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Victor Ibukun Agbajelola[1], Blessing Seun Agbajelola[2], Adekunle Bamidele Ayinmode[3]

HIDDEN PARASITE, VISIBLE IMPACT: THE PUBLIC HEALTH BURDEN OF CRYPTOSPORIDIOSIS IN NIGERIA'S LIVESTOCK SECTOR

[1]Department of Pathobiology and Integrative Biomedical Sciences, University of Missouri, United States
[2]Department of Health Promotion and Education, University of Ibadan, Nigeria
[3]Department of Veterinary Parasitology & Entomology, University of Ibadan, Nigeria

ABSTRACT

Cryptosporidiosis, caused by *Cryptosporidium* spp., remains a significant yet underrecognized cause of diarrhoeal disease in humans and animals in Nigeria, with implications for public health, livestock productivity, and food safety. The parasite's zoonotic potential, environmental resilience, and the close coexistence of people and livestock in smallholder systems sustain transmission across rural and peri-urban communities. This perspective synthesizes representative evidence published between 2010 and 2025 to examine the epidemiological patterns, transmission pathways, and structural control gaps surrounding cryptosporidiosis in Nigeria's livestock sector. Reported prevalence frequently exceeds 20% in cattle and small ruminants in several states, with documented contamination of milk, water bodies, and abattoir effluents, indicating multiple exposure routes. Despite these findings, cryptosporidiosis remains absent from Nigeria's national zoonotic priority framework, and surveillance across veterinary, environmental, and public health sectors remains fragmented. This article argues that sustainable control requires formal integration of cryptosporidiosis into Nigeria's existing One Health architecture. Key priorities include coordinated human–animal surveillance, targeted environmental monitoring in high-risk zones, strengthening molecular diagnostic capacity, and community-based livestock hygiene interventions. Recognizing cryptosporidiosis as a zoonotic priority would enhance food safety, protect vulnerable populations, and strengthen national health security. By repositioning the disease within a structured One Health framework, Nigeria can move from passive recognition of endemic transmission to proactive prevention and risk reduction.

Keywords: *Cryptosporidium, zoonosis, Nigeria, One Health, public health*

INTRODUCTION

Cryptosporidiosis, caused by protozoan parasites of the genus *Cryptosporidium*, remains a globally important enteric infection affecting both humans and animals (1). The infective oocysts are shed in feces in an immediately infectious form and demonstrate remarkable resistance to environmental stressors such as disinfectants and temperature fluctuations (2). Their low infectious dose facilitates rapid transmission through contaminated water, food, soil, and fomites (1,2). In humans, the disease is typically self-limiting in immunocompetent individuals but may become severe, chronic, and life-threatening in young children, the elderly, and immunocompromised populations, particularly those living with HIV/AIDS (3,4). Globally, cryptosporidiosis has been recognized as a leading contributor to moderate-to-severe diarrheal disease in children under five years in low- and middle-income countries (3,4).

Farmed animals, including cattle, sheep, goats, pigs, and poultry, play a pivotal role in the epidemiology of cryptosporidiosis because they frequently serve as reservoirs of zoonotic *Cryptosporidium* species while shedding large quantities of environmentally resilient oocysts (2,5). Numerous studies have demonstrated that livestock substantially contribute to environmental contamination and human exposure, particularly in settings where close human–animal interaction is common (6,7). In Nigeria, molecular and epidemiological investigations have identified zoonotic species such as *C. parvum* and *C. hominis*, alongside host-adapted taxa, underscoring the potential for bidirectional transmission between humans and animals (8-10). Reported prevalence rates in several states frequently exceed 20% in cattle and small ruminants, suggesting sustained endemicity.

The public health relevance of this parasite in Nigeria is amplified by the structure of livestock production systems. Smallholder and mixed farming systems predominate, often characterized by limited biosecurity, informal manure handling, shared water sources, and close proximity between animals and households. Practices such as handling livestock without protective equipment, applying untreated manure to cropland, and consuming unpasteurized milk or untreated water further enhance zoonotic spillover and environmental persistence of oocysts (7,11,12). Despite growing epidemiological evidence, there is no centralized national surveillance framework for cryptosporidiosis in livestock, and available data derive primarily from localized investigations. This fragmented evidence base, coupled with weak coordination between veterinary and public health sectors, limits accurate assessment of disease burden and its zoonotic implications.

Given the economic significance of Nigeria's livestock sector and the demonstrated zoonotic potential of *Cryptosporidium*, the continued marginalization of cryptosporidiosis within national zoonotic prioritization frameworks represents a critical oversight. The consequences extend beyond veterinary productivity losses to include preventable diarrheal disease in vulnerable human populations. However, this article does not seek to provide a comprehensive or systematic review of all available evidence. Rather, it presents a policy-oriented perspective that synthesizes representative findings to highlight an underrecognized zoonotic concern within Nigeria's livestock sector. By situating cryptosporidiosis within a One Health framework, this commentary aims to clarify its public health significance, identify structural surveillance and coordination gaps, and propose pragmatic directions for integrating the disease into Nigeria's evolving One Health architecture.

METHODS

This manuscript is structured as a policy-oriented perspective and not as a systematic or quantitative review. The literature search was undertaken to identify representative and contextually relevant evidence on *Cryptosporidium* infection in Nigerian livestock and related environmental interfaces. Relevant English-language studies and reports published between 2010 and October 2025 were identified through searches of PubMed, Scopus, African Journals Online (AJOL), and Google Scholar using combinations of the terms "*Cryptosporidium*," "cryptosporidiosis," "Nigeria," "livestock," "cattle," "goats," "sheep," "poultry," "zoonosis," and "waterborne." Additional institutional reports, postgraduate theses, and national policy documents were hand-searched to capture regulatory, surveillance, and One Health framework information relevant to the Nigerian context.

Studies were considered eligible if they reported *Cryptosporidium* infection in farmed animals, described zoonotic transmission pathways, documented environmental detection (e.g., water bodies, abattoirs, milk), or provided policy-relevant surveillance data within Nigeria. Rather than applying formal systematic review protocols or quantitative synthesis methods, the search strategy was designed to identify illustrative and policy-informative publications that reflect epidemiological patterns and structural realities.

Information extracted from selected materials included geographic location, host species, diagnostic approaches, identified *Cryptosporidium* species, reported prevalence ranges, and associated risk factors. Findings were synthesized thematically across four domains: epidemiology, transmission dynamics, public health implications, and implementation considerations within a One Health framework. Given the perspective nature

of this manuscript, emphasis was placed on studies that illuminate national trends, institutional gaps, and practical control challenges rather than on exhaustive enumeration of all available publications.

PUBLIC HEALTH THREATS OF CRYPTOSPORIDIOSIS

Cryptosporidiosis emerging from farmed animals poses a serious public health threat in Nigeria, particularly because of its zoonotic potential, environmental persistence, and the frequent close contact between humans and livestock. People in direct contact with animals such as farmers, herders, and abattoir workers, are especially vulnerable, and children under five and immunocompromised individuals are also at heightened risk of severe disease when exposed via contaminated water, food, or occupational routes.

Empirical studies conducted across multiple geopolitical zones in Nigeria underscore the widespread nature of cryptosporidiosis in livestock and the environment. A national meta-analysis by Odeniran and Ademola (13) reported pooled prevalence estimates of 26.1% in cattle, 26.0% in goats, 16.6% in sheep, and 20.1% in pigs, with a pooled human prevalence of 15.0%, highlighting sustained transmission across species. In northern Nigeria, Adamu et al. (14) documented a prevalence of 22.3% in cattle in Maiduguri using modified Ziehl–Neelsen staining, while Maikai et al. (8) identified zoonotic species in cattle in Kaduna State through molecular characterization, confirming the circulation of potentially transmissible genotypes. More recently, Esonu et al. (15) reported *Cryptosporidium* oocysts in sedentary Fulani cattle (18.3%), sheep (13.9%), goats (4.2%), and dogs (15.6%), in addition to detection in bulk milk (11.7%) and water bodies (13.3%) in Kaduna State, reinforcing evidence of environmental and foodborne exposure pathways.

In southwestern Nigeria, Akinkuotu and Fagbemi (16) identified coproantigens in livestock on a university teaching farm, suggesting institutional settings are not exempt from endemic transmission. Molecular investigations by Falohun et al. (17) confirmed contamination of rivers, abattoir effluents, and water treatment facilities in Ibadan, demonstrating environmental dissemination beyond farm boundaries. Studies in rabbits and companion animals in southern Nigeria further illustrate cross-species presence and zoonotic relevance (6,7). Collectively, these findings indicate that cryptosporidiosis is not geographically confined but distributed across northern and southern regions, rural pastoral systems, institutional farms, and peri-urban environments. Taken together, available evidence suggests that livestock prevalence in many surveyed states commonly ranges between 15% and 30%, with environmental detection in water bodies and dairy products further supporting ongoing

transmission at the human-animal-environment interface. While national surveillance data remain absent, the consistency of findings across independent studies and regions indicates that cryptosporidiosis represents an endemic, rather than sporadic, zoonotic concern in Nigeria.

Occupational exposure is amplified by common cultural practices: many rural farmers do not use gloves or protective boots; animals are reared near living spaces; rivers and streams contaminated by livestock and abattoir waste are used for bathing or recreation. Moreover, children often drink untreated water and may ingest oocysts during play in contaminated streams. Beyond individual health, the economic and social damage is also substantial, because livestock cryptosporidiosis in calves and lambs leads to growth retardation, reduced productivity (milk/meat), and increased mortality or morbidity, which directly affect household incomes in agrarian communities. On the human side, infections result in medical costs, lost working days, and in severe cases, hospitalization. In settings where health services are underfunded and awareness is low, the dual impact of animal illness and human disease can exacerbate poverty, reduce food security, and strain public health systems. Together, this evidence illustrates that cryptosporidiosis in farmed animals is not merely an academic concern but a tangible public health threat in Nigeria. It demands stronger surveillance, targeted preventive measures especially among high-risk occupations and young children, and policy actions grounded in One Health to interrupt transmission and reduce both animal and human disease burden.

FAILURES OF CONTROL AND PREVENTION STRATEGIES

Despite the absence of centralized national surveillance, available studies consistently indicate sustained endemic transmission of *Cryptosporidium* across multiple geopolitical zones in Nigeria. Moderate to high prevalence is repeatedly documented in calves and small ruminants, particularly in systems characterized by confinement, shared water sources, and poor manure management. Environmental detection of oocysts in rivers and abattoir effluents further supports ongoing community-level exposure. Although precise national burden estimates are unavailable, the convergence of independent findings suggests that cryptosporidiosis is widespread yet underrecognized within Nigeria's livestock–human interface.

Control efforts have remained largely ineffective, not because of insufficient scientific knowledge, but due to structural and socioeconomic constraints embedded within livestock production systems. Smallholder and pastoral operations dominate Nigeria's animal agriculture, often functioning with limited infrastructure, weak biosecurity, and minimal regulatory oversight. Routine pen sanitation, age segregation, and safe manure disposal are

inconsistently practiced. Overcrowded, poorly drained housing creates conditions that favor oocyst persistence, while water scarcity limits effective cleaning. The routine use of disinfectants with limited efficacy against *Cryptosporidium* further compounds the problem. Even institutional farms have reported infection rates as high as 35.7% (16), underscoring the resilience of environmental transmission despite organized management.

Manure management practices amplify transmission risks. Untreated manure is frequently stockpiled near animal housing or applied directly to fields, particularly during the rainy season when runoff facilitates contamination of streams and shallow wells. Co-rearing multiple species within confined spaces promotes cross-species transmission, while communal grazing and shared surface water sources in pastoral systems enable herd-wide dissemination. These practices are often economically driven and culturally embedded, making rapid behavioral change unlikely without structural support. Water and sanitation limitations extend exposure beyond farms, as municipal treatment systems rarely achieve filtration levels sufficient to remove oocysts, and rural communities largely depend on untreated rivers, wells, and boreholes. The detection of *Cryptosporidium* in abattoir effluents and urban waterways (17) illustrates how environmental contamination transcends agricultural settings. Aging infrastructure, inconsistent electricity supply, and poor maintenance further undermine effective water purification.

Occupational exposure remains high among farmers, herders, and abattoir workers, who frequently handle animals and fecal material without protective equipment. Zoonotic risk education, where provided, is rarely sustained. Therapeutic options are limited; nitazoxanide offers modest benefit and is less effective in immuno-compromised individuals (2,18). In the absence of vaccines or highly effective treatment, prevention depends largely on sanitation and behavior, both constrained by poverty, infrastructure deficits, and weak enforcement of veterinary public health standards. Taken together, these failures reveal that cryptosporidiosis in Nigeria is not simply a biomedical problem, but a systems-level challenge situated at the intersection of livestock production, environmental management, and human health governance. Fragmented interventions targeting only one sector, whether veterinary treatment, hygiene campaigns, or water improvement, are unlikely to produce sustained impact. The persistence of transmission across farms, water systems, and communities underscores the need for an integrated, multisectoral response. It is within this context that a structured One Health framework becomes not optional, but essential.

ONE HEALTH TO THE RESCUE: WHY IT SHOULD BE ADOPTED IN THE CONTROL OF CRYPTOSPORIDIOSIS IN NIGERIA

The persistent burden of cryptosporidiosis in Nigeria illustrates the limitations of fragmented, sector-specific responses to zoonotic disease. The parasite's transmission cycle spans humans, livestock, and the environment, rendering isolated veterinary or clinical interventions insufficient (2). In rural and peri-urban Nigeria, where livestock share water sources, grazing fields, and in many cases domestic spaces with humans, transmission is sustained through occupational exposure, environmental contamination, and inadequate sanitation. A coordinated One Health approach, integrating veterinary services, public health institutions, and environmental management systems, therefore represents not simply an ideal framework but a structural necessity (19,20).

LEGAL AND INSTITUTIONAL FOUNDATIONS

Nigeria already possesses a formal legal and strategic architecture capable of supporting a One Health response. The Nigeria Centre for Disease Control (NCDC) Act of 2018 legally mandates coordinated surveillance and response for infectious diseases affecting public health. Complementing this mandate, the National One Health Strategic Plan (2023-2027), jointly implemented by the NCDC, the Federal Ministry of Agriculture and Rural Development (FMARD), and the Federal Ministry of Environment (FME), provides an institutional platform for multisectoral collaboration in managing zoonotic threats. This framework has been operationalized in response to Lassa fever, anthrax, rabies, and avian influenza outbreaks, demonstrating functional coordination across surveillance, laboratory networks, and risk communication systems.

Under this structure, the NCDC oversees human disease surveillance and epidemic intelligence; FMARD supervises veterinary public health, livestock health monitoring, and abattoir regulation; and FME is responsible for environmental sanitation, water safety oversight, and ecological risk assessment. Academic institutions and state-level ministries serve as technical and operational partners. However, cryptosporidiosis is not currently prioritized within this coordinated framework, limiting formal reporting channels, resource allocation, and policy visibility. Integrating cryptosporidiosis into the National One Health Strategic Plan would therefore not require creating new institutions but rather expanding the scope of existing legal instruments to encompass an overlooked zoonotic pathogen.

GAP ANALYSIS: STRUCTURAL CONSTRAINTS TO IMPLEMENTATION

Despite the presence of an enabling framework, several systemic gaps undermine effective control. First, surveillance systems for human and animal health operate largely in parallel, with minimal data integration. Cryptosporidiosis is not routinely reported in livestock health databases, and diagnostic testing in hospitals is often limited to microscopy without molecular confirmation. Second, environmental monitoring for protozoan contamination in surface water and abattoir discharge remains sporadic. Third, laboratory capacity for species-level identification is concentrated in a small number of research institutions, limiting national epidemiological clarity. Finally, behavioural and socioeconomic realities, including informal livestock systems, limited access to clean water, and financial constraints – reduce compliance with biosecurity recommendations. These gaps are not purely technical; they are institutional and structural. Addressing them requires policy inclusion, resource prioritization, and adaptive implementation strategies sensitive to Nigeria's livestock production realities.

PILLARS OF IMPLEMENTATION: FEASIBILITY, OPPORTUNITIES, AND CONSTRAINTS

A livestock-centered One Health strategy for cryptosporidiosis would rest on four interconnected pillars: integrated surveillance, environmental monitoring, community-level behavioural adaptation, and laboratory strengthening. Integrated surveillance could be operationalized by incorporating cryptosporidiosis testing into existing NCDC epidemic intelligence systems and FMARD veterinary reporting channels. The advantage of this approach lies in leveraging established infrastructure and avoiding parallel systems. However, constraints include limited diagnostic kits, competing health priorities, and the need for staff training. Environmental monitoring represents a second pillar. Routine testing of surface water near grazing zones and abattoirs, coupled with promotion of safe manure composting practices, would directly target environmental reservoirs. This approach aligns with WHO guidance on integrated zoonotic surveillance (20). The principal benefit is early detection of contamination hotspots, yet feasibility may be challenged by laboratory costs and enforcement limitations in informal rural settings.

Community engagement constitutes a third pillar. Embedding One Health education within agricultural extension services and livestock cooperatives offers a culturally grounded pathway for behavioural change. Training programs emphasizing protective footwear, safe birthing practices, manure handling, and avoidance of untreated water consumption can reduce exposure risk. The strength of this strategy lies in sustainability and local ownership. Its limitation is reliance on consistent follow-up and resource availability for extension workers.

Finally, strengthening molecular diagnostic capacity in state veterinary laboratories and teaching hospitals would improve species identification and clarify zoonotic transmission pathways. Although resource-intensive, this investment would support not only cryptosporidiosis surveillance but broader emerging pathogen detection, thereby offering cross-cutting benefits.

ROADMAP FOR PROGRESSIVE INTEGRATION

From a policy perspective, implementation may proceed in phased stages. In the short term, inclusion of cryptosporidiosis in Nigeria's zoonotic priority list and incorporation into existing reporting templates would establish formal recognition. In the medium term, pilot integrated surveillance programs in high-prevalence states, particularly in regions with documented livestock and environmental detection, could generate operational models. In the long term, national data integration platforms linking human, veterinary, and environmental laboratories would enable predictive risk mapping and targeted interventions.

This phased approach balances ambition with feasibility, recognizing fiscal constraints while building incrementally upon existing infrastructure.

STRATEGIC SIGNIFICANCE

Embedding cryptosporidiosis within Nigeria's One Health framework is not merely an academic proposition; it is an economically rational and institutionally feasible step. The country's experience with coordinated responses to other zoonoses demonstrates that multisectoral action is operationally achievable when political will and prioritization align. By expanding the scope of existing legal and institutional mechanisms to include cryptosporidiosis, Nigeria can move from reactive case management to proactive environmental and occupational prevention. Ultimately, a structured One Health integration would enhance livestock productivity, protect vulnerable human populations, and strengthen national health security. Recognizing cryptosporidiosis within formal surveillance and policy frameworks would transform it from a neglected farm-associated infection into a managed zoonotic priority within Nigeria's broader public health agenda (19,20).

CONCLUSION

Cryptosporidiosis represents an underrecognized but measurable zoonotic threat within Nigeria's livestock production systems. Evidence from multiple regions demonstrates sustained infection in cattle and small ruminants, environmental contamination of water bodies, and plausible occupational and foodborne exposure pathways. Yet the disease remains absent from

Nigeria's formal zoonotic priority list and is not systematically integrated into national surveillance platforms.

A practical and achievable first step is the formal inclusion of cryptosporidiosis within the National One Health Strategic Plan (2023–2027), thereby enabling coordinated reporting between the Nigeria Centre for Disease Control, the Federal Ministry of Agriculture and Rural Development, and the Federal Ministry of Environment. Integrating routine livestock screening in high-prevalence states, piloting environmental monitoring around abattoirs and grazing zones, and incorporating cryptosporidiosis into existing veterinary extension programs would provide immediate and measurable progress. Strengthening molecular diagnostic capacity in selected state laboratories would further clarify zoonotic transmission dynamics and inform targeted interventions.

Experiences from other African settings demonstrate that integrated surveillance for zoonotic enteric pathogens within One Health platforms improves early detection and intersectoral coordination. Countries such as Ghana and Ethiopia have increasingly embedded zoonotic disease monitoring within collaborative veterinary-public health frameworks, illustrating the feasibility of structured multisectoral action in resource-constrained environments. Nigeria's existing One Health architecture is comparably positioned to implement similar integration for cryptosporidiosis without the need to establish new institutional systems.

Ultimately, sustainable control will depend less on isolated clinical treatment and more on coordinated surveillance, environmental risk reduction, and context-sensitive livestock management practices. Recognizing cryptosporidiosis as a formal zoonotic priority would transform it from a neglected farm-associated infection into a managed public health concern aligned with Nigeria's broader goals of food security, rural livelihood protection, and national health security.

Data Availability Statement

The raw data of this article will be made available by the authors, without undue reservation.

Ethical Statement

No ethical approval was necessary for this study.

Conflict of Interest

Authors declare that no conflicts of interest are directly or indirectly related to the work submitted for publication.

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Authors' Contributions

VIA and BSA conceived and designed the study, VIA validated the study. VIA, BSA and ABA wrote, read and approved the final manuscript.

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Address for correspondence:
Victor Ibukun Agbajelola
Department of Pathobiology and Integrative Biomedical Sciences,
University of Missouri, Columbia, United States
email: vianh2@missouri.edu