



## Scientific Research Report

# Evaluation of the Oral Health Education for Nurses and Community Health Workers (Project OHE-NCHeW) in Nigeria

Abimbola M. Oladayo<sup>a\*</sup>, Folake B. Lawal<sup>b,c</sup>, Oyinkansola O. Sofola<sup>d</sup>,  
 Omolara G. Utì<sup>d</sup>, Afolabi Oyapero<sup>e</sup>, Adetayo Aborisade<sup>f,g</sup>,  
 Mojisola Olujitan<sup>h,i</sup>, Omotayo F. Fagbule<sup>j</sup>, Adeola T. Williams<sup>d</sup>,  
 Aderonke Dedekè<sup>b</sup>, Ejìro Idìga<sup>b</sup>, Yahya-Imam Abdul-Kabir Adegokè<sup>k</sup>,  
 Ilorì Adenìjì Oluwagbengà<sup>l</sup>, Aìshatù Baba Mele<sup>f,g</sup>, Amìna Sani Baffa<sup>g</sup>,  
 Ifeoluwa Adetula<sup>m</sup>, Khadija Saad Musa<sup>n</sup>, Bernal Stewart<sup>o</sup>,  
 Carlo Amarin Daep<sup>o</sup>, Deon Hines<sup>o</sup>, Jacinto Beard<sup>p</sup>, Taiwo A. Lawal<sup>q</sup>,  
 Azeez Butali<sup>h,i</sup>

<sup>a</sup> Missouri School of Dentistry and Oral Health, A.T. Still University, Kirksville, Missouri, USA

<sup>b</sup> Department of Periodontology and Community Dentistry, University of Ibadan and University College Hospital, Ibadan, Nigeria

<sup>c</sup> Consortium for Advanced Research Training in Africa (CARTA), Nairobi, Kenya

<sup>d</sup> Department of Child Oral Health, University of Ibadan and University College Hospital, Ibadan, Nigeria

<sup>e</sup> Department of Preventive Dentistry, Faculty of Dentistry, Lagos State University College of Medicine, Lagos, Nigeria

<sup>f</sup> Department of Oral Diagnostic Sciences, Faculty of Dentistry, Bayero University Kano, Kano, Nigeria

<sup>g</sup> Department of Oral Diagnostic Sciences, Aminu Kano Teaching Hospital, Kano, Nigeria

<sup>h</sup> Department of Oral Pathology, Radiology and Medicine, College of Dentistry, University of Iowa, Iowa City, Iowa, USA

<sup>i</sup> Iowa Institute for Oral Health Research, University of Iowa, Iowa City, Iowa, USA

<sup>j</sup> School of Public Health, University of Nevada, Reno, Nevada, USA

<sup>k</sup> Department of Oral and Maxillofacial Surgery, Lagos University Teaching Hospital, Idi-Araba, Lagos, Nigeria

<sup>l</sup> Department of Restorative Dentistry, Lagos University Teaching Hospital, Idi-Araba, Lagos, Nigeria

<sup>m</sup> Department of Preventive Dentistry, Aminu Kano Teaching Hospital, Kano, Nigeria

<sup>n</sup> Faculty of Dentistry, Bayero University, Kano, Nigeria

<sup>o</sup> Colgate-Palmolive Company, Piscataway, New Jersey, USA

<sup>p</sup> National Dental Association Foundation, Washington, DC, USA

<sup>q</sup> Department of Surgery, Division of Pediatric Surgery, University of Ibadan and University College Hospital, Ibadan, Nigeria

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## ABSTRACT

**Introduction:** Educating primary healthcare workers (PHCWs) on oral health and its association with systemic health, as well as equipping them with skills to identify common oral diseases for referral to the dentist, is crucial for improving overall health outcomes in underserved regions. However, traditional oral health education programs for PHCWs have yet to increase patient referrals to dental centers significantly, hence the need for competency-based oral health training. This study evaluated the effectiveness of a competency-based oral health training pilot program – Project OHE-NCHeW on the oral health

\* Corresponding author. Missouri School of Dentistry and Oral Health, A.T. Still University, 1500 Park Ave, St. Louis, MO 63104, Kirksville, Missouri, USA.

E-mail address: [abimbolaoladayo@atsu.edu](mailto:abimbolaoladayo@atsu.edu) (A.M. Oladayo).

Abimbola M. Oladayo: <http://orcid.org/0000-0002-9934-1803>

Folake B. Lawal: <http://orcid.org/0000-0002-3193-387X>

Oyinkansola O. Sofola: <http://orcid.org/0000-0001-8848-5038>

Afolabi Oyapero: <http://orcid.org/0000-0003-4433-8276>

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Adetayo Aborisade: <http://orcid.org/0000-0003-2031-4915>

Omotayo F. Fagbule: <http://orcid.org/0000-0002-1351-9659>

Adeola T. Williams: <http://orcid.org/0000-0003-1915-2138>

Ejìro Idìga: <http://orcid.org/0000-0001-8567-8002>

Yahya-Imam Abdul-Kabir Adegokè: <http://orcid.org/0009-0004-9546-6555>

Amìna Sani Baffa: <http://orcid.org/0009-0006-5170-5491>

Taiwo A. Lawal: <http://orcid.org/0000-0002-8632-5783>

**Key words:**

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knowledge and referral practices of nurses and community health workers (CHWs) in Nigeria.

**Methods:** We utilized a quasi-experimental design with pre-and post-test assessments. One hundred twenty nurses and CHWs (60 intervention, 60 control) across Lagos, Kano, and Ibadan were recruited via cluster sampling. The intervention group underwent a 5-day competency-based oral health training, while the control group received a single-session lecture. Evaluations were conducted immediately after training and 3 months later to assess knowledge, attitudes, and referral practices (KAP) using a validated questionnaire.

**Results:** Overall, the mean age of the participants was  $41.4 \pm 10.3$  years, with an average of  $15.3 \pm 9.8$  years of practice. Both groups had similar baseline KAP scores. Post-training, the intervention group showed significant improvements in oral health knowledge ( $P < .0001$ ) and practice scores ( $P = .0096$ ) only. Referral outcomes varied by location, with Kano logging the highest number of referrals (60.0%), and many (57.5%) of the referred patients attended the clinic (57.5%). Decayed teeth (44.1%) and gum diseases (30.8%) were the most common reasons for referral across all sites.

**Conclusion:** The pilot training significantly enhanced the PHCW's oral knowledge and referral practices, demonstrating the potential to strengthen primary care and inform policies aimed at integrating oral health into primary care frameworks for broader public health impact.

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## Introduction

Oral diseases are a major global public health problem with particular concern over their rising prevalence and substantial costs in many low-income and middle-income countries (LMICs).<sup>1-3</sup> Equitable access to oral health services remains a global challenge, and impoverished populations in sub-Saharan Africa continue to bear a heavy burden of oral diseases.<sup>3</sup> In Nigeria, the persisting oral health disparities are further marked by an acute shortage of trained personnel and weak oral health policy implementation.<sup>4,5</sup> Given the dire oral health indices, care delivery models that ensure accessibility, quality, and efficiency are thus crucial as short-term approaches such as mobile dental clinic outreaches,<sup>6</sup> school-based dental programs,<sup>7</sup> and oral health missions<sup>8</sup> have been tried but lack sustainability.<sup>8</sup> Thus, addressing Nigeria's oral health crisis requires effective strategies, including improving health literacy, enhancing access to preventive and curative services, integrating oral health into broader health policies, and implementing task shifting.

Task shifting oral healthcare duties to non-dental primary healthcare (PHC) personnel is a feasible model for providing quality care, supported by its success in managing medical conditions.<sup>9</sup> The PHC system and its workers, particularly nurses and CHWs, are critical for bridging service gaps and delivering comprehensive care, acting as first responders for community health, and playing key roles in oral health promotion and education.<sup>10,11</sup> Previous Nigerian studies show that PHC workers can be trained as oral health educators, especially in underserved areas.<sup>12,13</sup> Some African countries have implemented community-driven oral health programs but lacked standardized models to ensure proper implementation.<sup>14,15</sup>

Furthermore, traditional oral health training may not fully utilize the potential of these personnel as it often prioritizes knowledge over the practical skills needed for clinical tasks.

This can leave healthcare workers lacking the confidence and proven ability to perform effectively. Competency-Based Education (CBE) addresses these challenges by focusing on demonstrating specific, job-relevant skills and competencies rather than just time spent in training.<sup>16-18</sup> This approach, supported by findings emphasizing observable outcomes, enhances educational relevance and learner engagement through activities applicable to clinical practice.<sup>17-20</sup>

While OpenWHO offers valuable oral health resources for Africa,<sup>21</sup> its coverage of specialized areas like maternal and child oral health (MCOH) is limited. Recognizing the disproportionate impact of oral healthcare gaps on vulnerable groups, including infants, young children, and pregnant women,<sup>13,22</sup> we supplemented the standard OpenWHO modules with a dedicated MCOH module.<sup>10</sup> Co-developed by experts with a Nigerian focus, this module provided culturally appropriate information addressing specific MCOH needs, including common diseases and stigmatized conditions like orofacial clefts and Noma. This integration aims to enhance the curriculum and better prepare PHC workers to address significant MCOH challenges in their communities.

This study, therefore, aimed to assess the impact of a structured 5-day oral health education program on nurses and CHWs knowledge and referral practices in selected regions of Nigeria using the modules from the recently launched standardized oral health promotion course for community health workers in Africa provided by the OpenWHO and an additional, dedicated MCOH module.

### Study objective

This study reports on the adaptation, development, facilitation, and evaluation of a 5-day pilot of the Project OHE-NCHeW modules among Nurses and CHWs in 3 Nigerian states. It also examined the impact of the standardized

OpenWHO oral health promotion modules and an additional maternal and child oral health (MCOH) module on participants' oral health knowledge and referral practices.

## Methods

### Study design

A non-randomized quasi-experimental study (pre-and post-with a nonequivalent control group) was conducted to assess the impact of a 5-day pilot oral health education program on the knowledge level and referral practices of Nurses and Community Health Workers in PHCs in 3 States in Nigeria (Lagos, Oyo, and Kano). This design was chosen for practical reasons, specifically to minimize potential contamination between the intervention and control groups by utilizing geographic distance from the training center. To mitigate bias, we used cluster sampling to ensure representative selection and matched intervention/control groups by proximity (to control for access to dental clinics). A pre-training evaluation was conducted before the commencement of training, and a post-evaluation was conducted immediately and 3 months after training.

### Sample size estimation

A sample size of 30 participants per group is recommended for pilot studies.<sup>23,24</sup> We recruited 40 nurses and community health workers per site using cluster sampling, totaling 120 participants (60 intervention, 60 control) across 3 sites. The study protocol provides details on sample size estimation and participant selection.<sup>10</sup>

### Inclusion and exclusion criteria

Eligibility criteria included full-time nurses or community health workers aged 18 and above with no prior oral health training. The full inclusion/exclusion criteria are detailed in the study protocol.<sup>10</sup>

### Participant involvement

The Nurses and CHWs engaged in this study were not directly involved in the design or conduct of the research. However, participants were added to a WhatsApp group to maintain communication and engagement post-training. The study's outcomes will be shared with participants through this platform, ensuring they are informed of the findings and can provide feedback. This approach ensures ongoing involvement in the dissemination process.

### Participant recruitment

In Lagos state, ethical approval was obtained from the University of Lagos/Lagos University Teaching Hospital Institutional Review Board. Permissions to conduct the study were obtained from the Permanent Secretary of the Lagos State Primary Health Boards (LSPHB), State Health Districts, and Directors of Nursing and Community Services. The nominal

rolls of nurses and community health workers served as the sampling frame, with 5 nurses and 5 community health workers selected from each district through simple random sampling (balloting). To prevent contamination, participants from distant districts were assigned to the control group, while those closer to the training center formed the intervention group (Districts II and IV for intervention, I and VI for control). De-identified participant codes were generated using a table of random numbers.

In Kano State, study approval and relevant permissions were obtained from the Aminu Kano Teaching Hospital Health Research Ethics Committee and permission from the Kano State Primary Healthcare Management Board. Twenty CHWs and 20 nurses were randomly selected from primary healthcare centers in Sharada, Madatai, Dan Maliki, Ja'en, Fuskar Gabas, and the AKTH community health outposts at Kumbotso and Gyadi Gyasi. De-identified codes were assigned, and participants were divided into control and intervention groups considering PHC proximity to avoid contamination.

In Oyo State, ethical approval was obtained from the University of Ibadan/ University College Hospital Ethics Review Board, and permissions to conduct the study were obtained from the Executive Secretary of the Oyo State Primary Health Care Board and the Head of the Department of the Primary Health Care Centre, University College Hospital for the release of the nurses at the Primary Health care center Six local government areas (LGAs) were randomly selected (balloting) from 11 LGAs that make up Ibadan. Lists of nurses and CHWs were obtained from the Primary Health Care Board, and eligible participants were contacted by phone. A total of 40 participants were recruited based on availability. To avoid contamination, participants from the same LGA were grouped together, with those from more distant PHCs forming the control group<sup>20</sup> and those closer to the training center assigned to the intervention group.<sup>20</sup>

### Intervention and control group

The intervention and control groups had similar characteristics. Day one included an introductory session to familiarize trainers and trainees. Participants then completed a self-administered pre-intervention questionnaire using Qualtrics to assess their baseline oral health knowledge. Control group participants received a single-session oral health lecture on oral health, tooth brushing, diet, and oral hygiene demonstration using dental models, followed by a post-test the same day.

The intervention group underwent a weeklong oral health education pilot training, with a separate module delivered daily by designated trainers- licensed dentists who were members of the study team. They also participated in activities such as oral exams, adapting local health education songs to oral health, filling activity sheets, demonstrating dental floss use and toothbrushing techniques, and Question and Answer (Q&A) sessions. After the fifth day of training, the intervention group completed a post-test; this was repeated after 3 months to monitor training impact and improvement. The questionnaires were developed based on the educational modules, focusing on the core content covered in the

training. Subject matter experts reviewed the modules to create relevant questions, ensuring the effective assessment of participants' knowledge and understanding.

## Instrument

### Training modules

The modules utilized for this project consist of an adaptation of the first 4 competency-based modules of the "Oral Health Training Course for Community Health Workers in Africa" developed by the World Health Organization,<sup>21</sup> Oral Health in Comprehensive Cleft Care Educational Resources for Non-oral Health Professionals developed by the World Dental Federation<sup>25</sup> and a maternal and child oral health (MCOH) module, co-developed by our team, focusing on conditions such as orofacial clefts and Noma, incorporating expertise from dental education, public health, and dental public health fields. This tailored module addressed stigmatizing conditions and provided specialized knowledge relevant to maternal and child oral health.<sup>10</sup> The principal investigator and team members completed all training and specialized modules for designated trainers. Research team members fluent in local languages (Hausa, Yoruba, and Fulfulde) provided summaries and interpretations of complex terms. In Lagos and Ibadan, designated Yoruba-speaking participants summarized each day's training module and led associated activities. In Kano state, Hausa is the most spoken language, with Fulfulde being the second most spoken language. Three of the Kano project members were native Hausa speakers, 2 project members spoke Fulani (Fulfulde) fluently, and the entire team spoke Hausa to varying degrees. Each training session lasted approximately 4 hours, as outlined in the protocol by Oladayo et al.<sup>10</sup>

Sessions began with lectures by a designated instructor, followed by a Q&A session where the participants interacted with the trainers and each other to assess initial understanding and provide clarifications where needed. Participants then completed multiple-choice questions to evaluate the modules objectively. The instructor randomly selected the participants to answer each question. To ensure accurate dissemination, participants were randomly selected to explain each module's concepts and verify their understanding of complex terms and key aspects.

### The introductory module

All participants completed a pre-training questionnaire for baseline evaluation. Both groups received the introductory module (Module 1) of the OpenWHO training. The introductory module comprises general oral health information, preventive strategies, common oral health conditions, and appropriate oral hygiene protocols.

### Core modules

Modules 2 to 4 of the OpenWHO training module for CHWs were administered only to the intervention group participants. This included an introduction to oral diseases and

conditions, techniques in oral health promotion and prevention, and school and community-based oral health promotion. The authors also developed an additional MCOH module for the intervention group. Each session was conducted using objective evaluation activities.

### Activity sheet for the post-didactic session group activities

After the didactic sessions each day, participants in the intervention group were allotted to their randomly pre-assigned groups for post-didactic module activities. We assigned different activities to the individual groups, and an assigned instructor moderated the activities of each group. The instructors informed each participant of the desired outcome of the group assignment. Group members were then required to allocate tasks among themselves and perform the requisite activities under the supervision of the instructors. These tasks include identifying parts of the oral cavity, differentiating between primary and permanent teeth, and recognizing healthy gum characteristics.

Additionally, participants were presented with pictures of common oral conditions such as tooth decay, gum diseases, and oral cancer. At the end of the activity section, all groups were reassembled for a joint session, and participants were randomly selected for demonstrations of the learned outcome. The activity sessions were then rounded up with a review of each module's learning objectives and the learning outcomes of the individual group assignments. Overall, the activities ensured participatory learning while helping participants to develop practical skills necessary for the effective implementation of lessons learned (see [supplemental material](#)).

### Logbook

Following the completion of the training, participants were presented with a comprehensive logbook to assess their oral health promotion activities and the rate and types of referrals made to the dental centers from the PHCs. The logbook tracked a range of weekly oral health promotion tasks, from recommending healthy diets to encouraging regular dental visits every 6 months. It also recorded referrals to secondary or tertiary hospitals, noting the number of patients referred and the conditions they were referred for (see [supplemental material](#)). This thorough assessment allowed for a comprehensive evaluation of participants' application of their training in their professional settings.

### KAP questionnaire

To evaluate the impact of the oral health training program, we used a web-based questionnaire via Qualtrics, which consists of 4 sections- (sociodemographic information, oral health knowledge, oral health attitudes, and oral health practices (KAP)) for the pre-and post-training assessments. The pre-training assessment established baseline KAP levels, while the post-training assessment measured changes and improvements resulting from the training. The KAP conceptual model, a widely used framework for assessing knowledge, attitudes, and practices across several research

settings, was employed to structure the questionnaire and guide the evaluation process.<sup>26-33</sup> To ensure the reliability and validity of the questionnaire, a pilot study was conducted with fifteen participants who were not part of the main study. This helped refine the questionnaire by identifying any ambiguities and ensuring the clarity and appropriateness of the questions. The feedback was used to make necessary adjustments, ensuring that the final version of the KAP questionnaire effectively captured the intended data on oral health KAP.

The oral health knowledge section consists of 18 questions, while the oral health attitude and oral health practice section consists of 9 questions and 6 questions, respectively. These questions were selected based on their frequent use in oral health KAP studies.<sup>27,28,32-37</sup> Participants got a score of 1 for the correct options selected and zero otherwise. Based on the scoring cut-offs used in previous studies, a score of 60% was considered average to good for each of the sections<sup>38,39</sup> (see [supplemental material](#)).

### Post-training evaluation

An immediate post-introductory module evaluation was administered to the control group on the first day of the program, after which subjective feedback was obtained from this cohort. For the members of the intervention cohort, the post-training evaluation was administered after the completion of all training modules. The post-training evaluation comprised a summative assessment test, post-training evaluation test, and course evaluation assessment. Individual groups were randomly selected to complete the summary assessment outlined in the OpenWHO training module. The summative assessment questions were moderated by designated instructors who had previously completed the designated training guide. Each instructor explained the basis of the assessment to the selected participants before administering the assessment. Selected participants were allowed 10 min to read through the summative essay before the Q&A session with the instructor.

The summative assessment comprised 2 sections: the knowledge section and the behavioral section. It was guided by a detailed marking scheme that provided all possible answers to the moderated questions. Each section summed up to 25 marks, and a participant was judged to have passed if they scored 18 marks. A post-training evaluation was administered to all the participants in the training group. All participants completed the course evaluation assessment forms.

### Program assessment

The quantitative evaluation involved administering questionnaires by trained facilitators, with data managed using Qualtrics software. Pre-training tests measured the initial oral health knowledge. The control group received a post-training evaluation immediately after the introductory lecture, whereas the intervention group took a post-test at the end of the 5-day training. The pre-and post-test scores for both groups were compared. Participants' abilities to screen for and detect oral diseases were also evaluated post-training

with picture tests. Three months later, a follow-up evaluation was conducted. The number of referrals from primary health-care centers to dental centers for oral health conditions during 3 months post-training was recorded. Data was collected from February to May 2024.

### Statistical analysis

Only respondents with complete responses to the questionnaires were retained for data analysis. Univariate analyses were conducted on both continuous and categorical variables, with descriptive statistics used to summarize these variables as appropriate. Simple proportions were calculated to determine the percentage of the cohort that scored above the established performance thresholds in the pre-training and post-training tests. This analysis provided a preliminary assessment of how well the training program improved participants' KAP scores. We employed parametric tests based on the Central Limit Theorem, which justified their use with our sample sizes exceeding the conventional threshold of 30 observations per group.<sup>40</sup> Our analyses met this criterion across all comparison groups, supporting the robustness of our parametric approach. Parametric tests, specifically t-tests, were used to compare the mean scores between intervention groups and controls in the KAP categories. Comparisons were also conducted across all 3 testing categories in the control group.

To account for the clustered nature of the data, we employed Generalized Estimating Equations (GEE) with a Poisson distribution and log link function to evaluate changes in oral health knowledge, attitude, and practice scores across 3 assessment points: pre-test (baseline), immediate post-test, and 3-month post-test. GEE is appropriate for quasi-experimental designs involving non-randomized clusters, as it adjusts for intra-cluster correlation and accommodates correlated observations within participants over time. An exchangeable correlation structure was assumed, indicating an equal correlation between any two time points within a participant. The GEE analysis was conducted separately for each outcome variable: oral health knowledge, oral health attitude, and oral health practice. This approach allowed us to appropriately adjust for clustering effects and improve the validity of statistical inferences. A Cronbach's alpha score of 0.62 demonstrated the validity of the structured questionnaires administered in this study. All statistical analyses for this study were carried out in SAS version 9.4.

## Results

A total of 120 primary healthcare workers (Nurses and CHWs) were recruited for this study. We sampled 40 individuals per study group at each of our study sites in Lagos, Kano, and Ibadan. The majority of our study sample (66.0%) were of Yoruba ethnicity, identified as females (88.9%), and had attained tertiary education (98.0%). The professional distribution included 46.6% nurses and 44.9% community health workers (CHWs), with only 1 midwife enrolled in this study ([Table 1](#)).

The overall mean age of the participants was  $41.4 \pm 10.3$  years (intervention:  $39.4 \pm 10.5$  vs controls:  $43.6 \pm 10.1$ ).

**Table 1 – Respondent characteristics.**

Study sample (n =118)	%	N	Interventions % (58)	Controls % (60)	P-value
<b>Ethnicity</b>					
Hausa	26.3	31	29.3 (17)	23.3 (14)	.7933*
Igbo	2.5	3	3.4 (2)	1.7 (1)	
Yoruba	66.0	78	62.1 (36)	70.0 (42)	
Others	5.2	6	5.2 (3)	5.0 (3)	
<b>Education</b>					
Secondary	1.7	2	1.7 (1)	1.7 (1)	1*
Tertiary	98.3	116	98.3 (57)	98.3 (59)	
<b>Occupation</b>					
Nurse	46.6	55	50.0 (29)	43.3 (26)	.358*
Midwife	0.9	1	0	1.7 (1)	
CHWs	44.9	53	39.7 (23)	50.0 (30)	
CHO	7.6	9	10.3 (6)	5.0 (3)	
Age		118	39.38	43.55	.02753
Years of practice		115	14.51	16.07	.396

CHWs, Community Health Workers; CHOs, Community Health Officers.

\* Fisher's exact.

**Table 2 – Proportion of participants with average-to-good scores ( $\geq 60\%$ ) in oral health knowledge pre- and post-training.**

	pre-training n (%)	post-training n (%)
Oral health knowledge	44 (37.3)	75 (63.6)
Oral health attitude	107 (90.7)	112 (94.6)
Oral health practice	104 (88.1)	114 (96.6)

Our study cohort represented a wide range of experience levels, with an average number of years of practice since graduation of  $15.3 \pm 9.8$  years. Table 2 shows the proportion (%) of participants scoring  $\geq 60\%$  (the threshold for "average-to-good" KAP). The results show that prior to the training, 37.3% of the participants had average-to-good oral health knowledge scores; this increased to 63.6% post-training. For oral health attitude, a high proportion of participants already had average-to-good scores at baseline, 90.7%; this proportion slightly increased to 94.6% after the training. Similarly, for oral health practices, 88.1% of participants reported average-to-good practices at baseline, which rose to 96.6% post-training.

The overall baseline knowledge, attitude, and practice scores for both groups pre-training were similar (Table 3), with an overall average of  $9.9 \pm 2.1$  for knowledge,  $4.9 \pm 1.3$  for practice, and  $7.5 \pm 1.8$  for attitude. Table 3 summarizes the t-tests comparing the baseline and immediate post-training scores for each group. None of the categories examined reached statistical significance ( $P$ -value  $> .05$ ).

Immediately following the training session, both groups took part in a post-session evaluation to assess the impact of the training on their knowledge, attitude, and practice. The results of this intermediate test are summarized in Table 3. Compared to the controls, the participants assigned to the intervention group showed a significant improvement in knowledge scores. However, no significant differences were observed between the intervention and control groups in the attitude and practice subcategories. A subsequent test was conducted 3 months after the training program to assess the long-term impact on the participants exposed to the intervention alone.

Overall, changes in the means were observed across the 3 domains of our outcome following the training. The results of these analyses are summarized in Table 4. Oral Health Knowledge scores increased significantly from the pre-test to the immediate post-test ( $P < .0001$ ) and remained significantly higher at the 3-month follow-up ( $P < .0001$ ). However, a slight, marginally significant decline was noted between the immediate post-test and 3-month follow-up ( $P = .0420$ ), suggesting some decay over time. Similarly, the Oral Health Attitude showed a significant increase from the pre-test to both the immediate post-test ( $P = .0228$ ) and the 3-month follow-up ( $P = .0320$ ). However, there was no significant difference between the immediate post-test and the 3-month follow-up ( $P = .6857$ ), indicating sustained improvement in attitudes. Oral Health Practice scores improved significantly from the pre-test to the immediate post-test ( $P = .0064$ ) and further at 3 months ( $P = .0001$ ). The difference between immediate post-

**Table 3 – Comparison of KAP scores between intervention and controls.**

	Intervention (mean [SD])	Controls (mean (SD))	t statistic	P value
Pre-training oral health knowledge score	9.9 (1.9)	9.9 (2.2)	0.2	.85
Post-training oral health knowledge score	12.8 (2.3)	10.8 (1.8)	5.3	<.0001*
Pre-training oral health attitude score	7.7 (1.7)	7.3 (1.8)	1.2	.24
Post-training oral health attitude score	8.2 (1.5)	8.3 (1.1)	-0.5	.66
Pre-training oral health practice score	5.0 (1.1)	4.8 (1.5)	0.9	.06
Post-training oral health practice score	5.5 (0.9)	5.6 (1.0)	-0.5	.62

\* Indicates statistical significance at  $P > .05$ .

**Table 4 – GEE analysis of changes in knowledge, attitude, and practice scores at three assessment points (pre-test, immediate post-test, 3-month post-test) in the intervention group.**

Outcome	Time comparison	Estimate	Standard error	95% CI	Z-statistic	P-value
Oral health knowledge	Immediate vs Pre-test	0.257	0.026	0.207, 0.308	9.98	<.0001
	3-Month vs Pre-test	0.181	0.040	0.104, 0.259	4.58	<.0001
	Immediate vs 3-Month	0.076	0.037	0.003, 0.149	2.03	.0420
Oral health attitude	Immediate vs Pre-test	0.067	0.029	0.009, 0.124	2.28	.0228
	3-Month vs Pre-test	0.079	0.037	0.007, 0.150	2.14	.0320
	Immediate vs 3-Month	-0.012	0.029	-0.070, 0.046	-0.40	.6857
Oral health practice	Immediate vs Pre-test	0.088	0.032	0.025, 0.152	2.73	.0064
	3-Month vs Pre-test	0.111	0.029	0.054, 0.168	3.82	.0001
	Immediate vs 3-Month	-0.023	0.027	-0.075, 0.030	-0.84	.4013

\*Statistically significant at  $P < .05$ .  $\beta$  = Estimated change in log outcome score from the GEE model (log link Poisson distribution exchangeable correlation structure).

**Table 5 – Referral outcomes and follow-up rates in Lagos, Kano, and Ibadan.**

	Lagos n (%)	Kano n (%)	Ibadan n (%)
Referrals logged	112	303	88
Referred patients who reached out to the clinic	93 (83.0)	185 (61.1)	11 (0.125)
Referred patients with decayed tooth	33 (29.5)	138 (45.5)	51 (0.58)
Referred patients with gum diseases	29 (25.9)	102 (33.7)	24 (0.27)
Referred patients with cleft lip/palate	3 (0.02)	3 (0.009)	1 (0.01)
Referred patients with Cancrum Oris	0	1 (0.003)	1 (0.01)
Referred patients with swelling around the head and neck region	1 (0.009)	17 (0.06)	3 (0.03)
*Referred patients with other oral conditions	47 (42.0)	42 (0.14)	8 (0.09)

\* Other oral conditions reported by participants for referral include poor oral hygiene, tongue tie, stained teeth, dentoalveolar abscess, tooth fracture, dental sensitivity, oral malodor, and foreign body impaction in the gingiva and natal tooth.

test and 3-month follow-up was not statistically significant ( $P = .4013$ ), suggesting maintained or only slightly improved practices over time.

Referral and Follow-up Rates extracted from the Weekly Logbook of the participants

The logbook data revealed differences in referral outcomes across Lagos, Kano, and Ibadan. In Lagos, a high number of referrals were logged, and a majority of referred patients reached the clinic. Most referrals were for decayed teeth and gum diseases, with fewer cases of cleft lip/palate, head and neck swellings, and other conditions. Kano had the highest number of referrals, with a substantial number of patients attending the clinic. Referrals were predominantly for decayed teeth and gum diseases, followed by head and neck swellings and other oral conditions. Ibadan had the fewest referrals and clinic follow-ups. Decayed teeth and gum diseases were the most common reasons for referrals, with a smaller number of cases for cleft lip/palate, Cancrum Oris, head and neck swellings, and other conditions. Overall, these results demonstrate significant variability in referral follow-up rates and the types of oral health conditions encountered across the 3 locations as shown in Table 5.

## Discussion

This intervention study in 3 Nigerian cities aimed to integrate oral health into primary care by training primary health workers (nurses and CHWs). The program effectively improved participants' oral health knowledge, attitudes, and practices, with notable but varied referral outcomes across locations.

The predominantly female participation in this study aligns with other studies in similar settings,<sup>12,41-43</sup> reflecting the gender distribution in PHC workforces and the nursing profession.<sup>44</sup> This offers a strategic advantage for oral health integration, as female providers often exhibit strong communication and empathetic skills crucial for effective education and prevention.<sup>45,46,47</sup> Patients, particularly women and children, may feel more comfortable discussing health issues with female providers, potentially improving education uptake and adherence.<sup>48,49</sup> Additionally, their significant role in maternal and child health services further positions them to integrate oral health into routine care.<sup>50</sup>

Our study found that most participants had inadequate baseline oral health knowledge, with only about a third showing average to good knowledge. This finding aligns with some previous studies.<sup>42,51</sup> However, it contrasts with others,<sup>12,41,43</sup> a variation possibly due to differing assessment methods, which further limits the direct comparisons of oral health knowledge across studies. Nevertheless, a common finding across studies<sup>12,41,43,52</sup> and consistent with ours is the acknowledged need to improve healthcare workers' oral health knowledge, likely stemming from insufficient prior training and a lack of structured oral health content in their curricula. Prioritizing such training programs for PHC workers is essential for sustainable oral health integration.

Despite limited baseline knowledge, most participants reported positive attitudes and good oral health practices, consistent with other Nigerian studies among nurses and CHWs.<sup>12,52</sup> This positive outlook likely stems from their daily exposure to the consequences of poor oral health and their focus on preventive care, reinforcing the value they place on oral health. Their positive attitudes, practices, and willingness to learn justify leveraging them to enhance oral health awareness and access in Nigeria,<sup>12,41,43,53</sup> particularly given the severe shortage of oral health professionals.<sup>8</sup> Their openness underscores the feasibility of future initiatives.

The training significantly improved participants' oral health knowledge, aligning with findings in similar Nigerian studies among CHWs<sup>12,41,43</sup> and nurses.<sup>42</sup> This knowledge gain was sustained at the 3-month follow-up, with only a slight, non-significant reduction, consistent with previous reports of sustained knowledge increases despite some decline over time.<sup>12,42</sup> Such post-training knowledge decline is expected without reinforcement, a trend observed in other health training like cardiopulmonary resuscitation.<sup>54,55</sup> However, a key limitation of our study is the 3-month follow-up period, which is relatively short to comprehensively assess the long-term sustainability of the observed improvements in KAP, particularly referral behaviors, highlighting the need for extended evaluation and the assessment of the long-term effectiveness of these interventions in future studies.

While the training significantly enhanced participants' oral health knowledge, we observed a less pronounced or statistically non-significant improvement in their reported oral health attitudes and practices following the intervention, particularly when compared to the substantial knowledge gains. This finding, though seemingly counterintuitive, is common in health education, where translating knowledge into sustained behavioral change is challenging. Several factors could explain this. Firstly, changing ingrained attitudes and practices requires more intensive and prolonged intervention than knowledge acquisition. Attitudes and practices are complex and influenced by personal beliefs, habits, and environmental factors, which a short training may not sufficiently impact. Secondly, applying new skills in busy, resource-constrained Nigerian PHCs faces practical challenges like heavy workload, lack of equipment, limited consultation time, or inadequate support, hindering the translation of positive intentions into consistent practice. Thirdly, self-reported attitudes and practices are susceptible to social desirability bias; objective assessments are needed for a more robust evaluation. Furthermore, while competency-based, the training focused more on knowledge and identification than on behavioral change strategies, counseling techniques, or practical integration into workflows. In summary, while knowledge increases, significant behavioral change likely requires multifaceted interventions beyond initial training, including ongoing mentorship, resources, and supportive structures.

The training led to participants referring patients to dental clinics, indicating a likely improvement in referral practices, consistent with a similar study in Lagos.<sup>41</sup> Training healthcare workers is known to increase the detection and referral of oral health problems.<sup>56,57</sup> Beyond simply increasing knowledge, the competency-based nature of the training, including practical sessions, likely enhanced confidence and skills in recognizing oral health issues and clarifying their referral role. These factors likely contributed significantly to the observed improvement in referral practices. However, referrals varied by site, with Kano having the highest and Ibadan the lowest. Moreover, over half of the referred patients eventually presented at dental clinics, a higher proportion than in a previous Lagos study.<sup>41</sup> While this study did not investigate the reasons, variations observed in referral across study sites could be due to several factors such as varying prevalence of oral diseases, local healthcare infrastructure, differences in patient volume, efficiency of existing referral pathways,

socioeconomic conditions, prior relationships between PHCs and dental clinics, and cultural health-seeking behaviors such as favoring traditional healers over dental clinics,<sup>8</sup> or unmeasured contextual factors unique to Lagos, Kano, and Ibadan. Future qualitative research exploring the perspectives of both healthcare workers and patients in these distinct settings could provide valuable insights into these contextual influences.<sup>12,58,59</sup> Within 3 months, participants identified and referred patients with various oral problems, including severe conditions like Noma and cleft lip/palate. While we cannot definitively state that these conditions would have been missed without training, previous cases show PHC workers have missed or delayed referrals for such conditions.<sup>60-63</sup> Identifying and referring patients with these oral health conditions, who might otherwise have been overlooked, justifies this study and highlights the need for integration.

### Limitations

This pilot study has several limitations that should be acknowledged. First, we assessed the impact of training on PHC workers' knowledge, attitudes, practices, and initial referral behaviors – along with patient presentation rates at clinics – we did not systematically collect data on the specific treatments received by patients or their treatment completion rates. This limits our ability to evaluate the ultimate effectiveness of the referral pathway on patient health outcomes. Future studies should incorporate follow-up mechanisms to track treatment adherence and clinical outcomes to provide a more comprehensive assessment of the intervention's impact.

Second, regional differences across the 3 states may have introduced variability in outcomes due to unmeasured contextual factors, such as disparities in dental clinic accessibility or socioeconomic status potentially influencing the observed outcomes. While our analysis adjusted for clustering effects and demonstrated baseline equivalence between groups, residual variability due to contextual factors cannot be ruled out. Further research should explore these confounders to understand better their role in shaping intervention outcomes. Lastly, as a pilot program with a 3-month evaluation period, this study shows promising trends in KAP scores and referral practices (Table 4). However, longer-term assessments are needed to determine whether these improvements are sustained over time and translate into lasting changes in service utilization. Future investigations would benefit from randomized cluster designs to strengthen causal inference, though our use of GEE models mitigates some biases inherent in quasi-experimental designs. Despite these limitations, the findings provide valuable preliminary evidence for scaling and refining the intervention.

### Conclusion

The training improved the knowledge, attitudes, and practices of nurses and community health workers regarding oral health. Notably, they identified and referred patients with oral health conditions, including those often missed, like

Noma and cleft lip/palate. These positive outcomes highlight the importance of targeted training for PHC providers to enhance oral health outcomes. The findings support the need for policy changes to incorporate oral health training in PHC services as part of the overall strategy of incorporating oral health into the PHC system and advocate for better resource allocation to sustain these efforts. While our findings at 3 months are promising, the relatively short follow-up period limits our ability to definitively assess the long-term sustainability of these improvements and their ultimate impact on population oral health outcomes. Future research should focus on the long-term impacts of such integrations and explore ways to overcome persistent barriers to accessing oral healthcare.

### Conflict of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Abimbola M. Oladayo reports financial support was provided by Colgate Palmolive. Abimbola M. Oladayo reports financial support was provided by National Dental Association Foundation. Bernal Stewart reports a relationship with Colgate Palmolive that includes: employment. Carlo Amorin Daep reports a relationship with Colgate Palmolive that includes: employment. Deon Hines reports a relationship with Colgate Palmolive that includes: employment. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### Author contributions

AMO: Funding acquisition and writing – original draft. AMO, FBL, OS, OU, AO, AA, AB: conceptualization, methodology, resources, writing – review & editing. All other authors contributed to the review and editing of the final version of the manuscript.

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### Supplementary materials

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.identj.2025.100891](https://doi.org/10.1016/j.identj.2025.100891).

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