the big aircraft. This situation may cause additional problems regarding communication with ground-based forces. If you have a problem with the radio connection, try again later. For instance, two military helicopters from the American Air Force can create a network of communication with each other if they are connected via satellite connections. Additionally, even after the flight, the two pilots may not necessarily have to switch off their telephones. It depends on whether someone asks them to turn back on it or not. Finally, these pilots also must ensure that their aircraft and passengers do not suffer any adverse health effects that occur because of exposure to extreme temperatures, altitude, radiation, or chemical substances as well as certain chemicals or chemicals, such as insecticides. Consequently, these pilots need to be extremely careful to ensure the environmental protection of themselves and passengers during the flight. According to DGCA (2011), UAVs are legalised in India. Additionally, many people have been employed to assist with the regulation of the equipment, which is also common among nations like China and Israel[28].

In contrast, the regulations of commercial aviation are based on standard operating procedures (SOP), which state that every pilot should follow the same instructions or rules regarding how to land and fly safely and according to what they have received in training and information, which is available on the internet. However, there are differences between the FAA and commercial airlines. While commercial airplanes operate according to the FAA's SOP and has a design similar to commercial planes, commercial aircraft have special equipment such as water jets, jet engines, automatic flight control systems, hydraulic systems, etc., and they do not need to undergo any stringent testing procedures, which means that they are safe without putting anyone at risk by making mistakes or accidents. Simultaneously, the FAA requires commercial pilots to undergo regular and continuous tests. Also, there are only three days per year in which the FAA can test a new version of its autopilot. Commercial pilots are expected to maintain six hours a day while they take care of their passengers, while the minimum number of hours is four. Commercial aeroplanes cannot operate without permission. Thus, the only way to get permission is to pay $1400 for three months. Moreover, it is forbidden to use non-commercial flights unless approved by the FAA or other regulatory bodies. Due to violating any mentioned norm, the commercial plane may end up being grounded for almost a month. Nevertheless, note that these regulations differ from those of

[28] D'Amato, Egidio. "Distributed Reactive Model Predictive Control for Collision Avoidance of Unmanned Aerial Vehicles in Civil Airspace". *Journal of Intelligent and Robotic Systems*, vol. 97, no. 1, Jan. 2020, pp. 185–203, doi:10.1007/S10846-019-01047-5.

industrial zones, which are designed to serve local industries and do not require the approval of the FAA or any other relevant bodies.

Nevertheless, both the civil and military aircraft have different requirements. Civil aircraft usually do not fall into the category of unmanned vehicles. Instead, they are equipped with controlled devices such as radars, sonars, and Lidar equipment. Therefore, these aircraft require special permission to have their movements performed in compliance with the regulations of the federal government. The military aircraft, however, are classified under the category of weapons. Here, these aircraft must meet particular conditions and regulations such as having to conduct their operations at night and at high altitudes. Besides, the military aircraft must adhere to specific regulations while operating at airports, namely, those, which limit the maximum speed of these aircraft to 12,000 feet and in a certain range of 1 mile. Likewise, unlike civil aircraft, these aircraft cannot fly when exceeding 200 feet above sea level. To comply with the safety standards in these regions, the military aircraft need to have the right temperature between -80- and 200-degrees Fahrenheit. Additionally, the aircraft need to have the ability to withstand wind speeds reaching 60 mph. Lastly, the military aircraft need to have a negative pressure environment and shock of 500 pounds per square second. All these features show that, compared to civilians, military aircraft need specialised permission from their commanders to be operated.

Many are opposed to the use of UAVs in national security areas. First, the theory of the so-called "killer machines" explains that these machines will threaten military forces and bases across the globe. Also, these products might eventually become part of weapons in future conflicts. Second, the technology itself does not pose any threat to civilians. Technology is just another form of weaponry on Earth. Besides, Technology that improves the efficiency of the army seems to be very useful in our daily lives. Third, these machines are cheap and don't require large amounts of investment to be put into place. Even though some companies offer huge deals, these contracts come at an unreasonable price, especially regarding R&D costs. Lastly, these machines provide much better results than many soldiers in fighting wars and other events. The biggest controversy in the field of artificial intelligence and in the military field of the United States seems to be linked to the fact that artificial intelligence researchers do not really have enough expertise or resources to ensure a stable employment relationship between the military and intelligence units and thus they will remain unemployed in a very short time. To counter this argument, US President Trump promised to bring together thousands of highly skilled scientists from around the world to work at

the cutting edge of Artificial Intelligence (AI) research. He believed that once AI starts working for the country, it will not just change the current business landscape. With the help of such powerful AI researchers, the country will be able to solve problems such as climate change, the lack of clean drinking water, inequality, and poverty, among others. What is more important, he said that "because we're going forward in a direction that benefits the economy, it's good for the health of the nation because it's good for our country" ("How to Get Over Donald Trump's Triggers for AI" 2016). So, in conclusion, President Trump believes that AI will become a key part of our national interest and the success of his agenda would depend on how quickly these organisations start applying AI to their businesses. And as long as this happens, then the future of warfare and combat will benefit human beings greatly. Without any doubts, this theory sounds reasonable and reasonable. If the President is indeed correct, then we need more efficient ways of keeping us safe throughout the world, a more effective means of improving the quality of life and prosperity of individuals, and better methods for providing a greater human experience and a safer living in general.

Indian Authorities have introduced a point of facilitation for purpose registration through i.e., "DigitalSky platform" means the online platform hosted by the Directorate General of Civil Aviation (DGCA) for various activities related to the management of unmanned aircraft system activities in India[29].

The unmanned aircraft system shall, based on the maximum all-up weight including payload, be classified:

- Nano: Less than or equal to 250 g
- Micro: Greater than 250 g and ≤2 kg
- Small: Greater than 2 kg and less than or equal to 25 kg.
- Medium: Greater than 25 kg and less than or equal to 150 kg.
- Large: Greater than 150 kg.

[29] La Cour-Harbo, Anders. "Probability of Low Altitude Midair Collision between General Aviation and Unmanned Aircraft". *Risk Analysis*, vol. 39, no. 11, July 2019, pp. 2499–513, doi:10.1111/RISA.13368.

"DGCA Notice No. 31018/2/2021-Drone dated 19th May, 2021, the validity of all provisionally accepted models has expired on 31st August, 2021. Therefore, UIN cannot be issued for provisionally accepted UAS models on Digital Sky Platform.

Users may obtain a Type Certificate for such models. UIN can be applied once the Type Certificate is issued. The Central Government promulgated the Unmanned Aircraft System Rules (UAS Rules), 2021, which came into force on 12th March, 2021; and received valuable feedback from academia, industry and other stakeholders; Now, therefore, the Central Government proposes to make certain rules in supersession of the UAS Rules, 2021, in exercise of the powers conferred by sections 5, sub-section (2) of section 10 and sections 10A, 10B and 12A of the Aircraft Act, 1934 (22 of 1934)".

7. Conclusion

Worldwide, countries have developed many legal mechanisms to regulate the production and use of personal drones. While this is really going on, we as Americans must remain mindful of what we state and do not attempt to go to others to determine what the laws are that we should apply ourselves to. Because all of us know about the regulations that are necessary to keep our land safe, this may not always be relevant. Especially, the FAA and ANPR regulations am very basic. They might not seem as important compared to personal airplane accidents, however, they play a vital part in protecting us in the safety of our land and ultimately our very own lives. It can be seen that the benefits of these vehicles in terms of preserving life and keeping the community safe far outweigh any potential drawbacks, which is perhaps among the main problems associated with them. From a practical perspective, these vehicles can be deployed for quite a long period when a need arises, allowing their usefulness to increase overtime. In addition to helping doctors get to patients quickly, these vehicles have a positive environmental impact on many ways, which in turn translates to reduced carbon dioxide emissions and less noise pollution, as well as lower rates of road accidents, heart attacks, respiratory disorders, and strokes. All of these features can mean a substantially better outcome than relying on ground transportation, which often provides slower transport times. Overall, the decision between doing what is best for everyone versus being responsible for my actions is not that simple. Ultimately, if one wishes to achieve the best outcomes

for himself/herself and the community at large, then the answer is 'not'. While it may appear unlikely that these machines can help solve our internal problems, note that they are often used to resolve existing problems. Nowadays, we have smart phones that enable us to communicate instantly with friends or family around the world and can help doctors perform duties faster. Consequently, despite the recent debate regarding whether or not to use these new tools, these machines are widely used to solve some urgent and urgent problems and relieve many stresses. Even though they are currently mostly used in military and police activities, these machines can be incorporated into emergency medical services for saving lives and ensuring the health of others. The primary role of physicians is to save lives and ensure the health and safety of others, but they often have to go through difficult periods that call for speedy responses and efficient solutions. These machines are used when human beings cannot operate and when humans need them most. To sum up, I think that the introduction of these machines can benefit humanity by providing faster results, improved efficiency and reduced costs, and less stressful environments that might otherwise cause accidents. Hopefully, the technology will expand in the near future and enable us to save lives and ensure the health and safety of others. The fact that UAVs are in existence has brought many challenges to our nation. Although some of these issues must be dealt with effectively, they still present serious threats that must be addressed. Policies must be established to protect the welfare of all parties involved in UAV operations. Such policies must include adequate training in operating methods. Also, enough surveillance of UAV operators must be provided. All possible measures must be implemented to help curb the use of these vehicles, especially during the time of emergencies. Moreover, stringent laws must be put in place to check the usage of vehicles that can endanger the lives of citizens and other people living around. In the process, the government must establish mechanisms to monitor all activities performed by the operators. Law enforcers must cooperate with each other in enforcing laws on UAVs. Additionally, laws regulating the flow of UAVs must be enforced to protect citizens and other residents. Lastly, strict laws should be implemented and strictly enforced to check the use of these vehicles.

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