

Cariology Curriculum in Nigerian Dental Schools: A Baseline Survey of Teaching Practices

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ABSTRACT

Background: Dental caries remains a widely prevalent disease, affecting approximately 2.5 billion people and causing a significant public health burden despite a decline in many regions. Socioeconomic disparities and limited access to care emphasize the need for preventive strategies. The modern understanding of caries as a dynamic, biofilm-mediated, sugar-driven disease has led to a shift toward non-surgical management, risk assessment, early detection, and patient-centered care. This transition requires updates in dental curricula. However, there is currently no data on African cariology curricula. Given Nigeria's documented burden of untreated caries and its substantial dental infrastructure, this study provides baseline data for future development of African cariology curricula.

Objectives: To investigate how cariology is taught in Nigerian dental schools—whether as a course or integrated topic—and identify participating departments. The study also explored faculty knowledge of core cariology curricula, diagnostic and management strategies, and implementation gaps.

Methods: A cross-sectional online survey was distributed via WhatsApp to Deans of all accredited Nigerian dental schools, who forwarded it to faculty involved in cariology teaching. Data from 20 respondents across nine schools (64.3% response rate) were analyzed using descriptive statistics.

Results: Most participants (75%) indicated that cariology is taught as a combined course, mainly within Restorative Dentistry (95%). While 60% knew the five domains of cariology, only 25% could list them. Visual–tactile and radiographic methods of caries detection were universally taught. The most common preventive strategy was diet modification (90%), while Glass Ionomer Cement restorations (90%) were the most common surgical intervention. Only 45% offered hands-on cariology workshops.

Conclusion: This first baseline study highlights knowledge gaps and the need for faculty development and standardized cariology curricula across Nigerian dental schools to align with global standards.

Keywords: Dental caries, Nigeria, cariology, curriculum, faculty development, competency-based education

INTRODUCTION

Dental caries remains one of the most prevalent chronic diseases globally, affecting individuals across all age groups and posing significant health, social, and economic burdens. (Petersen, 2005, GBD, 2017). Approximately 2.5 billion people globally are affected by dental caries, with a high prevalence of untreated cases. (Alves-Costa et al., 2025; WHO, 2022). It is now widely recognised as a dynamic, biofilm-mediated disease influenced by a complex interaction of biological, behavioural, and environmental factors, necessitating preventive, risk-

based, and minimally invasive management approaches (Featherstone, 2008; Takahashi & Nyvad, 2011).

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This evolving understanding has prompted a paradigm shift in dental practice and underscores the need for corresponding changes in dental education to ensure graduates are equipped with the competencies needed in contemporary cariology.

In response to these developments, structured frameworks for cariology education have been established internationally. The European Core Curriculum in Cariology, developed by the European Organisation for Caries Research (ORCA) in collaboration with the Association for Dental Education in Europe (ADEE), offers a comprehensive model organized into key domains, including caries detection and diagnosis, risk assessment, decision-making, and preventive and operative care (Schulte et al., 2011; Anderson et al., 2011). This framework highlights the integration of scientific knowledge with clinical decision-making and patient-centered care. Similar initiatives have been undertaken in other regions to adapt cariology education to local contexts (Abreu-Placeres et al., 2021; Ferreira-Nóbilo et al., 2014; Fontana et al., 2016; Díaz et al., 2018; Martignon et al., 2013; Tikhonova et al., 2018; Cortés-Martínicorena et al., 2022; Splieth et al., 2022). A consensus in the Caribbean region emphasized the importance of aligning undergraduate curricula with modern caries management principles while considering regional disease patterns and resource limitations (Abreu-Placeres et al., 2021). Similarly, a national consensus in Colombia outlined domains, learning objectives, and curriculum content in cariology, while recognizing variability in teaching methods and gaps in the implementation of current concepts (Martignon et al., 2014).

Despite global and regional progress, the burden of dental caries remains significant in many low- and middle-income countries, including Nigeria. Studies have documented a high prevalence of untreated caries and poor oral health behaviors among Nigerian populations (Afolabi et al., 2025; Folayan et al., 2025). Additionally, access to oral healthcare services is often hindered by financial, structural, and workforce-related barriers, which further complicate effective disease management (Uguru et al., 2020). These contextual challenges emphasize the need to equip dental graduates with strong preventive and management skills tailored to local needs.

Dental education plays a critical role in shaping the knowledge, attitudes, and clinical practices of future practitioners. Evidence from Nigerian dental schools suggests that while students receive adequate theoretical instruction, teaching methods remain largely didactic, with limited incorporation of competency-based and contemporary cariology approaches (Orenuga et al., 2022). Furthermore, Nigerian dentists have demonstrated a persistent gap between knowledge and clinical practice in caries management, with continued reliance on restorative rather than preventive strategies (Orenuga et al., 2022). This discrepancy has been attributed to limitations in undergraduate training, insufficient exposure to modern cariology concepts, and systemic constraints within the healthcare environment. Given the global shift towards prevention-oriented and minimally invasive caries management, alongside the availability of well-defined international curricula, it is essential to critically evaluate cariology education within the Nigerian context. Such an evaluation will help determine the extent to which current undergraduate

training aligns with contemporary standards and identify areas for improvement in curriculum design and implementation.

This study, therefore aims to assess cariology education in Nigerian dental schools, with a focus on curriculum structure, teaching methods, and alignment with internationally recommended competencies in caries management

MATERIALS AND METHODS

Study design and setting

The study was a cross-sectional survey of accredited Nigerian dental schools in 2023. There were about 13 fully accredited dental schools distributed across the country's geopolitical zones, as recognized by the Medical and Dental Council of Nigeria. Due to the absence of a national directory of cariology educators, we used a snowball sampling method through institutional gatekeepers. The questionnaire, created in Google Forms, was sent to the Deans via the WhatsApp group of Deans of Dental Schools. All the dental schools involved were public or government owned.

Informed consent: Participation was voluntary. The first page of the Google Form included a participant information sheet that explained the purpose of the study, the voluntary nature of participation, the anonymity of responses, and how data would be used for publication. Consent was assumed upon completion of the survey. No personally identifiable information was collected. All data were anonymized at the source.

Confidentiality: Institutional affiliation was collected only at the level of dental school name to enable estimation of response rates. No individual respondents can be identified from the published data.

Survey Instrument Development

The questionnaire was developed after reviewing published cariology curriculum surveys from Europe and Latin America (Schulte et al., 2011; Martignon et al., 2013) and consulting with two Nigerian dental educators with expertise in restorative dentistry and educational research. Content validity was evaluated through pilot testing with five dental educators from two institutions not included in the final sample; minor wording changes were made based on their feedback.

The final instrument comprised four sections:

Section A captured biodata including age, gender, academic rank, years of teaching experience, and primary departmental affiliation.

Section B addressed curriculum organisation, including: whether cariology is taught as a composite or distributed course; year(s) in which cariology teaching commences; departments involved in cariology teaching; and whether the respondent's department offers hands-on cariology workshops or laboratory sessions.

Section C assessed diagnostic and management content, including: caries detection methods taught (with options for visual, tactile, radiographs, fluorescence-based devices, transillumination, and other); non-surgical caries management strategies taught (cariogenic diet modification, fluoride therapy, chlorhexidine, xylitol,

silver diamine fluoride, resin infiltration, and other); and surgical caries management strategies taught (amalgam, resin composite, glass ionomer cement, resin-modified glass ionomer, component, and other).

Section D assessed knowledge of the five ORCA-ADEE cariology education domains. Respondents were first asked: "Are you familiar with the five domains of cariology education as articulated in the European Core Curriculum in Cariology?" (Yes/No). Those answering "Yes" were then asked: "Please list the five domains." Responses were coded as correct if they matched or closely paraphrased the published domains.

Participant Recruitment and Data Collection

The Google Form link was shared via the Committee of Deans of Nigerian Dental Schools' WhatsApp platform. Deans were asked to forward the survey link to department or unit heads responsible for teaching dental caries. These departmental heads were then asked to distribute the link to all faculty members involved in cariology education.

The survey was open for six weeks, with two reminder messages sent at two-week intervals. Participation was voluntary, and informed consent was implied by survey completion. No personally identifying information was collected; institutional affiliation was recorded at the level of dental school name to enable estimation of institutional response rates.

Data Analysis

Data were downloaded from Google Forms into Microsoft Excel for cleaning and coding, then exported to SPSS

version 24 (IBM Corp., Armonk, NY, USA) for analysis. Descriptive statistics—frequencies, percentages, means, and standard deviations—were computed for all variables. Due to the modest sample size and the descriptive nature of this baseline study, no inferential statistical tests were conducted.

RESULTS

There were 20 participants from 9 dental schools, representing 69.2% of the 13 accredited dental schools in 2023. The surveyed dental schools were spread across the country's geopolitical zones, with the North Central and North West regions not represented. Twelve participants (60%) were females, and most (55%) were in the 50-59 age group (see Table 1 for details). All participants understood what cariology education is, and fifteen (75%) reported that cariology is taught as a comprehensive course in their dental schools.

Although 60% reported knowing the five domains of cariology education, only 25% could list them accurately. Cariology instruction began in most schools (45%) during the fifth year (Figure I). The most common detection methods taught in their departments were visual, tactile, and radiographic approaches (Figure II). The most common non-surgical (Figure III) and surgical (Figure IV) caries management strategies were cariogenic diet modification (90%) and Glass Ionomer Cement restoration (90%), respectively.

Table 1: Demographic characteristics of the respondents

Characteristics	Category	n (%)
Gender	Male	8 (40)
	Female	12 (60)
Age group	30–39 years	2 (10)
	40–49 years	5 (25)
	50–59 years	11 (55)
	>59	2(10)
Academic rank	Lecturer II	3 (15)
	Lecturer I	5 (25)
	Senior Lecturer	8 (40)
	Associate Professor	3 (15)
	Professor	1 (5)
Years teaching	Mean (SD)	14.3±(6.8)
	Range	4–28
Geopolitical zone	North East	1(11.11)
	South East	1(11.11)
	South South	3(33.33)
	South West	4(44.44)

When is Cariology commenced in your department /unit

20 responses

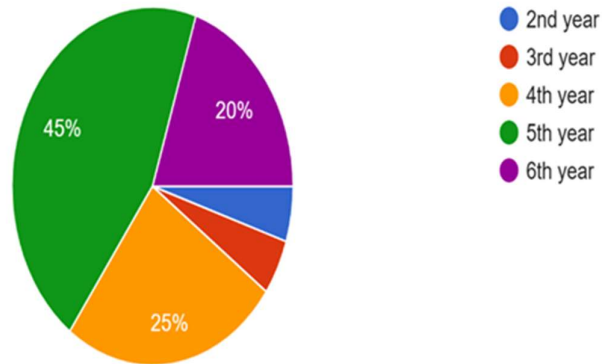


Figure 1: Year of Cariology Commencement in Nigerian Dental Schools

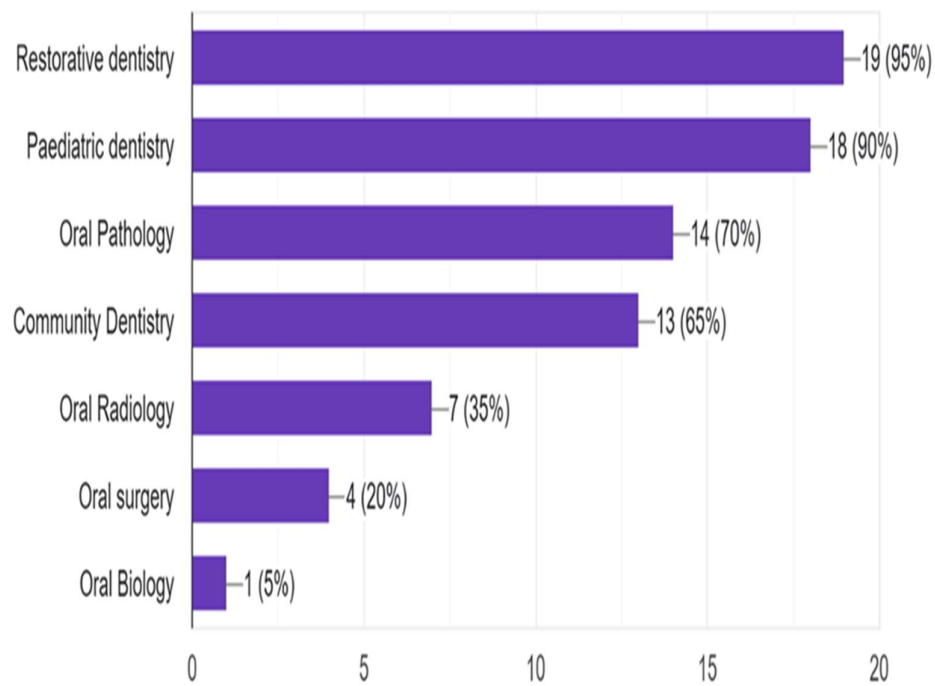


Figure 2: Departments of dental schools responsible for education in cariology

Non surgical caries management strategies addressed in your department /unit

20 responses

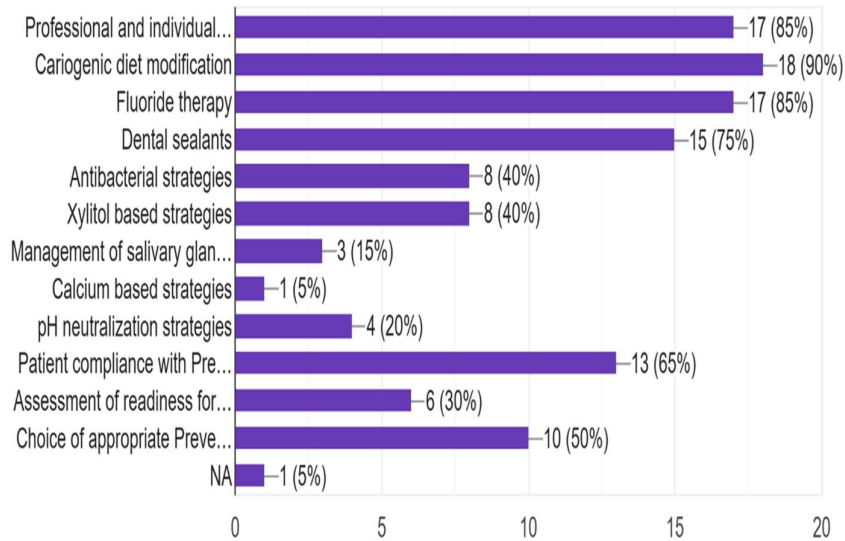


Figure 3: Non surgical caries management used

Surgical caries management strategies addressed in your department /unit

20 responses

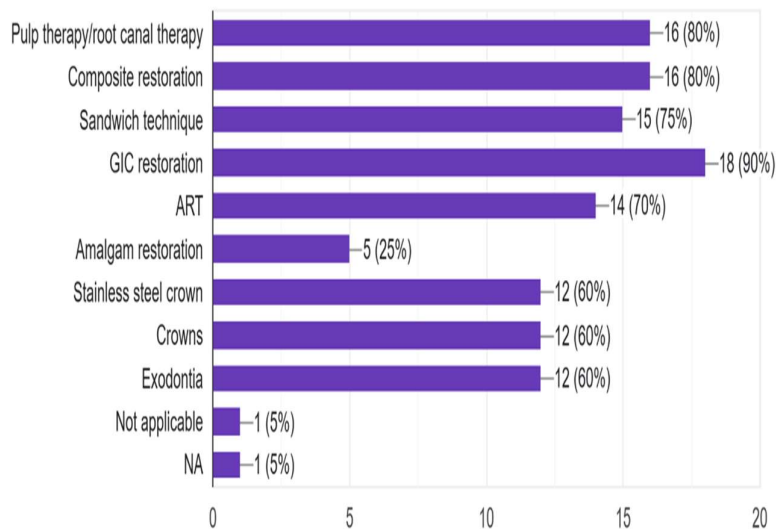


Figure 4: Surgical caries management used

DISCUSSION

This study provides the first empirical description of the content, structure, and faculty knowledge of cariology curricula in Nigerian dental schools, establishing a baseline for curriculum reform in Nigeria and the WHO African Region. The findings illustrate a sector in transition: cariology is widely taught but usually as a combined course mainly led by Restorative departments, introduced relatively late in training, and characterized by a gap between faculty self-reported familiarity with modern frameworks and their actual knowledge. These patterns are connected to resource limitations, limited faculty development, and structural challenges in educational research across the region. Below, we summarize and interpret the main results, compare them with international experiences, propose likely explanations, acknowledge limitations, and outline implications and priorities for future work.

We achieved a 69.2% institutional response rate with 20 individual participants. Similar studies conducted in Brazil, Spanish-speaking Latin American countries, and Europe yielded response rates of 57%, 60%, and 70% (Ferreira-Nóbilo et al., 2014; Martignon et al., 2013; Schulte et al., 2011), respectively. The use of the Deans' WhatsApp group demonstrated the potential of digital networks and their limitations when sustained research collaboration structures are lacking. Therefore, the moderate response likely reflects systemic barriers to participation rather than apathy, highlighting the need for stronger, more formalized educational research networks in the region. Equally glaring was the skewed representation of dental schools by geopolitical zones. Not all geopolitical zones of the country were represented. The Southern region had more representation than the North, with the Southwestern region being the most represented. This is likely because the Southwestern region has the majority of established dental schools.

Organization and timing of cariology teaching: Three-quarters of respondents reported that cariology is taught as a combined course, most often within Restorative departments (95% involvement). A similar finding was observed in the Brazilian study. While integrating content can help students understand the connections between disease processes and clinical management, the dominance of Restorative departments raises concerns that cariology may remain part of a traditional surgical-restorative approach rather than being taught as an integrated, prevention-focused discipline. This reflects international observations that disciplinary siloing between cariology and restorative dentistry hinders the adoption of competency-based curricula (ORCA consensus) (Sanabria et al., 2025).

Timing is also problematic: 45% of respondents indicated cariology begins in the fifth year. In 45% of surveyed schools, cariology was introduced in the fifth year, typically the penultimate year in Nigerian dental schools. This is a preclinical year in most Nigerian dental schools, where the students are introduced to aspects of cariology as part of the Operative Technique course. This contrasts with global recommendations advocating early

exposure—often in the second or third year—to reinforce preventive strategies before students engage in clinical practice (Featherstone, 2004). Late introduction may explain the overemphasis on surgical management (e.g., GIC restorations) rather than preventive measures. Possible reasons for this delay include: Traditional curriculum sequencing, where basic sciences precede clinical topics and resource constraints, limiting early clinical simulations or case-based learning.

This late introduction contrasts with competency-based recommendations that favor early and continuous exposure—foundational sciences in the early years, preclinical skills in the middle years, and increasingly complex clinical applications afterward (Fontana et al.; Schulte et al., 2011). Late sequencing risks compressing vital developmental stages, limiting opportunities for deliberate practice, and promoting reactive, surgical approaches rather than focusing on preventive care. Whether this timing results from curricular crowding, resource shortages for preclinical simulation, or deep-seated pedagogical philosophies needs further qualitative investigation.

Self-perceived versus demonstrated knowledge: A notable finding was the gap between faculty self-reported familiarity with the five-domain cariology framework, which was 60%, and their ability to list the domains, at only 25%. This difference indicates recognition without deep recall or understanding and aligns with broader research on the inaccuracy of self-assessment (Kruger & Dunning, 1999; Lawal et al., 2025). Possible explanations include: recognition without recall after exposure in workshops or readings; varying interpretations of “domains” (institutional course areas versus the formal framework); and social desirability bias leading to overstated familiarity.

This gap has practical implications. Relying on self-assessed competence to plan interventions risks underestimating true learning needs. Our data suggest faculty capability may be lower than perceived, supporting objective baseline assessments and targeted training before major curriculum reforms.

Diagnostic and management content: All respondents reported teaching traditional diagnostic methods—visual, tactile, and radiographic—consistent with global practice (Rapheal et al., 2018; Kühnisch et al., 2024). However, the heavy reliance on GIC restorations (90%) over minimally invasive techniques (e.g., silver diamine fluoride) suggests a lag in adopting newer evidence-based interventions. This may reflect limited continuing education for faculty on emerging trends in caries management and economic barriers, as some advanced materials may be cost-prohibitive in low-resource settings. Non-surgical teaching commonly included cariogenic diet modification (90%), reflecting knowledge of CCC domain 3.

Hands-on training and faculty capacity: No previous research has explored the availability of hands-on cariology training—such as workshops, lab sessions, or simulated learning experiences—in Nigerian dental schools. Because capability is the strongest predictor of competency-based teaching behavior in the COM-B

model, and since capability includes both knowledge and skills, the finding that fewer than half of respondents had access to hands-on cariology training highlights a potentially addressable barrier to curriculum modernization. The lack of such training opportunities may indicate broader limitations in educational resources, faculty expertise, or institutional priorities—each of which requires different intervention strategies.

The ORCA consensus similarly identified a lack of available eLearning and training resources as a major barrier to implementation (Sanabria et al., 2025). Investment in contextually appropriate faculty development—hands-on workshops, scalable eLearning, and faculty calibration—is a priority (Orenuga et al., 2022, Folayan et al., 2025).

Comparison with international frameworks and lessons from regional initiatives: The European Core Curriculum in Cariology (CCC) and the Latin American Core Curriculum (LACC) serve as models for competency-based, regionally adapted curriculum development (Fontana et al., 2017, Santamaría et al., 2024). Nigeria, with a central regulator (the Medical and Dental Council of Nigeria) and many dental schools, is structurally well positioned to pursue a national consensus process. Our finding that most schools teach cariology as an integrated course provides a foundation for developing competency-based frameworks.

However, experience from LACC follow-up warns that adopting a framework does not guarantee aligned teaching behaviors; support during implementation, faculty development, and monitoring are essential. Areas where health systems and population health intersect have been overlooked even when frameworks are in place—an aspect we did not fully explore but should be part of reform efforts (Martignon et al., 2013).

Regional implications and the case for a WHO African Region initiative: To the best of our knowledge, this study provides the first empirical data point from Africa in the international discussion on cariology curricula and highlights both engagement with international frameworks and notable gaps in capacity and training. Considering Africa's epidemiological situation and resource limitations, a regional consensus initiative modeled on LACC but tailored for the WHO African Region is timely. Such an initiative should be led by African dental educators and associations, integrate international frameworks, consult widely with the region's institutions, adapt competencies to local epidemiology and healthcare systems, and incorporate implementation science to address context-specific barriers (Santamaría et al., 2024; Sanabria et al., 2025).

Study Limitations

While this study provides valuable insights, several limitations must be acknowledged:

1. **Small sample size** (20 participants from nine schools), limiting generalizability.
2. **Self-reporting bias**, as respondents may overstate their familiarity with cariology domains.
3. **Lack of student perspectives**, which could reveal gaps between teaching and learning outcomes.

4. **Geographic bias**, as some Nigerian dental schools were not represented.

CONCLUSION AND RECOMMENDATIONS

Nigerian cariology curricula are evolving—neither fully based on an outdated surgical-restorative model nor fully aligned with modern competency frameworks. Cariology is generally integrated and mainly taught within Restorative departments, often beginning late in undergraduate training. A significant gap exists between faculty self-assessment of their familiarity with international cariology frameworks and their actual knowledge, mainly due to limited practical training. The findings underscore the need for curriculum reforms to align Nigerian cariology education with global best practices. Key recommendations include:

- **Introducing cariology earlier** (second/third year) to emphasize prevention.
- **Faculty development programs** to enhance pedagogical and clinical knowledge.
- **Adopting standardized cariology guidelines** to ensure comprehensive coverage of all domains.
- Encouraging research on innovative caries management suited to Nigeria's resource constraints.

There is a need for consensus on curricula at both national and regional levels, along with research focused on implementation. Addressing these issues can bring Nigerian training in line with global best practices while adapting competencies to local epidemiology and resources, ultimately strengthening undergraduate dental education and enhancing population oral health across the WHO African Region.

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DECLARATION

The author (AUU) used DeepSeek AI (<https://chat.deepseek.com>) to refine the academic language and improve the sentence structure of this manuscript.

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