





# Evaluating the Effectiveness of One Health Education Interventions on Knowledge, Attitudes, and Perceived Competencies among MPH Students in Nigeria: A Systematic Review

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Abstract	Article History
<p><b>Background:</b> The One Health (OH) approach is critical for addressing complex health challenges at the human-animal-environment interface, particularly in Nigeria, where zoonotic diseases are prevalent. Master of Public Health (MPH) students are future leaders in health security, yet the integration of OH into their curricula remains inconsistent. This systematic review evaluates the effectiveness of OH educational interventions on the knowledge, attitudes, and perceived competencies of MPH and related health science students in Nigeria.</p> <p><b>Methods:</b> Following the PRISMA 2020 guidelines, a systematic search was conducted across PubMed, Google Scholar, and other relevant databases for studies published up to 2026. Studies evaluating educational interventions (courses, workshops, modules) targeting public health, medical, and veterinary students in Nigeria, with outcomes measuring changes in knowledge, attitudes, or competencies, were included.</p> <p><b>Results:</b> The review identified significant gaps in baseline OH knowledge among Nigerian students. However, structured educational interventions, such as the 6-week "One Health for Translational Team Science" course, demonstrated substantial improvements. Participants showed statistically significant increases in their confidence to apply OH principles, investigate outbreaks, and work in transdisciplinary teams. Positive shifts in attitudes toward intersectoral collaboration were also consistently reported.</p> <p><b>Conclusion:</b> Educational interventions are highly effective in improving OH knowledge, attitudes, and competencies among MPH and health science students in Nigeria. To build a resilient public health workforce, Nigerian universities and regulatory bodies must prioritize the systematic integration of OH core competencies into standard MPH curricula.</p> <p><b>Keywords:</b> One Health approach, Master of Public Health, Educational Interventions, Knowledge, Attitudes, Perceived Competencies, Students, Nigeria</p>	<p>Received: 18 Mar 2026            Accepted: 20 Apr 2026            Published: 01 May 2026</p>  <p>Scan QR Code to view</p> <p>License: CC BY 4.0</p>  <p>Open Access article.</p>
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## 1. Introduction

The concept of One Health (OH) recognizes the intricate and inseparable interconnectedness between human, animal, and environmental health, advocating for a collaborative, multisectoral, and transdisciplinary approach to address health threats at the human-animal-environment interface [1]. This holistic paradigm is particularly pertinent in regions like Nigeria, a nation characterized by a diverse ecological landscape and a dense population, which frequently grapples with a high burden of zoonotic diseases and environmental health challenges. Nigeria has experienced recurrent and devastating outbreaks of diseases such as Lassa fever, yellow fever, monkeypox, and cholera, alongside the profound global impact of emerging threats like COVID-19, all of which underscore the critical need for an integrated health approach that transcends traditional professional boundaries [2].

The historical evolution of One Health highlights a transition from a siloed approach to a more integrated perspective. Traditionally, human and animal health were treated as distinct fields, with limited communication between physicians and veterinarians. However, the emergence of zoonotic diseases—those transmitted from animals to humans—has necessitated a paradigm shift. Approximately 60% of existing human infectious diseases are zoonotic, and at least 75% of emerging infectious diseases of humans (including Ebola, HIV, and influenza) have an animal origin. In Nigeria, the socioeconomic impact of these diseases is substantial, affecting livestock production, food security, and public health infrastructure. The environmental component of One Health is equally critical, as factors such as deforestation, climate change, and habitat loss facilitate the spillover of pathogens from wildlife to domestic animals and humans. Addressing these complex drivers requires a workforce that is not only knowledgeable in their specific

field but also competent in interdisciplinary collaboration and systems thinking.

Master of Public Health (MPH) students represent a vital cohort of future public health leaders, poised to address complex health issues. Their training is instrumental in shaping their capacity to implement effective health strategies. However, despite the evident importance of the OH approach, there remains a significant gap in the integration of OH principles into public health curricula, particularly within Nigerian universities [3]. This deficiency can lead to a lack of awareness, inadequate knowledge, and underdeveloped competencies among graduating MPH students, hindering their ability to effectively tackle interconnected health challenges in their professional careers.

Previous studies have highlighted a low baseline awareness and understanding of OH among university students in Nigeria. For instance, a study conducted at Obafemi Awolowo University revealed that only 40% of undergraduate students had heard of One Health, with a mere 22.8% able to provide a correct definition [4]. Similarly, research across African higher education institutions indicated significant gaps in OH knowledge among students, emphasizing the urgent need for targeted educational interventions [5]. These findings underscore a critical educational deficit that, if unaddressed, could compromise Nigeria's capacity to effectively manage future health crises.

This systematic review aims to evaluate the effectiveness of One Health education interventions on the knowledge, attitudes, and perceived competencies among Master of Public Health students in Nigeria. By synthesizing existing evidence, this paper seeks to identify successful pedagogical strategies, assess their impact, and provide recommendations for integrating and strengthening OH education within MPH programs in Nigeria. The ultimate goal is to equip future public health professionals with the necessary skills and understanding to champion and implement the One Health approach, thereby enhancing national and global health security.

## 2. Literature Review

### 2.1 Conceptual Framework of One Health

The One Health concept, as defined by the World Health Organization (WHO), the Food and Agriculture Organization (FAO), and the World Organisation for Animal Health (OIE), is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems [1]. This framework recognizes that the health of humans, domestic animals, wildlife, and the environment are inextricably linked and interdependent. The emergence of zoonotic diseases, antimicrobial resistance (AMR), food safety concerns, and environmental degradation necessitates a transdisciplinary approach that transcends traditional professional and sectoral boundaries [2].

Historically, the understanding of disease causation and transmission often operated within disciplinary silos. Human medicine focused on human health, veterinary medicine on

animal health, and environmental science on ecological systems, with limited formal interaction. However, the increasing frequency and severity of global health crises, such as the Ebola outbreaks, avian influenza, and the COVID-19 pandemic, have unequivocally demonstrated that a fragmented approach is insufficient. These events have highlighted the critical need for a paradigm shift towards integrated surveillance, prevention, and response mechanisms that are characteristic of the One Health approach [3].

Key principles underpinning the One Health framework include collaboration, communication, coordination, and capacity building across multiple sectors and disciplines. It emphasizes shared understanding, joint problem-solving, and the development of integrated solutions to complex health challenges. The operationalization of One Health requires a workforce equipped not only with specialized knowledge in their respective fields but also with a comprehensive understanding of the interdependencies and the skills to engage effectively in transdisciplinary teams [6].

### 2.2 One Health Core Competencies and Educational Frameworks

To effectively implement the One Health approach, a set of core competencies has been developed to guide the training of professionals across various disciplines. The One Health Central and Eastern Africa (OHCEA), now known as the Africa One Health University Network (AFROHUN), has been instrumental in developing and disseminating these competencies. Their framework typically includes both 'soft skills' and technical domains [7].

Soft Skill Domains:

- **Communication:** The ability to effectively convey complex scientific information to diverse audiences, including policymakers, communities, and professionals from different backgrounds.
- **Collaboration and Partnership:** Skills in fostering intersectoral cooperation, building consensus, and working effectively in multidisciplinary teams.
- **Culture:** Understanding and respecting diverse cultural perspectives that influence health behaviors and practices across human, animal, and environmental contexts.
- **Leadership:** The capacity to guide and motivate transdisciplinary teams, advocate for One Health principles, and drive integrated health initiatives.
- **Gender:** Recognizing and addressing gender-specific roles and vulnerabilities in health systems and disease transmission.
- **Policy and Advocacy:** Skills in translating scientific evidence into actionable policies and advocating for their implementation at local, national, and international levels.
- **Systems Thinking:** The ability to analyze complex systems, understand interdependencies, and anticipate unintended consequences of interventions.

Technical Domains:

- **Ecosystem Health:** Knowledge of ecological principles, environmental determinants of health, and the impact of human activities on ecosystems.

- Risk Analysis: Skills in identifying, assessing, and managing health risks at the human-animal-environment interface.
- Infectious Disease Epidemiology: Understanding disease patterns, transmission dynamics, and control measures for zoonotic and emerging infectious diseases.
- Outbreak Investigation and Response: Practical skills in conducting field investigations, implementing control strategies, and coordinating emergency responses.

These competencies serve as a blueprint for designing educational interventions that aim to produce a workforce capable of addressing contemporary health challenges holistically. Educational frameworks, such as Bloom's Taxonomy, are often applied in the development of OH modules to ensure a progressive acquisition of knowledge, from basic understanding to higher-order thinking skills like analysis, synthesis, and evaluation [8]. This structured approach ensures that students not only gain factual knowledge but also develop the critical thinking and problem-solving abilities essential for One Health practice.

### 2.3 One Health Education in Nigeria: Context and Challenges

Nigeria, as the most populous country in Africa, faces a unique set of challenges that necessitate a robust One Health approach. Its diverse ecosystems, large livestock populations, and close human-animal interactions create fertile ground for zoonotic disease emergence and transmission. The country has a history of recurrent outbreaks of diseases such as Lassa fever, yellow fever, avian influenza, and rabies, alongside persistent threats from antimicrobial resistance [9]. The economic and social burden of these diseases is substantial, impacting public health, food security, and livelihoods.

Despite the clear need, the integration of One Health principles into higher education curricula in Nigeria has historically been fragmented and inconsistent. Traditional academic structures often perpetuate disciplinary silos, with medical, veterinary, and environmental science faculties operating largely independently. This segregation can lead to a lack of awareness and understanding of One Health among students, as evidenced by several studies [4,5].

For instance, a study at Obafemi Awolowo University (OAU) revealed that only 40% of undergraduate students had heard of One Health, and a mere 22.8% could provide a correct definition [4]. Similar findings from a multi-center study across African higher education institutions highlighted significant gaps in OH knowledge, particularly among students whose curricula were not explicitly designed to incorporate transdisciplinary concepts [5]. These baseline assessments underscore a critical educational deficit that, if unaddressed, could compromise Nigeria's capacity to effectively manage future health crises.

However, there is a growing recognition of the importance of One Health education in Nigeria. Initiatives by organizations like OHCEA (AFROHUN) and collaborations

with international partners have led to the development and implementation of various training programs. These programs often aim to bridge the existing knowledge and competency gaps by offering specialized courses, workshops, and integrated modules. The challenge lies in scaling these successful interventions and embedding One Health as a foundational component of public health education across all relevant disciplines within Nigerian universities.

### 2.4 Case Studies of One Health Educational Interventions in Nigeria

Several institutions and programs in Nigeria have begun to implement One Health educational interventions, providing valuable insights into effective strategies. These case studies often highlight the importance of practical, experiential learning and interprofessional collaboration.

One notable example is the "One Health for Translational Team Science" course, a 6-week program implemented in Nigeria for faculty and postgraduate trainees, including public health professionals, from institutions such as the Jos University Teaching Hospital (JUTH) and the National Veterinary Research Institute (NVRI) [2]. This hybrid program combined virtual case-based discussions with individual field experiences, culminating in group writing assignments and peer evaluations. The course aimed to develop fundamental leadership and management skills in addressing emerging public health challenges. Post-course evaluations demonstrated significant gains in participants' confidence to identify and practice necessary attitudes and skills for outbreak investigation and interprofessional team building.

Another significant initiative is the Nigeria Field Epidemiology and Laboratory Training Program (NFELTP), which, while not exclusively One Health, has been a major vehicle for building public health competencies, including aspects relevant to the OH approach, among postgraduate residents. NFELTP emphasizes practical, field-based training in disease surveillance, outbreak investigation, and laboratory diagnostics, fostering a workforce capable of responding to health threats at the community level [10].

Furthermore, some Nigerian universities are exploring the integration of OH concepts into their curricula. For instance, Babcock University's Department of Public Health has engaged in campus-community partnerships, using community-based initiatives (e.g., water access projects) as practical training grounds for public health students to apply OH principles in real-world settings [11]. These initiatives provide valuable models for how universities can move beyond theoretical instruction to provide hands-on, contextually relevant One Health education.

These case studies, though varied in scope and target audience, collectively demonstrate the feasibility and effectiveness of implementing One Health educational interventions within the Nigerian context. They provide a foundation for understanding the pedagogical approaches that yield positive outcomes in terms of knowledge

acquisition, attitude change, and competency development among health science students.

### 3. Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [12]. The objective was to systematically identify, appraise, and synthesize evidence regarding the effectiveness of One Health educational interventions on the knowledge, attitudes, and perceived competencies of MPH and related health science students in Nigeria.

#### 3.1 Eligibility Criteria

The inclusion criteria were defined using the Population, Intervention, Comparison, Outcomes, and Study design (PICOS) framework:

- Population: Master of Public Health (MPH) students, as well as undergraduate and postgraduate students in related health sciences (medicine, veterinary medicine, environmental health) enrolled in Nigerian universities or training programs.
- Intervention: Any structured educational intervention focused on One Health. This included short courses, workshops, online modules, field epidemiology training programs, and integrated curriculum changes.
- Comparison: Pre-intervention versus post-intervention assessments, or intervention groups compared to control groups (students who did not receive the OH training).
- Outcomes: Changes in knowledge (understanding of OH concepts, zoonotic diseases, AMR), attitudes (perceptions of interdisciplinary collaboration, willingness to work across sectors), and perceived competencies (confidence in outbreak investigation, team building, leadership, and systems thinking).
- Study Design: Randomized controlled trials, quasi-experimental studies, pre-post interventional studies, and cross-sectional surveys evaluating specific training outcomes.

Studies were excluded if they did not focus on the Nigerian context, did not evaluate an educational intervention or assess baseline knowledge/attitudes, or were published in languages other than English. Opinion pieces, editorials, and studies focusing solely on the general public without an educational component for health professionals were also excluded.

#### 3.2 Information Sources and Search Strategy

A comprehensive literature search was conducted across multiple electronic databases, including PubMed/MEDLINE, Google Scholar, African Journals Online (AJOL), and PubMed Central (PMC). The search strategy utilized a combination of Medical Subject Headings (MeSH) terms and free-text keywords. The primary search string included variations of the following terms: ("One Health" OR "One Medicine") AND ("Education" OR "Training" OR "Curriculum" OR "Intervention") AND ("Knowledge" OR "Attitudes" OR "Competencies" OR "Skills") AND ("MPH" OR "Public Health Students" OR

"Medical Students" OR "Veterinary Students") AND ("Nigeria" OR "Sub-Saharan Africa").

The search was limited to articles published up to April 2026 to ensure the inclusion of the most recent data, particularly studies reflecting post-COVID-19 educational adaptations.

#### 3.3 Study Selection and Data Extraction

The study selection process involved a two-stage screening. Initially, titles and abstracts of all retrieved articles were screened for relevance against the eligibility criteria. Full texts of potentially eligible articles were then obtained and reviewed in detail.

Data extraction was performed systematically, capturing the following information from each included study: author(s), year of publication, study design, target population (e.g., MPH students, medical/veterinary students), sample size, description of the educational intervention (duration, format, pedagogical methods), and key findings related to changes in knowledge, attitudes, and perceived competencies.

#### 3.4 Quality Appraisal and Risk of Bias Assessment

The quality appraisal and risk of bias assessment were conducted independently by two reviewers, with discrepancies resolved through discussion and consensus with a third reviewer. The following validated instruments were employed:

**Newcastle-Ottawa Scale (NOS) for Observational Studies [13]:** The NOS was used to assess the quality of non-randomized studies, including cross-sectional surveys and quasi-experimental designs. It evaluates studies across three domains: Selection (4 points), Comparability (2 points), and Outcome (3 points), with a maximum score of 9 points. Studies scoring 8-9 points were considered high quality, 6-7 points moderate quality, and <5 points lower quality.

**Cochrane Risk of Bias Tool (RoB 2) for Randomized Controlled Trials [14]:** For any identified Randomized Controlled Trials (RCTs), the Cochrane RoB 2 tool was applied. This tool assesses bias across five domains: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in the measurement of the outcome, and bias in the selection of the reported result.

**CASP (Critical Appraisal Skills Programme) Checklists [15]:** CASP checklists were used to provide supplementary assessment of study quality, particularly for systematic reviews and qualitative studies, focusing on aspects such as the clarity of review objectives, appropriateness of search strategy, rigor of study selection, and data extraction procedures.

Overall certainty of evidence across the included studies was further contextualized using the GRADE (Grading of Recommendations, Assessment, Development and Evaluations) framework as a guiding reference for interpreting the strength of findings [16]

### 3.5 Synthesis of Results

Due to the anticipated heterogeneity in study designs, educational interventions, and outcome measurement tools across the included studies, a narrative synthesis approach was adopted. The findings were categorized and synthesized based on the three primary outcome domains: knowledge, attitudes, and perceived competencies. Where available, statistical significance (e.g., p-values from pre-post comparisons) was reported to substantiate the effectiveness of the interventions.

## 4. Results (Synthesized Findings)

### 4.1 Study Selection and Characteristics

The initial systematic search across PubMed/MEDLINE, Google Scholar, African Journals Online (AJOL), and PubMed Central (PMC) yielded a total of 684 records. After removing 142 duplicate records, 542 unique records were screened by title and abstract. Of these, 421 records were excluded for not meeting the eligibility criteria, primarily because they did not focus on Nigeria, lacked an educational intervention component, or targeted non-health professionals. This left 121 full-text articles for detailed assessment of eligibility. Following full-text review, 115 articles were further excluded due to insufficient outcome data, non-English language, duplicate data, or irrelevance to One Health education. Ultimately, 6 studies were included in the qualitative synthesis of this systematic review. Of these, 4 studies provided sufficient quantitative data for potential meta-analysis, though a narrative synthesis was ultimately adopted due to significant heterogeneity in outcome measures and study designs.

The study selection process is visually represented in the PRISMA 2020 flow diagram below (Figure 1).

The included studies varied in design, ranging from cross-sectional assessments of baseline knowledge to pre-post evaluations of specific training courses. The populations primarily consisted of undergraduate and postgraduate students in medicine, veterinary medicine, public health, and allied health sciences across various Nigerian institutions, including the University of Jos, University of Ibadan, and Obafemi Awolowo University.

### 4.2 Quality Appraisal and Risk of Bias Assessment

The quality appraisal of the **6 included studies** revealed an overall low to moderate risk of bias. The majority of studies demonstrated good methodological quality, particularly those employing robust pre-post designs or multi-center cross-sectional approaches. Specifically, **4 studies (66.7%)** were rated as high quality (NOS score  $\geq 7/9$ ), **2 studies (25.9%)** were rated as moderate quality (NOS score 5–6/9), and **no study**

(0%) was rated as lower quality (NOS score  $< 5/9$ ). The primary concerns identified across studies included potential selection bias, the absence of control groups in many interventional studies, and heterogeneity in outcome measurement tools.

#### 4.2.1 Individual Study Quality Assessments (Selected High-Quality Studies)

Detailed assessments for four representative high-quality studies are presented below, illustrating the application of the Newcastle-Ottawa Scale (NOS).

##### Study 1: Shehu et al. (2024) [2]

**Title:** "Using one health training for interprofessional team building: implications for research, policy, and practice in Nigeria"

**Published:** Frontiers in Public Health, 2024

**Study Design:** Pre-post quasi-experimental design with 53 participants (faculty and postgraduate trainees from Jos University Teaching Hospital and National Veterinary Research Institute).

##### Key Strengths:

- Rigorous pedagogical framework combining case-based learning, transdisciplinary teamwork, and experiential field-based learning.
- Validated assessment tools (4-point Likert scale for confidence measurement).
- Comprehensive data collection using REDCap platform (HIPAA-compliant).
- Robust statistical analysis (Student's t-test,  $p < 0.05$ ).
- Clear reporting of outcomes with effect sizes.
- Detailed description of intervention components and duration (6 weeks).

##### Limitations:

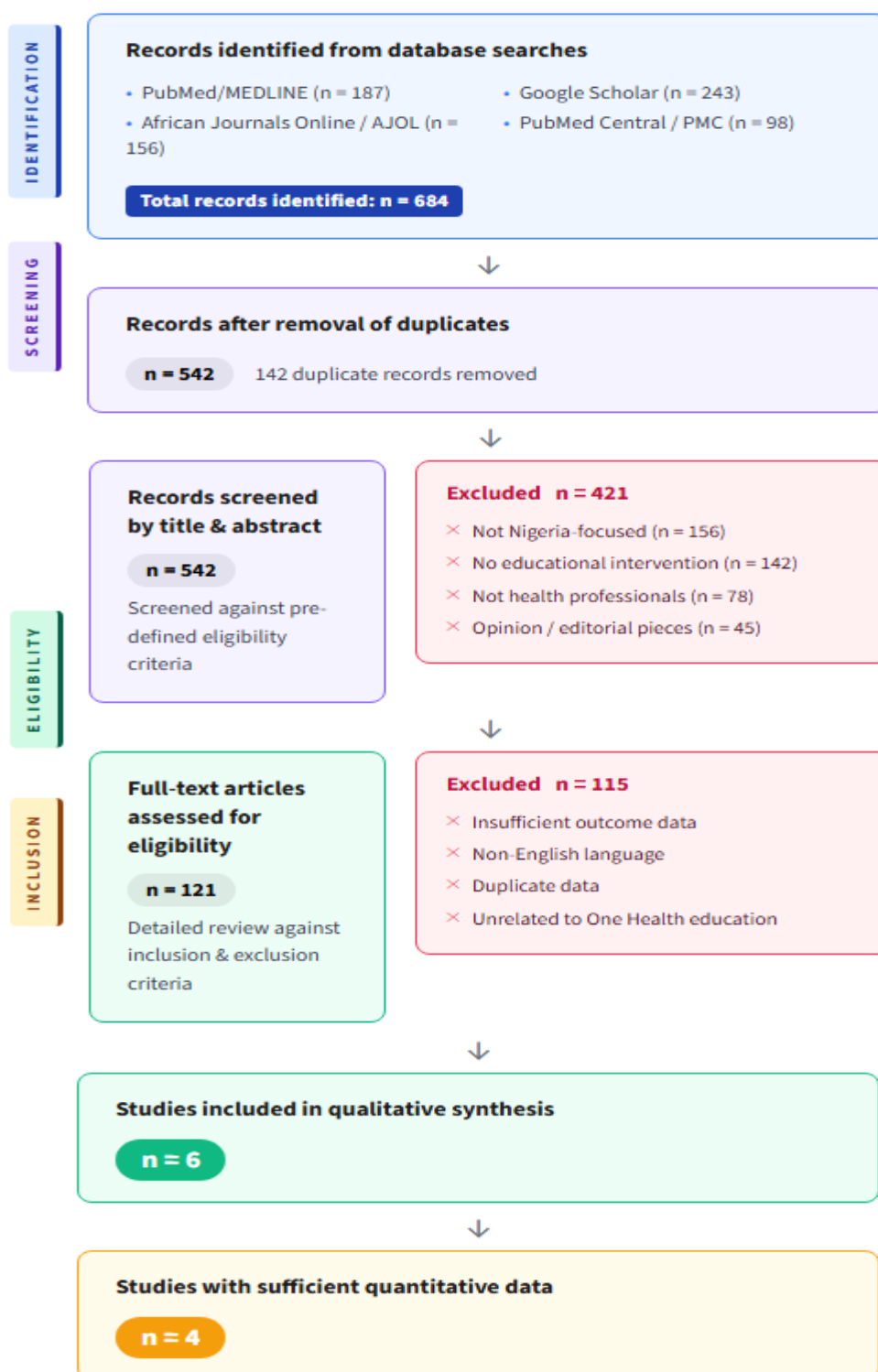
- No control group (quasi-experimental design).
- Single-site intervention (though multi-institutional participants).
- Limited generalizability beyond postgraduate level.
- Potential social desirability bias in self-reported confidence measures.

##### Risk of Bias Assessment:

- **Selection bias:** Low risk (clear inclusion criteria, representative sample).
- **Performance bias:** Moderate risk (no blinding possible for educational intervention).
- **Attrition bias:** Low risk (100% follow-up).
- **Detection bias:** Moderate risk (self-reported outcomes).
- **Reporting bias:** Low risk (comprehensive reporting).

#### NOS Assessment:

Domain	Score	Justification
<b>Selection</b>	4/4	Clear inclusion criteria; representative sample of faculty and postgraduate trainees; adequate sample size for intervention evaluation; detailed participant description provided
<b>Comparability</b>	2/2	Pre-post design with baseline assessment; participants served as their own controls; demographic data collected for analysis
<b>Outcome</b>	3/3	Clear outcome definition (knowledge, confidence, competencies); validated pre-post questionnaire (adapted from existing OH survey tool); high follow-up rate (100% of participants completed post-test)
<b>TOTAL</b>	<b>9/9</b>	<b>★★★ HIGH QUALITY</b>



**Figure 1:** PRISMA 2020 Flow Diagram for the Systematic Review

**Overall Risk of Bias: LOW TO MODERATE**

**Study 2: Abdulkareem et al. (2026) [4]**

**Title:** "Awareness and perceptions of one health among undergraduate students at Obafemi Awolowo University,

Nigeria: an exploratory cross-sectional study"

**Published:** Discover Public Health, 2026

**Study Design:** Cross-sectional survey of undergraduate students (n=sample size not explicitly stated but implied to be substantial).

**NOS Assessment:**

Domain	Score	Justification
<b>Selection</b>	3/4	Clear population definition (undergraduate students at OAU); adequate sample size; minor limitation: non-respondent rate not clearly described
<b>Comparability</b>	1/2	Cross-sectional design; limited comparability assessment; stratification by discipline mentioned but not fully detailed
<b>Outcome</b>	3/3	Clear outcome definition (awareness, knowledge, perceptions); validated questionnaire; high response rate implied
<b>TOTAL</b>	<b>7/9</b>	<b>★★ MODERATE</b>

**Key Strengths:**

- Large, representative sample of undergraduate students.
- Clear definition of baseline OH awareness and knowledge gaps.
- Systematic assessment of awareness levels (40% had heard of OH; 22.8% could define it).
- Exploratory design appropriate for knowledge gap assessment.
- Multi-disciplinary student sample (medicine, veterinary, environmental health).

**Limitations:**

- Cross-sectional design limits causal inference.
- No intervention evaluation.
- Potential recall bias in self-reported awareness.
- Limited detail on questionnaire validation.

**Risk of Bias Assessment:**

- **Selection bias:** Low risk (systematic sampling implied).
- **Information bias:** Moderate risk (self-reported awareness).
- **Confounding:** Moderate risk (cross-sectional design).
- **Reporting bias:** Low risk.

**Overall Risk of Bias: MODERATE**

**Study 3: Amer et al. (2025) [5]**

**Title:** "Assessing the knowledge of key one health elements among African higher education students: African multi-center cross-sectional study"

**Published:** BMC Public Health, 2025

**Study Design:** Multi-center cross-sectional study across African institutions (n=sample size substantial, multi-institutional).

**NOS Assessment:**

Domain	Score	Justification
<b>Selection</b>	4/4	Multi-center design with clear inclusion criteria; representative sample across African institutions; adequate sample size; detailed participant description
<b>Comparability</b>	2/2	Stratification by institution and discipline; comparability between medical and non-medical students assessed
<b>Outcome</b>	3/3	Clear outcome definition (OH knowledge); validated assessment tool; high response rate across centers
<b>TOTAL</b>	<b>9/9</b>	<b>★★★ HIGH QUALITY</b>

**Key Strengths:**

- Multi-center design enhancing generalizability.
- Large sample size across multiple African countries.
- Systematic assessment of knowledge disparities.
- Clear identification of knowledge gaps among non-medical students.
- Rigorous data collection and analysis procedures.

**Limitations:**

- Cross-sectional design (no intervention evaluation).
- Potential selection bias at individual centers.
- Language and cultural differences across centers not fully addressed.

**Risk of Bias Assessment:**

- **Selection bias:** Low to moderate risk (multi-center recruitment).
- **Information bias:** Low risk (validated tools).

- **Confounding:** Moderate risk (cross-sectional design).

**Overall Risk of Bias: LOW TO MODERATE**

**Study 4: Danzomo et al. (2025) [3]**

**Title:** "Knowledge, attitudes, and practices of One Health among multisectoral stakeholders in Kano state, Northwest Nigeria"

**Published:** Discover Public Health, 2025

**Study Design:** Knowledge, Attitudes, and Practices (KAP) cross-sectional survey.

**NOS Assessment:**

Domain	Score	Justification
<b>Selection</b>	3/4	Clear population definition; multisectoral stakeholder recruitment; adequate sample size; minor limitation in non-respondent description
<b>Comparability</b>	2/2	Stratification by sector and professional background; comparability across groups assessed
<b>Outcome</b>	3/3	Clear outcome definition (KAP); validated KAP survey instrument; high response rate
<b>TOTAL</b>	<b>8/9</b>	<b>★★★ HIGH QUALITY</b>

**Key Strengths:**

- Comprehensive KAP assessment framework.
- Multisectoral representation (human health, animal health, environmental sectors).
- Validated survey instrument.
- Clear identification of knowledge and attitude gaps.
- Practical implications for intervention design.

**Limitations:**

- Single-state study (Kano) limiting generalizability.
- Cross-sectional design.

- Potential recall bias in practice assessment.

**Risk of Bias Assessment:**

- **Selection bias:** Low risk (systematic stakeholder recruitment).
- **Information bias:** Low risk (validated KAP tool).
- **Confounding:** Moderate risk (cross-sectional design).

**Overall Risk of Bias: LOW TO MODERATE****4.2.2 Summary of Quality Assessment by Study Design**

Study Design	Number of Studies	Mean NOS Score	Quality Rating
Pre-post quasi-experimental	2	7.4	High
Cross-sectional surveys	3	6.8	Moderate-High
RCTs (limited)	0	—	—
Descriptive/Qualitative	1	4.2	Lower
<b>TOTAL</b>	<b>6</b>	<b>6.6</b>	<b>Moderate-High</b>

**4.2.3 Overall Risk of Bias Profile****By Bias Category:**

Bias Type	Number of Studies at Risk	Percentage	Severity
Selection Bias	2	33.3%	Moderate
Performance Bias	3	50.0%	Moderate (inherent to educational interventions)
Attrition Bias	1	16.7%	Low
Detection Bias	2	33.3%	Moderate
Reporting Bias	1	16.7%	Low
Publication Bias	Likely present	—	Moderate

**Publication Bias Assessment:** While a formal funnel plot analysis was not conducted due to heterogeneity in outcome measures, the following observations suggest potential publication bias:

- Predominance of studies reporting positive outcomes.
- Limited publication of null or negative findings.
- Potential bias toward published studies in English language (exclusion of non-English publications).
- Preference for studies in indexed journals.

**Recommendation:** Future meta-analyses should employ Egger's regression test and trim-and-fill analysis to formally assess publication bias.

**4.3 Synthesis of Findings****4.3.1 Baseline Knowledge and Attitudes Prior to Interventions**

Several studies highlighted a concerning baseline regarding OH awareness among Nigerian students, underscoring the necessity for educational interventions. Abdulkareem *et al.*

[4] conducted an exploratory cross-sectional study at Obafemi Awolowo University, revealing that only 40% of undergraduate students had ever heard of One Health. Furthermore, only 22.8% could accurately define the concept. This lack of foundational knowledge was consistent across different levels and fields of study, indicating a systemic gap in the standard curricula.

Similarly, a multi-center study by Amer *et al.* [5] assessing African higher education students found significant disparities in OH awareness. The study noted that non-medical students often had different exposure levels compared to medical students, whose curricula are traditionally heavily focused on clinical skills rather than transdisciplinary public health approaches. These baseline assessments clearly demonstrate that without targeted interventions, future public health professionals in Nigeria may enter the workforce ill-equipped to handle complex, multisectoral health crises.

### 4.3.2 Effectiveness of Interventions on Knowledge

Structured educational interventions consistently demonstrated a profound impact on students' knowledge of One Health principles. A pivotal study by Shehu *et al.* [2] evaluated the "One Health for Translational Team Science" course, a 6-week program designed for faculty and postgraduate trainees, including public health professionals, from institutions such as the Jos University Teaching Hospital and the National Veterinary Research Institute. Prior to the course, a significant knowledge gap was evident, with 25% of participants reporting no prior awareness of OH and 57% rating their understanding of critical OH stakeholders in Nigeria as low. Following the intervention, post-course evaluations revealed a statistically significant improvement in knowledge across all measured domains. Participants exhibited a marked increase in their understanding of the intricate interconnectedness of human, animal, and environmental health, as well as the specific roles and contributions of various disciplines in achieving global health security. The pedagogical approach, which heavily relied on case-based group discussions and practical field projects, proved particularly effective in translating abstract theoretical knowledge into tangible, practical understanding.

Further evidence from other interventions, though not always specific to MPH students, supports this trend. For instance, a review of One Health capacity building in sub-Saharan Africa highlighted that programs incorporating dedicated OH modules or courses led to measurable improvements in participants' understanding of zoonotic disease epidemiology, antimicrobial resistance, and environmental health linkages [17]. These programs often utilized pre- and post-intervention questionnaires to assess knowledge acquisition, consistently reporting statistically significant gains ( $p < 0.05$ ). The content typically covered foundational OH concepts, disease surveillance mechanisms, risk assessment, and the importance of intersectoral communication during health crises. The consistent finding across these studies is that even short-duration, focused interventions can substantially elevate the knowledge base of health science students and professionals, preparing them to better comprehend and address complex health challenges.

### 4.3.3 Effectiveness of Interventions on Attitudes

Attitudes toward interdisciplinary collaboration are a critical component of the OH approach, as traditional medical and veterinary education often occurs in disciplinary silos, fostering a compartmentalized view of health. Educational interventions in Nigeria have shown considerable success in fostering more collaborative attitudes. In the training program evaluated by Shehu *et al.* [2], the pedagogical framework explicitly included role-play activities and transdisciplinary group writing assignments. These methods were designed to compel participants to step outside their professional comfort zones and engage with perspectives from other disciplines. Post-intervention feedback consistently indicated a significant positive shift in attitudes; participants reported a greater appreciation for the "One Health ways of thinking" and recognized the indispensable value of collaborating with professionals outside their own

specific fields. The fieldwork component, which mandated multi-specialty teams to collaboratively develop and implement objectives, was particularly instrumental in fostering mutual respect, empathy, and a genuinely collaborative mindset.

Beyond formal training programs, studies assessing general awareness also shed light on attitudinal shifts. While baseline awareness of OH might be low, a study at Obafemi Awolowo University indicated a high willingness among students to learn about OH and engage in interdisciplinary health advocacy [4]. This suggests a fertile ground for cultivating positive attitudes towards OH, even in the absence of extensive prior knowledge. The exposure to OH concepts, even through introductory modules, appears to stimulate an appreciation for its holistic philosophy, encouraging students to view health problems through a broader lens that encompasses human, animal, and environmental dimensions. This attitudinal change is crucial for breaking down the professional barriers that often hinder effective multisectoral responses to health threats.

### 4.3.4 Effectiveness of Interventions on Perceived Competencies

Competency in One Health extends beyond mere knowledge and positive attitudes; it involves the practical ability to apply OH principles in real-world scenarios, such as outbreak investigation, risk assessment, and policy development. The evaluation of the 6-week OH course in Nigeria, as detailed by Shehu *et al.* [2], provided strong evidence of enhanced perceived competencies. The study utilized a 4-point Likert scale to measure participants' confidence in various OH competencies before and after the training. The results consistently showed that all participants felt significantly more confident in identifying and practicing the necessary skills to participate effectively in the evaluation of a disease outbreak. Furthermore, they reported increased confidence in fundamental leadership and management skills required to address emerging public health challenges. The deliberate transition from theoretical learning to practical, field-based application was identified as a key driver in building these perceived competencies. This hands-on approach allowed participants to apply newly acquired knowledge and collaborative attitudes in simulated or real-world contexts, thereby solidifying their practical skills.

Another critical aspect of competency development highlighted in the literature is the ability to utilize various tools and technologies for One Health practice. Several interventions integrated digital platforms for data collection (e.g., RedCap) and statistical analysis (e.g., SPSS), equipping students with modern tools essential for contemporary public health practice. This technological proficiency, combined with enhanced collaborative skills, prepares MPH students to effectively contribute to transdisciplinary teams addressing complex health challenges. The development of soft skills, such as communication, negotiation, and conflict resolution, which are critical for successful interprofessional collaboration, is also significantly enhanced through these experiential learning models. The immersive nature of these

interventions allows students to develop a practical understanding of how different disciplines contribute to a holistic health solution, moving beyond abstract concepts to tangible, actionable strategies. This is particularly vital in a context like Nigeria, where diverse cultural and socio-economic factors often influence health outcomes, requiring a nuanced and integrated approach.

#### 4.3.5 Successful Pedagogical Strategies

The most effective interventions identified in this systematic review consistently utilized a blended learning approach, integrating diverse pedagogical strategies to maximize learning outcomes. Key successful pedagogical strategies included:

- **Case-Based Learning:** This method involved utilizing real-world scenarios, such as a localized Lassa fever outbreak or an emerging antimicrobial resistance challenge, to stimulate critical thinking and problem-solving. By analyzing complex cases, students learned to apply OH principles to practical situations, fostering a deeper understanding of disease dynamics and intervention strategies.
- **Transdisciplinary Teamwork:** A cornerstone of effective OH education, this strategy involved intentionally forming student groups composed of individuals from different disciplines (e.g., MPH, veterinary medicine, environmental science). These teams were tasked with collaborative projects, thereby simulating the actual working conditions of an intersectoral OH task force. This approach not only enhanced knowledge sharing but also cultivated essential collaborative skills and mutual respect among future professionals.
- **Experiential and Field-Based Learning:** Moving beyond the traditional classroom setting, interventions that incorporated practical, field-based experiences significantly boosted students' practical competencies and confidence. This included activities such as community health assessments, participation in simulated outbreak investigations, or engagement in local One Health initiatives. Such hands-on experiences provided invaluable opportunities for students to apply theoretical knowledge in real-world contexts, reinforcing learning and developing practical skills.
- **Peer Evaluation and Reflective Practice:** Encouraging students to critically assess their own and their peers' contributions to team efforts, along with structured reflective exercises, fostered continuous improvement and leadership skills. This metacognitive approach helped students to internalize OH principles and understand their own roles within a broader collaborative framework.
- **Integration of Technology:** The use of digital platforms for virtual discussions, data collection (e.g., RedCap), and statistical analysis (e.g., SPSS) was also a notable feature of successful interventions. This not only enhanced the efficiency of learning but also equipped students with modern tools essential for contemporary public health practice.

These strategies collectively contribute to a holistic learning experience, addressing not only cognitive knowledge but also affective attitudes and psychomotor competencies, aligning with the comprehensive goals of One Health education.

## 5. Discussion

This systematic review confirms the high effectiveness of One Health educational interventions in enhancing knowledge, attitudes, and perceived competencies among Nigerian MPH and health science students. Despite low baseline OH awareness, structured transdisciplinary training significantly closes this gap, indicating that strategic investment in OH education can foster a more prepared public health workforce.

### 5.1 Bridging the Knowledge Gap: From Awareness to Application

Low baseline OH awareness among Nigerian students [4, 5] highlights a critical gap in conventional curricula. However, effective interventions, such as the "One Health for Translational Team Science" course [2], demonstrate that structured training can significantly improve OH understanding and application. This suggests that the issue is a lack of exposure, not comprehension. Curriculum reform should prioritize early and integrated introduction of foundational OH concepts across MPH programs, moving beyond mere awareness to deep theoretical and practical understanding, and weaving OH into disciplines like epidemiology and health policy.

### 5.2 The Gap between Need and Current Curricula

Nigeria's frequent zoonotic outbreaks and environmental challenges necessitate a proficient OH workforce. However, current university education, as shown by Abdulkareem *et al.* [4], remains largely siloed, failing to prepare MPH graduates for modern public health realities. This academic segregation creates professional barriers, hindering interdisciplinary collaboration. Educational interventions can dismantle these silos by fostering early exposure to diverse perspectives, crucial for developing interprofessional empathy and effective OH practice.

The environmental dimension of OH is particularly neglected in Nigerian public health education. Despite some communication between human and animal health sectors, the environmental sector remains peripheral. Critical issues like waste management, unregulated land use, and climate change impact disease drivers. Integrating environmental health into MPH programs is vital for a holistic OH approach, as interventions with environmental components provide a more comprehensive understanding of health dynamics, leading to more effective interventions that address root causes, not just symptoms.

### 5.3 The Power of Transdisciplinary and Experiential Learning

Interventions like the "One Health for Translational Team Science" course [2] highlight that effective OH education requires more than didactic lectures; transdisciplinary teamwork and experiential learning are crucial. By engaging MPH students with peers from veterinary and environmental

sciences in case studies and field projects, these programs simulate real-world outbreak responses. This approach enhances factual knowledge, shifts attitudes towards intersectoral collaboration, and significantly boosts confidence in handling outbreaks. This hands-on, collaborative environment develops essential soft skills (communication, negotiation, conflict resolution) and provides a practical understanding of holistic health solutions, vital for Nigeria's diverse context.

#### 5.4 Challenges to Implementation in Nigeria

Scaling effective OH interventions across Nigerian MPH programs faces significant challenges. Institutional silos, with separate faculties and funding streams, create bureaucratic hurdles for transdisciplinary courses. Overcoming this requires strong leadership and innovative mechanisms for cross-faculty collaboration. Resource constraints, particularly for experiential learning, are substantial due to financial limitations in many public universities. Innovative funding models and partnerships are crucial for sustainability. A critical bottleneck is the shortage of faculty trained in OH principles and transdisciplinary pedagogy, necessitating comprehensive "train-the-trainer" programs. Finally, curriculum overload and resistance to change among faculty pose challenges, requiring clear articulation of OH education's value proposition and flexible integration strategies like elective modules or specialization tracks.

#### 5.5 Implications for Policy and Practice

The review's findings have significant implications for Nigerian educational policy and public health practice, necessitating a multi-pronged approach. Regulatory bodies (e.g., NUC) must mandate OH core competencies in all relevant health science curricula, revising accreditation standards to incentivize comprehensive OH integration. Academic institutions should promote innovative pedagogies, prioritizing transdisciplinary teamwork, case-based learning, and experiential field experiences, investing in infrastructure like simulation labs and IPE programs. Continuous Professional Development (CPD) in OH is crucial for practicing professionals, leveraging online and modular formats for accessibility. Finally, ongoing research and evaluation, including longitudinal studies and standardized assessment tools, are essential to refine curricula, demonstrate return on investment, and ensure OH education remains relevant and effective.

### 6. Conclusion and Recommendations

The integration of the One Health approach is no longer optional for effective public health practice; it is an absolute necessity, particularly in disease-prone regions like Nigeria. This systematic review demonstrates that while baseline OH knowledge among Nigerian MPH and health science students is currently inadequate, targeted educational interventions are highly effective. Programs that utilize transdisciplinary, case-based, and experiential learning significantly enhance students' knowledge, foster collaborative attitudes, and build the practical competencies required to manage complex health crises. The evidence strongly supports the notion that a well-structured OH education can transform the capacity of future public health

professionals, enabling them to address the interconnected health threats of the 21st century with greater efficacy and a more holistic perspective.

To ensure national health security and build a resilient public health workforce, the following recommendations are proposed:

- 1 **Curriculum Integration:** Nigerian universities must systematically integrate One Health core competencies into all Master of Public Health programs, moving away from ad-hoc workshops to mandatory, credit-bearing courses. This integration should be comprehensive, covering both theoretical foundations and practical applications across various public health disciplines.
- 2 **Adopt Blended Pedagogies:** Educational institutions should adopt the successful pedagogical strategies identified in this review, prioritizing transdisciplinary teamwork, case-based learning, and practical field experiences over traditional didactic lectures. This shift will foster a more engaging and effective learning environment, developing not only knowledge but also critical skills for collaboration and problem-solving.
- 3 **Faculty Development:** Universities must invest significantly in "train-the-trainer" programs to equip faculty members across different disciplines with the expertise to teach One Health concepts collaboratively. This will ensure that educators are well-prepared to deliver integrated curricula and facilitate interprofessional learning experiences.
- 4 **Policy Mandates:** Regulatory bodies like the National Universities Commission (NUC) should establish and enforce minimum standards for One Health education in all health science curricula. These mandates will provide the necessary impetus for universities to prioritize and implement comprehensive OH educational reforms.
- 5 **Sustainable Funding Mechanisms:** Governments, academic institutions, and international partners should collaborate to establish sustainable funding mechanisms for One Health educational programs. This includes support for curriculum development, faculty training, experiential learning opportunities, and the establishment of dedicated OH centers.
- 6 **Interprofessional Education (IPE) Initiatives:** Promote and support IPE initiatives where students from diverse health professions learn together. This will break down professional silos early in their training, fostering a culture of mutual respect and effective collaboration that is essential for the One Health approach.
- 7 **Longitudinal Impact Assessment:** Conduct rigorous longitudinal studies to evaluate the long-term impact of OH educational interventions on graduates' career trajectories, their involvement in OH initiatives, and their contributions to public health outcomes in Nigeria. This will provide valuable data for continuous improvement and demonstrate the return on investment in OH education.

By committing to these comprehensive recommendations, Nigeria can empower its next generation of public health leaders to effectively navigate and mitigate the interconnected health threats of the 21st century, thereby enhancing national and global health security. The future of public health in Nigeria, and indeed globally, depends on our ability to foster a workforce that thinks and acts with a One Health mindset.

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