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Civil Aviation Biodefense Countermeasures Against Biothreats and Bioterrorism: Preparedness of Nigeria and the Way Forward

Lemmy Ojang Owan[1], Hamza Ibrahim[2]

[1]*Nigerian Civil Aviation Authority, Nnamdi Azikiwe International Airport, Abuja*
[2]*Nigerian Civil Aviation Authority, Nnamdi Azikiwe International Airport, Abuja*

Abstract

The potential threat of the use of biological agents against civil aviation is becoming increasingly real considering the devastating impact of Coronavirus Disease 2019 (COVID-19) to global civil aviation operations. Though various governments are making concerted effort in developing biodefense preparedness and response against any potential biothreats attacks. On the other hand, not much can be said on the preparedness of Nigeria to combat these potential threats. This article examines biothreats against civil aviation and biodefense preparedness of Nigeria to respond to biothreats to its civil aviation operations, and to proffer recommendations on the way forward in line with international best practices.

Keywords: Civil Aviation Security, Biodefense, Bioterrorism, Biothreats, Acts of Unlawful Interference

Introduction

Recently, threats to civil aviation by terrorists and other acts of unlawful interference have intensified[1], thus necessitating the international community to develop legal and regulatory regimes to combat threats to civil aviation.

Towards the end of the second world war, at the instance of the United States of America (USA), the international community met at a convention held in Chicago to design an effective legal instrument to govern international civil aviation[2]. The meeting which held in 1944 led to the adoption of the Convention on International Civil Aviation (also known as The Chicago Convention) by fifty-two (52) of the fifty-four (54) States invited. Thereafter, establishing the International Civil Aviation Organization (ICAO), which had as its objective, to facilitate the safety and orderliness in navigation of commercial air transport and to provide uniform standard across board[3,4].

ICAO, a specialized agency of the United Nations (UN) was responsible for coordinating international travels[2] and facilitating the safety and navigation of international civil aviation, as well as the provision of uniform standards across borders[5]. It develops the legal (in the form of multilateral conventions, declarations and resolutions) and technical (in the form of Standards and Recommended Practices [SARPs] and the Universal Security Audit Programme [USAP]) measures to combat and prevent intentional acts against civil aviation.

The Chicago Convention however had no explicit declaration regarding unlawful interference[2], as primary Contracting States were, at the time, primarily responsible for developing international civil aviation in a safe and good manner, by establishing international air transport services on the basis of equality of opportunity, as well as operating the services peacefully and economically[6]. As the threats to civil aviation began to rise Member States, have met over the decade at various conventions to develop, ratify and adopt legal resolutions and declarations on countermeasures to combat threats to civil aviation.

THREATS TO CIVIL AVIATION

The Global Terror Database (GTD) defined a terrorist attack as, "the threatened or actual use of illegal force and violence by a non-state actor to attain a political, economic, religious, or social goal through fear, coercion, or intimidation"[7]. Though there has not been an established definition of terrorism, there is however, a consensus that the concept involves an intentional act of the use of threats of violence to achieve set goals of the attackers[8]. Therefore, for an attack to be classified as a terror attack, it must be intentional, involving a threat of violence or an actual act of violence against an entity, to coerce and intimidate a victim with the aim of achieving religious, economic, social or political objectives[7].

While threats to civil aviation have predominately been those involving armed attacks, potential bombing of aircrafts and other civil aviation infrastructures, hijacking, terrorists have also resorted to the use of Man Portable Air Defense Systems (MANPADS), use of Liquids, Aerosols and Gels (LAGs), and cyber-attacks against civil aviation operations and facilities[1]. However, potential future threats exist, including the use of dangerous and contagious biological agents as weapons against civil aviation. With the global pandemic of COVID-19 still ravaging, the psychological and economic impact will leave an indelible mark in the history of civil aviation and the global economy.

Being a trillion-dollar industry, supporting well over 10.2 million direct jobs globally and contributing over $700 billion of the global Gross Domestic Product (GDP)[9], symbolizes economic power which makes it prime target to attacks. Civil aviation has suffered threats and attacks over the past decades and terrorists consider civil aviation as a staple target for attack aiming to cause fear, panic, psychological trauma and disruption[10]. In addition to the above, the global and interconnected nature of civil aviation attracts a considerable level of global media attention, cause mass potential human casualties, the disruption to civil aviation operations, and eventually the economic damage when an attack occur[1,8]. A successful terrorist attack will have significant impact to both governments and the aircraft operators,

***Corresponding author:** Kiconco Catherine, Department of EthnoBiology, Faculty of Applied Sciences, Bishop Stuart University, Mbarara, Uganda, Tel: +256-0772934766; E-mail: ckiconco61@gmail.com

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Billions of dollars' worth of damages to lives and properties will usually accompany a successful attack; the aftermath of the September 11, 2001 attacks on United States (US)[8,12].

EMERGING THREATS AGAINST INTERNATIONAL CIVIL AVIATION: BIOTERRORISM AND BIOLOGICAL WEAPONS

Bioterrorism attack, an emerging global threat, has been defined by Centers for Disease Control (CDC) as "the deliberate release of viruses, bacteria, toxins, or other harmful agents used to cause illness or death in people, animals, or plants"[13,14]. This may be perpetrated through the spread of biological agents in food, water or air[15]. Like other known threats to civil aviation, biological weapons have the potential to trigger colossal loss of lives and instill palpable fear and panic globally. However, the use of biological agents (bioagents) as a weapon of attack is unlike other threats to civil aviation, as it is extremely difficult to detect a bioweapon due to the asymptomatic nature that are usually not immediately recognized until several days or weeks after the attack has occurred[13]. This pose a very dangerous weapon for any terrorists in possession the pathogen, with an intent to attack, as they can successfully carry out an attack undetected[16].

The origin of the use of biological agents as bioweapons dates to ancient wars times where victims of plagues and other contagions were used to infect and weaken warring foes[17,18]. By the turn of the 20th century, most nations have either developed, produced or used biological agents as weapons of war against their rivals; plagues, typhoid and anthrax are examples of such pathogens deployed as bioagents of war[19].

While it is difficult to predict when and where a biological attack may occur, efforts are being made to address the challenge of bioterrorism. Governments around the world are preparing their nations for a potential biological attack, by determining how the attack may be perpetrated, including the type of biological agents that could be used, the extent of weaponization, the quantity and effectiveness as well as the mode of delivery of the agents[13].

Like other threats to civil aviation, biological weapon attack can cause disastrous damage to civil aviation, as biological weapon agents are highly contagious, resulting in potential widespread casualties, panic and economic disruption[20]. Since biological attacks mimic naturally occurring diseases, prevention and control pose a huge challenge due to the potential delay in recognizing that an attack has even occurred[17,20]. Furthermore, bioweapons are of more concern due to the ease of access, low production cost, ease of transportation and the difficulties of detecting them using routine security screening systems[21]. With advances in biotechnology and the life sciences, the prospect of developing novel or modified organisms has been simplified[17] and tends to increase the risk associated with threats of bioterrorism[20]. The likelihood to develop novel genetically modified microorganisms certainly with potential infectiousness cannot be ignored due to the implication to the stability of regional and global security.

INDUSTRY COUNTERMEASURES AGAINST TERRORISM THREATS

Legal instruments

In the effort to combat against threats to civil aviation, successive multilateral international conventions on civil aviation security have been adopted and domesticated by Member States of ICAO. These international conventions are developed by ICAO as legal instruments to combat and prevent intentional acts of unlawful interference against civil aviation[22].

The first convention on civil aviation security was the 1963 Convention on Offences and Certain Other Acts Committed on Board Aircraft, also known as the 1963 Tokyo convention, had as its main purpose, to secure the collaboration of Contracting States against terrorist activities directed at civil air transport[2]. The Tokyo Convention addressed the offence of aircraft hijack, however, it failed to address certain other offences including offences committed by terrorist activities against civil aviation.

To address the loopholes of the 1963 Tokyo Convention in combatting terrorism against civil aviation, in 1970, Member States met at the Hague for the Convention for the Suppression of Unlawful Seizure of Aircraft[2]. This Convention was also known as the 1970 Hague Convention, was necessitated as the rate of aircraft attack continued to rise at the time. This Convention criminalized the takes over or attempts to take over control of an aircraft by any means of force, threat or intimidation by any person and their accomplices while in flight. However, this convention did not cover certain other terrorist attacks such as the sabotage of aircraft and certain other terrorist acts committed on ground.

Following the failure of the previous Tokyo and Hague Conventions to address the offences committed on ground and against other navigational services and facilities, the Member States met in Montreal in 1971 for the Convention for the Suppression of Unlawful acts against the Safety of Civil Aviation (1971 Montreal Convention). This Convention criminalized a number of acts of unlawful interference against the safety of civil aviation, including acts of violence a person on board an aircraft in flight that could endanger the safety of the aircraft, the destruction of or damaging of air navigational facilities (including interference with their operations), destruction of an aircraft in service or causing any damage to an aircraft that renders it incapable of flight, placing a device or any substance that is likely to destroy or damage the aircraft, as well as the communication of false information that endangers the safety of the flight[2].

In 1988, the Protocol for the Suppression of Unlawful Acts of Violence at Airports Serving International Civil Aviation was adopted as a supplementary to the 1971 Montreal Convention, that is the 1988 Montreal Supplementary Protocol. This convention dealt with unlawful acts of violence at airports serving international civil aviation, including acts of violence against persons that may result in death or serious injury, or destruction or damage of facilities that may disrupt operations or endanger safety at the airport.

The 1991 MEX Convention, that is the Convention on the Marking of Plastic Explosives for the Purpose of Detection was adopted by ICAO as a technical security measure to identify firearms and other dangerous devices, as well as to prevent them from being introduced onto an aircraft [2]. The main objective of this convention was the establishment of a uniform method of marking explosives using one of the agents used for detection specified in the convention.

The tragic events of September 11th 2001in the US, involving the use of aircraft as weapon of mass destruction, highlighted several loopholes and gaps in the international regime with regards to civil aviation security. To address the weaknesses, the 2010 Beijing Convention and Beijing Supplementary Protocol were developed as measures for the prevention and suppression acts of unlawful interference civil aviation and its facilities and ensuring that culprits of such acts are held liable[23]. The Convention and the Protocol criminalized specified acts against civil aviation, including the use of civil aircraft as a weapon to discharge biological, chemical and nuclear (BCN) weapons or similar substances to cause death, injury of death, attacking civil aircraft with BCN weapons or similar substances, the unlawful transport of BCN

weapons, amongst other materials, for the purpose of terrorism against navigational aids and facilities[21].

Technical instruments

ICAO is also mandated to develop technical countermeasures in the form of Standards and Recommended Practices (SARPs) and Universal Security Audit Programme (USAP). Annex 17, which is the ICAO annex for Security, to safeguard international civil aviation against acts of unlawful interference was first adopted by ICAO during the Extraordinary 17th Assembly in 1974[2].

The primary objective of aviation security is the safety of passengers, crew, ground personnel and the public. To achieve this, Contracting States are required to develop and implement practices, and procedures by a designated appropriate authority responsible for aviation security of the state. Chapter Four (4) of Annex 17 spells out the preventive security measures required to prevent the introduction, on board an aircraft engaged in civil aviation, of weapons, explosives, dangerous devices, articles or substances, that could be used to commit an act of unlawful interference"[24].

Since the adoption of Annex 17 to the Chicago Convention in 1974, additional measures have been developed for the prevention of threats as the emerge. Such threats included armed attack threats, bomb threats, liquids aerosols and gels (LAGs) and Man Portable Air Defense Systems (MANPADS) [1]. Currently, the global aviation industry and the international community is grappling with the Coronavirus disease 2019 (COVID-19) pandemic, which incidentally has been spread across the continents chiefly through commercial air travels. Measures implemented at airports are mostly to curtail the spread of the disease, which has not been successful, except for total shutdowns, resulting in grounding the entire industry. The situation thus requires ICAO and its Member States to urgently develop measures and procedures for the protection of civil aviation against bioterrorism and biological threats.

Though the 2010 Beijing Convention and Beijing Supplementary Protocol encouraged criminalization of any act of bioterrorism, however the 16th amendment to the 10th Edition of Annex 17 only included standards and recommended practices on cyber threats[24]. Thus, the emerging threat of bioterrorism remains of grave concern to the industry, with its attendant consequences if measures are not developed to combat any potential threats.

NIGERIA'S PREPAREDNESS TO COUNTER POTENTIAL BIO-THREATS AGAINST ITS CIVIL AVIATION

The lack of countermeasures for combating the prevention and spread of COVID-19, coupled with the abysmal handling of the outbreak, the vulnerability of Nigeria to any bioterror attack, like with other nations of world, has been critical exposed. With the lack of preparedness and the lackluster attitude of government in the handling of the spread of the virus, the consequence could result in an exponential explosion in the number of cases, a position that has been acknowledged by the US National Security Council's national strategy for countering biological threats[25].

Developed nations like Russia, Japan, USA, Germany and UK are investing extensively in research to develop formidable capabilities of defense against bioterrorism or biological attacks[17]. This, however, cannot be said to be the case with Nigeria as demonstrated in its initial response to the virus. While biomedical research infrastructures are being developed (including the establishment and expansion of public health and medical infrastructures), not much is known about Nigeria's biodefense strategies to combat any potential threats of bioterrorism. This lack of preparedness further supports the case for an aggressive need to pursue programs and capabilities to combat any biothreats and bioterrorism.

Despite being a State Party to the Biological Weapons Convention of 1972 and making several commitments to the declarations and resolutions of the Convention, not much progress has been made by Nigeria in the implementation of the protocols and resolutions of this Convention[26]. While preparedness and recognition of specific agents of bioterrorism is very essential[27], if one were to assume that the outbreak of COVID-19 was an intentional act of terror, clearly, indications in Nigeria show the lack of capability to effective respond and defend itself, as there do not seem to be functional national biodefense response plan in place. With experts projecting that the outbreak will be very severe considering the porous nature of the borders, the poor state of the healthcare system and government inefficiencies in handling the situation[28]. For instance, the port health authority and the airport authorities at airports in Nigeria were caught unaware, resulting in the abysmal response to contain the spread of the virus at airports. For lack of a biodefense contingency plan, these authorities rather relied on protocol from World Health Organization (WHO), international agencies and the Nigerian Center for Disease Control (NCDC) for guidance, when such a contingency for biodefense is meant to in place as with contingency plans for other threats to civil aviation.

With the Government owning up to its shortcomings in the healthcare sector, the government seems poised to rebuild the sector to make it formidable at all levels[28]. As it sets out on this plan, focus too should be on developing a national biodefense programme. Substantial investment in manpower development to ensure that professionals with the appropriate skill sets and competencies are available to manage and mitigate biothreats at all airports. Efforts to develop a biodefense policy or strategy should emphasize on:

- Development and deployment bio-detection systems to detect biological agents that can be used as weapons of biological attacks at airports
- Stockpile of medical supplies to treat victims of biological attacks at airport serving civil aviation
- Funding research and development of aviation security and aeromedical within the Civil Aviation Authority to continually develop industry countermeasures to detect, prevent and respond to biological attacks and acts of bioterrorism.
- Development of a national contingency plan against biothreats

To achieve these, the defense capabilities should comprehensively identify, evaluate, prioritize and integration efforts to combat biothreats against civil aviation. It is essential to continually employ all means necessary to mitigate and prevent threats of bioattacks. This will require developing national policies, coordination and planning of biodefense strategies and capabilities within the civil aviation industry and the nation at large. Furthermore, cooperation with other ICAO Contracting States will maximize capabilities for mutual defense against bioterrorism.

DEVELOPING A NATIONAL BIODEFENSE PROGRAMME: WHAT NIGERIA SHOULD DO

The development and implementation of an effective biodefense programme includes effort such as the investment in biodefense research and development, effective communication and information management, development and management of biodefense infrastructure, public awareness and preparedness, human capital development and strengthening of international cooperation with other Member States.

The US National Research Council noted that the traditional public health response to terrorism, should also be applied in addressing emerging infectious diseases[29]. These traditional responses (including surveillance, prevention, detection, response and recovery) are also necessary to address bioterrorism, due to the unpredictability of infectious diseases. To prepare, investment in the detection, prevention and treatment was crucial. Similarly, Hoyt and Brooks[16] maintained that it was crucial for countries to invest in defensive measures against vulnerabilities to bioterrorism.

In an effort to respond to bioterrorism, measures such as threat awareness, prevention and protection, surveillance and detection, and response and recovery will form the essential pillars of biodefense to combat bioterrorism[20]. These should form the bedrock for developing the knowledge and skills required to assess and mitigate the risk posed by biothreats, whether by natural or intentional man-made threats. With increasing global biothreats (such as the anthrax letter attacks in the US) and the outbreak of other infectious diseases (including Zika, SARS, Ebola, and most recently the COVID-19) a comprehensive biodefense programme is necessary to enhance preparedness to mitigating bioterror attacks.

Threat Awareness and Risk Assessments

The US Government Accountability Office (GAO) acknowledged the importance of threats awareness in dealing with biothreats due to the dangers these threats pose to the health of the public, animals and plants. Biothreat awareness should consist of collection and analysis of intelligence, development of risk assessment and the anticipation of future threats[30]. The GAO therefore advocated for the funding of federal agencies to enable them identify capabilities for biodefense.

Increased awareness could significantly reduce the spread of the knowledge that could aid terrorists, without hampering the objective of sharing scientific information for legitimate purposes. The exchange of biotechnology information could enhance the safety and security in the handling, storage, and transportation of sensitive biological materials[29]. The application of information technology necessary to track international trafficking and proliferation of biotechnology products, thus providing warning information that enables the combat of bioterrorism.

As with other threats to civil aviation, accurate, timely and relevant intelligence on biothreats information is necessary in the development of biodefense programme against biological attacks. Awareness on biothreats should involve the identification, assessment, and prioritization of biothreats and associated risks, enabling planning, response and countermeasures.

As the proliferation of biological agents and technologies increases, the potential to develop agents capable of evading current countermeasures is also increased. Thus, it is necessary to develop dynamic capabilities and countermeasures with the sophistication to detect potential harmful contagions and provide mitigants to biothreats.

Thus, the development of periodic threat and risk assessments of evolving threats of bioweapons is critical, requiring the development of continuous processes for routine conduct of assessments of biodefense capabilities. This will guide the prioritization of funding of biodefense-related researches, planning, development and readiness.

Surveillance and Detection

Essential to biodefense against biothreats is the ability to recognize and detect a bioattack when it occurs, thus enabling a prompt response to mitigate the consequences[31]. The application of biomolecular technologies could allow for the development of sensitive systems to rapidly and accurately detect infectious pathogenic agents in the environment[29]. Currently, there is a lack of detection systems and expertise that will enable early detection of persons who are either unintentionally infected or who are intentionally weaponized with infectious bioagents to commit acts of unlawful interference, thus a robust bio-surveillance and detection system is required to detect biothreats at airports. However, with advances in the development of biosensors, specific antibodies with capabilities to detect respiratory pathogens[21], can be developed as a biodefense strategy to combat bioterrorism.

Prevention and Protection

Critical to biodefense against bioattacks is the availability of preventive measures that limits access of bioterrorists to bioagents and the technical know-how to develop, produce and utilize these agents as weapons for bioattack. Increased knowledge of pathogenicity and immune response to infectious bioagents is essential through the expansion of our research programmes. COVID-19 has exposed the deficiencies in our knowledge of potential biothreats to civil aviation, thus, efforts at research is critical for strategies to deter, prevent, respond and recover from the impacts of bioattacks.

It is therefore pertinent for the civil aviation industry to develop international legal and technical measures for the industry to ensure uniformity across board, which will be domesticated by ICAO Contracting States through national legislations. This will ensure the prevention of the proliferation of biological weapons that could be deployed against civil aviation.

The protection of critical civil aviation infrastructure that are most vulnerable targets (e.g. aircraft and airport terminal buildings) against bioattacks should also be top priority, due to the potential huge casualties that may arise in the event of a biological attack. An assessment of the risk exposure of these critical civil aviation facilities or infrastructures is essential for the defense of civil aviation against any bioattacks.

Furthermore, it is important to analyze the probable health and socio-economic impacts of bioattacks, through modeling tools to anticipate and prepare for such attacks. Measures for protecting persons and infrastructure also need to be developed to curb the spread pathogens and to decontaminate in the event of a successful attack.

The need to train first responders to a biothreat cannot be overemphasized, as one of the factors responsible for the widespread of the COVID-19 through commercial air transport was the lack of suitably qualified first responders at the airports. The Port Health personnel and aviation security personnel in Nigeria require training to better prepare them to respond effectively and efficiently to contain any potential biothreats. Also, personnel of the Appropriate Authority for civil aviation security should be trained to the standard to ensure effectively and efficiently oversight the implementation biodefense measures.

Response and Recovery

The response to a bioattack will depend on pre-attack planning and preparation, medical and physical countermeasures, capabilities to treat victims, decontamination, and risk communication. This will be dependent on rapid intervention by suitably trained personnel, including medical practitioners, law enforcement agents and public health[21], as well as personnel responsible for implementation or oversight of controls at airports.

The response and mitigation against a bioattack require inter-agency cooperation based on the outcome of a biothreat assessment and should be incorporated into the civil aviation contingency or emergency plan. This plan will require regular testing, by means of drills, as part of the airport emergency exercises stipulated in the contingency or emergency plan. In the event of a bioattack, the contingency plan is initiated to rapidly contain the spread of the disease, prevent the impact.

Availability of vaccines and antibiotic stockpile as part of the airport contingency plan will guarantee the safety of lives and prevent the

transmission of any contagious disease resulting from a bioweapon attack[20]. Hoyt and Brooks recognized the importance of vaccine development in the reduction of bioterrorism, noting that vaccines were central to the defense strategy, especially in protecting surrounding populations from secondary spread of infections[16]. Furthermore, the contingency plan will include decontamination and sterilization procedures of the site of the attack, as it will be necessary to ensure that operations are not grossly disrupted.

In order not to create panic in the industry and the public, a risk communication strategy should be developed to timely communicate to the relevant stakeholders and general public to raise awareness on the measures to limit collateral damage.

CONCLUSION

Bioterrorism also has the advantage of anonymity, as the weapon of the attack cannot be detected using existing screening equipment. Countermeasures, material, and human resources should be available at all airports serving civil aviation for the detection and containment of biothreats, as an attack at any airport could have a global impact.

The outbreak of COVID-19 has exposed a major vulnerability of civil aviation in detecting, preventing, and containing a biological outbreak much less an intentional attack. This deficiency deserves urgent attention, including new legislation, regulations, programmes and countermeasures. Manpower development remains cardinal to achieving the goals of a national biodefense regime for the country. The government needs to show leadership through the conscientious training of both civilian and non-civilian personnel, as well its engagement and multilateral cooperation in prevention and protection against bioterrorism.

Government's inability to address its biodefense strategy and policy will spell doom for its economic survival in the event of a successful bio-attack in its territory. The global impact witnessed by the COVID-19 outbreak should therefore serve as the catalyst necessary to elicit government action in this regard.

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