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POLICY BRIEF

Medical Drones in the United States and a Survey of Technical and Policy Challenges

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Drones, also known as unmanned aerial vehicles (UAVs), will likely play an important role in the future of healthcare. Technologists envision a world in which drones transport blood, medical supplies, drugs and vaccines, defibrillators, and telemedicine kits.[1] In fact, in several countries with light air traffic and accommodating regulations, most notably Rwanda and Ghana, medical drones have already become important components of those nations' rural healthcare systems, saving lives when time is critical. The United States could benefit from this same technology, transporting medical goods over vast rural areas, over urban traffic jams, and during weather conditions that make conventional transport hazardous or impossible. Across rural America there are areas short on physicians, hospitals, and other medical resources, and drones offer one tool for stretching resources.

While the number of possible drone applications is significant, making full use of this technology will require technological advances on the industry side and deft innovation on the regulatory side to mitigate the risks involved in adding large-scale drone traffic to America's heavily used airspace.

TECHNOLOGICAL CHALLENGES

Skeptics rightfully worry about the implications commercial drone use would have for an already-crowded air space. A catastrophic incident, such as a drone downing or damaging a passenger aircraft, is the main fear of aviation regulators. Drone manufacturers and operators will need to improve the technologies on a number of dimensions to make widespread use viable in the United States and other developed nations. Challenges include the following:

Sense-and-avoid systems. The United States has nearly 20,000 municipal and major airports and heliports scattered across the country.[2] This creates a busy national airspace full of planes, helicopters, hobbyist model airplanes, and even the occasional missile. Even though drones are restricted by law from flying near airports and a variety of military installations without permission, innocent mistakes and negligent drone operators are always possible. Drone companies are working on advancements such as "geofencing" and sense-and-avoid technology to help drones automatically avoid buildings, trees, geological features, cell towers, cranes, and other airspace users (including planes, birds, and other drones).[3]

Remote ID. Before there can be extensive drone delivery networks, regulators, law enforcement, and the public will want the drones to be identifiable, much like how vehicles on the road are identifiable with license plates. Remote ID is a proposed technology—a "digital license plate"—that would allow the rapid identification of drones from a distance via wireless technology or a computer connection. The Federal Aviation Administration (FAA) and the drone industry are currently working on technical standards and requirements for Remote ID, which is scheduled to be implemented in 2024.[4]

Unmanned traffic management. The FAA, NASA, and state departments of transportation are developing unmanned traffic management (UTM) systems—a highly automated and digital air traffic control for hundreds of thousands or even millions of commercial drones. Under current regulations, it's difficult to receive FAA permission to fly a drone beyond visual line of sight (BVLOS) of the operator. BVLOS is an essential component of a large-scale commercial drone sector. With BVLOS, remote pilots can manage multiple flights at once, enabling the industry to reap economies of scale. Without BVLOS, it is difficult to fly drones over much of the vast terrain of the United States or in urban areas, where buildings block vistas. UTM systems will eventually automatically manage drone flights—much like the current air traffic control system does—to ensure safe and rapid services. But for now, the technology is very young. It's also unclear how many UTMs there will be and whether they will be operated by the federal government, state governments, cities, or private operators.

Better communications systems. Drones will have to maintain reliable wireless communication at all times—a requirement that becomes considerably more challenging when flying BVLOS. Larger drones will require satellite communications or some other form of reliable architecture for communications with a ground operator. In some cases, safety and efficiency will entail heavy data flows, such as live video, so large bandwidth will be essential. In a sense, drone communications must be more reliable than those found on airplanes because, unlike on an airplane, there is no pilot to take charge when communications systems fail. No matter how good the design, communications will occasionally be lost, requiring "lost link procedures"—procedures for the drone to follow in the absence of contact with the UTM system. It will also be necessary to defend drones against hackers, terrorists, and others who might seek to harness drones for nefarious purposes.

Better motors, engines, and airframes. Today's battery-operated drones are limited in their range and weight-bearing capacity. Current battery-powered electrical engines and present-day airframe designs will need major improvements.[5] Alternative solutions include developing miniaturized internal combustion engines or power from hydrogen fuel cells. These developments are in their early stages, and previous estimates suggest that the up-front costs of developing them will be high.

PUBLIC POLICY CHALLENGES

The above technological improvements create a chicken-and-egg problem. Drone developers will have to spend enormous sums to develop the next-generation vehicles and communications. But innovators and investors will hesitate to invest the needed sums without guarantees that the new vehicles will be allowed aloft by regulators. Simultaneously, policymakers may hesitate to issue such guarantees without a high degree of certainty that the yet-to-be-developed vehicles will meet desired safety standards. The challenge is to devise a legal and regulatory framework—in essence a compact between industry and government—to overcome this problem. New regulations will have to tackle the following questions:

Current drone restrictions. There are currently a number of obstacles standing in the way of drones fulfilling their full commercial potential. Part 107 of title 14 of the US *Code of Federal Regulations*, which covers small unmanned aircraft systems, is one of them.[6] This part of the code restricts drone flight and impedes most commercial drone use. These rules, for instance, require that drone operators fly their drones within line of sight, that maximum allowable drone altitude be limited to 400 feet, and that drone flying time be confined to daylight hours. The rules also prohibit flying a drone over anyone not involved in the direct operation of the drone. Widespread drone services aren't possible with these restrictions. In February 2020, the FAA issued a proposal to certify certain drones for extensive, nationwide operation, but implementation is a few years away.[7]

Spectrum policy. The 2018 FAA Reauthorization Act instructed the FAA, the National Telecommunications and Information Administration, and the Federal Communications Commission to draft a comprehensive plan to ensure a reliable communications network.[8] They plan to do this by exploring whether drones can operate on specific band frequencies. If drones cannot, the FAA will recommend other frequencies that the drones can operate on. Use of satellite communications like these will be essential for effective and efficient communication between drones and the pilots on the ground. Without reliable communication, BVLOS flights become unreliable and unsafe.

Airspace design. Current airspace design was developed mostly decades ago. Inserting millions of new vehicles into this architecture is not a simple matter. Under existing law, the FAA alone manages all "navigable airspace." For decades this worked well because aircraft are usually hundreds or thousands of feet off the ground. Drones, however, effectively transform all outdoor areas into "navigable airspace." This massive expansion of the FAA's authority conflicts with the principles of property law. The Supreme Court has held that landowners own the "immediate reaches" of airspace above their property,[9] and many states vest low-altitude air rights—where drone operators want to fly—with landowners.

Privacy and security. In late 2019, the US Department of the Interior grounded nonemergency flights of Chinese-made drones out of security concerns.[10] China is by far the largest producer of commercial drones, and the Interior Department expressed concerns about the possibility of unwelcome surveillance.[11] There is also considerable angst over privacy concerns, as drones have the capacity to spy on individuals and businesses.[12] In an iconic legal case, an irate homeowner shot down a neighbor's drone flying over his backyard. A state judge ruled that he had the right to take such action, citing his privacy interests.[13] There are similar concerns over the use of drones for industrial espionage.[14]

FIRST STEPS TO ADDRESSING THE CHALLENGES

Federalism. The FAA and the states will need to walk a fine line to ensure the safety of the general population while allowing the free innovation of medical drone technology. This will require close coordination between the FAA and individual states. Under Supreme Court precedent, landowners such as homeowners and state governments own the airspace within the "immediate reaches" of their land and buildings. Congress should consider expressly delegating authority to states for managing low-altitude airspace and clearing up what "immediate reaches" means. At least one proposal currently in Congress would do that.[15] Hopefully lawmakers will bring legal clarity to when and how states can regulate low-altitude airspace.

State-level advisory boards.[16] These groups would be composed of stakeholders including public safety representatives, medical professionals, consumer groups, industry representatives, and academic experts. The objective of these groups would be to recommend public policy changes for state legislators to consider. These committees should explore policies that lay the groundwork for drone transportation infrastructure, including the deployment of 5G communications networks.[17] One idea is for city or state authorities to lease out "drone highways" above public roads and public property to drone companies.[18]

CONCLUSION

The success of futuristic drone applications, especially those in healthcare, depend on adopting a unique set of rules for low-altitude airspace separate from the rules that have traditionally applied to the national airspace. The infrastructure and public issues (e.g., noise restrictions and zoning) will be local. Efforts such as the FAA's Integration Pilot Program being conducted at the state and local level are introducing municipalities and states to drone delivery services. The next step would be for states to begin planning for drone infrastructure and light-touch drone airspace management.

If permitted, drones will change the nature of America's airspace, delivery systems, and ambulatory services. There are technical and legal obstacles to widespread medical drone services. Nevertheless, federal and state regulators can accelerate drone deployment by anticipating these challenges. Collaboration between local, state, and federal agencies and drone operators and manufacturers will be critical to ensuring the efficient and safe transition to drone services.

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NOTES

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