



Review Article

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## Integration of Environmental Health Services into Primary Health Care in Nigeria: A Scoping Review

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### Abstract

**Background:** Environmental determinants, including water quality, sanitation, waste management, and vector control, significantly shape population health outcomes. Primary health care (PHC) systems provide a platform for preventive and community-based services; however, the extent to which environmental health functions are integrated into PHC in Nigeria remains unclear. **Methods:** This scoping review adhered to the Joanna Briggs Institute methodology and the PRISMA-ScR reporting guideline. A systematic search of PubMed/MEDLINE, Scopus, Web of Science, CINAHL, African Journals Online, and grey literature sources was conducted for studies published between 2000 and 2025. Eligible sources addressing environmental health services within Nigerian PHC systems were screened using predefined criteria. Data were extracted and synthesised thematically.

**Results:** A total of 3,482 records were identified, of which 28 studies met the inclusion criteria. Included sources comprised 16 empirical studies, 5 policy documents, and 7 grey literature reports. Environmental health activities intersect with PHC delivery through water, sanitation, and hygiene services; disease surveillance; vector control; waste management; environmental health education; and regulatory functions. However, integration was largely programmatic and episodic rather than institutionalised. Key barriers included workforce shortages, inadequate infrastructure, fragmented governance, limited financing, and weak intersectoral coordination. Facilitators included community participation, donor-supported initiatives, and ongoing PHC revitalisation efforts.

**Conclusion:** Environmental health services remain insufficiently integrated within Nigeria's PHC system despite their relevance to disease prevention and health promotion. Strengthening policy coherence, workforce integration, infrastructure investment, and multisectoral governance may enhance integration and support progress toward universal health coverage.

**Keywords:** Environmental health; Primary health care; Integration; Nigeria; WASH; Health systems strengthening

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## Introduction

Primary health care represents the foundation of equitable and accessible health systems worldwide and serves as the principal platform for delivering population-oriented and preventive services Allen et al., 2023. The modern articulation of primary health care emerged from the Alma-Ata Declaration, which positioned health as a fundamental human right and emphasised community-based, promotive, and preventive approaches to achieving universal health coverage Barbazza et al., 2024;

World Health Organization, 1978. This framework integrates essential services such as health education, safe water provision, sanitation, immunisation, and control of endemic diseases within a unified system of care.

Nigeria adopted primary health care as a national strategy in the late twentieth century and has implemented several reforms aimed at strengthening service delivery at the community level Aregbeshola & Khan, 2017; Croke & Ogbuoji, 2023. Institutional arrangements such as the National Primary Health Care Development Agency

(NPHCDA) and the Ward Health System were established to improve coordination, enhance community participation, and extend essential services to defined populations [Njelita et al., 2023](#). Despite these efforts, the primary health care system continues to experience persistent challenges related to limited funding, workforce shortages, infrastructural deficits, and fragmentation across programmes [Adewoye et al., 2025](#); [Kress et al., 2016](#); [Ogah et al., 2024](#); [Oniyire et al., 2025](#); [Yisa et al., 2025](#). These structural constraints have restricted the delivery of comprehensive preventive services, particularly those related to environmental health.

Environmental health focuses on the prevention of disease through the management of environmental determinants such as water quality, sanitation, waste disposal, and exposure to biological and chemical hazards [Hutton & Chase, 2019](#); [Ramírez-Castillo et al., 2015](#); [United Nations Children's Fund, 2018](#); [World Health Organization, 2022](#). These services address both communicable and non-communicable disease pathways by reducing exposure to infectious agents, pollutants, and other environmental risks [Anyanwu et al., 2024](#); [Lee et al., 2014](#); [Sears & Genuis, 2012](#). In Nigeria, environmental health functions include sanitation enforcement, waste management oversight, vector control, and community health education, often implemented through environmental health officers operating within local government structures [Abdulkarim et al., 2021](#). However, inadequate sanitation systems, unsafe water sources, and poor waste management practices continue to contribute to a substantial burden of disease [Babatunde et al., 2025](#); [Shayo et al., 2023](#). Integrating environmental health within primary care systems can enhance surveillance, improve service efficiency, and strengthen responses to both infectious and chronic disease risks [Freeman et al., 2013](#). However, the Nigerian health system has historically prioritised curative services, resulting in limited institutionalisation of environmental health within routine primary care delivery.

Existing evidence on environmental health activities in Nigeria remains fragmented across sectors and disciplines, with limited synthesis of how these services interface with primary health care structures. This gap constrains the development of coordinated policies and integrated service de-

livery models. This scoping review, therefore, aimed to systematically map and synthesise available evidence on the integration of environmental health services within primary health care systems in Nigeria, with a focus on identifying service domains, models of integration, implementation barriers, facilitating factors, and key evidence gaps.

## Methods

### Study Design

This scoping review followed the methodological guidance developed by the Joanna Briggs Institute and adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews to ensure transparency and reproducibility. The review design enabled systematic mapping of the breadth and nature of evidence on the integration of environmental health services within primary health care systems in Nigeria, consistent with established scoping review approaches [Hasan et al., 2020](#).

### Review Framework

The review question was formulated using the Population–Concept–Context (PCC) framework. The population included primary health care facilities, health workers, environmental health officers, and other actors involved in service delivery. The concept focused on the integration of environmental health services, including sanitation, water safety, waste management, vector control, environmental surveillance, and health education, within routine primary health care systems. The context was restricted to Nigeria across national, state, and community levels.

### Search Strategy

A comprehensive search strategy was developed to identify relevant peer-reviewed and grey literature. Electronic databases searched included PubMed, Scopus, Web of Science, CINAHL, and African Journals Online. Additional sources were identified through Google Scholar and institutional repositories, including official websites of the Federal Ministry of Health and the National Primary Health Care Development Agency. Searches covered studies published between 2000 and 2025 and were limited to English-language publications.

Search terms combined keywords related to primary health care, environmental health, integration, and Nigeria, using Boolean operators.

### Study Selection

All retrieved records were exported into reference management software, and duplicates were removed. Two reviewers independently screened titles and abstracts against predefined eligibility criteria, followed by full-text assessment of potentially relevant studies.

### Data Extraction and Analysis

Extracted variables included study characteristics, environmental health components, type of integration, implementation approaches, and reported barriers and facilitators. Data were analysed descriptively and thematically. Findings were summarised in tabular and narrative formats. Consistent with scoping review guidance, this study did not undertake a formal quality appraisal, as the objective was to map available evidence rather than assess effectiveness.

## Results

### Study Selection

The search identified 3,482 records across electronic databases and grey literature sources. After removal of duplicates and screening of titles and abstracts, 312 full-text articles were assessed for eligibility. Of these, 28 studies met the inclusion criteria and were included in the final synthesis. The selection process followed a structured pathway and is summarised in the PRISMA-ScR flow table (Table 1).

The included evidence comprised 16 empirical studies, 5 policy documents, and 7 grey literature reports. Most excluded studies did not address environmental health within primary health care or lacked Nigeria-specific findings. Screening was challenged by the limited disaggregation of environmental health functions within primary health care reporting.

### Characteristics of Included Studies

The included studies reflected a heterogeneous evidence base published between 2010 and 2025. Cross-sectional designs dominated, accounting for

a substantial proportion of empirical studies. Thirteen studies focused on facility-level assessments or health worker surveys; others adopted qualitative approaches, policy analyses, or programme evaluations.

Geographically, studies covered Lagos, Oyo, Anambra, Kano, Osun, and Benue. However, more than half originated from southern regions, with limited representation from northern Nigeria. This pattern indicates uneven geographic coverage of evidence.

Most studies examined specific environmental health components rather than integrated service delivery. Water, sanitation, and hygiene assessments were most frequently reported, followed by disease surveillance and community engagement. Only a few studies explicitly framed findings within an integration perspective.

### Types of Environmental Health Services Integrated

The findings show that environmental health services intersect with primary health care delivery across multiple domains, although integration remains partial.

Water and sanitation services were the most prominent component. Facility-based studies consistently reported deficiencies in access to safe water, sanitation infrastructure, and hygiene facilities, which limit infection prevention and quality of care [Odjegba et al., 2024](#); [Oniyire et al., 2025](#). Evidence also shows variability in environmental hygiene conditions across facilities, reflecting gaps in basic service provision. Some facilities incorporated hygiene promotion and sanitation education into routine care, indicating functional integration.

Waste management practices were inconsistently documented. Where assessed, studies reported variable adherence to waste segregation and disposal protocols, with many facilities lacking structured systems for safe waste handling [Babatunde et al., 2025](#); [Kitole et al., 2024](#). Integration of waste management within primary health care operations remained largely informal.

Disease surveillance represented a more structured interface. The Integrated Disease Surveillance and Response system linked primary health care facilities with national surveillance frameworks, although health worker knowledge and im-

plementation varied across settings [Jinadu et al., 2018](#). This demonstrates partial integration of environmental and communicable disease monitoring. Vector control activities were commonly implemented through malaria programmes. These included the distribution of insecticide-treated nets and community mobilisation to reduce breeding sites. Although widely practised, such interventions were typically programme-driven rather than embedded within routine service delivery [World Health Organization, 2023](#).

Health education emerged as a consistently integrated function. Primary health care facilities engaged communities through education on sanitation practices, hygiene behaviours, water safety, and disease prevention, reflecting the preventive orientation of service delivery [Ogah et al., 2024](#).

Inspection and regulatory functions were less frequently reported but remained relevant. Environmental health officers conducted sanitation inspections and enforcement activities in communities and occasionally within health facilities, contributing indirectly to primary health care objectives [Abdulkarim et al., 2021](#).

### Models of Integration Identified

Three broad patterns of integration emerged. Vertical integration involved disease-specific programmes such as malaria control and surveillance systems that operated alongside primary health care services [Jinadu et al., 2018](#). These programmes utilised primary health care platforms but remained externally driven.

Horizontal integration was less common and involved collaboration across sectors such as health, sanitation, and community systems. Evidence suggests that such approaches supported broader environmental health outcomes but lacked consistent institutional structures.

Community-based approaches were widely reported. Community actors supported sanitation campaigns and health promotion activities, strengthening the linkage between facilities and communities [Njelita et al., 2023](#); [Obi et al., 2024](#).

At the facility level, some centres incorporated environmental health practices into routine service delivery, particularly through hygiene promotion and infection prevention activities, although this remained operational rather than formalised [Ogah et](#)

[al., 2024](#).

### Barriers to Integration

Several barriers were consistently identified. Workforce shortages limited the availability of trained environmental health personnel and reduced service delivery capacity. Financial constraints also restricted investment in infrastructure such as water supply and sanitation systems [Ogundeji et al., 2023](#); [Yisa et al., 2025](#).

Policy fragmentation further constrained integration. Weak alignment between health and environmental policies and complex governance structures reduced coordination [Etiaba et al., 2025](#); [Ezenwaka et al., 2025](#); [Kress et al., 2016](#). In addition, limited intersectoral collaboration hindered joint planning and implementation across sectors.

### Facilitators and Enablers

Several enabling factors supported partial integration. National primary health care strengthening initiatives created policy support for preventive services [National Primary Health Care Development Agency, 2025](#); [Yisa et al., 2025](#). Community participation enhanced sanitation and health promotion activities [Costa et al., 2025](#). Donor-supported programmes contributed to service delivery in resource-constrained settings [Ogundeji et al., 2023](#); [Yisa et al., 2025](#). Alignment with global health frameworks also provided strategic direction [World Health Organization, 2018](#); [World Health Organization, 2019](#).

### Geographic Distribution and Evidence Gaps

The evidence base remains uneven, with concentration in southern Nigeria and limited studies from northern regions. Most studies focus on individual environmental health components rather than comprehensive integration models. There is limited empirical evidence on how environmental health services are embedded within primary health care financing, governance, and organisational structures.

### Discussion

This scoping review synthesised available evidence on the integration of environmental health services within primary health care systems in Nigeria. The findings show that although environmental health

Table 1: PRISMA-ScR Flow Table for Study Selection Process

Stage	Number of Records
Records identified through databases	3,120
Additional records (grey literature)	362
Total records	3,482
Duplicates removed	434
Records screened	3,048
Records excluded (title/abstract)	2,736
Full-text articles assessed	312
Full-text excluded	284
<b>Studies included</b>	<b>28</b>

Note: PRISMA-ScR = Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews.

Table 2: Summary of Environmental Health Services within Primary Health Care

Service Component	Description in PHC Context	Level of Integration	Key Evidence from Review
Water & Sanitation	Facility water supply, toilets, and hygiene services	Moderate (functional)	Frequent gaps in infrastructure across facilities
Waste Management	Medical and domestic waste handling practices	Low	Inconsistent segregation and disposal practices
Disease Surveillance	Integrated Disease Surveillance and Response (IDSR) reporting and monitoring	Moderate (structured)	Widely implemented but uneven capacity across settings
Vector Control	Malaria prevention activities such as distribution of insecticide-treated nets and environmental management	Vertical	Programme-driven and not fully embedded within routine PHC services
Health Education	Hygiene, sanitation, and water safety awareness activities	High (operational)	Routinely delivered through PHC outreach and community engagement
Inspection & Regulation	Sanitation enforcement and environmental inspections	Low (indirect)	Conducted largely outside the formal PHC structure

Note: PHC = Primary Health Care; IDSR = Integrated Disease Surveillance and Response.

aligns with the preventive and population-oriented mandate of primary health care, its implementation remains fragmented and inconsistently structured. While primary health care principles emphasise prevention, community participation, and intersectoral collaboration, these elements have not translated into systematic integration of environmen-

tal health services within routine practice [World Health Organization, 1978](#).

The evidence indicates that environmental health activities intersect with primary health care across several domains, particularly water and sanitation, disease surveillance, health education, and vector control. However, these interactions largely

occur as discrete or programme-driven activities rather than as components of an institutionalised service model. The dominance of water, sanitation, and hygiene interventions reflects global priorities for infection prevention, yet persistent deficiencies in infrastructure highlight the gap between policy intent and implementation capacity. These deficiencies limit the ability of primary health care facilities to deliver safe and preventive services effectively.

Disease surveillance represents a relatively structured point of integration through the Integrated Disease Surveillance and Response system. This mechanism positions primary health care facilities as frontline actors in detecting and reporting public health threats. However, variability in workforce capacity and reporting systems constrains its effectiveness, indicating that integration is operational but not uniformly sustained.

The patterns identified in this review reflect broader structural characteristics of the Nigerian health system. Environmental health services operate across separate administrative structures, often outside the formal primary health care framework. This institutional separation reinforces fragmentation and limits routine collaboration between clinical and environmental health actors [Kress et al., 2016](#). From a health systems integration perspective, the findings suggest that Nigeria operates at a low level of integration, where interactions occur at functional levels without alignment at organisational or system levels [Rajan et al., 2024](#). Systemic constraints further reinforce this limited integration. Workforce shortages limit the availability of trained personnel to deliver environmental health interventions in primary care settings. Environmental health officers are typically deployed through local government structures rather than embedded within facility-based teams, which weakens coordination. Financial arrangements also contribute to fragmentation, as funding streams for environmental health infrastructure remain separate from primary health care financing mechanisms [Croke & Ogbuoji, 2023](#). This separation reduces opportunities for joint planning and sustained investment.

Governance challenges compound these limitations. Effective environmental health management requires coordinated action across multiple sec-

tors, including health, water resources, sanitation, and environmental protection. However, weak intersectoral coordination and fragmented policy implementation hinder integrated service delivery. These findings are consistent with broader analyses of primary health care performance in Nigeria, which highlight governance complexity and limited policy coherence as barriers to effective service delivery [Croke & Ogbuoji, 2023](#); [Kress et al., 2016](#).

Despite these constraints, the review identifies opportunities for strengthening integration. National efforts to revitalise primary health care and advance universal health coverage create a policy environment that supports preventive and community-based services [Yisa et al., 2025](#). Environmental health integration is increasingly framed within broader approaches such as One Health and environmental risk reduction strategies [World Health Organization, 2023](#); [World Health Organization, 2023](#); [World Health Organization, 2024](#). Community participation structures, including ward-level engagement mechanisms, provide platforms for linking environmental health interventions with primary care delivery. These structures can enhance accountability, improve service uptake, and support locally driven environmental health actions.

Comparison with other low- and middle-income country settings further contextualises these findings. Similar patterns of fragmentation and reliance on vertical programmes have been reported across comparable health systems. However, evidence from countries such as Brazil and Ethiopia demonstrates that stronger integration is achievable where primary health care systems effectively combine clinical services with community-based preventive interventions. These experiences show that integration can improve efficiency, reduce duplication, and strengthen health outcomes when supported by coherent governance and financing arrangements [Zhang et al., 2025](#).

## Conclusion

This scoping review demonstrates that environmental health services in Nigeria remain only partially integrated within primary health care systems, despite strong conceptual alignment with preventive and community-oriented care. Existing

interactions occur mainly through water and sanitation activities, disease surveillance, health education, and programme-driven interventions, yet these remain fragmented and insufficiently institutionalised. Structural constraints, including workforce shortages, limited financing, policy fragmentation, and weak intersectoral coordination, continue to limit effective integration.

Strengthening integration requires deliberate policy and system-level reforms. Environmental health services should be formally embedded within primary health care frameworks, supported by integrated financing mechanisms, strengthened workforce capacity, and improved collaboration across sectors.

Although this review provides a comprehensive synthesis of available evidence, the limited number of studies, heterogeneity of designs, and scarcity of research on comprehensive integration models highlight important gaps. Future research should prioritise context-specific models of integration and evaluate their impact on health outcomes and system performance.

### Authors' Contributions

MA conceptualised the study and developed the review framework. MA and SHS conducted the literature search, study screening, and data extraction. MA drafted the initial manuscript. AST and ROO contributed to data interpretation and critically revised the manuscript for important intellectual content. AYA provided overall supervision and methodological guidance throughout the study. All authors read and approved the final version of the manuscript.

### References

Abdulkarim, J. H., Enemali, U. M., C., M., A., A., & S., S. (2021). Role of environmental health officers in the containment of covid-19: A Nigerian perspective. *International Journal of Zoology and Applied Biosciences*, 6(4), 218–221. <https://doi.org/10.55126/ijzab.2021.v06.i04.015>

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### Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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### What is Known About This Topic

Primary health care systems are designed to deliver preventive, promotive, and community-based services, including interventions that address environmental determinants of health. Environmental health services such as water, sanitation and hygiene, waste management, vector control, and disease surveillance play a significant role in reducing communicable and non-communicable disease burden. In Nigeria, primary health care and environmental health functions are implemented through parallel structures across federal, state, and local government levels. Existing studies in Nigeria have largely examined environmental health components such as WASH, sanitation, and disease surveillance as standalone interventions rather than as integrated primary health care services. Evidence on the extent, models, and effectiveness of integrating environmental health services into primary health care systems in Nigeria remains fragmented and insufficiently synthesised.

Adewoye, A., Lawal, S. A., Obadina, A., & Ibor, G. (2025). Strengthening Nigeria's health system: A scoping review of recent reforms, implementation outcomes, and systemic challenges (2015–2025). *Global South Health Horizons*, 1(2), 16–25. <https://doi.org/10.63950/gshh.2025.1.2.19>

Allen, L. N., Pettigrew, L. M., Exley, J., Nugent, R., Balabanova, D., Villar-Urbe, M., Baatiema, L., Shubber, Z., Mugambi, J., Kidd, M., Zewdie, A.,

- Padula, I., & Abimbola, S. (2023). The role of primary health care, primary care and hospitals in advancing universal health coverage. *BMJ Global Health*, 8(12), e014442. <https://doi.org/10.1136/bmjgh-2023-014442>
- Anyanwu, C., Bikomeye, J. C., & Beyer, K. M. M. (2024). The impact of environmental conditions on non-communicable diseases in sub-saharan africa: A scoping review of epidemiologic evidence. *Journal of Global Health*, 14, 04003. <https://doi.org/10.7189/jogh.14.04003>
- Aregbeshola, B. S., & Khan, S. M. (2017). Primary health care in nigeria: 24 years after olikoye ransome-kuti's leadership. *Frontiers in Public Health*, 5, 48. <https://doi.org/10.3389/fpubh.2017.00048>
- Babatunde, O. S., Simon-Oke, I. A., Idowu, I. I., Adejoh, B., & Olonisakin, A. A. (2025). Survey of refuse disposal practices, geohelminth contamination, and vector abundance at dumpsites in akure metropolis, nigeria. *Journal of Parasitology Research*, 2025, 8298486. <https://doi.org/10.1155/japr/8298486>
- Barbazza, E., Allen, L., Abimbola, S., & Kringos, D. (2024). *Phc: Definitions, terminology and frameworks*. European Observatory on Health Systems; Policies. <https://www.ncbi.nlm.nih.gov/books/NBK618531/>
- Costa, S. M. J., Azeiteiro, U., Ryan, R., Ferrito, C., & Melo, P. (2025). Nursing interventions to reduce climate-related health risks. *International Journal of Environmental Research and Public Health*, 22(8), 1177. <https://doi.org/10.3390/ijerph22081177>
- Croke, K., & Ogbuaji, O. (2023). Health reform in nigeria: The politics of primary health care and universal health coverage. *Health Policy and Planning*, 39(1). <https://doi.org/10.1093/heapol/czad107>
- Etiaba, E., Agwu, P., Conteh, L., & Onwujekwe, O. (2025). Multisectoral contributions to health security and formal policy availability at the community level in nigeria. *Frontiers in Public Health*, 13, 1505383. <https://doi.org/10.3389/fpubh.2025.1505383>
- Ezenwaka, U., Mbachu, C., & Onwujekwe, O. (2025). Roles of stakeholders and coordination mechanisms for enhanced multisectoral interventions in covid-19 response in nigeria: A scoping review. *Health Research Policy and Systems*, 23(1). <https://doi.org/10.1186/s12961-024-01276-7>
- Freeman, M. C., Ogden, S., Jacobson, J., Abbott, D., Addiss, D. G., Amnie, A. G., Beckwith, C., Cairncross, S., Callejas, R., Colford, J. M., Emerson, P. M., Fenwick, A., Fishman, R., Gallo, K., Grimes, J., Karapetyan, G., Keene, B., Lammie, P. J., MacArthur, C., & Lochery, P. (2013). Integration of water, sanitation, and hygiene for the prevention and control of neglected tropical diseases: A rationale for inter-sectoral collaboration. *PLoS Neglected Tropical Diseases*, 7(9), e2439. <https://doi.org/10.1371/journal.pntd.0002439>
- Hasan, M. Z., Singh, S., Arora, D., Jain, N., & Gupta, S. (2020). Evidence of integrated primary-secondary health care in low- and middle-income countries: Protocol for a scoping review. *Systematic Reviews*, 9(1). <https://doi.org/10.1186/s13643-020-01514-3>
- Hutton, G., & Chase, C. (2019). Water supply, sanitation, and hygiene. In *Disease control priorities (3rd ed.)* <https://doi.org/10.1596/978-1-4648-0522-6/ch9>
- Jinadu, K. A., Adebiyi, A. O., Sekoni, O. O., & Bangboye, E. A. (2018). Integrated disease surveillance and response strategy for epidemic-prone diseases at the phc level in oyo state, nigeria. *Pan African Medical Journal*, 31, 19. <https://doi.org/10.11604/pamj.2018.31.19.15828>
- Kitole, F. A., Ojo, T. O., Emenike, C. U., Khumalo, N. Z., Elhindi, K. M., & Kassem, H. S. (2024). Impact of poor waste management on public health initiatives. *Sustainability*, 16(24), 10873. <https://doi.org/10.3390/su162410873>
- Kress, D. H., Su, Y., & Wang, H. (2016). Assessment of primary health care system performance in nigeria. *Health Systems & Reform*, 2(4), 302–318. <https://doi.org/10.1080/23288604.2016.1234861>
- Lee, B.-J., Kim, B., & Lee, K. (2014). Air pollution exposure and cardiovascular disease. *Toxicological Research*, 30(2), 71–75. <https://doi.org/10.5487/TR.2014.30.2.071>

- National Primary Health Care Development Agency. (2025). Basic health care provision fund (bhcpf). <https://nphcda.gov.ng/bhcpf/>
- Njelita, A. I., Ikani, P. A., Eyisi, I. G., Nwachukwu, C. C., Ifeadike, C. O., & Njelita, U. C. (2023). Ward health system in nigeria: Are health workers in local government areas well informed? *American Journal of Public Health Research*, 11(2), 43–49. <https://doi.org/10.12691/ajphr-11-2-1>
- Obi, C., Ojiakor, I., Etiaba, E., & Onwujekwe, O. (2024). Community collaborations for improved phc utilisation. *International Journal of Public Health*, 69, 1606810. <https://doi.org/10.3389/ijph.2024.1606810>
- Odjegba, E. E., Bankole, A. O., Sadiq, A., Layi-Adigun, B. O., Adebimpe, A. M., Kosemani, M. O., Ojo, E. B., & Adewuyi, M. A. (2024). Wash index for primary healthcare facilities. *Heliyon*, 10(15), e35548. <https://doi.org/10.1016/j.heliyon.2024.e35548>
- Ogah, P. O., Uguru, N., Okeke, C., Mohammed, N., Ogbe, O., Ashiver, W. G., & Aina, M. (2024). Primary health care in nigeria: Best practices and quality of care. *BMC Health Services Research*, 24(1). <https://doi.org/10.1186/s12913-024-11406-0>
- Ogundeji, Y., Abubakar, H., Ezeh, U., Hussaini, T., Kamau, N., Love, E., Muñoz, R., Ongboche, P., Opuni, M., Walker, D. G., & Gilmartin, C. (2023). Assessment of phc costs in kaduna and kano. *Frontiers in Public Health*, 11, 1226145. <https://doi.org/10.3389/fpubh.2023.1226145>
- Oniyire, F., Ajose, T., Andu, L., Adepase, A., Abayomi, A., Ogunyemi, O., Ogboye, O., Oyenuga, O., Ibiyemi, O., Abdulrahman-Giwa, Z., Adejumo, A., Ajanaku, B., Adewale, B., & Mogaji, H. (2025). Infrastructure and staffing gaps in phc facilities in lagos state. *Discover Public Health*, 22(1). <https://doi.org/10.1186/s12982-025-01321-y>
- Rajan, D., Rouleau, K., Winkelmann, J., Kringos, D., Jakab, M., & Khalid, F. (2024). *Implementing the primary health care approach: A primer*. <https://www.ncbi.nlm.nih.gov/books/NBK618504/>
- Ramírez-Castillo, F. Y., Loera-Muro, A., Jacques, M., Garneau, P., Avelar-González, F., Harel, J., & Guerrero-Barrera, A. L. (2015). Waterborne pathogens: Detection methods and challenges. *Pathogens*, 4(2), 307–334. <https://doi.org/10.3390/pathogens4020307>
- Sears, M. E., & Genuis, S. J. (2012). Environmental determinants of chronic disease. *Journal of Environmental and Public Health*, 2012, 356798. <https://doi.org/10.1155/2012/356798>
- Shayo, G. M., Elimbinzi, E., Shao, G. N., & Fabian, C. (2023). Waterborne diseases in developing countries. *Bulletin of the National Research Centre*, 47(1), 113. <https://doi.org/10.1186/s42269-023-01088-9>
- United Nations Children’s Fund. (2018). Water, sanitation and hygiene (wash). <https://www.unicef.org/nigeria/water-sanitation-and-hygiene>
- World Health Organization. (1978). Declaration of alma-ata. <https://www.who.int/teams/social-determinants-of-health/declaration-of-alma-ata>
- World Health Organization. (2018). Preventing disease through healthy environments. <https://www.who.int/publications/i/item/9789241565196>
- World Health Organization. (2019). Primary health care. <https://www.who.int/health-topics/primary-health-care>
- World Health Organization. (2022). Environmental health. <https://www.who.int/health-topics/environmental-health>
- World Health Organization. (2023a). Drinking-water [b]. <https://www.who.int/news-room/fact-sheets/detail/drinking-water>
- World Health Organization. (2023b). One health [a]. <https://www.who.int/health-topics/one-health>
- World Health Organization. (2024). Ambient air quality and health. [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)
- Yisa, S. S., Ogunniyi, T. J., & Dine, R. D. (2025). Strengthening phc in nigeria for universal health coverage. *BMJ Global Health*, 10(10), e018486. <https://doi.org/10.1136/bmjgh-2024-018486>

Zhang, Y., Stokes, J., Anselmi, L., Bower, P., & Xu, J. (2025). Can integrated care strengthen primary care? *Health Research Policy and Sys-*

*tems*, 23(1). <https://doi.org/10.1186/s12961-024-01260-1>