SPECIAL REPORT

Rise of the Unmanned Aerial Vehicles: An Imminent Public Health Threat Mandating Counter-Terrorism Medicine Preparedness for Potential Mass-Casualty Attacks

Derrick Tin, MBBS;[1] Zachary Kallenborn, MA;[2] Alexander Hart, MD;[3] Attila J. Hertelendy, PhD;[4] Gregory R. Ciottone, MD[5]

1. Senior Fellow, BIDMC Disaster Medicine Fellowship; Department of Emergency Medicine, Beth Israel Deaconess Medical Center and Harvard Medical School, Cambridge, Massachusetts USA
2. Research Affiliate, Unconventional Weapons and Technology Division, START, University of Maryland; Policy Fellow, Schar School of Policy and Government, George Mason University, Fairfax, Virginia USA
3. Director of Research, BIDMC Disaster Medicine Fellowship; Department of Emergency Medicine, Beth Israel Deaconess Medical Center; Instructor, Harvard Medical School, Boston, Massachusetts USA
4. Faculty, BIDMC Disaster Medicine Fellowship; Department of Emergency Medicine, Beth Israel Deaconess Medical Center, Boston, Massachusetts USA
5. Director, BIDMC Disaster Medicine Fellowship; Department of Emergency Medicine, Beth Israel Deaconess Medical Center; Associate Professor, Harvard Medical School, Boston, Massachusetts USA

Correspondence:
Derrick Tin, MBBS
Senior Fellow, BIDMC Disaster Medicine Fellowship
Department of Emergency Medicine
Beth Israel Deaconess Medical Center
Harvard Medical School
Cambridge, Massachusetts USA.
E-mail: derrick@alphazodiac.com

Conflicts of interest/funding: The authors have no conflict of interest or financial disclosure to declare.

Keywords: counter-terrorism medicine; disaster medicine; drone; mass-casualty incident; prehospital medicine

Abstract

The mass proliferation and increasing affordability of unmanned aerial vehicles (UAVs) in recent years has given rise to weaponized UAV use by terrorists, leading to mounting and credible concerns this attack methodology will be the next terrorism modus operandi. Counter-Terrorism Medicine (CTM) specialists need to consider how UAVs alter or create new mass-casualty scenarios that can further exploit existing medical preparedness vulnerabilities. With an opportunity to be proactive in disaster prevention, mitigation, and preparedness, it is imperative this gathering storm be acknowledged and stakeholders explore how best to prepare for, respond to, and mitigate the consequences of UAV incidents.

Tin D, Kallenborn Z, Hart A, Hertelendy AJ, Ciottone GR. Rise of the unmanned aerial vehicles: an imminent public health threat mandating counter-terrorism medicine preparedness for potential mass-casualty attacks. *Prehosp Disaster Med.* 2021;36(5):636–638.

The Kettering Bug, the world's first unmanned aerial vehicle (UAV), began development in 1917 as a prototype for an unmanned flying bomb at the request of the US Army.[1] Also referred to as drones, unmanned aircraft, or remotely piloted vehicles, UAVs today are considered an integral part of many modern militaries' arsenals, both as an intelligence, surveillance, and reconnaissance tool, as well as a combat instrument.[2,3]

Like many technologies borne out of military applications, modern day UAVs have evolved beyond their wartime origins and made the leap into both civilian and commercial sectors, with a wide range of applications from aerial photography and building safety inspections to locating survivors using body heat surveillance to the delivery of medical and other supplies to remote locations.[4,5]

Specialists in Counter-Terrorism Medicine (CTM), an emerging sub-specialty of disaster medicine focusing on the health care related mitigation, preparedness, and response demands of increasingly more complex and asymmetric terrorist attacks, have also identified UAVs as a potential and concerning mass-casualty attack platform.[5] There is precedent. In the early 1990s, the Aum Shinrikyo cult explored the use of UAVs to deliver chemical weapons before the Tokyo Subway attack, and in 2019, the Houthi movement in Yemen launched a UAV attack on oil processing facilities in Saudi Arabia, something that continues today with on-going, sporadic attacks.[6,7] While these examples represent the use of UAVs as a novel platform for both conventional and non-conventional weapons rather than a novel

Abbreviations:
CTM: Counter-Terrorism Medicine
UAV: Unmanned Aerial Vehicle

Received: January 22, 2021
Revised: March 21, 2021
Accepted: April 11, 2021

doi:10.1017/S1049023X21000765

attack methodology, per se, their ease of use, coordination, scalability, and potential to create a compounding disaster can exploit current vulnerabilities in the health care sector.[8]

The mass proliferation and increasing affordability of UAVs in recent years has given rise to weaponized UAV use by terrorists, leading to mounting and credible concerns this attack methodology will be the next terrorism modus operandi.[9–12] Low acquisition costs and the availability of multiple low-profile purchase pathways, along with the potential for high-accuracy targeting, operational flexibility, inadequate defenses, and low levels of infrastructure and training needs to support the use of simple UAVs, all add to their appeal.[13]

Alarmingly, UAVs can disrupt air traffic, and amateur/unsophisticated modification of civilian, off-the-shelf UAVs could enable them to carry explosives, creating a significant risk to mass-gathering events.[14,15] Agricultural UAVs designed to spray pesticides could be reappropriated as highly-effective delivery systems for chemical weapons attacks.[16,17] Increasingly sophisticated technologies, from autonomous behavior to collaborative swarming, are further enhancing UAV capabilities and creating new opportunities for terrorists to carry out complex, coordinated, multi-modality attacks with the potential of inflicting proportionally more harm.[18,19]

Existing government technology, funding, and policies do not appear sufficient to reduce the risk. The Center for the Study of the Drone at Bard College (New York USA) identified 537 counter-UAV systems available on the commercial market in December 2019. However, limited operational data are available to assess their efficacy, and few appear designed to handle multiple UAVs at once.[20] Likewise, a recent Office of the Inspector General (US Department of Health and Human Services; Washington, DC USA) review found the US Department of Homeland Security (Washington, DC USA) had limited capabilities to counter UAVs and has not adequately funded counter-UAV operations.[21] Current US law only allows federal authorities to operate counter-UAV systems, which may require the US government to adopt novel strategies to protect numerous, geographically dispersed critical infrastructure facilities.[22,23] While major international efforts, like United Nations Security Council Resolution 1540, seek to limit non-state actor access to traditional weapons of mass destruction, unfortunately, these efforts do not apply to conventionally-armed UAVs.[24]

Specialists in CTM need to consider how UAVs alter or create new mass-casualty scenarios that can further exploit existing medical preparedness vulnerabilities. Larger-scale incidents from more effective chemical or biological weapon delivery systems, health care facilities as primary or secondary targets, and dispersed victim spread in multiple and fluctuating warm or hot zones from simultaneous, timed, and coordinated attacks all add to an already complex disaster response to terrorist attack matrix.

Exactly how UAVs change medical response requires further investigation and necessitates regular multi-agency discussions with disaster and CTM specialists, security, intelligence, and law enforcement experts, as well as counter-terrorism and counter-UAV specialists, to explore risk mitigation strategies to this extremely real and dangerous threat.[25] Focus should emphasize how UAV incidents differ from traditional terrorist incidents in terms of geographic dispersion of casualties, the distribution and type of injuries, and other factors.[26] With an opportunity to be proactive in disaster prevention, mitigation, and preparedness, it is imperative this gathering storm be acknowledged and stakeholders bolster response capabilities that include updated and practiced CTM measures.

References

1. Hunt D. World War I History: The Kettering Bug—World's First Drone. Owlcation. https://owlcation.com/humanities/World-War-1-History-The-Kettering-Bug-Worlds-First-Flying-Bomb. Accessed March 21, 2021.
2. Urcosta R. The revolution in drone warfare: the lessons from the Idlib de-escalation zone. *JEMEAA*. 2020. https://www.airuniversity.af.edu/JEMEAA/Display/Article/2329510/the-revolution-in-drone-warfare-the-lessons-from-the-idlib-de-escalation-zone/. Accessed April 14, 2021.
3. Sayler K. A world of proliferated drones: a technology primer. *CNAS*. 2015. https://www.cnas.org/publications/reports/a-world-of-proliferated-drones-a-technology-primer. Accessed April 19, 2021.
4. Joshi D. Future of drones: applications & uses of drone technology in 2020. *Business Insider*. 2019. https://www.businessinsider.com/drone-technology-uses-applications?r=AU&IR=T. Accessed March 21, 2021,
5. Court M, Edwards B, Issa F, Voskanyan A, Ciottone G. Counter-terrorism medicine: creating a medical initiative mandated by escalating asymmetric attacks. *Prehosp Disaster Med*. 2020;35(6):595–598.
6. Center for Arms Control, Energy, and Environmental Studies at MIPT. Media Reports of Terrorist Attempts to Employ UAVs. 2005. https://www.armscontrol.ru/UAV/clips.htm. Accessed March 21, 2021.
7. Hubbard B, Karasz P, Reed S. Two Major Saudi Oil Installations Hit by Drone Strike, and US Blames Iran. *New York Times*. https://www.nytimes.com/2019/09/14/world/middleeast/saudi-arabia-refineries-drone-attack.html. Accessed March 21, 2021.
8. Tin D, Hart A, Ciottone GR. Rethinking disaster vulnerabilities. *Am J Emerg Med*. 2020;S0735-6757(20):30973–30976.
9. Braun T, Fleiss A. Miniature menace: the threat of weaponized drone use by violent non-state actors. *Air University*. 2020. https://www.airuniversity.af.edu/Wild-Blue-Yonder/Article-Display/Article/2344151/miniature-menace-the-threat-of-weaponized-drone-use-by-violent-non-state-actors/. Accessed March 21, 2021.
10. Bunker R. *Terrorist and Insurgent Unmanned Aerial Vehicles*. Carlisle Barracks, Pennsylvania: Strategic Studies Institute, US Army War College; 2015.
11. Arianti V, Taufiqurrohman M. Weaponized drones: the next terrorist modus operandi in Southeast Asia? *The DIplomat*. 2021. https://thediplomat.com/2021/03/weaponized-drones-the-next-terrorist-modus-operandi-in-southeast-asia/. Accessed March 21, 2021.
12. Drones are a looming domestic terrorism threat. *911Security*. 2017. https://www.911security.com/blog/drones-are-a-looming-domestic-terrorism-threat/. Accessed March 21, 2021.
13. Emil A, Yannick VL. Drone imagery in Islamic State propaganda: flying like a state. *International Affairs*. 2020;96(4):955–973.
14. Gregg P. Risk in the Sky? https://udayton.edu/udri/news/18-09-13-risk-in-the-sky.php. Accessed March 23, 2021.
15. US Attorney's Office – Central District of California. Hollywood Man Pleads Guilty to Federal Charge that He Recklessly Operated Drone that Collided with and Damaged LAPD Helicopter. https://www.justice.gov/usao-cdca/pr/hollywood-man-pleads-guilty-federal-charge-he-recklessly-operated-drone-collided-and. Accessed March 23, 2021.
16. Lambert C. The chemical and biological attack threat of commercial unmanned aircraft systems. *Assoc United States Army*. 2020. https://www.ausa.org/sites/default/files/publications/SL-20-5-The-Chemical-and-Biological-Attack-Threat-of-Commercial-Unmanned-Aircraft-Systems.pdf. Accessed March 23, 2021.
17. Koblentz GD. Emerging technologies and the future of CBRN terrorism. *Washington Quarterly*. 2020;43(2):177–196.
18. Kallenborn Z, Bleek PC. Swarming destruction: drone swarms and chemical, biological, radiological, and nuclear weapons. *Nonproliferation Rev*. 2018;25(5-6):523–543.
19. Kallenborn Z. A new age of terror: new mass casualty terrorism threats. *US Army Mad Scientist Laboratory*. 2019. https://madsciblog.tradoc.army.mil/179-a-new-age-of-terror-new-mass-casualty-terrorism-threats/. Accessed March 23, 2021.
20. Michel AH. *Counter-Drone Systems*. Second Edition. New York USA: Bard College Center for the Study of the Drone; 2019.

https://doi.org/10.1017/S1049023X21000765 Published online by Cambridge University Press

21. Cuffari JV. *DHS Has Limited Capabilities to Counter Illicit Unmanned Aircraft Systems*. Washington, DC USA: Office of Inspector General, DHHS; 2020.
22. Cybersecurity and Infrastructure Security Agency. Advisory on the Application of Federal Laws to the Acquisition and Use of Technology to Detect and Mitigate Unmanned Aircraft Systems. https://www.cisa.gov/publication/advisory-application-federal-laws-acquisition-and-use-technology-detect-and-mitigate. Accessed March 23, 2021.
23. Kallenborn Z. Build a national counter-drone network. *Defense One*. 2020. https://www.defenseone.com/ideas/2020/07/build-national-counter-drone-network/166675/. Accessed March 23, 2021.
24. United Nations. *Resolution 1540: International Instruments Related to the Prevention and Suppression of International Terrorism*. New York USA: United Nations; 2008.
25. Kallenborn Z. *Are Drone Swarms Weapons of Mass Destruction?* Maxwell Air Force Base, Alabama: Air University – US Air Force Center Strategy Deterrence Studies; 2020.
26. Heszlein-Lossius H, Al-Borno Y, Shaqqoura S, et al. Traumatic amputations caused by drone attacks in the local population in Gaza: a retrospective cross-sectional study. *Lancet Planet Health*. 2019;3(1):e40–e47.

https://doi.org/10.1017/S1049023X21000765 Published online by Cambridge University Press