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Contents

Towards a new perspective on oral health, Cariology Education and Public Health in Latin America and the Caribbean

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Dental caries disease poses a significant challenge to global public health, particularly in the Latin American and the Caribbean Countries (LACC). Despite the significant progress in understanding as a preventable non-communicable disease,[1] the high prevalence of untreated caries in these regions remains a cause for concern[2,3] that reflects the social and economic inequalities and inadequate funding for prevention and treatment these countries face.[4]

The situation in the region is aggravated by the high sugar consumption reported in LACC.[5] According to reports from dentistry opinion leaders on regulating sugar consumption in LACC, there were some public policies that regulated the sale of processed and ultra-processed foods, sometimes supported by guidelines. However, the participants reported a low level of knowledge about the per capita consumption of sugar among the countries. Additionally, the creation of protocols and regulations concerning fluoride use are key factors in the fight against dental caries. While some countries in the region have adopted fluoride use policies, their adoption continues to be challenging. Hence, incorporating oral health into the global agenda is a pivotal step in combatting this disease. Institutions such as the World Health Organization (WHO) and the World Dental Federation (FDI) have proposed concrete measures to ensure universal health coverage in oral health by 2030. Likewise, entities such as the Alliance for a Cavity-Free Future (ACFF) and the Latin American Oral Health Association (LAOHA) are actively collaborating in this direction.

Another crucial aspect is the appropriate education and clinical practice on cariology for the translation of knowledge and understanding of dental caries to key stakeholders. This should lead to the appropriate formulation of public policies positively impacting the population. In recent years, there has been a marked global transition in cariology education, moving from a predominantly restorative focus to an emphasis on prevention and oral health promotion. From this new perspective, dental caries is viewed as a controllable disease through patient-centered management, risk-based approaches, and a focus on long-term oral health throughout all life cycles. Notably, the European Core Curriculum in Cariology has served as an inspiration in this change, inspiring LACC countries to adapt similar structures.

Now the primary goal is to establish a basic curricular framework in cariology for Spanish-speaking and for Portuguese-speaking (Brazilian) dental schools in Latin America. This should address not only dental

caries education but also encourage discussions so that professionals can contribute to the development of policies on fluoride use and sugar consumption. In summary, respecting the differences and priorities of each country, there is a need for the implementation of policies across the region, promoting research collaboration. Indeed, knowledge exchange among countries is essential for achieving progress in this area and effectively addressing dental caries.

Aware of the aforementioned, since 2020, the Latin American Oral Health Association (LAOHA) has driven various initiatives to improve the dental caries situation in LACC. A significant example is the inclusion of three actions being promoted with the participation of experts in various areas of cariology throughout the region. This publication is a result of the work done by LAOHA by means of these three initiatives. Action 1, policies for the use of fluoride and reduction of sugar consumption in Latin American and the Caribbean countries;[6] Action 2, the development and consensus of a cariology core curriculum framework for dental schools for Spanish-speaking Latin American countries;[7] and Action 3, includes this consensus for dental schools in Brazil.[8] These initiatives have been shaped by different teams and work groups, in which regional experts and various associations and organizations actively participated to achieve the proposed goals.

Each of these initiatives described has been explored in different articles presented in this edition. Furthermore, these actions are annually highlighted in the "Call for Action", an event prepared by LAOHA during the World Cavity-Free Future Day in October. Furthermore, results have been shared at conferences and events such as the meeting of the Organization of Faculties and Schools of Dentistry (OFEDO-UDUAL) in Punta Cana in 2022; the European Organisation for Caries Research (ORCA) in Egmond aan Zee, Netherlands; and at the combined General Session of the International Association for Dental Research and Latin American IADR Region Session (IADR/IADR-LAR) in Bogotá, Colombia, both in 2023. Specifically, during this IADR/LAR meeting in Bogotá, these actions were presented within the symposium titled: Consensus on Dental Caries and Periodontal Disease in Latin America: Combined Strategies. This event featured prominent cariology and periodontology experts from the region, making it significantly relevant in showcasing the actions being pursued at the regional level.

In conclusion, the ongoing effort to reduce dental caries in the region, in collaboration with various institutions and organizations illustrated in Table, aligns with LAOHA's mission and goals for the benefit of Latin America and the Caribbean. Undoubtedly, this work lays the foundation for future initiatives, not only focused on reducing dental caries but also on developing public policies and optimizing education on this condition in LACC.

Table. Organizations/Associations that support the Call for Action and/or its respective initiatives.

Organization	Country/Region
International Association of Pediatric Dentistry (IAPD)	International
European Organisation for Caries Research (ORCA) - Education Platform	International
World Dental Federation (FDI)	International
Alliance for a Cavity-Free Future (ACFF)	International
Latin America Regional Organization of the World Dental Federation FDI (LARO)	Latin America
Latin American Dental Federation (FOLA)	Latin America
International Association for Dental Research (IADR/LAR) - Caries Group and Elderly Group/GLIOC	Latin America
Latin American Oral Health Association (LAOHA) - Cariology Group	Latin America
Caribbean Oral Health Initiative (COHI)	Caribbean
Ibero-American Observatory of Public Policies in Oral Health	Latin America

Continue

Continuation	
OFEDO/UDUAL (Organization of Faculties and Schools of Dentistry)	Latin America
Ibero-American Federation of Periodontology (FIPP)	Latin America
Latin American Association of Operative Dentistry and Biomaterials (ALODYB)	Latin America
Academy of Cariology of Chile	Chile
American Academy of Cariology (AAC)	The United States
Argentine Dental Association (AOA)	Argentine
Argentine Society of Periodontics (SAP)	Argentine
Bolivian College of Dentists	Bolivia
Brazilian Association of Collective Health (ABRASCO)	Brazil
Brazilian Association of Dental Education (ABENO)	Brazil
Brazilian Dental Association (ABO)	Brazil
Brazilian Dentistry Teachers Group (GBPD)	Brazil
Brazilian Group of Teachers of Orthodontics and Pediatric Dentistry (GBPOO)	Brazil
Brazilian Society of Periodontics and Implantology (SOBRAPI)	Brazil
Center for Epidemiology and Surveillance of Oral Diseases (CEVEO)	Chile
Chilean Society of Odontogeriatrics	Chile
College of Dental Surgeons of Costa Rica	Costa Rica
Colombian Academy of Aesthetic Operative Dentistry and Biomaterials (ACODEB)	Colombia
Colombian Academy of Prosthodontics (ACP)	Colombia
Colombian Association of Dental Faculties (ACFO)	Colombia
Colombian Dental Federation (FOC)	Colombia
Conselho Federal de Odontologia (CFO)	Brazil
International Association for Dental Research - Brazilian Division (SBPqO)	Brazil
Mexican Federation of Dental Schools and Colleges (FMFEO)	Mexico
National Society of Researchers in Dentistry (SNIO)	Mexico
North-Northeast Society for Dental Research (SNNPqO)	Brazil
São Paulo Association of Dental Surgeons (APCD)	Brazil
UNICA - Caries Rsearch Unit, El Bosque University	Colombia
Uruguayan Society of Pediatric Dentistry (SUOP)	Uruguay
Uruguayan Dental Association (AOU)	Uruguay
Venezuelan Society of Dental Surgery, Aesthetics and Biomaterials	Venezuela
Colgate-Palmolive	International

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Situational diagnosis of policies in Latin American and Caribbean countries for the use of fluoride and reduction of sugar consumption

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Abstract: Policy evaluation and guidance on fluoride use and sugar consumption in Latin American and Caribbean countries (LACC) may provide a scientific evidence basis for policymakers, dental professionals, civil society organizations and individuals committed to improving public oral health. A cross-sectional study was conducted to evaluate the extent of implementation of policies/guidelines on fluoride use, and sugar consumption in LACC. The study had two stages. First a questionnaire covering four major areas was developed: fluoridation of public water supplies; salt fluoridation; fluoride dentifrices, and sugar consumption. Then, the questionnaire was applied to collect data among representative participants in public oral health from LACC. Ninety-six participants from 18 LACC answered the questionnaire. One-hundred seventy documents were attached, and 285 links of websites were provided by the respondents. Implementation of policies and guidelines on water and table salt fluoridation and processed and ultra-processed food consumption were found in most countries, with some issues in the consensus and coverage. Thus, differences were identified in the extent of implementation of public oral health strategies on sugar consumption and fluoridation among the countries. There is no consensus on the policies in LACC to reduce sugar consumption and for the use of fluoride. A few policies and guidelines were applied in isolated countries, with a variety of strategies and standards. For future actions, it will be important to encourage the development of strategies and public policies within countries, and to evaluate the effectiveness of existing policies in reducing dental caries and in improving oral health in LACC.

Keywords: Dental Caries; Caribbean Region; Latin America; Sugar; Fluorides.

Introduction

Managing and controlling dental caries continues to be a challenge for Latin American and Caribbean countries (LACC), with a high prevalence of the disease.[1,2] The oral health challenges in these countries are reflections of persistent inequality, poverty, high levels of corruption,

and overburdened public healthcare systems.[3] Moreover, the sugar industry represents a significant amount of the LACC economy, with sugar produced in LACC accounting for approximately 40% of the global sugar output.[4]

Individual and context-driven health strategies such as controlled sugar consumption and regular contact with fluoride effectively prevent dental caries across all ages.[5] Controlling sugar consumption may be achieved by reducing the amount of sugar in products or by reducing of the frequency of consumption of sugar-containing products.[5] Although policies on fluoride use were adopted in some LACC, others show limited strategies targeting increased accessibility and affordability of fluoride use.[6] Public health policies used to reduce the prevalence of dental caries in LACC must tackle the historical and cultural aspects of the disease burden in addition to its social determinants, avoiding discontinuity of the strategy across time.[3]

Furthermore exploration of the extent of implementinng policies and guidelines on fluoride use and sugar consumption in LACC may provide a deeper understanding of how oral health has been faced in these countries, and may provide important information for the next steps.[6] Therefore, the aim of the present study was to carry out a situational diagnosis of policies in LACC to reduce sugar consumption and to guide the use of fluorides.

Methodology

Study design

A cross-sectional study was conducted with the aim of evaluating policies and guidelines on the use of fluoride, sugar consumption and health surveillance in LACC. The study was divided into two major stages. The first part involved the development of a questionnaire that addressed the key points for data collection. In the second part, the questionnaire developed was applied among the representatives/managers in each LACC, including health professionals (*e.g.*, dentists, physicians, nutritionists etc.), government representatives, researchers, university professors and others. This study received approval from the Human Research Ethics Committee (certificate number: 58623922.2.0000.5149) from Universidade Federal de Minas Gerais and was conducted in accordance with the Declaration of Helsinki.

Questionnaire development

A pragmatic questionnaire was developed to assess policies and guidelines on fluoride use, sugar consumption and health surveillance in LACC. Three dentists with experience in Pediatric Dentistry and Public Health analyzed the theoretical framework based on official LACC documents and literature reviews regarding the proposed objectives. The questionnaire covered four major areas: public water supplies fluoridation; salt fluoridation; fluoride dentifrices, and sugar consumption. The questionnaire was comprised of open-ended and multiple-choice items. Furthermore, the participants were invited to attach documents and links referring to policies and guidelines. Eventual disagreements about an item were solved by discussion and consensus between dental surgeons and the board of the Latin American Oral Health Association Cariology Group (LAOHA). After the development of the first version, a board of eleven members of the LAOHA, from six countries, reviewed the instrument. The consensus had a Content Validity Index (CVI) higher than 0.80.

Data collection

After this step, the questionnaire was applied online using the Google Forms platform (Google Inc., Menlo Park, United States of America). The questionnaire was presented and shared in events sponsored by LAOHA. Additionally, individual e-mails were sent to key representative persons in public oral health from LACC suggested by LAOHA members. Secondary documents submitted by participants had to encompass policies and guidelines for sugar consumption and fluoride use in LACC. The documents were in the public domain given the purpose. Data organization and descriptive analysis were performed using the Statistical Package for Social Sciences software (IBM SPSS Statistics for Windows, version 22.0, Armonk, IBM Corp.). Since all variables analyzed were categorical, relative frequencies (percentages) were reported.

Results

A total of 96 participants from 18 countries from LACC answered the questionnaire (Figure 1). The majority of the participants were female (64,6%) from Higher Education Institutions (84.4%). A total of 170 documents were attached to the forms and 285 links were provided (Table 1).

The results about the extent of implementing policies and guidelines on fluoride use in LACC are presented on Table 2. According to participants, less than one-quarter of the population had access to fluoridated water (38.5%) and 55.2% reported that there were no policies that regulated water fluoridation for public supply. The majority of participants (57.3%) reported that there was a public policy that regulated table salt fluoridation, and 61.5% reported that non-fluoridated table salt could be found on the market. Most countries had guidelines/ recommendations for the fluoride concentration in toothpaste (79.2%), usually developed by the Ministry of Health (88.9%). However, only 66.3% of the participants reported

Figure 1. Countries in Latin America and the Caribbean that responded to the survey are colored on the map.

Table 1. Description of respondents' information.

Respondents' information	Frequency (%)
Country	
Argentina	07 (07.3)
Bolivia	02 (02.1)
Brazil	16 (16.7)
Chile	05 (05.2)
Colombia	27 (28.1)
Costa Rica	03 (03.1)
Ecuador	03 (03.1)
El Salvador	01 (01.0)
Guatemala	02 (02.1)
Mexico	10 (10.4)
Nicaragua	01 (01.0)
Panama	01 (01.0)
Paraguay	02 (02.1)
Peru	06 (06.3)
Puerto Ryco	01 (01.0)
Dominican Republic	02 (02.1)
Uruguay	04 (04.2)
Venezuela	03 (03.1)
Respondent's sex	
Male	34 (35.4)
Female	62 (64.6)
Type of institution where the respondent works*	
Public institutions (ministries, state or municipal departments; regulatory agencies)	17 (17.7)
Professional associations	17 (17.7)
Scientific or technical associations	06 (06.3)
Higher education institutions (universities, colleges, etc.)	81 (84.4)
Other institutions	05 (05.2)
Attachments	
Documents	170 (37.4)
Links	285 (62.6)

* Respondents could work in more than one type of institution.

that there were guidelines that differentiated the recommendations on fluoride concentrations by age group. Differently from the access to water fluoridated, there was broader access to fluoridated toothpaste (62.5%) according to the participants.

Interventions to regulate sugar consumption on LACC based on participants' reports are presented in Table 3. The majority of participants reported that there were some public policies that regulated the sale of processed and ultra-processed foods (64.6%), sometimes supported by guidelines (46.9%). Although the participants reported a low level of knowledge about the per capita consumption of sugar among the countries (76.0%), they mentioned that there were policies/ guidelines that reinforced the non-introduction of sugar into the diet of children

Table 2. Policies and guidelines on fluoride use in LACC based on respondents' knowledge.

Fluoride variables	Frequency (%)
The country has public policies that regulate water fluoridation for public supply	
Yes	41 (42.7)
No	53 (55.2)
Sphere of government that developed water fluoridation policy	
Federal	34 (85.0)
State	01 (02.5)
Municipal	00 (00.0)
Federal and Municipal	02 (05.0)
Federal, State, and Municipal	03 (07.5)
Percentage of the population with access to fluoridated water	
Less than 25%	37 (38.5)
Between 25% and 50%	08 (08.3)
More than 50%	24 (25.0)
Does not know	27 (28.1)
The country has an epidemiological surveillance policy to control water fluoridation for public supply	
Yes	40 (41.6)
No	42 (43.8)
Does not know	14 (14.6)
The country has a public policy that regulates table salt fluoridation	
Yes	55 (57.3)
No	33 (34.4)
Does not know	08 (08.3)
Sphere of government in which table salt fluoridation policy was developed	
Federal	53 (84.1)
State	00 (00.0)
Municipal	00 (00.0)
Does not know	10 (15.9)
Non-fluoridated table salt can be found at the market	
Yes	59 (61.5)
No	18 (18.7)
Does not know	19 (19.8)
The country has an epidemiological surveillance policy to control table salt fluoridation	
Yes	40 (41.7)
No	33 (34.4)
Does not know	23 (24.0)
The country has regulations for the concentration of fluoride in toothpaste	
Yes	58 (60.4)
No	28 (29.2)
Does not know	10 (10.4)

Continue

Continuation	
Organization that established public policies for the concentration of fluoride in toothpaste	
Health ministry or another ministry	56 (88.9)
State health surveillance agencies	06 (09.5)
Municipal secretary	01 (01.6)
The country has guidelines/ recommendations for the concentration of fluoride in toothpaste	
Yes	76 (79.2)
No	13 (13.5)
Does not know	07 (07.3)
Organization that developed guidelines/recommendations for the concentration of fluoride in toothpaste	
Health ministry	25 (53.2)
Professional associations	02 (04.2)
Scientific or technical associations	06 (12.8)
Higher education institutions (universities, colleges, etc.)	07 (14.9)
Other institutions	07 (14.9)
The guidelines differentiate recommendations for fluoride concentration in toothpaste by age group	
Yes	55 (66.3)
No	18 (21.7)
Does not know	10 (12.0)
The guidelines/recommendations mention the amount of toothpaste that children should use	
Yes	67 (80.7)
No	09 (10.8)
Does not know	07 (08.4)
Percentage of the population with access to fluoride toothpaste	
Less than 25%	00 (00.0)
Between 25% and 50%	15 (15.6)
More than 50%	60 (62.5)

under two years of age (52.1%), to prevent and control childhood obesity (66.7%), eating disorders (52.1%), dental caries (55.2%), diabetes (62.5%), and cardiovascular disease (45.8%), all focusing on controlling sugar consumption.

Based on the information extracted from the documents and links provided by participants from the 18 countries (Table 4), 55,6% of LACC had access to community fluoride either by water fluoridation (16,7%) and/or table salt fluoridation (38,9%). The concentration of fluoride varied across countries (Figure 2). The majority of countries had regulations/ guidelines differentiating the amount/ concentration of fluoride by age group (61,1%) and had public policies that regulated the sale of processed and ultra-processed foods (61,1%). Labelling law providing information about excessive amounts of sodium, sugar and fats was the most prevalent policy across LACC (Figure 3).

Discussion

Dental caries is one of the most prevalent conditions among all diseases worldwide, affecting individuals of all ages.[7] In most LACC, over half of the child population experience dental caries, and over 85% of adults are affected.[3]

Sugar consumption is a modulator factor for dental caries, exhibiting a dose-effect relationship.[8,9] Therefore, its consumption should be limited and

Table 3. Policies and guidelines on sugar consumption in LACC based on respondents' knowledge.

Sugar consumption variables	Frequency (%)
The country has public policies that regulate the sale of processed and ultra-processed foods	
Yes	62 (64.6)
No	20 (20.8)
Does not know	14 (14.6)
The country has guidelines to control the sale of processed and ultra-processed foods	
Yes	45 (46.9)
No	28 (29.1)
Does not know	23 (24.0)
Knows the consumption of sugar in the country	
Yes	23 (24.0)
No	73 (76.0)
The country has policies/ guidelines to reinforce the non-introduction of sugar into the diet of children under two years of age	
Yes	50 (52.1)
No	28 (29.2)
Does not know	18 (18.8)
The country has policies/ guidelines to prevent and control childhood obesity	
Yes	64 (66.7)
No	14 (14.6)
Does not know	18 (18.7)
The country has policies/ guidelines to prevent and control eating disorders	
Yes	50 (52.1)
No	15 (15.6)
Does not know	31 (32.3)
The country has policies/ guidelines to prevent and control dental caries focusing on controlling sugar consumption	
Yes	53 (55.2)
No	33 (34.4)
Does not know	10 (10.4)
The country has policies/ guidelines to prevent and control diabetes focusing on controlling sugar consumption	
Yes	60 (62.5)
No	13 (13.5)
Does not know	23 (24.0)
The country has policies/ guidelines to prevent and control cardiovascular disease focusing on controlling sugar consumption	
Yes	44 (45.8)
No	16 (16.7)
Does not know	36 (37.5)
Organization that established public policies/ guidelines for the control of sugar consumption	
Public institutions (ministries, state or municipal departments; regulatory agencies)	11 (36.7)
Professional associations	03 (10.0)
Scientific or technical associations	01 (03.3)
Higher education institutions (universities, colleges, etc.)	01 (03.3)
Other institutions	01 (03.3)
Does not know	13 (43.4)

Table 4. Policies and guidelines on fluoride and sugar consumption based on documents and links provided by participants.

Variables	Frequency (%)
The population has some access to fluoride by means of water fluoridation and/or table salt fluoridation (based on documents provided)	
Yes	10 (55,6)
No	08 (44,4)
The country has water fluoridation for public supply (based on documents provided)	
Yes	03 (16,7)
No	15 (83,3)
The country has table salt fluoridation (based on documents provided)	
Yes	07 (38,9)
No	11 (61,1)
The country has regulations and/or guidelines regarding the concentration of fluoride in toothpaste/paste (based on documents provided)	
Yes	06 (33,3)
No	12 (66,7)
The country has guidelines/ recommendations differentiating the amount/ concentration of fluoride by age group (based on documents provided)	
Yes	11 (61,1)
No	07 (38,9)
The country has public policies that regulate the sale of processed and ultra-processed foods (based on documents provided)	
Yes	11 (61,1)
No	07 (38,9)
The country has policies/ guidelines for the prevention and control of diseases focused on sugar consumption (based on documents provided)	
Yes	09 (50,0)
No	09 (50,0)

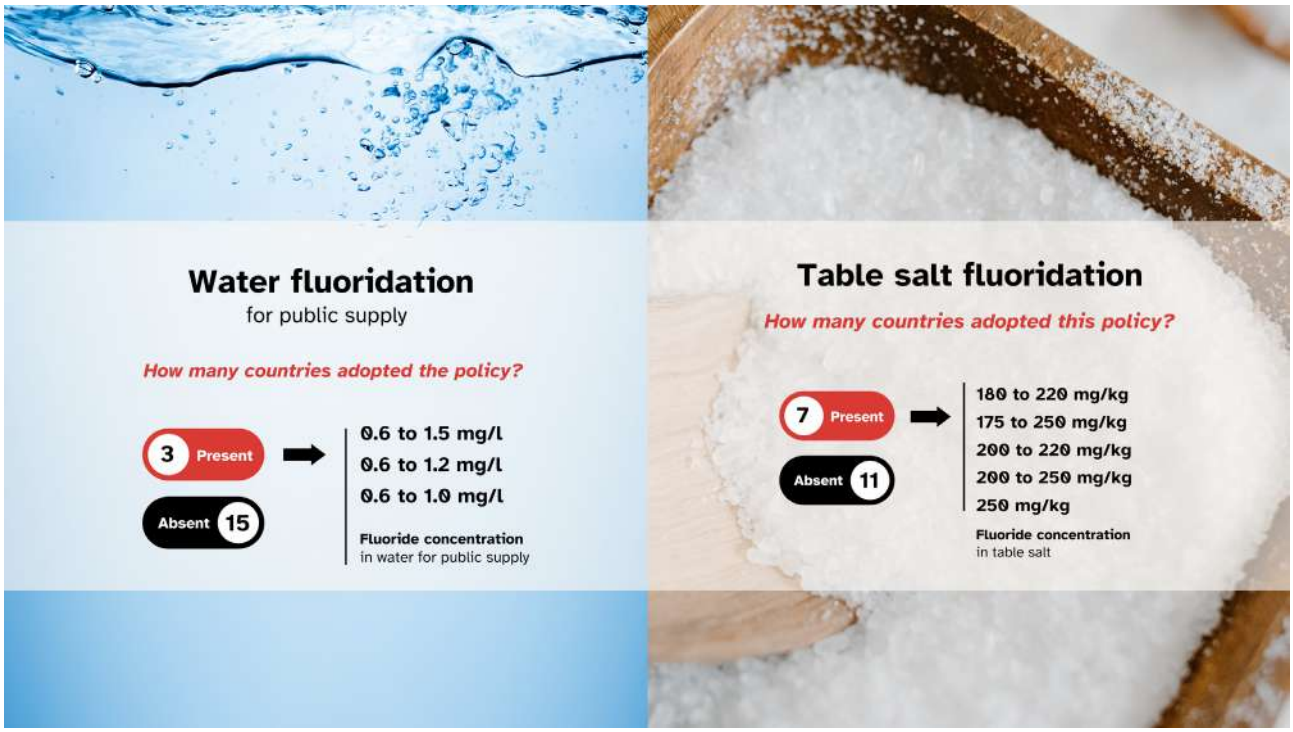

Figure 2. Concentration of fluoride in water from public supply and in table salt, based on the documents and links provided.

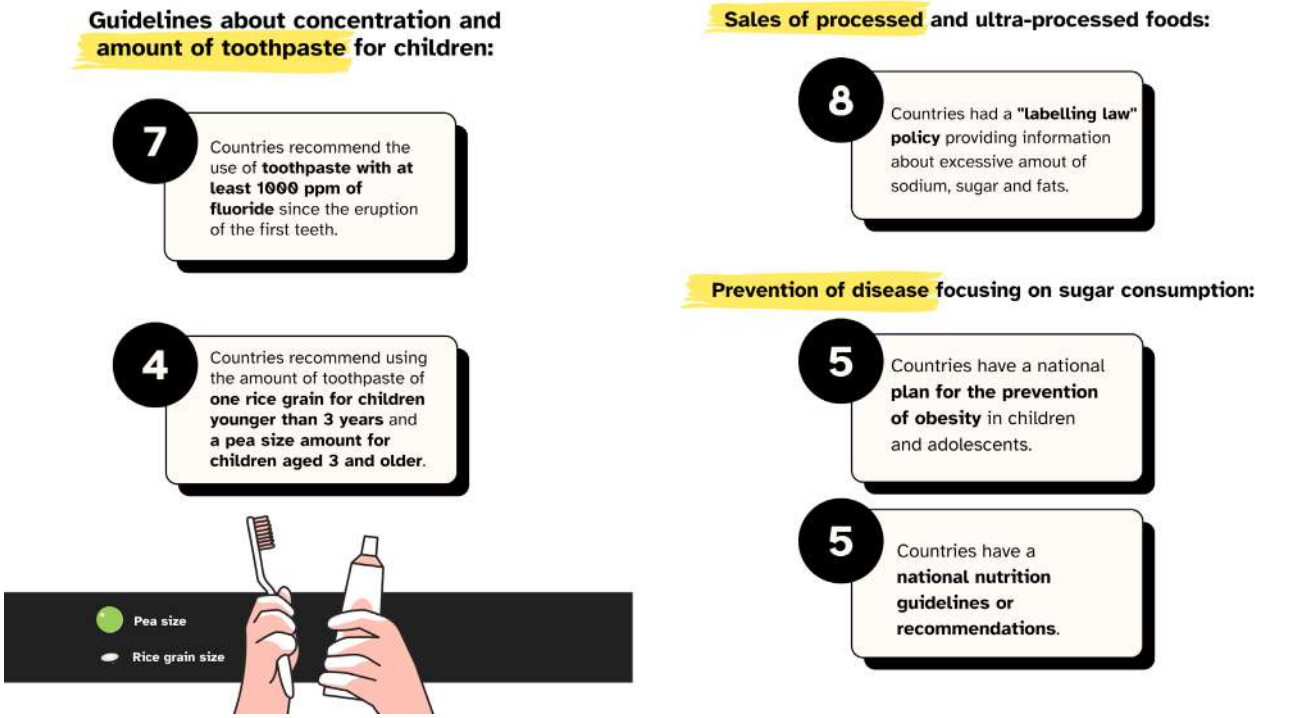

Figure 3. Frequent regulations, policies and guidelines about fluoride concentration and amount of toothpaste, sales of processed foods and prevention of diseases focused on sugar consumption of participating Latin American and Caribbean countries.

avoided. The World Health Organization (WHO) recommends that free sugar intake should not exceed 10% of daily total energy intake,[9] which was a goal largely unmet in most LACC. Based on assessment of the current situation, many countries in Latin America and the Caribbean lacked policies or guidelines addressing this issue. Sugar intake in foods and drinks should be limited and free sugar should be avoided by children under 2 years of age, as recommended by the International Association of pediatric Dentistry.[8] High sugar consumption during childhood leads to an increase in caries risk throughout the life course[10], and higher sugar consumption over life determines a higher caries increment.[11] Therefore, policies focusing on reducing and avoiding sugar intake in early life as a preventive strategy should be encouraged in LACC.

Based on the documents and links provided by the participants, some policies and guidelines have been implemented to control and regulate sugar and ultra-processed food consumption in LACC. However, there was no consensus on the specific policies and strategies, and only a few were adopted in more than one country. One common policy was the "labelling law", which made it mandatory for the labels of processed products to include information about excessive amounts of sugar, sodium, and fats. The aim of this policy is to inform consumers about unhealthy or excessive ingredient levels, thereby educating them and encouraging healthier food choices.[3] Strategies and policies that enhance knowledge, such as the inclusion of information on food labels, can have a positive impact on individuals' health.[3] Moreover, higher levels of oral health literacy were associated with a positive oral health status, including lower prevalence of dental caries and higher frequency of seeking dental treatment.[12]

The most prevalent strategies for the prevention of diseases related to sugar consumption in the participating LACC were centered around obesity prevention and nutritional guidelines. Excessive intake of free sugar can lead to various health problems, including dental caries, obesity, diabetes, and cardiovascular disease, with the latter two

being mediated by risk factors such as overweight, obesity, and others.[9] The high cost of treating dental and chronic disease could place a significant burden on LACC, exacerbating inequalities, poverty and overloading public healthcare systems.[3] Dental caries and high sugar consumption also negatively affected the nutrition of individuals. Untreated caries could result in episodes of pain, difficulty in chewing and sleeping, impacting on the quality of life and productivity.[7] In severe cases, untreated caries with pulp inflammation could contribute to underweight in children.[7] Additionally, excessive consumption of free sugar also threatened the nutrient quality of the diet, as sugar provides a significant source of energy without essential nutrients.[9] Unfortunately, a detailed analysis of the content of guidelines was not possible. Nevertheless, a consensus on those strategies was encouraged, following the recommendations on sugar consumption and considering the cultural and socioeconomic aspects of LACC.

The role of fluoride in oral health has a long history, first documented in the late 1800s and recognized by dentists in the 1930s.[13] Community water fluoridation is outstanding as a major achievement in public health, leading to the development of various strategies to deliver fluoride, such as in toothpaste, gels, tablets and table salt.[14,15] All of these strategies have been designed to prevent dental caries at a community and individual level. Water fluoridation and table salt fluoridation are particularly significant policies in low- and middle-income countries, as they ensure access to fluoride access by the entire population, irrespective of their socioeconomic status. Unfortunately, not all countries in LACC had a community-level fluoridation policy. Those who had such programs faced challenges, such as discrepancies in the areas covered, unequal access, and a need for surveillance programs.[3]

A concern about the use of a community-based method to deliver fluoride is the occurrence of dental fluorosis. However, studies have shown that, at the appropriate concentration, the risk of developing dental fluorosis was outweighed by its effectiveness in preventing caries. Having access to water fluoridation decreased the experience of dental caries by 35% in the deciduous dentition and by 26% in the permanent dentition. The concentration of 0.7 ppm of fluoride was responsible for only 12% of fluorosis cases that affected patients' esthetic appearance.[14] The fluoride concentration in water and table salt varied slightly across the countries included, emphasizing the importance of vigilance policies to ensure that the population was provided with an effective amount of fluoride. According to the participants' responses, not all countries had policies focused on vigilance.

The majority of the countries included had guidelines or recommendations that differentiated the amount or fluoride concentration required for different age groups. However, no consensus was identified in the documents and links provided. The recommendation of toothpaste with a minimum of 1000 ppm of fluoride was the most common. This concentration was in accordance with the recommendations of the List of Essential Medicines from WHO,[16] which included toothpastes with a concentration ranging from 1000 to 1500 ppm fluoride, acknowledging its proven effectiveness in preventing dental caries.[17] To be effective for preventing dental caries, fluoride must be constantly available in the oral cavity. Hence, daily brushing with toothpaste containing the necessary minimum concentration of fluoride is essential. To avoid fluorosis, young children should use the appropriate amount of toothpaste. The literature suggests that for children under three, a smear or rice-sized amount of fluoridated toothpaste is sufficient, while children aged three to six should use no more than a pea-size amount of fluoridated toothpaste.[18] Good habits established in early life can perdure throughout life course.[13] It is important for children's teeth to be brushed twice daily with the appropriate amount of toothpaste, right from the time of eruption of the first teeth.[8] Policies and guidelines to regulate the concentration and amount of fluoride based on age groups are important. Equally significant are policies that provide access to fluoridated toothpaste. Conducting epidemiological evaluations is encouraged for the purpose of assessing the level of access to fluoride among all LACC' populations.

The authors consider it important to emphasize that data collection was based on participants' reports and the provided documents and links. Although an

extensive search through the documents and links was performed to confirm all the information provided, it is possible that not all the policies, guidelines and strategies implemented by the countries were included. The majority of respondents worked in higher education institutions, public institutions, or professional associations, which could help mitigate this bias. Considering that some participants were unfamiliar with certain aspects of the questionnaire, it might be beneficial not only to establish new policies and guidelines, but also to highlight the importance of those that have already been established in the LACC. For future actions, it is important to have a situational diagnosis and analysis of the other countries in Latin America and the Caribbean that were not included in this research.

This paper, together with two others published in this volume, highlight the importance of a consensus when dealing with dental caries in LACC. There was no consensus on the policies in Latin America and the Caribbean to reduce sugar consumption and on the use of fluoride. A few policies and guidelines were applied in isolated countries, with a variety of strategies and standards. Unfortunately, there is a lack of knowledge relative to how effective those policies and guidelines were in reducing dental caries, due to insufficient epidemiological data in the region,[3] and lack of longitudinal studies evaluating their methods of implementation and results. Some LACC had clear and established policies on the use of fluoride and sugar intake, but others did not. Understanding the impact of these policies on the population's oral health by means of epidemiological surveillance would be a means to provide support for implementing similar and effective strategies throughout all LACC.

Recommendations

Establish Consistent Policies

Encourage the establishment of clear and consistent policies across all LACC regarding fluoride use and sugar consumption. This could be achieved by a consensus encompassing guidelines on fluoride levels recommended, sugar intake and strategies to reduce free sugar consumption, in addition to related health education.

Encourage Research and Data Collection

Promote and support research initiatives in LACC focused on gathering comprehensive epidemiological data relative to oral health, sugar consumption patterns, fluoride use, and ongoing policies, recommendations and guidelines. This data should be used to refine existing policies and design new ones.

Promote Collaboration and Knowledge Sharing

Multicentric collaboration and knowledge sharing among LACC to exchange best practices, successful policy implementations, epidemiological data, and research findings. Encourage regular regional meetings or conferences to foster collaboration and shared knowledge.

Promote Public Awareness and Education

Develop captains to educate individuals about the impact of excessive sugar consumption on oral and general health and the benefits of appropriate fluoride use. Utilize media channels and community outreach to disseminate information about the importance of policies implemented. Advocate for stricter enforcement to empower consumers to make informed, healthier choices.

Tailor Age-Specific Policies

Promote policies and guidelines in all LACC to address age-specific needs, especially children. Provide clear recommendations for fluoride concentrations and emphasize the proper amount of toothpaste for different age groups.

Enhance Implementation of Existing Policies

Strengthen the implementation of ongoing policies in some countries and expand them to all LACC.

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Core Cariology Curriculum Framework in Spanish for Latin American dental schools: development and consensus

Abstract: The aim of this study was to develop and achieve consensus on a cariology teaching framework for dental schools in Latin American Spanish-speaking countries. The Delphi process, with a ≥8 0% pre-defined participants' agreement, included three phases and a Coordinating Group. During the Preparation phase three panels of experts were selected and invited to participate: a) Regional academic/professional Dental Associations (Associations-Panel): n = 12; b) Regional Dental Schools (Dental-Schools-Panel): existing dental schools (n = 263) from the 19 Spanish-speaking regional countries; c) International academic/professional associations Peer Experts (Peer-Panel): n = 4. Based on consensus documents from Europe, Colombia, the Caribbean, USA, Chile and Spain, and updated scientific evidence, the Coordinating Group developed a baseline framework proposal of domains, main competencies (MC) and specific competencies (SC). The Consultation-Agreement and Consensus phases included three rounds of questionnaires with a step-wise sharing of the MC updated version of the consensus framework with the Dental-Schools-Panel and including SC with the Associations-Panel. Diverse communication strategies were used (*e.g.*, independent google-form questionnaires and workshops). Consensus was reached after an on-site Associations-Panel workshop and secret voting, followed by an online meeting with the Peers-Panel. A total of 127 academic/professional institutions participated (Associations-Panel: 11, 91.6%; Dental-Schools-Panel: 112, 42.6%, all countries; Peers-Panel: 4, 100%). The baseline Cariology teaching framework of 5 domains, 10 MC and 92 SC underwent modifications after agreements for a final consensus framework consisting of 5 domains, 10 MC and 85 SC. A Core Cariology curriculum framework in Spanish for Latin American Dental Schools was successfully developed and agreed upon with regional dental academic and professional institutions.

Keywords: Education, Dental; Dental Caries; Curriculum; Competency-Based Education.

Introduction

Dental caries was defined in 2021 as 'a biofilm-mediated, diet modulated, multifactorial, non-communicable, dynamic disease resulting in net mineral loss of dental hard tissues', in the international

cariology terminology consensus report by ORCA (European Organisation for Caries Research) and CRG IADR (Cariology Research Group of IADR).[1] Despite the shift that the understanding of dental caries has undergone over the course of decades,[2-4] and notwithstanding the available evidence-based, best-practice and cost-effective measures, untreated caries in permanent dentition continues to be the most common health condition that occurs in primary teeth in over 40% of children and it is associated with health inequalities.[5-8]

To change this global health scenario 'oral health has finally been included in the global agenda'.[9] By reducing the prevalence of oral disease and promoting well-being through the course of life, and recognizing dental caries as a non-communicable disease, public health actions have been taken by the World Health Organization (WHO) and the World Dental Federation (FDI) to ensure progress towards universal health coverage for oral health by 2030.[10,11] In parallel, a taskforce from the Alliance for a Cavity-Free Future (ACFF) delivered in 2021 a consensus of policy recommendations 'towards a more progressive and holistic long-term, patient-centered, tooth-preserving preventive care system, to reduce the incidence of dental cavities and to secure improvements in both oral and general health'.[12] Its first policy recommendation involves curriculum related changes. Simultaneously, experts from Latin America and the Caribbean, gathered together with support from the Latin American Oral Health Association (LAOHA)[13] and reported on a regional review of caries-related epidemiology, quality of life, risk factors, prevention and management.[14-18] From the latter, a general recommendation towards a stakeholders' regional oral health agenda was derived.[19] This included three Call-to-action initiatives that were defined during the LAOHA online regional symposium-related, held the 14th of October 2021:[20] Fluoride use and sugar reduction policies in Latin America (1),[21] and working on regional-level consensus documents for cariology teaching among dental schools for Spanish-speaking Latin American countries (2) and for Brazil (3).[22] This paper focuses on the second Call to action.

Transformation of the cariology curriculum has been driven by the need to translate the caries paradigm shift into education and the practice, to move away from the curative approach shown in cariology teaching surveys in dental schools worldwide (*e.g.*, in Japan,[23] Europe,[24] Latin America,[25] Brazil,[26,27] Chile,[28] Canada,[29] Australia with New Zeland[30] and Asian and Arabian countries[31]), towards a curricula where caries is considered a preventable disease that can be controlled through a patient-centered, risk-based caries management, with a focus on health outcomes to maintain oral health and preserve tooth structure in the long-term.[32]

The European Core Curriculum in Cariology started the process in 2010 with the support from ORCA and the Association of Dental Education in Europe (ADEE).[33] Since then, adapted consensuses have been agreed upon by dental schools on a national-basis, such as in Colombia, with the Colombian Association of Dental Schools (ACFO, as per its Spanish acronym) and the Alliance for a Cavity Free Future (ACFF)[34] and in the USA, with the American Dental Education Association.[35] Other Spanish-speaking countries such as Chile, the Caribbean countries and Spain have followed.[36-38] All documents follow the European core structure[33] and include five to six caries-driven domains related to knowledge base, assessment, synthesis, diagnosis and care - both at the individual level of caries risk and at the tooth-surface level of caries lesions, and by evidence-based cariology in clinical and public health practice.[33]

The aim of this study was to develop and achieve consensus on a competency-based core cariology curriculum framework for use in dental schools in Latin American Spanish-speaking countries.

Methodology

This paper reports the process used to develop and achieve the cariology teaching consensus framework for dental schools in Latin American Spanish-speaking countries based on the previously mentioned frameworks,[33-38] on best evidence and taking into consideration the regional context. The original language of the framework is Spanish,

applicable to Latin America, and its structure follows that of the European Core Curriculum,[33] in five Domains, each encompassing a minimum of one Main Competency (MC) supported by Specific Competencies (SC) with different levels of learning, as defined by Cowpe et al. (Table 1).[39] These, in a general way, are intended to cover the basic and fundamental aspects of cariology training, for use by educators, dental schools and countries, subject to national or internal adaptations.

Prior to the development and consensus of cariology, a survey and a hybrid workshop were held in November 2021 during the annual meeting of OFEDO-UDUAL (Organization of Dental Schools - Union of Latin American Universities). A total of n=121 (46%) deans participated, agreeing on a general curative approach within dental schools, and 91% manifested the will to participate in the development and consensus of a cariology curriculum framework for the region.

In order to conduct a thorough process of regional inclusivity and agreement, the Delphi process was used to establish the MC and SC to be considered, by using the nominal group method favored by consensus.[40] The process included three phases and was previously discussed and agreed upon by the LAOHA Cariology Core group. An agreement percentage of ≥ 80% among participants was preset.

Preparation phase

Three panels and a coordinating group were selected: a panel inviting experts representing 12 regional academic and professional dental associations (Associations-Panel); a panel composed of representatives of the n = 263 dental schools in all Spanish-speaking Latin American 19 countries who accepted to participate (Dental Schools-Panel); a panel of expert peer reviewers willing to represent four international academic and professional associations (Peers-Panel), and a Coordinating Group of five experts and collaborators from UNICA (Caries Research Unit) at Universidad El Bosque. The Coordinating Group took into consideration the comparison of previous frameworks[33-38] and updated scientific evidence, and produced a baseline framework proposal (Framework 1st version) by adapting the original five domains, the MC and their supporting SC.

Consultation and agreement phase.

This corresponded to a series of three rounds of questionnaire conducted to stabilize opinions. Although anonymity among participants' answers was maintained, later discussion was invited for achieving agreement. The coordinating group was in charge of controlling the feedback and updating the frameworks at each stage. In all rounds, each participant was asked to independently assess each item from the pedagogical

Table 1. Definitions of competencies and their levels of development (modified from Cowpe et al.).[39]

Definitions of Competence
Main Competency (MC), for this consensus, is conceived as the ability (including knowledge, skills and attitudes) of a dental student upon graduation to perform or provide a particular, complex service or job. Its complexity suggests that multiple and more specific skills (Specific or Supporting Competencies) are required to support the performance of any MC.
Specific Competency (SC) are specific or supporting skills, which can be considered subdivisions of a MC. The achievement of a MC requires the acquisition and demonstration of all the SCs related to that particular service or job. However, some SCs may also contribute to the achievement of other MCs.
Levels of Competency
Be capable of: A graduating dental student should demonstrate a theoretical knowledge and understanding of the subject matter, along with adequate clinical experience to be able to solve problems encountered in the clinic independently or without assistance.
Have knowledge of: A graduating dental student should demonstrate a solid theoretical knowledge and understanding of the subject matter, but may have limited clinical/practical experience.
Be familiar with: A graduating dental student should demonstrate an understanding of the subject matter, but need not have experience and is not expected to perform procedures or approaches independently.

and cariology perspective and define whether the MC or SC should or should not be included. A negative answer had to be supported by evidence and in case of a positive answer, conceptual and/or wording modifications could be proposed for both types of competencies, as well as changes in the level of development of learning for specific competencies.

The first round was conducted from February to April 2022, by sharing the baseline framework with the AP in two consecutive time intervals. It started with the 10 MC (including the five domains) and then continued with the SC. Each time, the document was shared via a Google Forms platform questionnaire (Google Inc., Menlo Park, United States of America) and this was followed by an online workshop that allowed for 'round table' discussions of controversial items until an agreement was achieved. Based on the agreements the CG produced a Framework 2nd version.

The second round was conducted by sharing the adapted 10 MC with the Dental Schools' panel via a Google Forms platform questionnaire. Up to three reminders were sent to the representatives and deans of dental schools who accepted to participate (May - August 2022). Answers went through discussion within the CG, who then produced a Framework 3rd version.

Consensus phase

The third and last round was conducted with the Associations' panel in a workshop held in Universidad El Bosque during September 2022. At this stage, the MC and SC were read out and the only available answering options were 'agree' or 'agree with modifications'; a secret voting was conducted with an electronic program (Turning Point interactive software, Ingesonic®). After the first voting, thorough "round table" discussions of items were held as and when required, either due to a lower-than-80% agreement or to different opinions about wording/concepts, and after their adaptation, agreement was confirmed by secretly voting for a second time. Subsequently, the Coordinating Group adapted the Framework 4th version, circulate it with the peer reviewers' panel and held an online meeting with them for final agreements and recommendations about the document (October 2022). This resulted in the Framework 5th version and final cariology teaching consensus Framework for dental schools in Latin American Spanish-speaking countries.

Results

A total of 127 academic/professional institutions participated (Supplementary Table 2). These were distributed in n = 11 from the AP (91.6%) (ALOP -the Latin American Association of Pediatric Dentistry did not accept to participate); 112 dental schools (42.6%) from all (100%) Spanish-speaking countries in the DSP (see Table 3 for proportion of DS participation by country) and one additional English-speaking country DS from Trinidad and Tobago, and four associations in the EP (100%).

The baseline Framework 1st version included five Domains, 10 MC and 92 SC. The overall MC and SC agreement results after the first round (AP) corresponded to (mean; range): Full agreement (88%; 83–100%); Agreement with modifications (11%; 0–16%) and Disagreement (2%; 0–4%). After analysis of answers and modifications proposals, the CG derived a Framework 2nd version of 10 MC and 86 SC, applying wording modifications of Domains 1, 3 and 4, and content and wording modifications of seven and nine SC, respectively. Corresponding MC agreement results after the second round (DSP) disclosed: 92%; 87–96%; 8%; 4–13% and 0%, respectively. Wording adaptations were made in 29 MC for the Framework 3rd version. The third and on-site round (AP) reported high agreement results (mean; range) for MC (97%; 89–100%) and SC (99%; 89–100%). After discussions it was agreed to merge two SC of Domain 5 into one; to make content modifications in 18 SC, changing the learning level of one SC, making changes in the wording in three MC and 50 SC. Resulting Framework 4th version included five Domains, 10 MC and 85 SC. The suggestions from the PP were discussed and agreed, resulting in content modification of two MC and four SC, changing learning level in two SC, and changes in wording in Domains 3 and 4, 10 MC and two SC, for a final Cariology Core Curriculum Framework for Dental Schools in Latin American Spanish-speaking countries of five Domains, 10 MC and 85 SC. Figure shows the Cariology Framework general structure with

Table 2. Academic/professional participating Institutions.

Panel	Country/Region	Name of institution
Panel of Regional Dental Academic or Professional Associations (D A/P A) (11/12 invited)	Colombia	ACODEB (Colombian Academy of Aesthetic Operative Dentistry and Biomaterials)
	Colombia	ACP (Colombian Academy of Prosthodontics)
	Latin America	ALODYB (Latin American Association of Operative Dentistry and Biomaterials)
	Colombia	FOC (Colombian Dental Federation)
	Latin America	FOLA (Latin American Dental Federation)
	Latin America	LAOHA Core Team (Latin American Oral Health Association) (n=9 participants)
	Latin America	LARO (Latin American Regional Organization)
	Latin America	IADR LAR (International Association for Dental Research-Latin American Region) - GLIOC (Elderly Group)
	Latin America	IADR LAR Caries Group (n=2 participants)
	Latin America	OFEDO/UDUAL (Organization of Dental Schools - Union of Latin American U.)
	Colombia	UNICA – Caries Research Unit, Universidad El Bosque (n=5 participants)
Panel of Peers: International D A/P A (4/4 invited)	The United States	AAC (American Academy of Cariology)
	International	FDI (World Dental Federation)
	International	IAPD (International Association of Pediatric Dentistry)
	International	ORCA (European Organisation for Caries Research) - Education Platform
Dental Schools Panel (112/263 dental schools -DS invited, with participation of all 19 Spanish-speaking countries) and 1 English-speaking DS invited	Argentina (9/20 DS)	Universidad Abierta Interamericana, Universidad Católica de Córdoba, Universidad Católica de La Plata Universidad de Buenos Aires, Universidad del Salvador, Universidad Nacional de Córdoba, Universidad Nacional de Río Negro, Universidad Nacional de Rosario, Universidad Nacional de Tucumán
	Bolivia (2/10 DS)	Universidad Privada Franz Tamayo-El Alto, Universidad Privada Franz Tamayo-Santa Cruz
	Chile (16/22 DS)	Pontificia Universidad Católica de Chile, Universidad Andrés Bello, Universidad Arturo Prat, Universidad Austral de Chile, Universidad Autónoma de Chile, Universidad de Antofagasta, Universidad de Alba-Pedro Valdivia, Universidad de Chile, Universidad de La Frontera, Universidad de La Serena, Universidad de Los Andes, Universidad de Talca, Universidad de Valparaíso, Universidad Mayor, Universidad San Sebastián, Universidad Viña del Mar
	Colombia (21/27 DS)	Corporación Universitário Rafael Núñez, Fundación Universidad del Norte, Fundación Universitaria San Martín, Institución Universitaria Colegios de Colombia-Bogotá, Pontificia Universidad Javeriana, Universidad Antonio Nariño, Universidad Autónoma de Manizales, Universidad CES, Universidad Cooperativa de Colombia (UCC)-Bogotá, UCC-Medellín, UCC-Pasto, UCC-Villavicencio, Universidad de Antioquia, Universidad de Cartagena, Universidad del Sinú-Cartagena, Universidad del Valle, Universidad El Bosque, Universidad Nacional de Colombia, Universidad Metropolitana, Universidad Santiago de Cali, Universidad Santo Tomas De Aquino
	Costa Rica (2/3 DS)	Universidad Latinoamericana de Ciencias y Tecnología, Universidad de Costa Rica
	Cuba (1/1 DS)	Universidad de La Habana
	Ecuador (5/16 DS)	Universidad Católica de Santiago de Guayaquil, Universidad de Los Hemisferios, Universidad Central del Ecuador, Universidad Regional Autónoma, Universidad San Gregorio de Portoviejo de Los Andes
	El Salvador (2/4 DS)	Universidad Evangélica de El Salvador, Universidad del Salvador
	Guatemala (1/3 DS)	Universidad De San Carlos de Guatemala
	Honduras (2/3 DS)	Universidad Católica de Honduras-San Pedro Sula, Universidad Católica de Honduras-Tegucigalpa

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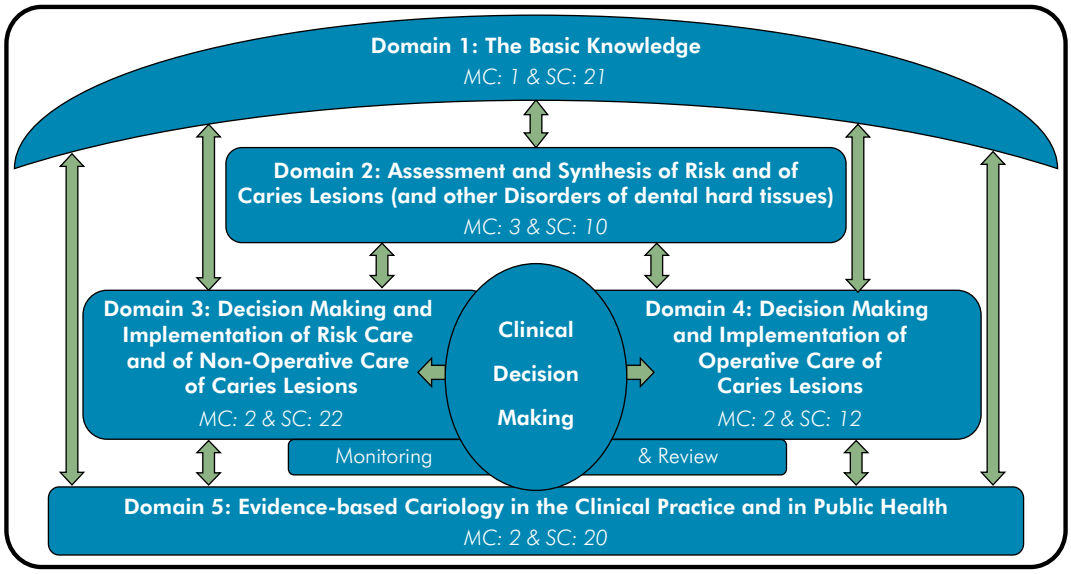
Dental Schools Panel (112/263 dental schools -DS invited, with participation of all 19 Spanish-speaking countries) and 1 English-speaking DS invited	Mexico (23/ 81 DS)	Escuela Nacional de Studio's Superiores-Unidad León, Facultad de studios Superiores Zaragoza, Instituto Latinoamericano de Ciencias y Humanidades, Universidad Anáhuac, Universidad Autónoma de Campeche, Universidad Autónoma de Coahuila-Saltillo, Universidad Autónoma de Nayarit, Universidad Autónoma de Nuevo León, Universidad Autónoma de San Luis Potosí, Universidad Autónoma de Sinaloa, Universidad Autónoma de Yucatán, Universidad Autónoma de Zacatecas, Universidad Autónoma del Estado de México, Universidad Autónoma Metropolitana-Xochimilco, Universidad de La Salle Bajío, Universidad Latinoamericana-Campus Norte, Universidad Nacional Autónoma de México, Universidad Intercontinental, Universidad Popular Autónoma del Estado de Puebla, Universidad Regional del Sureste, Universidad Quetzalcóatl Irapuato, Universidad Veracruzana, Universidad Veracruzana-Río Blanco
	Nicaragua (1/3 DS)	Universidad Americana de Managua
	Panama (3/3 DS)	Universidad de Panamá, Universidad Latina, Universidad Interamericana de Panamá
	Paraguay (3/7 DS)	Universidad Autónoma del Paraguay Pierre Fauchard, Universidad Nacional de Asunción, Universidad Nacional de Concepción
	Peru (5/36 DS)	Universidad Católica Santo Toribio de Mogrovejo, Universidad Científica del Sur, Universidad de San Martín de Porres, Universidad Nacional Mayor de San Marcos, Universidad Peruana Cayetano Heredia
	Puerto Rico (1/1 DS)	Universidad de Puerto Rico
	Dominican Republic (6/13 DS)	Instituto Tecnológico de Santo Domingo, Universidad Católica Nordestana, Universidad Central del Este, Universidad Iberoamericana, Universidad Nacional Pedro Henríquez Ureña, Universidad Tecnológica de Santiago
	Uruguay (2/2 DS)	Universidad Católica de Uruguay, Universidad de La República de Uruguay
	Venezuela (7/8 DS)	Universidad Central de Venezuela, Universidad de Carabobo, Universidad de Los Andes, Universidad de Zulia, Universidad Gran Mariscal de Ayacucho, Universidad José Antonio Páez, Universidad Santa María
	Trinidad & Tobago (1/1)	The University of West Indies

Domain titles and respective number of MC and SC, illustrating the inter-relationship between domains. Table 3 shows the complete Cariology Framework.

A series of high-relevance general considerations were considered throughout the consensus process as common to all domains and competencies. These included:

a. Aspects of social determination; life cycles/ life courses, with their particularities and differences, including their outcomes; emerging evidence; health promotion in a general context, including oral health; working in the context of the WHO and FDI 2030 emerging goals.[10,11]
b. In addition, the following considerations apply to clinical domains: Obtaining informed assent and/or consent; working with other members of the dental and health care team; critically evaluating new scientific and technological developments and how to integrate them into their clinical activities; as regards to the term dental caries, this includes its classifications according to coronal/root location, if it is primary or secondary (associated with restorations and sealants - CARS), and in the primary (early childhood caries) or permanent dentition; other disorders of dental hard tissues (*e.g.*, erosive tooth wear - associated with erosion, abrasion, attrition, abfraction, and developmental defects of the enamel, including but not limited to dental fluorosis, molar- incisor hypomineralization-MIH, hypomineralized second primary molar -HSPM, hypoplasia) are considered as part of the cariology teaching.[33-38]
c. This consensus is of cariology and should be integrated with other clinical and systemic conditions related to oral health (such as periodontal disease, other dental, occlusal, articular conditions).
d. It should be noted that each of the competencies (core and specific) should exist in the context of 'what for' and considering 'how it will be measured'.
e. Terms used are in agreement with the dental caries terminology consensus report.[1]



Adapted from Schulte et al.[22]

Figure. General characteristics of the core cariology curriculum framework for dental schools in Latin American Spanish-speaking countries.

Discussion

This paper presents the process of development and consensus of the Core Cariology Curriculum Framework in Spanish for Latin American Dental Schools. This framework is based on European Core Cariology Curriculum[33] and those derived from it,[34-38] and it takes into consideration the aspects of variability in education and context in the 19 Spanish-speaking Latin American countries. The development of this framework recognizes and respects the 'university autonomy' according to the Latin American Project of Convergence in Education (PLACEO, as per its Spanish acronym) seeking to offer *"developing directives as model for the educational institutions, as well as the government and academic authorities, to make the modifications required to allow for adaptation of the existing educational systems in Dentistry, and would thus make it possible to achieve the standards of education of Dentists that our communities need"*.[41] The comprehensive focus assumed for the domains and main competencies favored the approach of learning results of dentistry programs, as an explicit description of *"what a student should know, understand, and be capable of performing, as the learning result"*.[42] The resulting cariology curriculum framework had previously undergone regional and up-to-date adaptations related to content and wording, and it corresponded to a valuable dental education guideline in cariology within the region. After adapting the framework to local education systems, it is expected that its 10 Main Competencies will be followed, supported by the Specific Competencies. This framework offers precise parameters regarding cariology teaching and counts on being sufficiently flexible to allow for an independent implementation in each dental school.[35]

The implementation of this cariology teaching framework poses a challenge to dental schools, in terms of infrastructure, budget, and curriculum components, including expected learning outcomes that reflect on the students' grading. Moreover, as Fontana et al. pointed out,[35] it requires educators' capability of teaching students to think critically and solve problems based on best available evidence. As an example of lack of evidence translated into clinical practice, we cite that in dental clinics, the requirements relative to evaluation have shown that they were traditionally focused on developing the ability to eliminate carious tissue completely, without considering a tooth-preserving appraoch.[43] In general, surveys on cariology teaching through-out the world have shown that the curative approach continues to be followed.[23-31]

Considering that the future challenge is to translate the evidence (and guidelines, *e.g.*, this framework)

Table 3. Core Cariology Curriculum Framework for Dental Schools in Latin American Spanish-speaking countries.

Domain I. The Knowledge Base		
This domain describes the basic knowledge necessary for domains II to V. A varying depth of knowledge and understanding of each aspect will be required in order to achieve the appropriate levels of competence.		
Main Competency 1.1		
Upon graduation, a dentistry student, should be capable of applying the knowledge and understanding of basic, biological, health, social, and applied sciences in clinical and collective practice, in order to recognize the process of dental caries and other alterations of hard dental tissues for decision making in health promotion, prevention and management of the disease in individuals and populations.		
Specific Competencies		
With regard to the development, growth and structure of relevant oral tissues, a dental student upon graduation should:		
Have knowledge of:		
1.1.1 The normal development, growth and structure of dental and oral tissues (e.g. dental hard tissues, pulp and salivary glands) at the macroscopic, microscopic and molecular levels.		
1.1.2 Developmental disorders of dental and oral tissues at the macroscopic, microscopic and molecular levels.		
Specific Competencies		
With regard to the etiology, pathogenesis, and modifying factors of dental caries and other dental hard tissue disorders, a dental student upon graduation should:		
Be capable of:	*Have knowledge of:*	*Be familiar with:*
1.1.3 Describing and discussing the mechanisms and dynamic processes involved in the maintenance of health, as well as the response to dental caries and dental hard tissue alterations, at the macroscopic, microscopic and molecular levels.	**1.1.6** Biochemical events in dental biofilm, saliva and dental hard tissues.	**1.1.10** Individual risk assessment of other dental hard tissue disorders.
1.1.4 Describing and discussing the role of dental biofilm, saliva, fluorides, diet and nutrition related to dental caries and other dental hard tissue disorders.	**1.1.7** Microbiological events, including acid and base production and other biofilm metabolic processes associated with dental caries.	
1.1.5 Describing and discussing the role of individual risk factors and social determinants related to dental caries and other dental hard tissue disorders.	**1.1.8** The role of environmental factors, medications, and systemic diseases related to caries and other dental hard tissue disorders.	
	1.1.9 The different instruments for clinical assessment of individual caries risk.	
Specific Competencies		
With regard to the identification/detection, assessment and synthesis/diagnosis in relation to caries risk and caries lesions, as well as other dental hard tissue alterations, a dental student upon graduation should:		
Have knowledge of:	*Be familiar with:*	
1.1.11 The physical, biochemical and biological basis of hard tissue changes related to the detection and assessment of dental caries and other dental hard tissue disorders.	**1.1.15** The mode of action and limitations of emerging methods of detection, assessment and diagnosis of caries and other dental hard tissue disorders.	
1.1.12 The physical, biochemical and biological basis of methods of detecting and assessing dental caries and other dental hard tissue changes for diagnosis.		
1.1.13 The rationale for the operational characteristics to assess the validity and performance (sensitivity, specificity and predictive values) of detection, assessment and diagnostic methods for dental caries and other dental hard tissue disorders.		
1.1.14 The principles for assessing individual risk factors and social determinants related to risk for dental caries and other dental hard tissue disorders.		
Specific Competencies		
With regard to behavioral sciences, a dental student upon graduation should:		
Have knowledge of:		
1.1.16 The psychological, sociological, and socioeconomic factors, which delineate interpersonal skills, communication, and behavior modification at the individual and group levels in relation to the management of dental caries and other dental hard tissue disorders.		
1.1.17 The principles of ethics, bioethics and professionalism in relation to the management of dental caries and other dental hard tissue disorders.		

Continue

Continuation

Specific Competencies	
With regard to prevention and management, a dental student upon graduation should:	
Have knowledge of:	*Be familiar with:*
1.1.18 The mode of action, composition, properties, limitations and side effects (local and/or systemic), of dental biomaterials, products and, limitations and side effects of techniques, for the management of caries risk and the non-operative and operative management of caries and other dental hard tissue disorders, at the individual and collective level.	**1.1.19** The theoretical basis of emerging strategies, including dental biomaterials, for caries risk management and the nonoperative and operative management of caries and other dental hard tissue disorders.
Specific Competencies	
With regard to epidemiology and research methodology, a dental student upon graduation should:	
Have knowledge of:	
1.1.20 Basic concepts of epidemiology.	
1.1.21 Research methodology, including study designs, sampling, bias control, and statistics, and their limitations.	
Domain II: Assessment and Synthesis of Risk and of caries lesions (and other dental hard tissue disorders)	
This domain refers to the assessment and diagnostic synthesis of caries risk and lesions and other dental hard tissue disorders. It represents a bridge between basic knowledge and decision making, preventive management (risk and non-operative) and operative management. It requires synthesis and evidence-informed and appropriate decision-making skills for clinical and public health practice. It also applies to other dental hard tissue disorders.	
Main Competency 2.1	
On graduation, the dentist must be capable of identifying individual risk factors and social determinants for caries (development/progression of caries lesions). The graduate should also have the ability to apply these skills to dental hard tissue disorders. An appropriate level of knowledge and understanding is required to reliably collect and record valid and clinically relevant data.	
Specific Competencies	
With regard to risk assessment, a dental student upon graduation should:	
Be capable of:	
2.1.1 Assess and record, individually and collectively, the presence of caries protective and risk factors (social, systemic, intraoral and behavioral), based on clinical history/anamnesis, interview and clinical examination, considering periodic reevaluation. It also applies to other dental hard tissue alterations.	
Main Competency 2.2 - Detection and assessment of caries lesions and other dental hard tissue disorders.	
Detection of a caries lesion involves an objective method to determine whether or not the disease is present, differentiating from other alterations. The assessment of the caries lesion seeks to categorize its severity and evaluate its state of progression (activity). The detection and assessment of severity also applies to other dental hard tissue alterations. Upon graduation, the dentist must be capable of collecting, based on visual/tactile and radiographic methods, data on the signs and symptoms of dental caries, detecting the experience (past occurrence) of dental caries, as well as the presence of caries lesions on tooth surfaces, assessing and categorizing their state of severity and their state of activity. Similar competence is required for the detection and assessment of other dental hard tissue disorders.	
Specific Competencies	
With regard to screening and assessment, a dental student upon graduation should:	
Be capable of:	*Have knowledge of:*
2.2.1 Recognizing abnormal dental tissue in primary and permanent dentition, differentiating between carious and non-carious lesions, as well as between primary and secondary coronal and root caries lesions.	**2.2.5** The operational characteristics and limitations of other diagnostic methods (e.g. fluorescence based) for caries and other dental hard tissue disorders.
2.2.2 Collecting and recording data on the presence of the caries process (detection) and assess its different stages of severity and its activity (related signs and symptoms).	
2.2.3 Collecting and recording data on signs and symptoms of other dental hard tissue disorders, with emphasis on erosive tooth wear and developmental enamel defects such as dental fluorosis and hypomineralization of molar-incisor molars (HMI) or primary second molars (HSMP).	

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Continuation

2.2.4 Appropriately use visual-tactile (with rounded tip probe support) and radiographic (coronal radiographs) diagnostic aids for dental caries, recognizing their operational characteristics and limitations. Visual diagnostic aids also apply to other dental hard tissue disorders.
Main Competency 2.3 - Synthesis and diagnosis of caries risk and lesions (and other dental hard tissue disorders)
Synthesis is an important step in ensuring that all information obtained from the oral health record/anamnesis, assessments, and complementary exams, is integrated in a systematic way at a specific moment, into a diagnosis for individual/collective benefit. Upon graduation, the dentist must be capable of synthesizing all relevant information contained in the clinical history by combining and interpreting individual/collective risk factors and caries findings, taking into account the patient's needs, preferences and interests, to decide the risk classification, severity and activity of caries lesions, establish a diagnosis and together with the patient, design a personalized management plan, including both follow-up and re-evaluation. The graduate should also be competent in applying these skills with respect to other dental hard tissue disorders. These aspects are linked to the clinical decision making reviewed in domains III and IV.
Specific Competencies
With regard to synthesis and diagnosis, of risk and caries lesions (and of other dental hard tissue alterations), a dental student upon graduation should:
Be capable of:
2.3.1 Comprehensively analyze caries risk data, obtained from individual/group assessment and existing monitoring, review or reassessment, to classify the risk, deciding together with the patient or guardian/group, considering their needs, preferences and interests, a health promotion plan, preventive management and reassessment intervals accordingly. It also applies to other dental hard tissue disorders.
2.3.2 Comprehensively analyze data on caries lesions, obtained from current assessment and existing monitoring, review or reassessment, to classify their severity and activity, deciding together with the patient/guardian, considering their needs, preferences and interests, an appropriate management plan, including control, non-operative management and operative management with preservation of tooth structure, as well as monitoring. It also applies to other dental hard tissue disorders.
2.3.3 Communicate to the patient/guardian or group the results of the caries risk assessment and the presence, severity and activity of caries lesions and other dental hard tissue disorders and provide recommendations that give them tools to control the pathology(ies) and improve their oral health.
2.3.4 Provide interdisciplinary consultation and management, or refer for specialist or medical diagnosis and management, in case of systemic conditions related to caries or unknown dental hard tissue disorders.
Domain III. Decision making and implementation of risk management and nonoperative caries lesions management
This domain is concerned with the individual/group management of risk and caries lesions and other dental hard tissue disorders (primarily erosive tooth wear and developmental enamel defects), with emphasis on planning, re-evaluation and long-term maintenance of risk management and non-operative management of caries lesions. This domain also includes communication with the patient (individual/group) as an essential part of the decision-making process.
Main Competency 3.1 - Patient, Family and Community Communication in Different Health Care Settings
Upon graduation, the dentist must be capable of communicating to patients of all ages, families and caregivers (or collectively), aspects of risk management and non-operative management of caries lesions, and other dental hard tissue disorders, in an effective, reflective and interactive manner. Communication should consider the age, socio-economic and cultural circumstances of the patient/families/caregivers/ collective and the environment in which it takes place, strengthening autonomy and participation.
Specific Competencies
With regard to communication with the patient, family/caregivers and the collective, in different health care settings, a dental student upon graduation, should:

Be capable of:	*Have knowledge of:*
3.1.1 Establishing an empathetic and mutually trusting relationship with the patient/family/caregivers/ collective.	**3.1.7** Behavioral factors that facilitate the delivery of preventive management dental care.
3.1.2 Identifying and understanding and discussing the expectations, wishes, attitudes, needs and demands of the patient/family/caregivers/collective as inputs for promotional and preventive management planning.	**3.1.8** Patient/family/caregiver/collective factors that influence communication and affect preventive management recommendations (e.g., expectations, time adherence, and manual dexterity).
3.1.3 Identifying and understanding the psychological, physical, socioeconomic and cultural factors that may influence patient/ family/caregiver/collective adherence to the measures implemented for promotional and preventive management and their outcome.	**3.1.9** Nonverbal communication skills; e.g., intonation, body language, sitting position, and eye contact.
3.1.4 Helping the patient/family/caregivers/group understand the importance of their role in the preventive management of dental caries, involving them to promote their understanding of the disease, to increase their adherence to individual/group preventive measures, and thus contribute to their future oral health. It also applies to other dental hard tissue disorders.	**3.1.10** Behavioral interventions; e.g., motivational interviewing, self-determination theory, and short behavior change tool.

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3.1.5 Providing appropriate and timely consultation/inter-consultation by exchanging patient/family/caregiver/collective information with other dental specialties and/or relevant health care professionals.	**3.1.11** The importance of patient/family/ caregiver/collective recognition of the association between oral diseases and systemic diseases.
3.1.6 Assessing patient/family/caregiver/collective readiness to change and potential compliance with the proposed preventive management plan.	

Main Competency 3.2 - Decision Making and Risk and Non-operative Management of caries lesions

The dental student upon graduation should be competent in collecting, interpreting and synthesizing all relevant information, contained in the oral health record, necessary to formulate appropriate management options that can be presented and agreed upon with the patient or guardian/ collective, to decide on a specific management plan. This includes a strategy for risk management and non-operative management of caries lesions, according to the needs, risks and compliance capabilities at the individual, family, caregiver and group levels, and additionally, the systematic assessment of their outcomes, both during management and at reassessment intervals, formulating alternative plans, if required.

Specific Competencies

With regard to decision making and risk management and non-operative management of caries lesions, a dental student upon graduation, should:

Be capable of:

3.2.1 Making decisions based on synthesis (Domain II).

3.2.2 Developing health education actions directed to patients/families/caregivers/collective, relative to the etiology of dental hard tissue diseases and empower them to take responsibility for their oral health.

3.2.3 Developing actions to promote healthy eating aimed at patients/families/caregivers/collective.

3.2.4 Developing actions to teach appropriate oral hygiene measures to patients/families/caregivers/collective.

3.2.5 Conducting professional prophylaxis.

3.2.6 Recognizing the mechanisms of action, limitations and adverse effects of self-applied and professionally applied individual/collective preventive management agents (e.g. fluorides, antimicrobials, calcium/arginine-based strategies, sealants), as well as their methods of administration/application.

3.2.7 Administrating, prescribing or applying, preventive and/or therapeutic agents, when indicated, for risk management and non-operative management of caries lesions.

3.2.8 Monitoring the effects of mechanical and chemical control of dental biofilm, as well as the clinical status of sealants (assessing whether they need to be reapplied or repaired).

3.2.9 Polishing, adapt and/or repair dental biofilm retentive restorations that do not require replacement.

3.2.10 Considering the needs of people in vulnerable conditions, such as frailty, cognitive dependence or impairment, disabling conditions, systemic or psychiatric illnesses.

3.2.11 The role of diet and its association with the risk of developing caries and other dental hard tissue disorders.

Domain IV. Decision making and implementation of the operative management of caries lesions

This domain deals with the operative management of caries lesions and other alterations of dental hard tissues, with emphasis on their planning, maintenance and re-evaluation, accompanied by continuous preventive (risk and non-operative) management (Domain III). It involves applying the principles of tooth structure preservation. In addition, it is aligned with other fundamentals of dentistry: pediatric dentistry, restorative dentistry, endodontics, orthodontics, periodontics and prosthodontics, in terms of the execution of the restorative phase or an operative management plan for caries lesions. It is recognized that operative intervention should only be considered when non-operative (preventive) management options alone are no longer likely to be successful.

Main Competency 4.1 - Clinical decision making leading to operative management of caries lesions

Upon graduation, the dentist must be capable of collecting, interpreting and synthesizing all relevant information contained in the clinical history necessary to formulate appropriate operative management options that can be presented and agreed upon with the patient or guardian to decide on an individualized plan. This requires the ability to decide when it is appropriate to intervene operatively (in cavitational/cavitated caries lesions or those beyond the outer third of the dentin) and to know how to do so, understanding the consequences and prognosis of the decisions made. This applies to other dental hard tissue lesions.

Specific Competencies

With regard to clinical decision making leading to the operative management of caries lesions, a dental student upon graduation, should:

Be capable of:	*Have knowledge of:*
4.1.1 Selecting the appropriate treatment option for each situation, based on the best available evidence from the full range of non-operative and operative management options available, and on the individual case.	**4.1.4** The reactions of the dentin-pulp complex to the caries process and other dental hard tissue alterations and restorative procedures.

Continue

Continuation

4.1.2 Recognize, understand and manage the outcomes and consequences of operative intervention.	**4.1.5** The success and failure rates of the different types of restorations.
4.1.3 Conduct ongoing reflection on the decision-making process and management plan for operative interventions.	

Main Competency 4.2 - Operative management of caries lesions

Upon graduation, the dentist must be capable of using the operative management of caries lesions and other dental hard tissue alterations in an appropriate manner, with maximum preservation of dental structure, considering the restoration of dental tissue loss in form, function and esthetics, and simultaneously, promoting oral health. Additionally, the graduate should be able to systematically evaluate (at re-evaluation intervals and during management) all outcomes of operative management, and to adequately make decisions for maintenance, repair or replacement of a restoration, giving appropriate instructions to the patient or guardian, for its maintenance, as well as for the prevention of damage to their restorations and caries lesions associated with them.

Specific Competencies

With regard to the operative management of caries lesions and their re-evaluation and follow-up, a dental student upon graduation, should:

Be capable of:	*Have knowledge of:*
4.2.1 Deciding, prior to performing a restoration, taking into account the restorability of the tooth, when, how and how far to extend the removal of decayed tooth tissue (or other dental hard tissue alteration), seeking to achieve maximum preservation of tooth structure, maintain pulp and periodontal viability and generate functionality, to prolong tooth survival and increase the longevity of the restoration, consistent with the patient's comprehensive treatment plan.	**4.2.7** Emerging techniques for the removal of carious tissue (e.g. step-by-step excavation) and for the management of other dental hard tissue disorders.
4.2.2 Selecting and handling of the appropriate restorative biomaterials, considering their physical-mechanical and chemical properties, biocompatibility and longevity.	
4.2.3 Selecting and performing appropriate operative techniques, both for the biomaterial and the case.	
4.2.4 Identifying the response of operative procedures performed on the mucosa, pulpal organ-dentin, periodontal tissues, occlusion and function.	
4.2.5 Evaluating and monitoring the outcomes (results) of operative management of caries lesions over time.	
4.2.6 Establishing a maintenance schedule for the restoration, to prolong its longevity, and repair or replace when appropriate.	

Domain V. Evidence-based cariology in clinical practice and public health

This domain addresses the core skills of evidence-based dental practice within the undergraduate curriculum, which includes the two phases of cariology, clinical (particularly related to individuals) and public health (particularly related to the collective). It should be noted that public health cariology requires additional competencies to those listed in domains II-IV. This domain relates to caries and other dental hard tissue disorders. The core competencies in evidence-based dentistry, which are generic to the undergraduate curriculum as a whole and not just cariology, are integrated with critical thinking and lifelong learning skills within dental practice. The clinical cariology competencies in caries assessment and management for the individual patient fall within domains II-IV, and for Public Health cariology, the competencies are presented within this domain, in close relation to the principles of evidence-based dentistry.
It is important for these topics to be recognized in the clinical and public health practice setting.

Main Competency 5.1 - Oral Public Health in Relation to Cariology

Upon graduation, the dentist must be capable of preventing and controlling dental caries and other dental hard tissue disorders, at a collective level. This requires an understanding of epidemiology, social determinants, health promotion and preventive strategies, the right to health, public policies, care systems and current regulations in oral health. It also requires an understanding of the interaction of these oral pathologies with other disorders, general health status and nutrition.

Specific Competencies

With regard to oral public health as it relates to cariology, a dental student upon graduation, should:

Continue

Continuation

Be capable of:	*Have knowledge of:*	*Be familiar with:*
5.1.1 Recording and interpreting dental caries and other dental hard tissue disorders at an epidemiological level.	**5.1.5** The rights, duties and interests of individuals and health-related professionals, and the management of situations related to these.	**5.1.11** Understanding health systems, their evolution at the global and national levels, and current regulations in relation to oral health.
5.1.2 Assessing oral health conditions, dental caries and dental hard tissue disorders in a community and their needs for care and attention.	**5.1.6** The concept of quality of life related to general and oral health, with emphasis on dental caries and other alterations of dental hard tissues.	**5.1.12** Trends in oral health patterns and treatment needs.
5.1.3 Planning, implementing and evaluating jointly, with the corresponding entities and with patients or guardians, strategies for health promotion and prevention of dental caries and other dental hard tissue disorders and their relationship with other pathologies, at the individual and collective levels.	**5.1.7** The interactions between dental caries and other health problems. Also applies to other dental hard tissue disorders.	**5.1.13** International approaches to oral health care systems.
5.1.4 Analyzing population risk, considering social determinants and their relationship with the oral health situation and the burden of disease due to dental caries and other dental hard tissue disorders during the course of life, including identification of lifestyles, previous knowledge and social practices related to oral health, participating in the development of proposals to transform the situations found.	**5.1.8** Health promotion and prevention of oral disease in populations, with emphasis on caries and other dental hard tissue disorders.	**5.1.14** General health - economics aspects of the management of dental caries and other dental hard tissue disorders.
	5.1.9 The organization of oral health care and public health in their country, in accordance with the national health system and current regulations.	
	5.1.10 The descriptive epidemiology of caries and other dental hard tissue disorders, in relation to different variables such as age, general health and social determinants.	
Main Competency 5.2 - Evidence-based cariology		
Upon graduation, the dentist must be capable of developing an evidence-based practice to apply to the fields of dental caries, malformation injuries, traumatic injuries and other dental hard tissue disorders. This requires the ability to search for evidence of best clinical practices, make a critical appraisal, to select and apply in an informed manner the best available evidence.		
Specific Competencies		
With regard to dental caries and other evidence-based alterations of dental hard tissues, a dental student upon graduation. should:		
Be capable of:	*Have knowledge of:*	
5.2.1 Identifying gaps in knowledge; formulate a structured clinical question that has a possible answer and search for evidence, using appropriate scientific resources (including biomedical research databases such as Pubmed, Cochrane, Scielo, etc.).	**5.2.4** The principles of evidence-based dentistry and the hierarchy of evidence.	
5.2.2 Seek out and use the most appropriate current clinical management guidelines, recognizing their limitations.	**5.2.5** The transfer of evidence-based dentistry to clinical practice and public health, as well as to the individual and collective level.	
5.2.3 Critically analyzing the evidence on diagnostic methods and therapies to decide on their implementation, recognizing the existing methodological limitations.	**5.2.6** The principles of research methodology, including study design, bias control, representativeness, biostatistics, and extrapolation.	

into practice in order to render its real relevance,[44] work with implementation science[45] and support from the COM-B (capability, opportunity, motivation behavior model)[46] is on the way to start elucidating these aspects. For the moment this will occur on a small scale in eight Latin American Spanish-speaking dental schools. A survey (with COM-B) describing how dental students, educators and practitioners diagnose and manage caries in Colombia, after an overall moderate exposure of over 10 years to the

ICCMS system (International Caries Classification and Management System), indicated that students perform many related up-to-date clinical behaviors with increasingly more significant frequency than educators and practitioners do.[47] The study also reported that best clinical practices would more frequently translate into best clinical practices relative to diagnosis of risk and caries lesions, if resources (*e.g.*, time, oral health recording software) were increased. Moreover, caries management would also improve if the capability of the professionals and students related to these activities were also enhanced.

A limitation of this study was the low participation of dental schools in the area (42.6%). Although direct contact was made with OFEDO-UDUAL, and all 19 Spanish-speaking countries participated, there was a regional lack of an updated Latin American Spanish-speaking dental schools' directory. This could have occurred for many reasons, included the rapid and increasing number of dental schools in the region. For example, many of them have not yet become members of OFEDO-UDUAL and there were difficulties with online access; thus many showed no apparent interest in participating. Nevertheless, we now have a more updated directory that will enable us to offer future opportunities to participate in regional initiatives. This will be kept in the LAOHA repository and will be available by formal request.

The process of development and reaching consensus to achieve this framework was robust by implementing the Delphi methodology[40] that was thoroughly and successfully followed. In the process. the academy was highly represented, evident by an important participation of dental schools - including all Spanish-speaking countries, and the participation of representatives of academic and professional associations that work closely with dental caries management and education.

There is increasing relevance of the implementation and adoption of this cariology teaching Framework by the academic community, given its contribution to the quality of education of future dentists, with the performance of evidence-based best clinical practices, in the context of the right to health, assuming ethical and social responsibility. Other aspects that will influence its implementation include the development of an oral health record that allows for registration of these updated aspects of cariology, in addition to being linked to a standardized software;[47] training and calibrating educators;[35] the shift of national health systems and health providers to payment systems focused on health outcomes[48] as well as shifting public and industry behavior to demonstrate the value of a cavity-free world.[46] Furthermore, the current relevance of caries as a non-communicable disease,[4] that has not only provided the opportunity of the disease being included in the WHO and FDI agendas.[10-12] Altogether, these aspects might influence the education area to recognize dental caries and cariology teaching at the same level and receiving emphasis equal to that laid on periodontal disease.[49]

Conclusion

A Core Curriculum Framework in Cariology for Dental Schools in Latin American Spanish-speaking countries was successfully developed and agreed upon with regional dental academic and professional institutions.

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Consensus for teaching dental caries in the Portuguese Language at Brazilian dental schools

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Abstract: The aim of this paper was to present a summary of the process of developing and preparing the final documents of the national consensus for teaching undergraduate Brazilian dental students the dental caries curriculum in the Portuguese language. The final document was developed in three steps: a) The ABENO and LAOHA cariology group invited experts from all five regions of Brazil to participate in the discussion. The theoretical support for crafting the first draft of the consensus was based on two publications: National Curriculum Guidelines of the Dentistry graduation in Brazil, Ministry of Education (2021) and the competences described in the European Core Curriculum for Cariology (ORCA-ADEE, 2011); b) The group of experts was divided into 5 working groups: G1-Domain, Main and Specific Competences, G2-Essential knowledge, G3-Life course perspective, G4-Social determinants and dental caries, G5- Glossary. The document was finalized by thoroughly reviewing the process using Delphi methodology; c) The 5-chapter document (one from each working group) was submitted to three open public consultations in 2022 (May-June, August, and October) using Google-forms. The suggestions (content/wording) were discussed within the group as: totally accepted, partially accepted, and rejected. A total of 192 suggestions were registered from 31 dental schools in all regions of Brazil. The number of suggestions received per Group were: 84, 28, 26, 24, 30 suggestions for G1, G2, G3, G4 and G5, respectively. The majority of suggestions were totally accepted by the group of experts (n = 172, 89.6%), 15 were partially accepted (7.8%), and 5 were rejected. Conclusion: The final document could be considered to be the first national consensus for teaching the dental caries curriculum in Brazil.

Keywords: Education, Dental; Dental Caries; Dentistry.

Introduction

Dental caries is defined as a dynamic, multifactorial, non-communicable, biofilm-mediated, diet-modulated disease resulting in the loss of minerals from the hard tissues of the tooth.[1] It is considered the most prevalent chronic non-communicable disease in the world that can occur throughout an individual's life, and is a cause for concern in babies, children, young people, adults, and the elderly. The prevalence

of untreated caries in primary and permanent teeth is high in many parts of the world, including Latin American and Caribbean (LAC) countries.[2] This disease, determined by biological, behavioral, psychosocial, and environmental factors, affects thousands of Brazilians.

Teaching dental caries in Schools of Dentistry is always a challenging task since this is a complex disease with no single causation pathway and there are an increasing number of strategies for managing the caries processes and outcomes.[3,4] In the majority of circumstances, cariology is the main discipline to organize and provide the best evidence for a consistent and systematic education on the subject of dental caries. Therefore, in 2010, the European Organization for Caries Research developed a workshop for proposing a Core Curriculum in Cariology, which has influenced many dental schools all over the world.[5-9]

In 2013, only 15% of the Brazilian dental schools had a specific discipline denominated "Cariology".[8] In the following year, the Brazilian Association of Dental Education (ABENO) began to support workshops and discussions focused on the introduction of cariology in the curriculum of undergraduate dental courses in Brazil. A few years later, 32% of the Brazilian dental schools offered cariology as a discipline in their curriculum and 85% of the dental schools responded that they would support a national curriculum of cariology. The increasing interest in teaching cariology, however, occurred with evident geographical regional differences, and most importantly, with the observation of low impact of this discipline on the dental clinical practice of the curriculum.[10] In other words, in many cases, cariology was restricted to the initial phase of the curriculum as a theoretical fragmented or isolated framework that was disconnected from the main purpose of the process of dental education.

In 2021, publication of the National Curriculum Guidelines (DCN) on graduation in Dentistry in Brazil, presented the coordinators, lecturers, and dental students with new challenges. This document sets the guidelines for the graduation course, bachelor's degree, to be followed for elaborating the curriculum of Higher Education Institutions (IES) in the country. These guidelines established the principles, foundations, and purposes of dental education, and had to be applied on a national scale in the organization, development, and evaluation of the pedagogical projects of undergraduate courses in Dentistry within this year.[11] Meanwhile, the Latin American Oral Health Association (LAOHA), created a cariology group for discussing dental caries in Latin American and Caribbean (LAC) countries. As a result, a caries consensus for the region was accomplished with several recommendations including the need for rethinking the curriculum of cariology in this part of the world.[2] Considering that there were over 500 dental schools in the country in 2021, a national workshop to discuss cariology teaching in Brazil was indeed an impossible project. Hence, an ABENO-LAOHA task force was formed for thinking about, planning, and preparing a national consensus for guiding the teaching of a dental caries curriculum in Brazilian dental schools.

It is of significant importance to point out that the present guidelines were prepared with focus on "dental caries" and not in "cariology" due to the profile of graduates' (bachelor) in Dentistry demanded by the DCN: "*generalist, endowed with solid technical-scientific grounding, active and permanent construction of their knowledge; humanist and ethical, caring about the person's dignity, individual and collective needs, promoter of integral health, and transformer of the reality in favor of society; capable of performing teamwork in an interprofessional, interdisciplinary, and transdisciplinary manner, as a proactive, entrepreneur, with and attitude of leadership; communicative, able to express themselves clearly; critical, reflexive, and active dentistry practice at all levels of health care; aware of and participative in social, cultural, economic, environmental policies, and technological innovations*".[11] Moreover, the DCN supported emphasis on the "*health-disease process of the individual, family, and population in the different life cycles, referred to in the epidemiological and professional reality*".

The main and supporting competencies for teaching a dental caries curriculum in this Brazilian consensus proposal were based on the ORCA consensus for teaching cariology. Small modifications to focus

on the teaching of dental caries were done.[5] This emphasis should not be interpreted as a fragmentation or dissociation of dental caries from other health problems, clinical situations, or other fields of knowledge. On the contrary, the objective was to overcome the limits of the "cariology" curricular component so that "dental caries" would become a transversal topic across the entire undergraduate course. Moreover, this approach can contribute to a transdisciplinary educational concept to be included in the curriculum.

Finally, the objective of this paper was to present a brief report about the development of the project and final documents (in five chapters) of the national consensus for teaching undergraduate Brazilian dental students the dental caries curriculum in the Portuguese language.

Methodology

The ABENO and LAOHA cariology group invited experts in different fields (Cariology, Operative Dentistry, Pediatric Dentistry, Public Health, and Dental Education) and from all five regions of Brazil - to guarantee geographical representativeness – to participate in the process. The theoretical support for crafting the first draft of the consensus was primarily based on the combination of two publications: The Ministry of Education's National Curriculum Guidelines on Graduation in Dentistry in Brazil and the competences described in the European Core Curriculum for Cariology ORCA-ADEE.[5,11] Other documents were also used for supporting the idea of focusing on dental caries integrated into the National Health System (SUS) and standardization of terminologies of dental caries and dental caries management.[4,12,13]

The team of experts was divided into 5 working groups: G1-Domain, Main and Specific Competences, G2-Essential knowledge, G3-Life course perspective, G4-Social determinants and dental caries, G5-Glossary. The background document created was finalized by submitting it to a thorough review procedure using Delphi methodology. Finally, the 5-chapter document was submitted to three open public consultations in 2022 (May-June, August, and October) using Google-forms on ABENO's homepage. Dental associations and institutions were invited to collaborate by e-mail and official letters. The suggestions could be made in two categories: for content and/or wording. Finally, all suggestions and comments were subsequently discussed within the group of experts, classified as: totally accepted, partially accepted, and rejected.

Results

As stated, the final document was structured in five chapters, one for each working group: Chapter 1-Domain, Main and Specific Competences, Chapter 2-Essential knowledge, Chapter 3-Life course perspective, Chapter 4-Social determinants, and dental caries and Chapter 5-Glossary. In this report, emphasis will be laid on Chapter 1 due to its direct relations with the understanding, requirements and planning of a curriculum for teaching dental caries in five domains, in a manner similar to that of the European Core Curriculum in Cariology.[5]

A total of 192 suggestions received from 31 dental schools in all regions of Brazil were registered. The numbers were: 84, 28, 26, 24, 30 suggestions for Groups G1, G2, G3, G4 and G5, respectively. The majority of suggestions were totally accepted by the group of experts (n = 172, 89.6%), 15 were partially accepted (7.8%) and only 5 were rejected.

Chapter 1. Domain, Main and Specific Competences

The present document was structured from general to the more specific topics for all sections. Each category or domain had a list of articles linking the text to the National Curriculum Guidelines (DCN) of graduation in Dentistry program in Brazil. Moreover, all direct indications for other dental hard tissue conditions were removed (*e.g.*: fluorosis, MIH, dental erosion, and many non-carious lesions).

Domain I: Basic Knowledge

This domain described the fundamental knowledge required for domains II to IV. To reach appropriate levels of competence, it was necessary to deepen different levels of knowledge and understanding of basic knowledge.

Major Competence

Apply knowledge and understanding of biological, health, basic and clinical sciences to recognize dental caries and other changes in dental tissues and make decisions about controlling dental caries at the individual and population levels (DCN Art. 11-I, Art. 11-III, Art. 11-IV, Art. 17, Art. 18, Art. 22, Art. 23, Art. 24- I).

Supporting Competences

Relative to the development, growth, and structure of tissues of the oral cavity, the graduate must:

Have essential knowledge about:

1.1 Normal development, growth and structure of dental tissues and the oral cavity (teeth, pulp, and salivary glands) at the macro/microscopic and molecular levels (DCN Art. 23).

Be familiar with:

1.2 Disorders of the development of dental tissues and the oral cavity at the macro/microscopic and molecular levels (DCN Art. 23).

Supporting Competences

In relation to the etiology, pathogenesis and modifying factors related to caries and other dental tissue disorders, the graduate must:

Be competent at:

1.3 Describing and discussing the mechanisms and dynamic processes involved in states of health at the macro/microscopic and molecular levels (DCN Art. 11-IV, Art. 23 , Art. 24-I).

Have essential knowledge about:

1.4 Role played by biofilm, diet, nutrition, saliva and other host factors, fluoride and behavioral/social factors related to dental caries and other dental tissue disorders.

1.5 Biochemical events in biofilm, saliva, and dental tissues.

1.6 Production of acids and bases, buffering properties and the effects of mineral saturation levels in saliva and biofilm (DCN Art. 18, Art. 23).

Be familiar with:

1.7 Role of environmental factors, medications, systemic diseases related to caries and other dental tissue disorders. (DCN Art. 11-III, Art. 23, Art. 25-III).

Supporting Competences

In relation to the detection, evaluation and diagnosis of dental caries, the graduate must:

Have essential knowledge in:

1.8 Physical and biological bases of changes in dental tissues related to the detection and evaluation of caries and other disorders of dental tissues.

1.9 Biological and physical aspects of radiographic examination related to the detection and evaluation of caries and other dental tissue disorders, including radioprotection problems.

1.10 Principles for evaluating the performance of diagnostic methods applied to caries and other dental tissue disorders (DCN Art. 5-VI, Art. 11-V, Art. 23, Art. 25-VII).

Be familiar with:

1.11 Mechanisms of action and limitations of emerging methods for detection, evaluation and diagnosis of caries and other dental tissue disorders (DCN Art. 6-I, Art. 25-VII).

Supporting Competences

In relation to behavioral sciences, the graduate must:

Have essential knowledge of:

1.12 Behavioral sciences including principles of psychology and sociology, considering interpersonal Competences, communication and behavior modifications. (DCN Art. 7-I, Art. 8-IV, Art. 24-I, Art. 24-IV)

Supporting Competences

Relative to prevention and management, the graduate must:

Have essential knowledge of:

1.13 Mode of action, composition, properties, limitations and side effects of frequently available

materials, and techniques for the non-restorative (non-invasive) and restorative (invasive) management of caries and other dental tissue disorders, at individual, group, and community levels (DCN Art. 5-VI, Art. 25-VI)

Be familiar with:

1.14 Theoretical bases of emerging strategies and materials for the prevention and management of caries and other dental tissue disorders (DCN Art. 6-II, Art. 11-VI)

Supporting Competences

In relation to epidemiology and research methodology, the graduate must:

Have essential knowledge in:

1.15 Bases of epidemiology

1.16 Principles of risk assessment

1.17 Scientific methodology and its limitations, including experimental designs, sampling, biases, and statistics (DCN Art. 9-II, Art. 11-VIII, Art. 23-II, Art. 24-VI).

Domain II: Risk Assessment, Diagnosis, Synthesis

This domain is a bridge between basic knowledge (Domain I) and decision-making regarding non-restorative and restorative options for controlling dental caries. Competences in synthesis and decision-making are necessary to obtain evidence- based information and appropriate decisions for clinical and public health practice.

• Risk assessment

Major competence

Identify and estimate the probability of a patient developing new carious lesions or progression of existing lesions during a given period. The graduate is required to have in-depth knowledge and understanding of the aforementioned competences so that he or she can collect, record and analyze clinical data reliably, thus allowing him or her to classify patients into different groups or categories of risk for dental caries (DCN Art. 11-IV, Art. 25-I, Art. 25-II).

Supporting Competences

2.1 Obtain information from risk factors/indicators (if/when applied): patient history (medical, dental), social and economic aspects; oral health behavior (oral hygiene, knowledge, preferences, dietary habits and intraoral biological factors); caries experience, use of fluorides; systemic health conditions; consider new risk factors validated in accordance with scientific evidence.

2.2 Communicate the results of the risk analysis to patients/guardians/caregivers and provide recommendations that allow the patient to reduce the risk of developing new lesions or progression of existing lesions – see domains III and IV (DCN Art. 7-I, Art. 11-III, Art. 11-IV, Art. 24-I).

Have essential knowledge in:

2.3 Evaluating emerging information on risk factors and indicators (DCN Art. 6-II).

• Diagnosis

Major Competence

The graduate must be competent in diagnosing caries at the patient level and at lesion level by means of data collection and analysis, integration of information about signs and symptoms, assessment of the lesion status of activity on the tooth surface, and identification past or present occurrence of caries disease. (DCN Art. 11-IV, Art. 23, Art. 25-I)

Supporting Competences

The graduate must:

2.4 Recognize "normal" and "abnormal" dental tissue; perform differential diagnosis between carious and non-carious changes and abnormalities in dental tissues, coronal and root surfaces.

2.5 Collect and record information about the presence of different stages of the carious process (signs and symptoms).

2.6 Determine the activity of the lesion in its different stages. (DCN Art. 11-IV, Art. 23, Art. 25-I).

Have essential knowledge in:

2.7 Evaluating current and emerging methods for detecting and assessing the extent of carious lesions,

assessing carious lesion activity, and be capable of using this information to guide decision making.

(DCN Art. 6-II, Art. 11-VI , Art. 25-I).

Be familiar with:

2.8 Different types of developmental abnormalities and differentiate these conditions from caries (DCN Art. 23).

• Synthesis

Major Competence

Ensure ongoing and appropriate management of dental caries at both the patient and lesion levels and combine and interpret information obtained from risk analysis, the processes of diagnosis and decision making; assessing the patient's needs, preferences and interests; and monitor, review and re-evaluate patient-centered and patient-shared information (DCN Art. 5-V, Art. 6-II, Art. 11-IV, Art 11. VI, Art. 11-X, Art. 25- I, Art.25-II).

Supporting Competences

The graduate must:

2.9 Identify and assess patients' needs, preferences, and interests in relation to the management of dental caries.

2.10 Incorporate, when necessary, information on monitoring, review and reassessment of caries in decision making (DCN Art. 5-V, Art. 6-II)

Be familiar with:

2.11 Treatment options, including when to refer for specialized treatment (medical/dental) for rare dental tissue disorders or for medical conditions that are causing dental tissue disorders (DCN Art. 5-II, Art. 5-III, Art. 10- II, Art. 11-III, Art. 11-IV, Art. 11-IX, Art. 25-III).

Domain III: Decision-making and preventive non-restorative therapies

This domain is related to the control of caries and other disorders of the hard dental tissues with an emphasis on long-term preventive care and maintenance. It involves the application of the principles of primary and secondary prevention. These Competences must be applied differently, from the perspective of respecting the course of life.

• Communication with patients, families, and communities in different healthcare environments

Major Competence

The graduate must be competent in communicating aspects of prevention in an effective, interactive, and reflective manner to patients of all ages, their families and caregivers. The communication style must be appropriate to the age and social circumstances of the patient/community and the setting in which he/she operates. The term "patient" will be used to refer to families and caregivers when appropriate (DCN Art. 7-I, Art. 7-II, Art. 7-III, Art. 7-IV, Art. 7-V, Art. 24-IV, Art. 24-V).

Supporting Competences

The graduate must be competent in:

3.1 Establishing a trusting professional-patient relationship.

3.2 Identifying the patient's expectations, desires, competence to collect, interpret and synthesize all information, values, attitudes, needs and demands for preparing the preventive treatment plan.

3.3 Identifying psychological, physical, cognitive and social factors that can influence patient adherence and consequently the results of implemented and advised preventive measures.

3.4 Identify factors in health services that make it difficult for patients to understand and access dental treatment (oral health literacy)

3.5 Involve patients so that they understand the disease in order to improve their cooperation in relation to individual/professional preventive measures.

3.6 Obtain informed consent from patients/guardians for all aspects of preventive care.

3.7 Work together with other members of the health team in a collaborative manner and recognize the role and responsibility of each of them in the production of oral health care.

3.8 Appropriately share information and professional knowledge with other healthcare professionals and know when to refer patients at high risk of caries to secondary care

3.9 Stimulate supported self-care, seeking to empower people to self-manage their condition, through knowledge of the signs of their health condition, self-assessment of health status, agreement on goals, development of person-centered care plans and monitoring continuous. (DCN Art. 5-III, Art. 5-IV, Art. 5-V, Art. 5-VII, Art. 7-I, Art. 7-II, Art. 8-II, Art. 24-IV, Art. 24-V).

Have essential knowledge in:

3.10 Behavioral factors that facilitate the implementation of preventive care.

3.11 Patient-related factors that influence the outcomes of preventive counseling, e.g., expectation, adherence over time, and manual dexterity.

3.12 Non-verbal communication competences, e.g.: intonation, body language, eye contact.

3.13 Behavioral interventions, such as motivational interviewing

3.14 Enable the patient to recognize the association between the oral cavity and systemic diseases (DCN Art. 7-IV, Art. 8-IV, Art. 11-III, Art. 24-I, Art. 24-IV).

Be familiar with:

3.15 Behavioral differences related to cultural aspects (DCN Art. 5-IV, Art. 24-I, Art. 24-IV)

• Decision making for non-restorative preventive therapies.

Major competence

The graduate must be competent to collect, interpret and synthesize all relevant information necessary for developing treatment options that can be presented to and discussed with the patient, to obtain a shared decision and person-centered treatment plan.

This includes preventive care strategies according to needs, risks and possibilities of adherence at the individual, family and community levels. Non-restorative management must consider not only the site/tooth, but also patient-related factors. This requires recognizing the potential for changes in risk factors and monitoring caries damage over time. In addition, the graduate must be competent in systematically evaluating all results of preventive treatment in follow-up consultations and formulating alternative plans when necessary (DCN Art. 5-IV, Art. 5-V, Art. 6-II, Art 11-IV, Art. 25-I, Art. 25-II).

Supporting Competences

The graduate must be competent in:

3.16 Decision making based on the synthesis described in domain II.

3.17 Educate patients regarding the etiology of dental hard tissue diseases and encourage them to take responsibility for their own oral health.

3.18 Educate patients regarding dietary habits relevant to oral health.

3.19 Teach patients how to properly perform oral hygiene procedures.

3.20 Consider the needs of certain risk groups (elderly, patients with special needs or systemic/psychiatric illnesses).

3.21 Perform professional dental prophylaxis.

3.22 Apply sealants.

3.23 Administer preventive agents (fluorides) appropriately.

3.24 Monitor the effects of mechanical and chemical control of dental biofilm (DCN Art. 5-V, Art. 5-VI, Art. 6-I, Art. 6-II, Art. 8-IV, Art. 11-III, Art 11-VI, Art. 25-III, Art. 25-VI, Art. 25-X- Art. 25-XI)

Have essential knowledge in:

3.25 Mechanisms of action of caries-preventive agents, their means of use and administration.

3.26 Limitations and adverse/side effects of agents/products used in preventive care.

3.27 Protective and destructive role of diet in dental caries (DCN Art. 5-VI, Art. 23, Art. 25-VI)

Be familiar with:

3.28 Critical assessment of new technologies/developments and how to integrate them into clinical activities (DCN Art. 6-II).

Domain IV: Decision-making and restorative therapies

This domain concerns the control of dental caries and other disorders of the hard tissues of dental elements with an emphasis on restorative treatment and maintenance (accompanied by continued

preventive care - domain III). This domain involves application of the principles of preserving dental hard tissues in line with other aspects of restorative dentistry, endodontics, and prosthetics. Furthermore, it involves performing the restoration and carrying out restorative treatment plan. It is recognized that the restorative option should be considered when control of the disease process is unsuccessful, or for the purposes of protecting the dentin-pulp complex, reestablishing tooth form and function, facilitating mechanical removal of biofilm, strengthening the remaining teeth or for aesthetic reasons.

• Decision making for the purpose of applying restorative therapy.

Major competence

The graduate must collect, interpret, and synthesize all relevant information necessary to develop treatment options that can be presented and discussed with the patient in order to obtain a shared decision for the individualized treatment plan.

This requires the ability to decide when restorative intervention should be used (for caries and other tooth conditions) and understand the consequences and prognosis of these decisions (DCN Art. 5-VI, Art. 6-I, Art. 6-II, Art. 11-IV, Art. 25-I, Art. 25-II).

Supporting Competences

4.1 Select the most appropriate treatment option based on the broad knowledge of non-restorative and restorative treatment possibilities available.

4.2 Recognize, understand and manage consequences of restorative intervention.

4.3 Continuous assessment/reflection of the decision-making process as well as the results of the restorative intervention (DCN Art. 5-VI, Art. 6-I, Art. 6-II, Art. 11-VI, Art. 25-VI).

Have essential knowledge in:

4.4. Reactions of the dentin-pulp complex to the carious process and restorative procedures (DCN Art. 11-VI, Art. 23)

Be familiar with:

4.5. Restoration success/failure rates (DCN Art. 6-I, Art. 6-II, Art. 25-VI)

• Restorative therapies

Major Competence

The graduate must be competent in carrying out the appropriate restorative treatment to treat caries while preserving the tooth structure. The graduate must be competent in restoring lost dental tissue with regard to form, function and esthetics, and at the same time, establish and promote oral health (DCN Art. 6-II, Art. 11-VI, Art 25-III, Art. 25-VI).

Supporting Competences

The graduate must be competent in:

4.6 Deciding when, how and to what extent the decayed tissue should be removed before placement of a restoration, in order to preserve tooth structure and pulp vitality.

4.7 Select and manipulate restorative materials, considering their physical and chemical properties, biocompatibility and longevity.

4.8 Select and execute operative techniques that are appropriate for the material used and the case in question (DCN Art. 6-II, Art. 25-VI).

Have essential knowledge in:

4.9. Impact of restorative procedures on mucosa, periodontal tissues, occlusion and oral function (DCN Art. 5-VI, Art. 6-II, Art. 25-VI).

Be familiar with:

4.10 New methods of removing decayed tissue, identifying/detecting what actually needs to be removed/ "state of the art" in removing decayed tissue.

4.11 Restorative techniques and materials.

4.12 Biomechanics of restorations (DCN Art. 6-II).

• Follow-up of restorative therapy

Major Competence

The graduate must be competent in the follow-up process (stages and return times for periodic observations of a treatment), in diagnosing caries around restorations, and restorative failures in follow-up consultations. The graduate must be competent in decisions about the maintenance, repair or replacement of a restoration, and in guiding/ instructing the patient to prevent damage to the

restoration (DCN Art. 5-V, Art. 6-II, Art. 7-I, Art. 8-IV, Art. 25-I, Art. 25-II, Art. 25-III).

Supporting Competences

The graduate must:

Have essential knowledge in:

4.13. Evaluating and monitoring treatment results over time.

4.14. Extending the longevity of the restoration (DCN Art. 6-II, Art. 25-VI).

Be familiar with:

4.15. Economic aspects of surgical/restorative therapy (DCN Art. 6-I, Art. 6-II, Art. 25-VI).

Domain V: Evidence-informed cariology in clinical practice and public health

This domain deals with the Major Competences of evidence-informed clinical practice in undergraduate Dentistry, which supports the double facet of cariology (directed particularly towards individuals) and public health cariology (directed at groups of individuals/ populations). Public health cariology requires additional competences in addition those listed in domains II-IV. Major competencies of evidence-informed Dentistry, which are generic skills in the undergraduate curriculum as a whole and not just for teaching about caries, are fundamental for the constant development of competences. The competences of clinical cariology in the assessment and control of caries at the individual level are addressed in domains II-IV, and for public health cariology they are presented in this domain in close relationship with the principles of evidence-based Dentistry. It is important that these topics are emphasized by including practical experiences in the clinic as well as in the public health setting.

• Public Health in Relation to Teaching Dental Caries

Major Competence

The graduate must be competent in the prevention and control of dental caries (and other changes in the hard tissues of dental elements) at individual, group and community levels. This requires understanding epidemiology and preventive and health promotion strategies in a multidisciplinary and integrated manner with the National Health System (SUS), and with other general health and nutrition strategies, considering the socioeconomic context (DCN Art. 5-I, DCN Art. 5-II , Art. 5-III, Art. 5-IV, Art. 5-V, Art. 5-VI, Art. 6-II)

Supporting Competences

The graduate must be competent in:

5.1 Promoting the prevention of dental caries in groups of individuals.

5.2 Assessing health-related behaviors including patterns of change.

5.3 Stimulating health promotion in a multidisciplinary manner as a strategy to prevent dental caries and other diseases.

Have essential knowledge in:

5.4 Management of issues related to both human rights, and interests, responsibilities and professional rights.

5.5 Record dental caries using appropriate indices for different levels of severity in the public health environment.

5.6 Indices for different oral problems associated with the differential diagnosis for dental caries.

5.7 Concepts of oral health and more specifically dental caries and quality of life.

5.8 Descriptive epidemiology of dental caries in relation to different independent variables, such as age, general health and socioeconomic status.

5.9 Identification of individuals, groups of individuals and populations at risk of developing dental caries.

5.10 Assessing the need for treatment from a public health perspective.

5.11 Interaction of levels of organization for prevention (individual, groups of individuals and populations).

5.12 Interaction between dental caries and other health problems.

5.13 Organization of oral health care for the individual and for collective oral health.

5.14 Role of different health professionals and their interactions with public health.

Be familiar with:

5.15 Application of epidemiological methods in public health.

5.16 Trends in oral health patterns and treatment needs.

5.17 Oral health promotion and prevention for populations as part of general health promotion.

5.18 Concepts of general public health in populations.

5.19 International approaches to oral health care systems.

5.20 Health economic aspects of oral health programs.

• Teaching Dental Caries informed by Evidence.

Major Competence

Graduates must understand the benefits of evidence-informed clinical practice at both the individual and collective health levels. Graduates must also have good knowledge and Competences in these areas and apply them in the prevention and management of dental caries (DCN Art. 5-III, Art. 6-II, Art. 11-III, Art. 11-VI, Art. 11 -VII, Art. 25-III).

Supporting Competences

The graduate must be competent in:

5.21 Promoting the prevention of dental caries in groups of individuals, ensuring the particularity of each person.

5.22 Formulating research questions with potential answers and search for scientific evidence using appropriate resources.

5.23 Seeking and using the most appropriate clinical guidelines.

5.24 Critically assessing scientific evidence concerning diagnostic methods, caries detection and their therapies.

5.25 Assessing scientific evidence concerning new therapeutic strategies for dental caries with a view to making decisions about their implementation.

5.26 Recognizing the limitations of research methodology and clinical guidelines.

Have essential knowledge in:

5.27 Principles of evidence-informed dentistry and the hierarchy of evidence.

5.28 Methods of communicating scientific evidence to individuals, groups of individuals and populations.

5.29 Advantages and disadvantages of clinical guidelines.

5.30 Translating research findings into clinical practice at the individual and collective levels.

Be familiar with:

5.31 Research principles including study design, sampling, biases, and biostatistics (related to Domain I).

Chapter 2. Essential knowledge for teaching dental caries

The National Curriculum Guidelines (DCN) of the Dentistry graduation in Brazil focus on the curricular contents of dental sciences organized from a course of life perspective. This approach allows the teaching of caries to be divided into a series of curricular components, simultaneously throughout the undergraduate course. In addition, it provides students with the opportunity to connect basic knowledge with its application to individuals and populations.

Therefore, the essential content for teaching dental caries in undergraduate dentistry courses was also designed and structured in this way. For better didactic organization, these contents were grouped into three sets, namely: (I) Dental caries: initial approach, (II) Dental Caries: health promotion and disease control in individuals and (III) Dental caries: health promotion and disease control in populations. Although there is a natural didactic sequence between them, with greater emphasis on basic knowledge related to the etiology and pathology of caries at the beginning of graduation (set I), then nourishing the theoretical framework necessary for conscious clinical action (set II) and an effective approach to populations (set III), there is also ample possibility of flexibility and intersection between these sets, in accordance with the Pedagogical Project and the curricular organization of each educational institution. For example, we mention students going to the field at the beginning of their degree to develop health promotion activities in population groups (set III), with adequate guidance and supervision from the teacher/tutor. An example or guide for the distribution of these three sets of

content throughout the undergraduate course, with possible intersections, can be seen in Figure 1.

The adoption of a teaching model connected with scientific evidence, which largely supports the philosophy of minimal dental intervention, requires some transformations, even in the way of evaluating and valuing the procedures performed by students in the clinical setting. A difficult, deep, and comprehensive debate on what is happening in dental schools is necessary to move from a classic restorative model to a minimally invasive model. After this critical thinking process the group listed twelve questions, including: how teaching about caries is being taught, whether in a purely theoretical way, or applied to practice; whether all instructors/lecturers of clinical disciplines are committed to non-operative treatment; and whether non-operative/invasive procedures are scored and valued in the same way as operative/invasive procedures.[14]

From different intersections, Caries Teaching must cover the ground from basic knowledge to its applicability in clinical practice and field work for population care. In this way, teaching will occur gradually and cumulatively, going through stages. As the theoretical and practical complexity of these stages advance, they involve basic knowledge in Cariology (fundamentals) to support decision-making, whether intervention or non-intervention, in addition to techniques of treatment itself. Health maintenance is also considered in all preventive or curative actions.

All these aspects are relevant to the teaching of caries at the clinical level of care for individuals and must be considered when establishing a guiding principle for the teaching of caries throughout the undergraduate course.

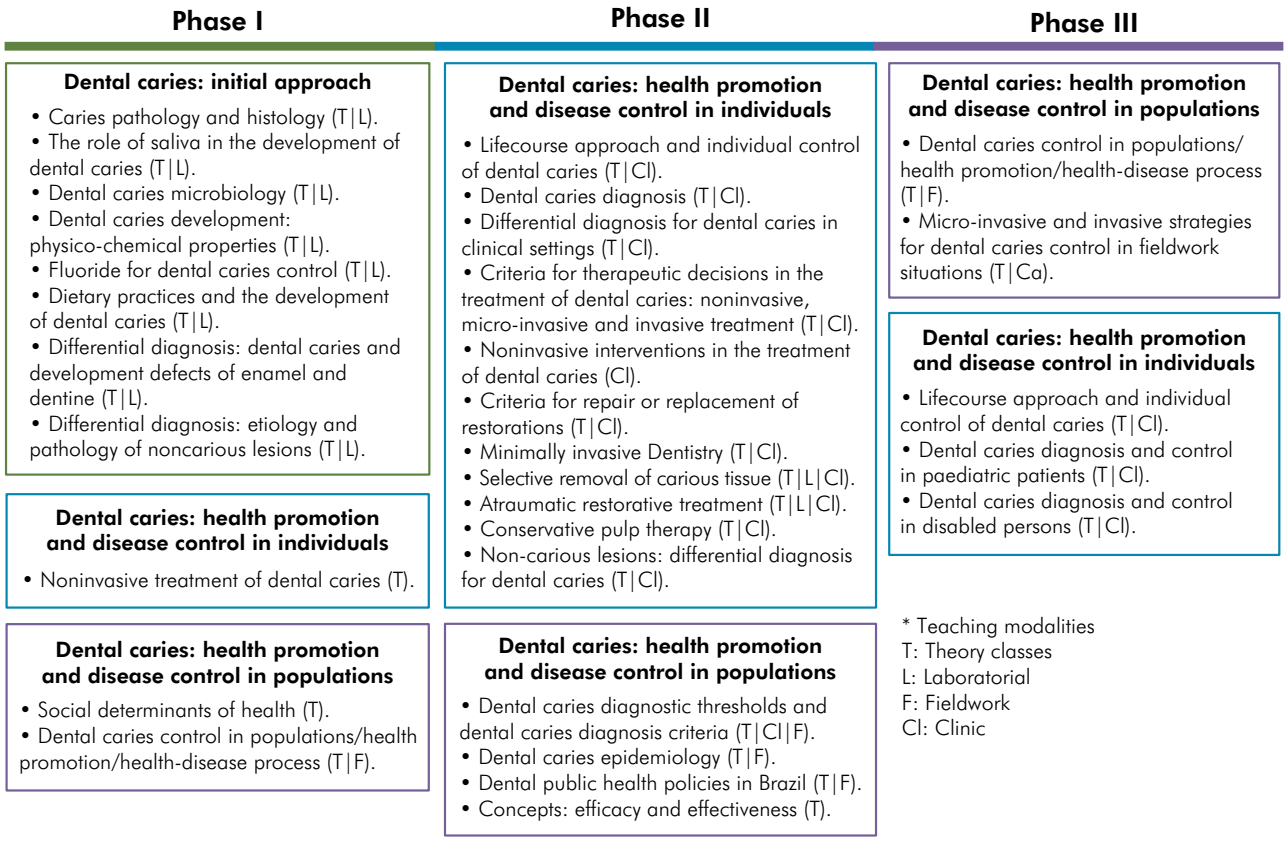

Figure 1. Essential content for teaching dental caries in the undergraduate dentistry course: distribution in three phases according to the timeline of the course.

Chapter 3. Dental caries from a course of life perspective

The approach to health from the perspective of continuing throughout the course of an individual's life considers the etiology of chronic non-communicable diseases, such as dental caries, in the long term, throughout life. Thus, it is understood that the conditions to which individuals are exposed throughout their lives may be related to the occurrence of these diseases.[15] Epidemiological studies using a life course approach have sought to improve understanding of the determinants for the experience of dental caries throughout life.[16,17]

Considering the recommendations of the DCN for the construction of a comprehensive essential curriculum, which contemplates individuals in their different life course perspectives and its relevance to the necessary skills required of dentists, the objective of the present chapter was to present recommendations for teaching the dental caries disease in undergraduate Dentistry courses in Brazil based on the care of individuals from their different life course perspectives.

The first stage was pregnancy, and the importance of prenatal dental care and the window of opportunity during the baby's first 1000 days was included for providing guidance and adoption of healthy habits.18 For babies (0 to 24 months), the period of dietary transition and consumption of free sugars were emphasized as important etiological factors for tooth decay. In children (2 to 9 years old) and adolescents (10 to 19 years old), we focused on the negative impact on the quality of life of the individual and their families, such as emotional and esthetic involvement and school absenteeism. In adults (20 to 59 years old), relevant points were emphasized such as the prevalence of gingival recessions, root exposures, and risk factors for the development of dental caries on exposed root surfaces. In the elderly (60 years or over), the greater need for support and support to perform oral hygiene was included, with attention to the etiology of ingesting medications containing sugar and those that can reduce salivary flow. For people with physical and/or cognitive disabilities, factors related to the individual's life approach must be taken into account.

Figure 2 provides one example of the recommendations for children from birth to 24 months.

Chapter 4. Caries as a marker of social inequity

This chapter focused on dental caries as a marker of social inequities and the implications for teaching this condition in Dentistry courses.

The social, economic, and cultural conditions of a population can reveal and also interfere in different epidemiological profiles between social groups. Living conditions, environment and health conditions generate an inseparable triad of etiological factors with multiple and complex interactions. The National Commission on Social Determinants of Health (2008) stated that the socioeconomic, cultural, and environmental conditions of a population generated the stratification of individuals and population groups, thus giving them different social positions, which were directly related to the conditions of health.[19]

According to Bernal Alvarez (2000), dental practice must provide construction, reaffirmation, and confrontation with theory.[20] Hence, theory and practice must be permanently interrelated, to provide spaces for creation, integration, and critical thinking.

This is one of the challenges to generalist training, as it needs to bring technical and scientific knowledge closer to the skills and competencies of the health professional who knows how to assess risks, has a solid basis in the etiology of the disease, in microbiology and therapy. In addition to isolated knowledge, it is important for the undergraduate student to be capable of understanding illness in a social matrix, in the structure of society, with its wide cultural and economic variations, and its different values.

Finally, the authors supported the suggestion from Ringel and co-workers (2000) that the Dentistry curriculum matrix must be based on learning under real conditions.[21] This model must include: 1. *Community-oriented teaching* – Knowledge of the oral health of human groups by recognition of the social context and its epidemiological reality, linking it with the clinic; 2. *Patient/user-centered teaching* –

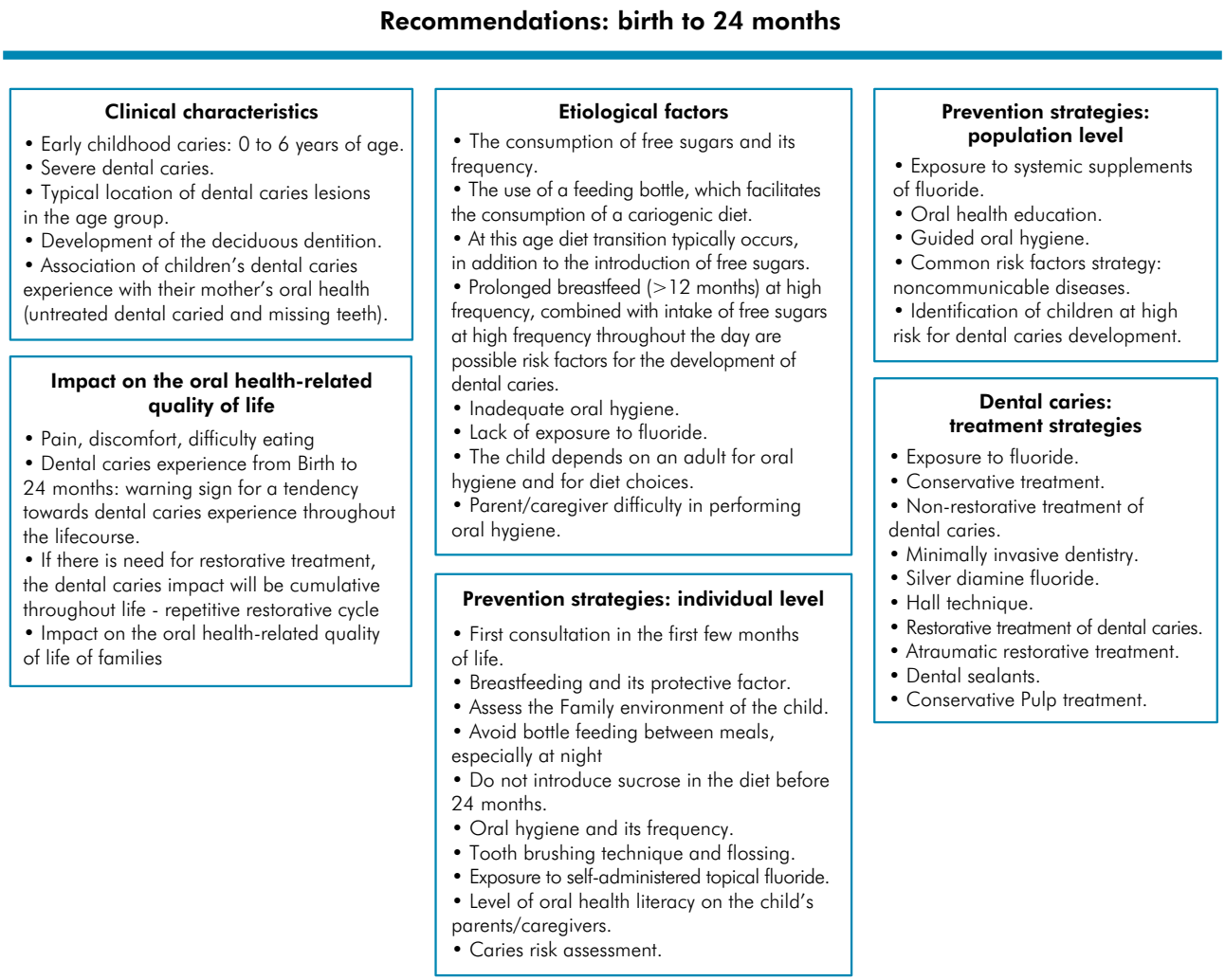

Figure 2. Recommendations for children from birth to 24 months.

Teaching in which therapeutic proposals are carried out based on the needs of the patient/user and not on the needs of the Curricular Unit and 3. *Student-centered teaching* – Training that integrates knowledge of the reality and resources offered to Dentistry, with the objectives of the teaching-learning process and graduate profile. It should allow students to be trained through self-motivated teaching, solving problems arising from the reality of the clinic and oral pathologies.

Chapter 5 - Glossary

The fifth chapter of the final document is a glossary that presents the main terms and definitions that are commonly reported in papers and publications about dental caries in recent years. The health descriptors (DeCS/MeSH) from BIREME - Regional Library of Medicine – Latin American and Caribbean Center for Health Sciences Information (https://decs.bvsalud.org/) were taken as a basis and, when possible, the identification number has been included. Likewise, the terms contained in the document "Consensus of Terminologies for Caries and Caries Management" proposed by the mixed committee of ORCA (European Organization for Caries Research) and the cariology group of IADR (International Association for Caries) were also listed.[13] Considering this ORCA-IADR publication, only terms with more

than 80% consensus among experts were included in this glossary. Finally, several other publications were used for crafting the list of terms of the final document.[1,2,4]

Conclusion

The National Curriculum Guidelines (DCN) of the Dentistry graduation in Brazil promoted a clear shift moving from the minimal curriculum to an essential curriculum. This is regarded as a significant step towards a high-quality and consistent integral dental education. It is also important to highlight its power as a resolution, which in practical terms is motion that must be adopted by all dental faculties/ schools (Higher Education Institutions) within the Brazilian territory. [11]

The National Curriculum Guidelines (DCN) in Brazil can raise two different positions simultaneously. On the one hand there is the power of the law. On the other, it is undeniable that this resolution is an opportunity that can open a large window for new approaches to teaching Dentistry.

This consensus for teaching dental caries may be criticized for taking an approach focused only on caries disease when the recent concept of cariology has been interpreted as the science that deals with all disturbances of the mineralized tissues of the teeth. Hence, its concept goes beyond the concept of solely studying "dental caries". The field has been expanded to incorporating other conditions (e.g.: fluorosis, MIH, tooth wear, and many non-carious lesions). However, the curriculum based on guiding pathways (e.g.: caries, periodontal diseases, edentulism, oral cancer, among others) allows a true integration for teaching the health-disease process of the individual, family, and population in many perspectives. It is obvious that consensuses of these guiding pathways must be prepared. However, it might be easier since they can all have a similar structure: domains, major and supporting competences; knowledge related to the disease or condition, the relationship between the condition in a life course perspective, and the social determinants.

Brazil is undergoing a disorganized process of expansion of Dentistry courses.[22] To date, there are 619 active dental courses, most of them from the private sector (90%).[23] This expansion took place in recent years and poses a real challenge. It is expected that this consensus could be a good instrument for promoting a better understanding of the National Curriculum Guidelines (DCN) and a facilitator for implementing a comprehensive curriculum based on a humanistic teaching-learning process on dental caries.[11,24]

Conversely to the National Curriculum Guidelines (DCN) resolution this consensus for teaching dental caries in Portuguese language for Brazilian dental schools is not a body of rules that have been laid down from top to bottom. Consequently, it is does not have the power of law and must be taken as a guideline. Hopefully, other Portuguese speaking countries can use the original version for building up their own consensus for teaching dental caries, or cariology depending on their regulations.

Finally, we hope that new consensuses promote interdisciplinary teams working together for an inclusive-humanistic curriculum that articulates social, biological, dental knowledge and supports the principles of transdisciplinary and transversality in education.

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