

A Review of the Efficacy of Current Management Strategies in Mitigating Lassa fever In Nigeria

Samira Ahmad Bashir

Department of Public Health, Texila American University, Guyana

Abstract

Lassa fever is a disease endemic to Nigeria that has shown increased virility annually. Problem: An increase in reported cases and resultant death. Risk Assessment: Endemic to areas of low socioeconomic persons characterized by high density and poor hygiene and sanitation. Results: There is a gap in surveillance and communication with sub-optimal compliance to health protection guidelines. Though environmental policies have been established there is very small evidence of implementation. Recommendation: Emphasis on environmental sanitation and hygiene must be ensured.

Keywords: *Environmental sanitation and hygiene, Lassa fever.*

Introduction

Lassa fever is an acute viral hemorrhagic fever that occurs predominantly in the sub-Saharan region of Africa (mainly West Africa). Sierra Leone, Liberia, Guinea, and Nigeria are the main endemic countries reported, although there has been some evidence to suggest a wider area of endemicity [1]. It was first described as a clinical entity in the 1950s but was not identified scientifically until two American missionary nurses died from the disease in 1969 in the village of Lassa, Nigeria [2]. McCormick and Fisher-Hoch (2002) described the Lassa virus as a type of arenaviruses that has co-evolved along with their rodent hosts to cause fatal human illness [3]. It is caused by a single-stranded RNA with a secondary disseminated viral infection. Lassa is spread by its rodent host of the genus ‘*Mastomys natalensis*’ known as “multimammate rat” [4].

The main mode of transmission of Lassa virus from rodents to humans is through the handling of food and household items contaminated by the mastomys rat’s feces and urine. However, there is evidence to suggest human to human transmission through contact with bodily fluids

of an infected person, thereby increasing its level of contagiousness [5]. Thus, the spread within the community and in some cases hospital workers is propagated. With nosocomial infections reaching record levels due to challenges within the health care system [5]. Clinical symptoms of the infection range from fever, fatigue, hemorrhaging, gastrointestinal symptoms (vomiting, diarrhea, and stomachache), respiratory symptoms (cough, chest pain, and dyspnea), and neurologic symptoms (disorientation, seizures, and unconsciousness) [2]. With an incubation period for the disease is 3-21 days, the fatality ratio lies between 15% -50% in hospitalized cases [6].

Although the WHO [4] states the infection rate for Lassa is low as 80% of people infected will develop mild to no symptoms and only one in five will develop a severe disease, the current outbreak of Lassa fever in Nigeria has rendered the disease a public health emergency. There has been a steady rise in the rate of Lassa fever infections in recent years: from an estimated 100 000 – 300 000 in 2016 [5] to an estimated 300 000 – 500 000 in 2019 [7].

Received: 19.05.2022

Accepted: 07.08.2022

Published on: 30.09.2022

Corresponding Author: Sabashir079@gmail.com

This is demonstrated by the current Lassa outbreak, in which reports show from 1st January to the 9th of February, 472 cases were reported that spread across 26 out of 36 states with 70 deaths (case fatality ratio: 14.8%) [4]. Whereas in 2019, reports show that during the whole outbreak from 1 January to 28 April, there were 554 laboratory-confirmed cases, including 124 deaths reported across 21 states [7]. These figures show a sharp increase in Lassa cases from the previous year. However, researchers [8] [6] speculate this could either be due to more widespread and aggressive viral diseases or better surveillance and reporting.

However, no matter the cause for such a spike in reported cases, the trend is alarming. Nigeria is facing its worst Lassa fever outbreak, in recorded history, with a possible higher fatality rate than in previous years [9].

Sequel to previous success in managing and containing deadly infectious diseases like Ebola, the annual Lassa endemic reveals gaps in the commitment of both the government and health sector in tackling this disease [10]. This paper will aim to assess the risks responsible for the possible annual reoccurrence of this disease and the possible effective modes of management of those risks.

The aim of this study was to answer the following research questions:

1. What are the health risks responsible for an increased incidence and virility of Lassa fever in Nigeria?
2. Are the current modes of management effective enough to mediate this new trend?

Methodology

This paper is a literature review on the status of Lassa fever in Nigeria and level of response to curb the epidemic.

Only articles from accredited medical information databanks were used, such as PubMed, Cochrane, Elsevier, and the lancet. News media outlets from respected and licensed news companies were assessed. Web pages from

registered international organizations were also assessed.

42 articles were assessed that met the inclusion:

1. Only articles that have Lassa fever as a key word.
2. Articles that have Lassa fever management.
3. Articles with environmental degradation as a key word.
4. Articles with poor hygiene and cultural practices in relation to sanitation and hygiene.
5. Articles on Nigerian policies on Lassa fever.

After critical analysis 35 articles were chosen for the paper on further assessment 31 articles were finally included in the current article.

Health Risk Assessment

Emerging infectious diseases are a burden to developing countries like Nigeria: the constant battle to fight existing communicable and non-communicable diseases coupled with new emerging infectious diseases nearly cripples the overburdened health system [11]. These diseases are prevalent among the communities of low socio-economic status and has been termed the ‘infectious diseases of poverty [11].

Apart from the major three diseases (TB, Malaria, and HIV/AIDs), other neglected tropical diseases are included, of which Lassa fever is among. Presently, Nigeria is suffering from the deadliest outbreak of Lassa on record [4]. There is an urgent need to fully identify populations at risk and the risk factors of such a disease to be able to prevent the occurrence of this episode.

Lassa fever being is endemic to Nigeria and has portrayed sporadic outbreaks with a sudden increase in yearly infections since 2012 [9]. The infection can be severe although researchers state that over 80% of infections are mild or asymptomatic with one in five infections becoming severe and death occurring in 20% of hospitalized cases [4]. However, the severity and number of infections have increased, as demonstrated by the ongoing Lassa fever

outbreak. This has led to the Nigerian center for disease control (NCDC) to declare Lassa fever a public health emergency. For effective management, a complete risk assessment must be done.

Populations at Risk

Lassa fever is mostly observed among the low socio-economic regions of the country especially areas of high density [12]. Areas that are overpopulated and have rapid uncontrolled growth with few basic amenities result in poor solid waste and sewage disposal [9]. Moreover, figures have proven people living in temperate zones with temperatures below 32°C tend to have a higher number of reported cases than in areas with much higher temperatures [13]. It is also interesting to note that over the years outbreaks have begun in and have the highest concentration in 2 states: Edo and Ogun [7]. Populations at risk are estimated to be about 21 million Nigerians annually, with an estimated infection rate of about 500,000 [6].

Demographics

Lassa fever is mostly endemic in areas of low personal and environmental hygiene [12]. As stated previously, most of the population affected are under-educated, ignorant or have a rank disregard for community-based hygiene. The endemic areas in Nigeria have many poor hygienic habits like open defecation. UNICEF [14] stated that over 47 million Nigerians practice open defecation, a problem associated with ignorance, poor water accessibility, and attitudinal snag. It is shocking to discover that open defecation is a normal practice within not only poor neighborhoods but some middle-class neighborhoods [14]. It is a normal occurrence to see a person urinating by the roadside, ravine, gutter, or open waterway [15]. The magnitude of the problem can be demonstrated by the fact that only 13 local government areas out of 774 are currently certified as having achieved open defecation-free status [16]. Below are pictures of people engaging in open defecation.



Figure 1. People Engaging in Open Defecation in an Open Gutter within a Residential Area



Figure 2. Children Engaging in Open Defecation in a Residential

Moreover, Nigeria has a garbage crisis [17]. Solid waste poses grave dangers to the health of the people living in and around the vicinity. Not only does it cause innumerable infectious diseases such as cholera, but it is a festering ground for snakes, scorpions, rodents, and numerous insects and annelids [17]. These all pose dangers to the community. However, high-risk Lassa communities tend to have a culture of

uncontrolled growth and insufficient basic amenities like proper drainages, sewage systems, and garbage dumps [18]. Hence, there is a tendency for people to find other ways of disposing of their waste. Coupled with ignorance and a rank disregard for the personal and community hygiene, this has resulted in rank environmental degradation [19].



Figure 3. A Sea of Garbage Within a Residential Area [17]

Furthermore, most residents of such areas take rats as a delicacy to be cherished. This is evidenced by a man taking to social media to boast of his ‘Rat-catch’ and the dish he made of

it [19]. In many parts of the country, rats are considered a delicacy called “Bush Meat” and are a staple of many local dishes.



Figure 4. A Meal with a Rodent as the Main Source of Protein [19]

These bad habits result in sever challenges to the health of the community [17]. Open defecation causes not only water-borne diseases and Air pollution but vector-borne diseases such as Lassa. Whereas ingestion of the rodents themselves exposes the person to the disease by direct handling of the rodent.

Environmental Factors

Nigeria has a terrible sanitation problem. WHO and UNICEF statistics show a drop in environmental sanitation coverage in Nigeria, from 36 per cent in 2000 to 33 in 2015 [14][20]. The majority of these statistics are obtained from low socioeconomic areas. Which are usually a cluster of shanty towns, shacks and run-down houses that are notorious for poor and often open sewage systems spilling into roads and

pathways, festering gutters and poor wastage disposal systems [18]. The Prominence of large garbage dumps by roadsides or even blocking the roads is also a frequent occurrence. Additionally, the culture of throwing garbage into gutters, ravines, and streams in addition to sewage that in most cases contaminate sources of water and form festering ponds of disease, has resulted in an attractive environment for an array of insects, arthropod and annelids in addition to Lizards, rats, snakes, and street dogs [21-22]. These factors promote the advent of all sorts of communicable disease as well as the emergence and quick spread of new infections such as Lassa [18]. The pictures below clearly show the level of the garbage crises and environmental degradation.



Figure 5. A Garbage Dump in the Middle of Road Within a High-density Area [22]



Figure 6. An Open Sewage within a Residential Area [22]

Climatic Factors

The fact that Lassa fever is endemic to West Africa alone, begs the question why? Researchers have tried to come up with the answer in the race to understand the risk factors and allow for better prevention tactics. In a study by Fischet-Calvet and Rodgers [23] that attempted to portray a risk map for Lassa fever, it was found that different climates have an impact on the propulsion of the disease. The authors stated that the outbreaks required a specific combination of high rainfall and a particular form of variability and seasonal timing. They reported the virus tended to occur after the culmination of the rainy season with reservoirs of the virus being affected twice more during the rainy season. Although Fischet-Calvet and Rodgers reported temperature having little effect on the disease distribution. [23] stated that the disease tended to be more virulent in more temperate regions with temperatures between 27°C and 32°C than in high temperatures of about 38°C. They further suggested that the viability of the infection may also be due to the ability of the virus to survive outside the host for a longer period [23].

The Health System Available

Populations in which infectious diseases are more prevalent tend to have poor medical facilities and infrastructures nearby [7]. There are insufficient health facilities. The available structures and incapable of addressing pressing medical issues [24]. There is also a culture of rank distrust of the healthcare system by rural populations. Moreover, a reduction in active surveillance and resultant early laboratory diagnosis could be another contributing factor [25].

Furthermore, insufficient, and sometimes undertrained staff in primary health care centers fail to follow standard infection prevention and control precautions when caring for suspected infectious patients. The WHO reported 5 cases among health workers in January 2022 alone

[25]. This shows preventive measures are adopted at suboptimal levels [4].

Risk Management

According to studies of the previous trends of Lassa fever outbreak, the probability of future outbreaks is very high. In a risk matrix, it might even be addressed as extremely high. Due to the increasing numbers of infected persons per year, Lassa fever in Nigeria has been made a Public Health Emergency [7]. The first step to effectively addressing the endemic disease is to map outlines of managing the risks obtained from the risk assessment. Health risk management is about the identification, assessment, understanding and control of the health risk factors in a specific population before they cause diseases or health-damaging issues.

Nigeria being a Lassa fever endemic country has developed the capacity to manage Lassa fever outbreaks. The government in response to emerging new infections and the crippling persistent nature of pre-existing infectious diseases like Malaria, TB, and HIV, established the Nigerian Centre for Disease Control (NCDC) in 2011 to strengthen the surveillance system for infectious diseases [7]. In collaboration with international health organizations, different strategies have been adopted with the aim of tackling the disease. The situation utilized the normal accident theory [26] to manage the risks as a lack of some organizational factors resulted in the advent of the outbreak.

Initial Response

As a result of the spontaneous outbreak of Lassa Fever that began in Ondo and quickly spread to Edo state, the epidemic management committee at the state ministries of Health in collaboration with the World Health Organization (WHO) state field offices reactivated the existing Incident Management System (IMS) which was modeled after the Emergency Operating Centre (EOC) for the control of Ebola Virus Disease (EVD) in Nigeria [27]. [28] stated that in other Committees such

as Epidemiology and Surveillance committee, Case management committee, and the Infection Control and Burial committee were established to aid combat different aspects of the outbreak.

Surveillance

To effectively monitor suspected cases epidemiologists and surveillance officers adopted a standard definition of any suspected or confirmed Lassa fever case [24]. This provided an operational base in which to identify probable cases and death during active case searches in hospitals and communities. The definition adopted was the WHO definition which stated ‘any illness or death following a gradual onset and one or more of the following symptoms: malaise, fever, headache, sore throat, cough, nausea, vomiting, diarrhea, myalgia, chest pain, hearing loss and a history of contact with excreta of rodents or with a case of LF’ [28]. In keeping with this objective, there was training of surveillance personnel at different levels of the health care system, especially those situated in rural areas. Public health officials were engaged and deployed to various states within the country to monitor and evaluate findings of suspected cases [7]. Any confirmed case was fully documented and contact tracing performed on all known contacts of such person. The contacts were placed in isolated surveillance facilities for 21 days.

Laboratory Investigations

Five laboratories with the capacity to positively test for the Lassa virus have been set up across the country [4]. Samples were obtained by specially trained personnel in triple-sealed packaging, from suspected cases and confirmed by positive tests utilizing the Lassa virus-specific reverse-transcriptase PCR (RT-PCR). Results were mostly available within 48-72 hrs [28].

Community Awareness Creation and Campaign

Large awareness campaigns were conducted by both foreign and local organizations using

billboards, banners, social media, news outlets, television, radios, and health talks in all healthcare facilities [24]. The main message promoted was the discouragement of direct handling of rats, cessation of ingesting rats as food and protecting of food and food items from rats. Other messages were put across that involve constant washing of hands and extra-precaution against people with high-grade fevers. Moreover, messages and pictorials that detailed the symptoms of Lassa fever were promoted on billboards and fliers. Community and religious leaders were empowered and informed on how to engage their communities. And safe identification and referral practices were taught at both community and hospital levels for early detection and referral to isolation centers [29].

Environmental Health Association

Many state environmental health associations established strategies to tackle rat infestations. There was the training of environmental staff on the latest methods for easy rodent extermination [25]. Areas most likely to be affected by rat infestations were identified and deployment of officers to the region. Many markets, motor parks and garbage dumps were identified for the operation [4]. However, not all states participated in the exercise and the level of environmental degradation is still very much prevalent in most states of Nigeria [19-22].

Preventive Measures

Standard protective measures were applied with the distribution of necessary supplies such as gloves, apron, alcohol, soap, and chlorine, including complete Personal Protection Equipment (PPE) kits [30]. Additionally, seminars were conducted to enlighten hospital staff on the standard operation procedure in dealing with infectious diseases like Lassa. Daily decontamination of medical facilities was carried out and all medical staff the came into contact with confirmed cases were immediately started on Ribavirin [25, 30]. However, this was mainly restricted to urban hospitals. And very

few materials reached the primary health centers. It is also important to note that most medical staff did not strictly adhere to the standard procedures for safety and precaution [4].

Case Management

Clinical conventions were carried out to map out new guidelines in the management of for Lassa fever. All suspected cases were transported to the different isolation centers around the country [25]. Effective treatment was begun with 500mgs of Ribavirin 6 hourly [3]. Rehydration therapy was administered, and complications were addressed. Although cases confirmed were subjected to contact tracing, not all were completed.

Results

Based on Study objectives

What are the Health Risks Responsible for an Increased Incidence and Virility of Lassa Fever in Nigeria?

Lassa fever is a viral hemorrhagic fever endemic to Nigeria: it is primarily transmitted through contact with food or items contaminated with by-products from the *Mastomys* rats. Transmission could also occur through direct human contact or bodily fluid transfer though this is rare [25].

Nigeria has demonstrated a high affinity for the disease with cases continuing to rise annually despite pre-existing preventive measures. In 2022, the WHO reported 211 cases with 40 deaths (19% fatality ratio) in January alone. That contrasts with 54 confirmed cases with 12 deaths reported during the same period in 2021. It has also demonstrated a greater geographical spread than in previous years [25]. This has resulted in the WHO labelling it a high-risk disease [25].

Persons that are most at risk were people from low socioeconomic levels living in high-density, poorly ventilated, and substandard settlements [12]. With poor hygiene, sanitation, and poor drainage [14]. These settlements boasted large garbage dumps that festered without any hope

for dispatch [17]. Moreover, cultural attitudes of persons living in these areas were an added disadvantage such as the culture of “bush meat” ingestion which is basically rodent meat [19, 22].

Another possible reason for the endemicity of Lassa in Nigeria was purported by Fischet-Calvet and Rodgers [23] to be climatic variability. As previously reported, Lassa fever has its peak within December to April each year [23, 25]. This resulted in authorities trying to explain this phenomenon as the disease having a particular affinity for the season after high rainfall, such as the dry season since the *Mastomys* rat's reproduction cycle falls within the rainy season [23, 25].

Are the Current Modes of Management Effective Enough to Mediate this New Trend?

Multiple measures have been put in place for disease management in Nigeria such as surveillance and coordination: however, response at some state levels is still sub-optimal [7]. Case management and infection prevention guidelines have been disseminated; however complete objective assessment of compliance was not obtained. Clinical management of laboratory-confirmed cases was done according to WHO guidelines. Furthermore, Ministries of environment have been engaged in promoting community hygiene [25]. Unfortunately, environmental degradation remains alarming especially in high-risk areas [20, 22].

Conflict of Interest

Author had no conflict of interest.

Recommendations

Nigeria is a known endemic country of the viral infectious disease of the poor (Lassa). The country has developed the capacity to fight this infection. However, capacities remain suboptimal with many challenges within the health system as well as the community. To effectively avert future outbreaks of Lassa in Nigeria, the cause of the etiology of the disease must be addressed. As stated by Fischet-Calvet

and Rodgers [12] it is impossible to eradicate the rodent host of the virus as they are endemic to the region. However, it is possible to greatly reduce the number of these rodents within residential areas [15]. Promotion of community-based hygiene must be a priority for the government. With implementation of laws by empowered environmental police [14, 15]. Moreover, regular cleanups should be established, and garbage dumps relocated away from residential within the metropolis.

Additionally, there must be a nationwide campaign on the dangers of some cultural practices like the ingestion of rodents as meat. The most effective way would be to incorporate education and awareness campaigns on the dangers of “Bush Meat” in mainstream school curriculums. The government could also propose a policy to ban hunting, killing, and marketing rodents with the purpose of ingesting. Additionally, the culture of open defecation must be abolished. Government should provide adequate latrines in schools, markets and public places and ensure they are kept clean to discourage open defecation [14, 25]. But most importantly cultural habits and factors of the high-risk communities that lead to the Virus’s endemicity must be changed [30].

On the other hand, the strict adherence to the standard rules of safety and precaution in

infectious disease needs to be established. In cases of severe illness, other routes of preventing death should be explored. [31] proposed focusing on complications such as septic shock and renal failure, which are the usual indicators for death in Lassa fever. Furthermore, familiarizing medical staff with new guidelines, early detection techniques and undertaking routine risk assessments may help in mitigating future response [31].

Conclusion

Lassa fever an endemic viral fever in Nigeria has shown the ability to spread quickly and has evolved into a public health emergency. It so far shows no chance of slowing down and hence begs the need to find a lasting solution. Although there are medical challenges in treating the disease, the main cause for the infection is due to cultural habits and factors. Therefore, to effectively fight the Lassa virus Nigerians must be willing to change their bad attitude towards environmental and community hygiene.

Acknowledgement

I would like to thank the University of South Wales and UniCaf for their support towards the development of this paper.

References

- [1] Sogoba, N. Feldmann, H and Safronetz, D., 2012, Lassa Fever in West Africa: Evidence for an Expanded Region of Endemicity, *Zoonoses and Public Health*, 59 (2) 43-47, <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1863-2378.2012.01469.x>.
- [2] Richmond, J. K and Baglole, D. J., 2004, Lassa fever: epidemiology, clinical features, and social consequences, *BMJ*, 327, 1271, <https://www.bmj.com/content/327/7426/1271>.
- [3] Fisher-Hoch, S. P and McCormick, J. B., 1987, Pathophysiology and Treatment of Lassa Fever, *Current Topics in Microbiology and Immunology:*

Arena viruses, *CT Microbiology*, 134 231-239, www.link.springer.com/chapter/10.1007/978-3-642-71726-0_10.

- [4] WHO 2020, Lassa fever – Nigeria, <https://www.who.int/csr/don/20-february-2020-lassa-fever-nigeria/en/n>.

- [5] Ilori, E. A. Furuse, Y. ipadeola, O. P. et al. 2019, Epidemiologic and Clinical Features of Lassa Fever Outbreak in Nigeria, January 1–May 6, 2018, *Emerging infectious Diseases*, 25(6) 1066–1074, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6537738/>.

- [6] Adebayo D, Nwobi EA, Vincent T, Gonzalez JP., 2015, Response Preparedness to Viral Hemorrhagic

- Fever in Nigeria: Risk Perception, Attitude towards Lassa fever, *Epidemiology*, (sunnyvale), 5 (3) 199, <https://pdfs.semanticscholar.org/addf/8f4d842ed3c0ff2d240a506761c33333b750.pdf>.
- [7] Dan-Nwafor, C. C. Furuse, Y. Ilori, E. A. Ipadeola, O. et al., 2019, Measures to control protracted large Lassa fever outbreak in Nigeria, 1 January to 28 April 2019, *Euro Surveillance*, 24(20), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6530254/>.
- [8] Ogbua, O. Ajuluchukwub, E and Unekec, C. J., 2007, Lassa fever in West African sub-region: an overview, *Journal of Vector Borne Diseases*, 44, 1-11, <http://mrcindia.org/journal/issues/441001.pdf>.
- [9] Mofolorunsho, K. C., 2016, Outbreak of lassa fever in Nigeria: measures for prevention and control, *PanAfrican Medical Journal*, <http://www.panafrican-med-journal.com/content/article/23/210/full/>.
- [10] Tambo, E. Adetunde, O. T and Olalubi, O. A., 2018, Re-emerging Lassa fever outbreaks in Nigeria: Re-enforcing “One Health” community surveillance and emergency response practice, *Infectious Diseases of Poverty*, 7(37), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5923006/>.
- [11] Tobin, E. A. Asogun, D. Akpede, N. Adomeh, D. Odi, I and Gunther, S., 2015, Lassa Fever in Nigeria: Insights Into Seroprevalence And Risk Factors In Rural Edo State: A Pilot Study, *Journal of Medicine in the Tropics*, 17(2) 51 – 55, <http://www.jmedtropics.org/article.asp?issn=2276-7096;year=2015;volume=17;issue=2;spage=51;epage=55;aulast=Tobin>.
- [12] Fichet-Calvet, E and Rodgers, D. J., 2009, Risk Maps of Lassa Fever in West Africa, *PLoS Negl Trop Dis*, 3(3) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2644764/>.
- [13] Stephenson, E. H. Larson, E. W and Dominik, J. W., 1984, Effect on environmental factors on aerosol-induced Lassa virus infection, *Journal of Medical Virology*, 14, 295–303, <https://pubmed.ncbi.nlm.nih.gov/6512508-effect-of-environmental-factors-on-aerosol-induced-lassa-virus-infection/>.
- [14] UNICEF, 2015, Making Nigeria Open-Defecation-Free By 2025: A National Road Map, Federal Ministry of Water resources, <https://www.unicef.org/nigeria/media/1491/file/Nigeria-making-Nigeria-open-defecation-free-by-2025.pdf>.
- [15] Okwe, O., 2019, Finally, Nigeria turns world capital of open defecation, *The Sun Nigeria* 8th October, <https://www.sunnewsonline.com/finally-nigeria-turns-world-capital-of-open-defecation/>.
- [16] NijaDazz, 2018, Open Defecation (toilet) in Nigeria: Causes, Environmental hazards, and Control Measures, <https://www.naijadazz.com/open-defecation-nigeria/>.
- [17] Joel, M and Ajikobi, D., 2019, what a waste: fact-checking four claims about Nigeria’s garbage problem, *The Guardian* 30 July, <https://africacheck.org/reports/what-a-waste-fact-checking-four-claims-about-nigerias-garbage-problem/>.
- [18] Momodu, N. S. Dimuna, K. O. and Dimuna, J. E., 2017, Mitigating the Impact of Solid Wastes in Urban Centres in Nigeria, *Journal of Human Ecology*, 34(2), <https://www.tandfonline.com/doi/abs/10.1080/09709274.2011.11906377>.
- [19] Daily Advent Nigeria, 2019, SEE The Food This Nigerian Man Made with the Rat He Caught (Photos), July, 6, <http://www.dailyadvent.com/lifestyle-fashion/2019/07/06/see-the-food-this-nigerian-man-made-with-the-rat-he-caught-photos/>.
- [20] WHO, 2015, Lassa fever. www.who.int/healthtopics/lassafever.
- [21] Gobir, Y. S and Gobir, S. S., 2017, Open Defecation, a Threat to Public Health and Sustainable Development Goals: A Case Study of Gwadabawa Local Government, Sokoto State, Nigeria, *International Journal of Medical and Biosciences*, 1(1), “Frontiers of Knowledge Journal Series” www.smrpi.com.
- [22] Surajudeen, A., 2016, Nigeria can achieve sustainable solid waste management, <https://www.environmentnewsigeria.com/nigeria-can-achieve-sustainable-solid-waste-management>.
- [23] Lecompte, E. Fichet-Calvet, E. Daffis, S. Koulémou, K. Sylla, O. et al., 2006, *Mastomys*

- natalensis and Lassa fever, West Africa, *Emerging Infectious Diseases*, 12 1971–1974, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3291371/>.
- [24] WHO, 2020, Lassa fever – Nigeria, <https://www.who.int/csr/don/20-february-2020-lassa-fever-nigeria/en/n>.
- [25] Perrow, C., 2007, Disasters Ever More? Reducing U.S. Vulnerabilities, in: Rodríguez, H., Quarantelli, E.L., Dynes, R.R. (Eds.), *Handbook of Disaster Research, Handbooks of Sociology and Social Research* Springer New York, New York, NY, 521–533, https://doi.org/10.1007/978-0-387-32353-4_32.
- [26] Shuaib, F. Gunnala, R. Musa, E. O. Mahoney, F. J. Oguntimehin, O. Nguku, P. M et al., 2014, Ebola virus disease outbreak- Nigeria, July-September 2014' morbidity and Mortality Weekly Report, 63(39), 867-72, <https://pubmed.ncbi.nlm.nih.gov/25275332-ebola-virus-disease-outbreak-nigeria-july-september-2014/>.
- [27] Isere, E. E. Fatiregun, A. A. Ilesanmi, O. Ijarotimi, I. Egube, B. Adejugbagbe, And Famokun, G. A., 2018, Lessons Learnt from Epidemiological Investigation of Lassa Fever Outbreak in a Southwest State of Nigeria December 2015 to April 2016, *PMC "NCIB"*, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6537738/> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6063375/>.
- [28] Fatiregun, A. A. and Isere, E. E., 2017, Epidemic Preparedness and Management: A Guide on Lassa fever Outbreak Preparedness Plan, *Nigerian Medical Journal*, 58(1), 1-6, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5715560/>.
- [29] WHO, 2022, Lassa fever – Nigeria, www.who.int/emergencies/disease-outbreaks/lassa.
- [30] Inegbenebor, U. Okosun, J and Inegbenebor, J., 2010, Prevention of Lassa fever in Nigeria' *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 104(1) 51–54, <https://doi.org/10.1016/j.trstmh.2009.07.008>.
- [31] Okokhere, P. Colubri, A. Azubike, C. Iruolagbe, C. Osazuwa, O. Tabrizi, S. et al, 2018, Clinical and laboratory predictors of Lassa fever outcome in a dedicated treatment facility in Nigeria: a retrospective, observational cohort study, *Lancet Infect Dis.*, 18(6) 684– 695, <https://pubmed.ncbi.nlm.nih.gov/29523497-clinical-and-laboratory-predictors-of-lassa-fever-outcome-in-a-dedicated-treatment-facility-in-nigeria-a-retrospective-observational-cohort-study/>.