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Evaluation of Emergency Preparedness and Inter-Agency Response Coordination at Nnamdi Azikiwe International Airport, Abuja, Nigeria

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ABSTRACT

This study evaluated emergency preparedness and inter-agency response coordination at Nnamdi Azikiwe International Airport (NAIA), Abuja. A mixed-methods descriptive survey design was adopted. Quantitative data were collected using a structured five-point Likert-scale questionnaire administered to 150 multi-agency personnel, of which 120 valid responses (80.0% response rate) were analysed. Qualitative data were obtained through key-informant interviews and documentary review. Reliability of the instrument was confirmed with an overall Cronbach's alpha of 0.94. Findings revealed high levels of emergency preparedness (composite mean = 3.92, SD = 0.52) and equipment adequacy (M = 3.68, SD = 0.61), while inter-agency coordination, though high (M = 3.55, SD = 0.58), was comparatively weaker. Major challenges included inadequate funding (M = 4.15), communication-system limitations (M = 4.02), and poorly maintained equipment (M = 3.91). Overall response effectiveness was rated high (M = 3.73, SD = 0.54). Pearson correlations showed significant positive relationships between preparedness ($r = 0.671$), equipment adequacy ($r = 0.598$), inter-agency coordination ($r = 0.724$) and response effectiveness (all $p < 0.01$). Multiple regression indicated that the four predictors jointly explained 65.9% of the variance in response effectiveness ($R^2 = 0.659$; $F(4,115) = 55.42$, $p < 0.001$), with inter-agency coordination making the strongest unique contribution ($\beta = 0.412$). The study concludes that NAIA possesses a functionally sound emergency response architecture, but communication interoperability, sustainable funding, equipment maintenance, and traffic/access coordination require strengthening.

Keywords: Emergency preparedness; Inter-agency coordination; Airport emergency management; Aircraft rescue and fire fighting (ARFF); Communication interoperability; Nnamdi Azikiwe International Airport.

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1. INTRODUCTION

Aviation remains one of the safest modes of transportation globally; however, the potential consequences of aircraft accidents and other aerodrome emergencies are catastrophic in terms of loss of life, property damage, and disruption of critical national infrastructure. Effective emergency preparedness and seamless inter-agency response coordination are therefore indispensable components of modern airport safety management systems.

The International Civil Aviation Organization (ICAO) mandates that every certified aerodrome establish and maintain an Aerodrome Emergency Plan (AEP) whose primary objective is to minimize the effects of an emergency, particularly with respect to saving lives and maintaining aircraft operations (ICAO, 2018). Annex 14, Volume I of the Chicago Convention requires aerodrome operators to coordinate the actions of on-aerodrome entities (air traffic control, rescue and fire-fighting services, medical services, security, and police) and off-aerodrome partners (fire departments, police, health authorities, military, and civil defence). Periodic full-scale emergency exercises at intervals not exceeding two years, complemented by partial exercises in intervening years, are prescribed to test the adequacy of the plan and to correct identified deficiencies (ICAO, 2018).

In Nigeria, the Nigeria Civil Aviation Authority (NCAA) has transposed these international standards into the Nigeria Civil Aviation Regulations (Nig. CARs) Part 12 and the associated Advisory Circular NCAA-AC-ARD007-1 on Aerodrome Emergency Plans. The Federal Airports Authority of Nigeria (FAAN) is responsible for implementing these requirements at all airports under its management, including Nnamdi Azikiwe International Airport (NAIA), Abuja. As the primary gateway to the Federal Capital Territory, NAIA handles a substantial volume of domestic and international traffic and hosts numerous high-profile passengers, elevating the strategic importance of robust emergency readiness.

Recent full-scale simulation exercises conducted at NAIA have repeatedly highlighted both progress and persistent gaps. Airport management has publicly acknowledged that while response times have improved, weaknesses remain in communication channels, resource deployment, traffic control, and inter-agency alignment (Daily Trust, 2025; NEMA, 2025). Participating agencies typically include FAAN's Aerodrome Rescue and Fire Fighting Service, the National Emergency Management Agency (NEMA), Nigeria Police Force, Nigeria Security and Civil Defence Corps (NSCDC), Federal Road Safety Corps (FRSC), Federal Fire Service, Nigerian Air Force, Red Cross, and multiple hospitals. The multi-agency nature of airport emergencies demands a high degree of interoperability, clear command structures, and pre-established mutual-aid agreements.

Despite regulatory mandates and periodic drills, questions persist regarding the actual level of preparedness, the adequacy of emergency response equipment and facilities, the effectiveness of coordination mechanisms, and the major challenges that constrain optimal performance. Successive emergency simulation exercises have revealed operational lapses in communication, resource deployment, traffic management and inter-agency alignment, even as response times have shown modest improvement (Daily Trust, 2025). Airport managers have openly stated that the response system mechanism "still remains weak with some gaps that need to be addressed urgently." Empirical studies on African airports further indicate that formal emergency plans and equipment inventories alone do not guarantee effective response; human reliability, organizational culture, training frequency, and inter-agency interoperability exert decisive influence.

While regulatory frameworks and simulation exercises exist, there remains a paucity of systematic, empirical evaluation specifically focused on the level of emergency preparedness, the adequacy of equipment and facilities, the effectiveness of inter-agency coordination, and the principal challenges at NAIA. Without such evidence, policy and operational improvements risk being based on anecdotal observations rather than rigorous analysis. This study therefore seeks to systematically evaluate these dimensions at Nnamdi Azikiwe International Airport, Abuja, with a view to generating evidence-based recommendations that can strengthen the airport's emergency response architecture.

The aim of this study is to evaluate the level of emergency preparedness and inter-agency response coordination at Nnamdi Azikiwe International Airport, Abuja. Specifically, the study sought to: (a) assess the level of emergency preparedness at NAIA; (b) examine the availability and adequacy of emergency response equipment and facilities; (c) evaluate the effectiveness of coordination among agencies involved in airport emergency response; and (d) identify the major challenges affecting emergency preparedness and inter-agency response coordination at the airport.

2. LITERATURE REVIEW

2.1 Concept of Emergency Preparedness in Aviation

Emergency preparedness in the aviation context refers to the systematic process of anticipating, planning for, and building capacity to respond to incidents that threaten life, property, or the continuity of aerodrome operations. ICAO defines aerodrome emergency planning as "the process of preparing an aerodrome to cope with an emergency occurring at the aerodrome or in its vicinity," with the dual objectives of saving lives and maintaining aircraft operations (ICAO, 2018, Annex 14, 9.1.1). Preparedness encompasses the development of an AEP, the provision of rescue and fire-fighting services, medical and ambulance resources, communication systems, training of personnel, and regular testing through exercises. Key elements include risk assessment, resource allocation, development of standard operating procedures, establishment of command and control structures (Emergency Operations Centre and mobile command post), and the cultivation of a safety culture that encourages proactive reporting and continuous improvement (ICAO Doc 9137, Part 7).

2.2 Inter-Agency Response Coordination

Inter-agency response coordination denotes the mechanisms, protocols, and relational processes through which multiple independent organizations align their actions during an emergency. In the airport environment, coordination must bridge on-aerodrome entities (ATC, RFFS, airport administration, airline operators, security) and off-aerodrome partners (NEMA, police, fire service, medical facilities, military, Red Cross). Effective coordination requires clear role definition, interoperable communication systems, pre-negotiated mutual-aid agreements, a unified incident command structure, and regular joint training (FAA, 2010; ICAO, 2018). The absence of effective coordination typically manifests as delayed response, duplicated or conflicting efforts, resource misallocation, and degraded situational awareness.

2.3 Theoretical Framework

This study is anchored on two complementary theoretical perspectives: the Systems Theory of Emergency Management and the Incident Command System (ICS) / Multi-Agency Coordination System principles. Systems theory views an organization or network of organizations as an open system composed of interrelated subsystems that interact with their environment (von Bertalanffy, 1968). Effectiveness depends on the quality of interactions among subsystems rather than on the performance of any single component. The Incident Command System provides a standardized hierarchical structure for command, control, and coordination during emergencies, delineating five functional areas—Command, Operations, Planning, Logistics, and Finance/Administration—and emphasizing unity of command, span of control, and modular organization (FEMA, 2008). These frameworks collectively underscore that preparedness and coordination are systemic properties that must be deliberately designed, exercised, and continuously refined.

2.4 Empirical Review and Research Gap

Empirical investigations into airport emergency preparedness in Africa remain relatively sparse. A study assessing fire and rescue preparedness at Murtala Muhammed International Airport, Lagos, reported generally high ratings for equipment adequacy, personnel training, and regulatory compliance, yet noted deficiencies in fire-alarm maintenance and passenger communication

systems (Zenodo, 2025). A qualitative synthesis of human reliability and organizational factors across African airports concluded that formal plans and equipment inventories are insufficient without robust human performance, safety culture, and inter-agency coordination mechanisms (ResearchGate, 2025). Case analyses of the 2005 Bellview Airlines crash in Nigeria and the 2010 Afriqiyah Airways crash in Libya highlighted the critical role of human factors, including insufficient training, delayed search-and-rescue, and poor inter-agency communication (ResearchGate, 2024).

At NAIA itself, successive full-scale exercises organized by FAAN and NAMA have confirmed improvements in response time yet consistently exposed residual weaknesses in communication, resource deployment, traffic control, and inter-agency alignment (Daily Trust, 2025; NEMA, 2025; Leadership, 2025). The literature establishes that effective airport emergency response rests on three interdependent pillars: comprehensive preparedness planning, adequate and maintained equipment/facilities, and robust inter-agency coordination. A focused, multi-dimensional evaluation of these variables at Nnamdi Azikiwe International Airport remains under-explored, constituting the gap this study seeks to fill.

3. METHODOLOGY

3.1 Research Design

The study adopted a descriptive survey research design with both quantitative and qualitative components (mixed-methods). The descriptive survey is appropriate because the research seeks to assess existing levels of preparedness, equipment adequacy, coordination effectiveness, and challenges as perceived by stakeholders, without experimental manipulation of variables. Quantitative data were collected through structured questionnaires, while qualitative insights were obtained via key-informant interviews and document review of recent exercise reports.

3.2 Population and Sample

The target population comprised personnel of agencies that routinely participate in emergency response at NAIA, including FAAN (Aerodrome Rescue and Fire Fighting Service, Airport Operations, Aviation Security, Medical Services), NEMA, Nigeria Police Force, NSCDC, FRSC, Federal Fire Service, Nigerian Air Force, Port Health/medical teams, and Nigerian Red Cross Society. An estimated accessible population of approximately 350 operational and supervisory personnel was identified based on typical participation levels in recent full-scale exercises. A sample size of 150 respondents was determined using Yamane's (1967) formula for finite populations at a 5% margin of error. Stratified random sampling was employed to ensure proportional representation of the major agencies. Within each stratum, simple random sampling was applied. For the qualitative component, purposive sampling was used to select 12 key informants (senior officers who had served as Incident Commanders or agency coordinators during recent exercises).

3.3 Research Instruments and Data Collection

A structured five-section questionnaire measured demographic characteristics, level of emergency preparedness, adequacy of equipment and facilities, effectiveness of inter-agency coordination, challenges, and emergency response effectiveness. Items were rated on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). A semi-structured key-informant interview guide explored deeper insights into coordination mechanisms, exercise lessons learned, and systemic challenges. Secondary data were drawn from publicly available exercise debrief reports, NCAA Advisory Circulars, and FAAN operational documents. Content validity was established through expert review by three specialists in aviation safety and emergency management. Construct validity was assessed via pilot testing with 20 respondents from a comparable airport environment. Reliability was determined using Cronbach's alpha; the overall instrument coefficient was 0.94, with individual construct coefficients ranging from 0.86 to 0.91, confirming excellent internal consistency.

3.4 Data Analysis

Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics (frequencies, means, standard deviations) were used to answer the research questions. Interpretation of mean scores followed the conventional five-point Likert scale: 1.00–1.80 = Very Low; 1.81–2.60 = Low; 2.61–3.40 = Moderate; 3.41–4.20 = High; 4.21–5.00 = Very High. Inferential statistics—Pearson's product-moment correlation and multiple regression analysis—were used to test the hypotheses at the 0.05 significance level. Qualitative data were subjected to thematic analysis. Ethical protocols including informed consent, anonymity, confidentiality, and voluntary participation were observed throughout.

4. RESULTS

4.1 Response Rate and Respondent Profile

Out of 150 questionnaires distributed, 128 were returned and 120 were found usable after data cleaning, yielding a valid response rate of 80.0%. Respondents were drawn from all major participating agencies, with FAAN constituting the largest group (23.3%), followed by Nigeria Police Force (12.5%) and Medical/Port Health staff (11.7%). Junior/operational staff formed the majority (43.3%), followed by middle/supervisory officers (34.2%). A substantial proportion (55.0%) had more than ten years of service, and 80.8% had participated in at least one emergency exercise at NAIA, enhancing the credibility of their assessments.

4.2 Level of Emergency Preparedness

The composite mean for emergency preparedness was 3.92 (SD = 0.52), indicating a high level of preparedness at NAIA. The highest-rated items were the existence of a current and clearly documented Aerodrome Emergency Plan (M = 4.18) and the regular conduct of emergency exercises (M = 4.05). Role definition, personnel familiarity with procedures, and prompt activation procedures also received high ratings. Slightly lower (though still high) scores were recorded for continuity-of-operations arrangements (M = 3.68) and the regularity of training (M = 3.72). Qualitative informants confirmed that the AEP is reviewed after every major exercise and that lessons are formally documented.

4.3 Adequacy of Emergency Response Equipment and Facilities

The composite mean for equipment and facilities was 3.68 (SD = 0.61), placing the construct in the "High" category. Fire-extinguishing agents (M = 3.95) and fire-fighting vehicles (M = 3.89) received the strongest endorsement, indicating that core Rescue and Fire-Fighting Service (RFFS) resources largely meet minimum standards. Relative weaknesses were identified in passenger/family assistance facilities (M = 3.36 – Moderate) and emergency communication equipment (M = 3.41). These findings are consistent with earlier observations at other Nigerian airports that, while primary fire-fighting and rescue assets satisfy regulatory minima, communication systems and passenger-assistance infrastructure remain areas of comparative under-investment.

4.4 Effectiveness of Inter-Agency Response Coordination

Inter-agency coordination recorded a composite mean of 3.55 (SD = 0.58)—still within the "High" range but the lowest of the three positive constructs. Joint emergency exercises (M = 4.12) and post-exercise debriefings (M = 3.89) were strongly endorsed as mechanisms that improve mutual understanding of roles. However, moderate scores for effective communication among agencies (M = 3.38), interoperability of communication systems (M = 3.29), uncommonness of conflicting instructions (M = 3.21) and well-coordinated traffic control (M = 3.35) highlight residual operational gaps. Key informants repeatedly cited incompatible radio frequencies, delayed transmission of critical information from the Emergency Operations Centre to off-aerodrome partners, and parallel command channels as sources of confusion during exercises.

4.5 Major Challenges

Challenges were perceived as substantial (composite mean = 3.78, SD = 0.55). Ranked by mean severity, the most critical challenges were: inadequate funding (M = 4.15), communication-system limitations (M = 4.02), inadequate or poorly maintained equipment (M = 3.91), delayed activation of coordination arrangements (M = 3.88), traffic congestion/access constraints (M = 3.86), and conflicting instructions or unclear authority (M = 3.84). Qualitative accounts linked equipment-maintenance shortfalls and delayed vehicle overhauls directly to budgetary limitations.

4.6 Emergency Response Effectiveness and Hypothesis Testing

Overall emergency response effectiveness was rated high (composite mean = 3.73, SD = 0.54). Prompt initiation of response (M = 3.94) and arrangements that protect life and property (M = 3.86) received the strongest support; communication support for timely decision-making was the relatively weakest dimension (M = 3.48).

All four null hypotheses were rejected at the 0.05 significance level. Pearson correlations showed significant positive relationships between preparedness and response effectiveness ($r = 0.671$, $p < 0.01$), equipment adequacy and response effectiveness ($r = 0.598$, $p < 0.01$), and inter-agency coordination and response effectiveness ($r = 0.724$, $p < 0.01$). Challenges were negatively correlated with effectiveness ($r = -0.458$, $p < 0.01$). Multiple regression analysis confirmed that the four predictors jointly explained 65.9% of the variance in emergency response effectiveness ($R^2 = 0.659$, Adjusted $R^2 = 0.647$, $F(4, 115) = 55.42$, $p < 0.001$). Standardised coefficients indicated that inter-agency coordination ($\beta = 0.412$) made the largest unique contribution, followed by preparedness ($\beta = 0.287$), equipment adequacy ($\beta = 0.198$) and challenges ($\beta = -0.156$). Variance inflation factors were well below 5, indicating no problematic multicollinearity.

5. CONCLUSION AND RECOMMENDATIONS

The study concludes that Nnamdi Azikiwe International Airport, Abuja, has a generally high level of emergency preparedness and emergency response capability; however, important operational and coordination gaps remain that prevent the airport from achieving optimal performance. The emergency response architecture at NAIA is functionally sound but not yet fully optimised. The airport has established important institutional strengths through its Aerodrome Emergency Plan, emergency exercises, emergency response resources and multi-agency arrangements. Nevertheless, the effectiveness of these arrangements depends substantially on the quality of inter-agency coordination, communication interoperability, equipment readiness, adequate funding and efficient access control.

Inter-agency coordination emerged as the strongest predictor of response effectiveness, underscoring that investment in communication systems, joint training, and unified command structures will yield the greatest improvement in overall performance. Addressing the identified weaknesses—particularly the communication and interoperability gap, funding and equipment-maintenance challenges, and traffic/access-control constraints—would enhance NAIA's capacity to achieve a higher level of emergency preparedness, coordination and response effectiveness.
Based on the empirical findings, the following recommendations are advanced:

1. Strengthen interoperable communication systems through priority investment in standardised radio and data-communication platforms that enable seamless information exchange among on- and off-aerodrome partners.
2. Secure dedicated and predictable funding for emergency-response readiness via a ring-fenced budget line covering vehicle overhaul, equipment maintenance and replenishment of extinguishing agents.

3. Enhance passenger/family assistance and triage facilities to move these dimensions from the Moderate to the High range.
4. Institutionalise more frequent joint table-top and partial exercises focused on communication protocols, command transfer, and traffic/access control, complementing the mandatory full-scale exercises.
5. Improve traffic and access control protocols through pre-agreed management plans involving FRSC, Police and Aviation Security, with controlled access corridors for emergency vehicles.
6. Reinforce a single, clearly understood Incident Command System through regular joint orientation sessions, laminated role cards, and visible incident-command identification during exercises.
7. Establish a transparent performance dashboard tracking response-time metrics, communication-success rates, equipment-readiness indicators and exercise-lesson closure rates to sustain continuous improvement.

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