



Review Article

Can Nigeria's fragile Health System tackle the recent Anthrax emergence? A narrative review

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Abstract

Background: Nigeria's healthcare system grapples with systemic inadequacies which potentiate the inadequate management of infectious disease outbreaks. This is concerning as Anthrax, a neglected zoonotic disease emerged in 2023.

Objectives: This paper aims to review the weaknesses in the country's healthcare system and propose solution for Anthrax mitigation, drawing lessons from past polio, COVID-19, Ebola outbreaks.

Methodology: A preliminary search was conducted on Ovid Medline and public databases with combination of Medical Subject Headings (MeSH) keywords, resulting in 173 articles. Five authors screened the articles based on selection criteria (including language, year of publication, relevance, and peer-review). Using a nonsystematic approach, a narrative synthesis was used to analyse and discuss the results from 29 selected studies.

Result: Nigeria's health system is grappling a myriad of challenges significantly impacting the nation's healthcare landscape. These challenges include accessibility to care, inequitable distribution of health services and health workers, catastrophic spending for healthcare, physician emigration, frequent industrial disputes, insecurity, and underfunding. Additionally, there are issues with inadequate disease surveillance infrastructure, while limited veterinary services and poor animal husbandry practices increase the potential for zoonotic disease outbreaks.

Conclusion: The review underscores the potential for Nigeria to effectively address the challenges of Anthrax and mitigate its impact on human and animal populations. Strengthening disease surveillance, increasing research funding, and raising public awareness are crucial. Targeted vaccinations, isolation facilities, treatment protocols, and collaboration among healthcare professionals, government, and international organizations are essential. The study recommends practical strategies and legislation to ensure human and animal safety.

Keywords: Anthrax, zoonoses, disease outbreaks, one health, Nigeria.



Introduction

Anthrax, caused by the spore-forming gram-positive bacterium *Bacillus anthracis*, is an ancient infectious disease that has influenced the development of antimicrobial therapeutics.¹ It primarily affects livestock and wildlife but can also infect humans.^{1,2} Soil is the primary reservoir, and it can be found in the wools and hair of infected animals.^{2,3} The disease is prevalent in underdeveloped regions with dense populations, limited vaccination, and inadequate screening for suspected livestock-related exposures.^{1,2} While bioterrorism-related cases have been reported in developed countries, a global response to the disease has been inadequate due to its higher prevalence in the global south.^{2,4}

Recognizing the need for global assistance, the World Health Organisation (WHO) has classified Anthrax as a Neglected Zoonotic Disease (NZD) and emphasised the need for support as health systems determine how well a country manages disease outbreaks.^{2,4,5} Nigeria, a resource-constrained country, faces challenges in diagnosing Anthrax due to similarities in presentation with other endemic diseases.^{2,3} The country has implemented the multidisciplinary 'One Health Strategic Plan 2019-2023' to address zoonotic diseases comprehensively, including Anthrax.^{6,7} This integrated framework recognises the interdependence of human, animal, and environmental health. This paper examines Nigeria's health system's ability to manage anthrax outbreaks effectively within the One-Health Approach framework. The recent outbreak of a new disease in the country has raised serious questions regarding the system's capacity to manage such crisis. Health policymakers and decision-makers would benefit from a quick synthesis of knowledge and evidence that is streamlined to the local context and can lead to success.

This narrative review aims to address this gap by identifying the areas of weakness in the country's health system, appraising the country's response to anthrax emergence, deducing learning points from previous disease outbreak management, and making future recommendations.

Method

The literature search encompassed PubMed, Google Scholar, MEDLINE, Embase, as well as repositories of the World Health Organization (WHO), Nigeria Centre for Disease Control and Prevention (NCDC), Centre for Disease Control and Prevention (CDC), and websites of the Federal Ministry of Health (FMoH), Nigeria. Published reports on recent and past outbreaks in Nigeria, including Anthrax, Ebola, COVID-19, and

Polio, were reviewed. A non-systematic approach was followed to develop a narrative synthesis within a narrow time window after the official confirmation of Anthrax in Nigeria. The search strategy involved using keywords and Medical Subject Headings MeSH indexing terms such as 'Anthrax', 'Health Systems', 'One Health', 'Outbreak', 'Ebola', 'COVID-19', 'Polio', and 'Nigeria'.

The search was limited to English-language articles published between 2009 and 2024. Relevant articles about anthrax or infectious disease outbreaks in Nigeria or similar countries with fragile health systems were identified. Five authors employed a multi-criteria method to screen papers, as summarised in Table 1. Relevant data was extracted, and limitations were noted where applicable. All deductive approaches were used, and a consensus was reached for every final decision. A narrative synthesis was utilised considering the heterogeneity of the sources in design and content. Trends and common themes were identified to generate topical areas for discussion.

Ethical approval: Since this was a literature review, ethical approval was not required.

Results

A total of 29 studies were reviewed and analyzed thematically to discuss the first confirmed case of anthrax in Nigeria, the state of the country's healthcare system, and its capacity to effectively handle an Anthrax outbreak (Table 2). Additionally, research articles were examined to identify potential lessons from previous outbreaks such as Ebola, COVID-19, and Polio that could inform outbreak management.^{2,3,24,25,26,27,28} The review highlighted several challenges that could hinder an adequate response, including limited access to healthcare services, inequitable distribution of health workers, and poor healthcare financing.^{2,3,4,9,10,14,15,16,21,22,29} Furthermore, poor infrastructure for local manufacturing of medications, high out-of-pocket expenses, and poor coverage of health insurance programs exacerbate the situation.

Other challenges include poor management of drug revolving funds, poor drug inventory, irrational drug use, low health literacy, weak advertising regulations for untested alternative medicine, and inadequate disease surveillance infrastructure. These challenges limit the capacity to deploy effective antimicrobial management and reduce morbidity and mortality from anthrax.

Diagnostic limitations, limited veterinary services, and poor animal husbandry services further increase the



spread of zoonotic diseases like anthrax, making effective control a distant reality. This narrative review also explored potential strategies to improve disaster surveillance infrastructure, improve the utilization of

one health plan, and recommendations from the management of previous infectious disease outbreaks^{2,3,6,7,8,9,15,16,17,20,25,26,27,28} (Table 2).

Table 1: Showing Article Selection Process for Reviewing Nigeria's Health System Capacity to Tackle Anthrax Emergence

Stage	Description	Number of Articles
Initial search	Database search using keywords like 'Anthrax', 'Health Systems', 'One Health', 'Emergence', 'Outbreak' 'Ebola' 'COVID-19', 'Polio' and 'Nigeria'	146
Reference Review	Review of reference list of identified articles	+28
Total Articles	Total articles acquired from a detailed literature search	174
Screening	Selection using inclusion criteria	
• Language	Articles in English	140
• Year of publication	2009-2024	98
• Excluding redundant papers	repetitive or similar articles	76
• Relevance	Articles aligned with the context in Nigeria or developing countries in sub-Saharan Africa	31
• Peer-reviewed or in regulatory repositories.	Articles published in peer-reviewed journals or regulatory repositories.	30
Final Selection	Articles meeting all inclusion criteria	29

Table 2: Table Showing Challenges of Nigeria's Health System and Recommendations

Challenges of Nigeria's Health System	Lessons from the Past and Recommendations
Accessibility.	Effective leadership and coordination. ^{9,13}
Inequitable distribution of Health facilities.	Improved surveillance and response mechanisms. ⁹ Community engagement and mobilisation. ^{8,9,15,25}
Inequitable distribution of health workers.	Strengthen surveillance infrastructure. ⁷
High out-of-pocket expense.	Increasing funding and public awareness. ^{7,8,25,13}
Physician emigration.	Innovative and traditional communication systems. ^{2,6,15,16,25}
Frequent Industrial Action	Responsible antibiotic use. ^{6,29}
Insecurity.	Mass livestock vaccination. ^{2,7,8}
Underfunding for Health Sector.	Vaccine education campaigns ⁷
Poor coverage of health insurance.	Targeted vaccination for high-risk individuals. ²⁶
Poor infrastructure for local medicine production.	Mobile vaccination points. ^{6,9,25,27}
Mismanagement of drug-revolving fund.	Isolation facilities and medical treatment protocols. ^{15,25}
Poor drug inventory.	Transparent communication channels ^{3,15,25,26}
Irrational drug use.	Improve health service infrastructure. ^{9,27,28}
Low health literacy.	Capacity building and training of health workers. ^{2,6,9}
Weak advertising regulations for untested alternative medicines.	Disease Research. ⁶
Inadequate Disease Prioritisation.	Legislation and regulation. ^{6,9}
Inadequate Surveillance and response.	Flood Disaster Preparedness. ²¹
Diagnostic limitations.	International collaboration. ^{15,17,25,27,28}
Limited veterinary services.	
Poor animal husbandry Practices.	

Discussion

First Anthrax Case Confirmed In Nigeria

On July 17, 2023, the Nigeria Centre for Disease Control and Surveillance (NCDC) and Federal Ministry of Agriculture and Rural Development (FMARD)



confirmed an Anthrax outbreak in Niger State, Nigeria.³ This confirmation was based on positive test results from the National Veterinary Research Institute (NVRI) in Plateau State.^{3,7} The outbreak originated from a mixed-livestock farm where eight animals showed signs of haemorrhagic disease and died suddenly.³ FMARD established a One-Health Anthrax Technical Working Group and activated a National Incident Management System (IMS) in collaboration with NCDC.³ Contact tracing was initiated for exposed livestock and individuals, and an Incident Action Plan (IAP) was developed for confirmed human cases.^{3,7} Vaccination programs were implemented in multiple states, with FMARD donating 50,000 Anthrax vaccines to the Lagos State Government.^{3,8} Medical and laboratory supplies for control, management, and extensive testing were prepared for distribution.^{3,8} Additionally, both agencies collaborated on an Anthrax advisory document that provided information on disease presentation, risk factors, preventive measures, and guidelines for reporting incidents.³ This coordinated response highlights the significance of the One-Health Plan in facilitating effective collaboration and addressing diagnostic limitations that may have hindered the confirmation of previous cases in Nigeria.^{6,7}

Overview of Nigeria's Health System

Nigeria's health system can be assessed using the WHO's framework, which consists of six essential components: service delivery, health workforce, health information systems, access to essential medicines, financing, and leadership/governance.^{5,9} The country faces significant challenges in each of these areas, contributing to a weak health system (Table 2).^{6,9,10}

Despite offering comprehensive health services, Nigeria struggles with accessibility due to an inequitable distribution of resources and high out-of-pocket expenses.^{10,11} The shortage of healthcare workers further exacerbates the situation, as many professionals emigrate due to poor remuneration, insecurity, and a lack of laboratory facilities.^{12,13} Industrial actions in the health sector also disrupt access to care.⁹ Additionally, Nigeria has failed to allocate the promised 15% of its annual budget to healthcare, hindering the development of a robust health system.^{9,11}

Legislation has been implemented to address these challenges, including the National Health Act of 2014 and the Animal Disease Control Act, which regulate human and animal health systems.⁶ The Nigeria Health Insurance Authority Act of 2021 replaced the National

Health Insurance Scheme (NHIS) to improve health coverage, which had previously achieved only 4% coverage in 12 years.^{9,10}

Although essential medicines are available, their accessibility is hindered by mismanagement of drug-revolving funds and a lack of technology and infrastructure for local production.^{10,11} This affects affordability and availability, particularly in areas with a high disease burden.¹⁴ Public facilities often experience stock depletion without replacement due to poor inventory control. At the same time, underutilised primary healthcare centres lead to additional transportation costs for patients seeking reliable but expensive facilities far from rural areas.¹⁴

Irrational drug use in animal and human populations poses risks such as antimicrobial resistance (AMR), compromising effective treatment and disproportionately affecting vulnerable patients.^{2,6} Low health literacy contributes to the preference for unscientifically proven alternatives to conventional medicines.^{15,16} Advertising laws restrict health professionals, while unregulated practitioners can freely promote their services, potentially enabling misinformation.¹⁵

The Nigerian government has been criticised for neglecting to improve healthcare capacity and quality.⁹ However, they have demonstrated unexpected proficiency in managing epidemics such as Ebola, Coronavirus, and Polio outbreaks.⁹

Anthrax in the Context of Nigeria's Health System

In Nigeria, the responsibility of preventing and managing disease outbreaks typically falls under the purview of the Federal Ministry of Health (FMoH), particularly the NCDC – the national public health institute responsible for disease surveillance.⁶ Additionally, the Federal Department of Veterinary and Pest Control Services (FDVPCS) under the Federal Ministry of Agriculture and Rural Development (FMARD) caters to animal health services.⁶ The National Agency for Food and Drug Administration and Control (NAFDAC) and Nigeria Agricultural Quarantine Service (NAQS) regulate livestock health and consumption in collaboration with FMARD.⁶ These agencies play a vital role in controlling anthrax outbreaks in Nigeria. However, before the five-year One-Health Strategic Plan was implemented, there was a lack of cooperation among these agencies.⁶



The inadequate prioritisation of diseases hinders Nigeria's disease surveillance efforts.² Neglect has impaired surveillance for certain zoonotic diseases, as resources are primarily directed towards conditions that are epidemic-prone or targeted for eradication, neglecting other major public health concerns.^{2,6} This ineffective surveillance and response system also delays the diagnosis and management of infectious diseases, including Anthrax, resulting in increased disease spread and difficulty implementing control measures, delaying case detection and response.^{6,17} Furthermore, clinician knowledge of standard case definitions is inadequate, posing a challenge at the first stage of disease surveillance.¹⁷ Diagnostic limitations affect the ability to identify cases accurately and promptly, carry out quarantine protocols, perform contact tracing, and make vaccines available.^{5,9,18}

Under the One-Health Plan, efforts have been made to improve surveillance infrastructure to address zoonotic diseases. This includes domesticating the Integrated Disease Surveillance and Response (IDSR) strategy, which focuses on disease reporting.^{6,17,18} Additionally, tools like the Surveillance Outbreak Response Management and Analysis System (SORMAS), National Animal Disease Information and Surveillance System (NADIS), and Animal Resource Information System (ARIS) have proven useful.⁶ However, challenges related to workforce shortages, lack of expertise, and internet connectivity issues have made it difficult to utilise these resources fully.¹⁷ The scarcity of veterinary practitioners in the country and limited access to specialist services for livestock owners further exacerbates the situation.^{2,6} With only nine veterinary institutes and three colleges of animal health, this shortage will likely worsen due to emigration.⁶

In Nigeria, the agricultural sector faces numerous challenges that increase the likelihood of Anthrax transmission. Poor animal husbandry practices, such as inadequate vaccination, lack of biosecurity measures, and limited veterinary services, significantly increase the risk.^{2,4} Additionally, human spread is more likely in environments where animals are nearby, such as pastoral farms, household domestication, and abattoirs.^{2,4,8} Given that pastoralism is common in Nigeria, this could contribute to the spread of Anthrax across grazing areas.^{4,8} Furthermore, infected animals can shed Anthrax spores into their environment, creating environmental reservoirs and potentially contaminating soil and vegetation other animals graze on.² Therefore, proper meat handling, preparation, and hygiene during

production are crucial factors that affect Anthrax risk.^{3,8} Insufficient personal protective equipment (PPE) used by individuals working with animals or animal products can lead to direct exposure.²⁻⁴

Using untreated animal hides, skins, milk products, and traditional animal handling and slaughtering methods in cultural practices significantly contribute to the spread of anthrax.^{4,7} Additionally, the lack of proper oversight agencies has led to unsanitary abattoirs, further heightening the risk of anthrax transmission through contaminated animal products and environments.^{4,8} Popular Nigerian street foods, such as 'suya' (spiced grilled meat), can also be a means of anthrax transmission if the meat is contaminated with anthrax spores, which are proven to be resistant to extreme conditions.^{1,4,7} Other animal products from bush meat or boiled animal hide, known as '*pomo*', carry similar risks.^{1,4,7}

Nigeria's high population density (246 people per square kilometre), especially in unplanned urban areas, challenges disease control.^{19,20} Crowded living conditions, limited access to sanitation facilities, and inadequate healthcare services can increase transmission rates.^{3,8,19} Poverty, limited education, and food insecurity can also impact people's understanding and adherence to preventive measures, increasing transmission rates.²¹⁻²³ Flooding, which occurs seasonally in certain areas, can exacerbate poverty and food insecurity, increasing the likelihood of disease spread.^{21,24} Additionally, some individuals are hesitant to cull infected livestock due to economic factors and food insecurity, which can lead to the consumption of sick or dead animals.^{4,7,25} Inadequate livestock and pets vaccination programs put vulnerable populations at risk.⁷ Furthermore, limited access to reliable and timely information and low literacy rates can hinder public awareness campaigns.^{4,23} These socioeconomic factors can compound transmission rates by reducing awareness and compliance with preventive measures.²¹⁻²³ Therefore, targeted strategies tailored to local contexts are crucial for effectively disseminating information about anthrax transmission, prevention, and control measures.^{6,8} To effectively mitigate the spread of Anthrax in Nigeria, addressing these predisposing factors through a comprehensive approach encompassing effective veterinary care, heightened public awareness, targeted vaccination initiatives, stringent hygiene practices, and vigilant surveillance measures is essential. This multifaceted approach will prove invaluable in addressing complex



influences contributing to Anthrax's transmission and propagation.

Addressing Anthrax through Lessons Learned From Previous Outbreaks

Nigeria can draw valuable lessons from its experiences in eradicating polio, managing Ebola Virus Disease (EVD), and dealing with the COVID-19 pandemic to prevent an outbreak of Anthrax (Table 2). Effective leadership, coordination, and improved surveillance and response mechanisms can be adapted from previous public health campaigns.⁹ Community engagement and mobilisation should also be prioritised.⁹

Nigeria must strengthen its surveillance infrastructure by increasing funding and public awareness to control infectious diseases like Anthrax.⁷ Utilizing strategies such as mobile text messaging and traditional communication systems (town criers), which were influential during the COVID-19 pandemic, will aid prompt case identification and contact tracing.^{2,6,16,17,26} Rapid response teams should be established to manage suspected cases and conduct contact tracing. Public awareness campaigns must educate people about Anthrax, including its symptoms, transmission modes, and preventive measures.^{8,26} Additionally, responsible antibiotic use is critical to prevent antimicrobial resistance while managing Anthrax.⁶

Mass livestock vaccination is a critical measure in controlling Anthrax.² Nigeria's commendable mass vaccination drives initiated by FMARD after the 2023 incident are a step in the right direction.^{7,8} However, targeted vaccination for high-risk groups, such as healthcare workers, livestock handlers, and veterinarians, should also be implemented.²⁷ Additionally, isolation facilities and medical treatment protocols must be in place to manage anthrax cases effectively and prevent further spread.^{16,26} Establishing mobile vaccination points can effectively reach remote populations, necessitating the recruitment and capacity building of additional healthcare workers.^{6,9,26,28} Health education initiatives are essential to increase vaccine acceptance and understanding of the benefits and accessibility of vaccines.⁷

Effective collaboration among healthcare professionals, government agencies, and international partners, as seen during Nigeria's EVD outbreak, is crucial. Transparent communication channels, such as those created by NCDC and FMARD, should be established to disseminate accurate information and prevent

misinformation.^{3,16,26} A comprehensive strategy is imperative to prevent and control Anthrax in Nigeria. Bolstering the healthcare infrastructure is a priority, requiring investments in medical facilities, diagnostics, and an adequate healthcare workforce.^{9,13,28} The government must prioritise public health infrastructure in outbreak-prone regions to combat anthrax emergence in Nigeria. This can be done by addressing workforce shortages, improving local laboratory testing capacity, encouraging antimicrobial stewardship, and providing isolation and treatment facilities, in addition to personal protective equipment.^{6,9,16,18,28,29}

Additionally, improving the identification and early diagnosis of anthrax can be achieved through capacity building and training of health workers.^{2,6,9} Research is vital to understanding anthrax transmission patterns, risk factors, and effective interventions.⁶ Hence, evidence-based strategies must guide the development of targeted measures. Legislation and regulation must be established to govern animal handling, food safety, and vaccination practices to curtail anthrax transmission.^{6,9}

Preparing for disasters like floods is crucial in developing plans considering anthrax transmission during such incidents.²¹ Public awareness and active engagement with at-risk communities are pivotal; establishing vital programs involving local communities in disease surveillance, response, and preventive efforts will foster ownership and active participation, ensuring protocol compliance.^{16,26} Nigeria's success in combating the emergence of anthrax might require international collaboration, support, and advocacy for increased funding, expertise, and resources.^{16,18,26,28} Combining these short-term interventions with long-term strategies will empower Nigeria's health system to effectively address the challenges of Anthrax and substantially mitigate its impact on human and animal populations (Table 2).

Implications of Findings and Strengths of the Review

The review article is an essential resource for public health preparedness in Nigeria, with several strengths that make it a valuable contribution to the field. Its multifaceted approach, combining a comprehensive literature review with a critical analysis of the Nigerian health system and an exploration of past outbreaks, provides a more nuanced understanding of the potential vulnerabilities and opportunities for managing a future anthrax or similar disease outbreak. The critical analysis of the Nigerian health system goes beyond merely describing its limitations, allowing for a detailed



examination of the system's vulnerabilities and areas for improvement. This examination strengthens the foundation for developing targeted strategies to address potential shortcomings, making the review a valuable resource for policymakers and public health officials. Moreover, the paper's real-world application for managing a potential anthrax outbreak adds significant value to the findings. As anthrax outbreaks can directly impact public health preparedness and response in Nigeria, the article's insights are timely, critical, and comprehensive, making it an indispensable resource for anyone interested in public health preparedness in Nigeria. Overall, the review article's strengths position it as a critical resource for public health preparedness in Nigeria, providing valuable insights and recommendations for policymakers, public health officials, and other stakeholders.

Limitations of the Review

Potential limitations of this review stem from the exclusion of non-English language articles and the reliance on published literature, which could result in publication bias and potentially missing out on relevant studies despite deploying a comprehensive search strategy. A data extraction form was developed to collect pertinent information to address this. Five authors were part of the data extraction, and thematic areas were deduced for most themes based on the original authors' conclusions. In other cases, the authors read the entire manuscript and decided on the key takeaways. Another limitation of this study is the short time required to conduct the research; a systematic approach could have been more beneficial and is recommended for future research. To reduce this limitation we employed a nonsystematic methodology that aligned with the provisions for set out by the SANRA guidelines, the scale for the quality assessment of narrative reviews.³⁰

Conclusion

Nigeria's healthcare system has been widely criticised for its inadequacies and lack of resilience in controlling infectious diseases like Anthrax. Nigeria can learn from experiences with polio, Ebola, and COVID-19 to prevent an outbreak. The review highlights the urgent need for comprehensive surveillance, public awareness, targeted vaccination campaigns, treatment protocols, and a well-equipped healthcare infrastructure. Collaboration among healthcare professionals, government agencies, and international organisations is critical to developing a comprehensive response plan. Additionally, active engagement with at-risk

communities and international collaboration will be instrumental in successfully combating Anthrax in Nigeria. The challenges are significant, but with concerted efforts, Nigeria can develop a robust and effective response plan to tackle Anthrax and other infectious diseases.

Abbreviations

AMR- Antimicrobial Resistance
ARIS- Animal Resource Information System
CDC- Centre for Disease Control and Prevention
EVD- Ebola Virus Disease
FDVPCS- Federal Department of Veterinary and Pest Control Services
FMARD- Federal Ministry of Agriculture and Rural Development
FMOH- Federal Ministry of Health
HIV/AIDS- Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
IAP- Incident Action Plan
IDSR- Integrated Disease Surveillance and Response
IMS- Incident Management System
NADIS- National Animal Disease Information and Surveillance System
NAFDAC- National Agency for Food and Drug Administration and Control
NAQS - Nigeria Agricultural Quarantine Service
NCDC- Nigeria Centre for Disease Control and Prevention
NHIS- National Health Insurance Scheme
NVRI- National Veterinary Research Institute
NZD- Neglected Zoonotic Disease
SORMAS - Surveillance Outbreak Response Management and Analysis System
WHO- World Health Organisation

Declarations

Ethical consideration: Since this was a literature review, ethical approval was not required.

Authors' contribution: DFM- Conceptualization, methodology, data curation supervision, drafted the original manuscript, edited and reviewed the final manuscript.
EVE- Project administration, Drafted the original manuscript, edited and reviewed the final manuscript.
EEA-Supervision, Drafted the original manuscript edited and reviewed the final manuscript.
UBM- Drafted the original manuscript edited and reviewed the final manuscript.



GMA- Drafted the original manuscript edited and reviewed the final manuscript.

ERN- Drafted the original manuscript edited and reviewed the final manuscript.

JPT- Drafted the original manuscript edited and reviewed the final manuscript.

NS- Drafted the original manuscript edited and reviewed the final manuscript.

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