

Cariology Curriculum in Chilean Universities

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ABSTRACT

Aim: To describe the current state of undergraduate Cariology teaching in Chilean universities. **Material and Methods:** A previously content-validated questionnaire was used to conduct a cross-sectional study including all private/public universities. Statistical analysis was performed determining frequency distributions of categorical variables with the Stata Data Analysis and Statistical Software 13.1®.

Results: Cariology is a key issue in undergraduate education, and in most universities, is taught as key axis of courses, in various departments, for more than one year. Consistency was found in Cariology topics taught. The clinical threshold for surgical treatment is roughly divided into thirds (33.3% enamel microcavitation, 38.9% underlying shadow and 27.8% dentin cavity), no university indicated operative treatment for non cavitated lesions. Radiographic threshold for surgical treatment is the external dentinal third (66.7%).

Conclusions: Answers revealed a mix of traditional and modern Cariology concepts. Despite some encouraging results, half of Chilean universities considered that Cariology is not appropriately implemented and no standardization exists between theoretical teaching and clinical management, nonoperative management is not properly clinically implemented, students are evaluated for tissue damage restoration and resistance to non-invasive philosophy adoption remains.

KEYWORDS

Caries; Cariology; Cariology teaching; Cariology learning; Dental education.

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INTRODUCTION

Dental caries in permanent teeth is the most prevalent human disease, affecting 2.4 billion people worldwide. In deciduous teeth is one of the most common diseases, affecting 621 million children worldwide⁽¹⁾. Despite the reported prevalence and severity reduction worldwide⁽²⁾, caries remains a public health issue in most countries, associated with health care access barriers and economic, educational, and social inequalities^(1,3). It is also the fourth most expensive chronic disease to treat⁽¹⁾.

Caries understanding shifted from the traditional cavitated lesion concept (advanced destructive disease stage) to being considered a dynamic continuous demineralization-remineralization process clinically manifested once ecological imbalance is established with net mineral loss⁽⁴⁾. This can be arrested at any time, mainly in its early stages. Elimination and/or modification of predisposing factors before cavitation can prevent or delay surgical management and subsequent restoration/re-restoration cycle and thus operative dentistry then becomes a mean for disease control by removing cariogenic biofilm retention sites⁽⁵⁾. The new caries paradigm, concerned with the disease as much as with the resulting lesions, results in the need to change traditional teaching⁽⁶⁾.

Chilean dental education began in 1888 at the University of Chile. Until 1995, there were five dental schools in five universities. Multiple dental schools have emerged since then, and now there are 33 dental schools in 21 universities distributed as follows: 15 universities (1 dental school each), 3 universities (2 dental schools each), 1 (3 schools), 1 (4 schools) and 1 (5 dental schools).

The first Cariology teaching study was conducted in North America⁽⁷⁾, and similar studies have been conducted in Japan⁽⁸⁾, Europe⁽⁹⁾, U.S.⁽¹⁰⁾, Spanish-Speaking Latin American Countries (SSLA)⁽¹¹⁾, and Brazil⁽¹²⁾. Between 2010 and 2011, the European Organization for Caries Research (ORCA) and the Association for Dental Education in Europe (ADEE) developed and published a core Cariology curriculum for undergraduate students covering important Cariology aspects⁽¹³⁾. It was subsequently reviewed, analyzed, and used as the basis for a core curriculum for undergraduate Colombian⁽⁶⁾ and U.S.⁽¹⁴⁾ students. Chile has not proposed nor adopted a core Cariology curriculum. Based on this background and the lack of Chilean-specific studies, the objective of this study is to describe the current state of undergraduate Cariology teaching in Chilean

universities. This information will allow for the current situation analysis and national unified curricula improvement proposals.

MATERIAL AND METHODS

A cross-sectional study was conducted between July 2014 and March 2015 using a 20 item questionnaire designed and previously validated for content in SSLA dental schools by Martignon et al.⁽¹¹⁾. Questions assessed four Cariology teaching areas: curriculum(7), diagnosis(5), management(7) and perceptions(1).

All public and private universities with dental schools were identified, including those affiliated to the Chilean Association of Dental Teaching (ACHEO, n=14) and those with websites on the internet up to July 2014 (n=7), totaling 21 universities. Invitation letters were sent via email to Deans or Directors, as was deemed appropriate for each Faculty or Dental School respectively, inviting them to participate in this study along with a brief description of the project. Recipients were asked to provide contact details for Cariology teacher(s) in their Faculty/School, who were then invited to answer the questionnaire via email. Email reminders were sent (up to 4) and participants were also reminded via phone calls. Data was then transferred to an Excel spreadsheet (Microsoft Office, 2010) by an experienced researcher. Another researcher reviewed the data consistency to minimize possibility of errors. Universities with more than one dental school were considered to be one entity, due to the similarity in teaching models reported among all of its schools. Analysis was performed determining frequency distributions of categorical variables with the Excel software® (Microsoft Office, 2010).

RESULTS

Completed questionnaires were returned from 18 out of the 21 identified universities, with a response rate of 85.7%.

Cariology Curriculum. To question "Is Cariology teaching at your Faculty/School the axis or part of a course?" 66.7% answered that is the axis of a course.

To question "Which department/area teaches Cariology at your Faculty/School?" Operative/Restorative Dentistry was the most mentioned (50%), followed by Cariology (44.4%) and Pediatric Dentistry (38.9%). 55.6% of

universities teach in one department/area, while 38.9% of the universities do it in 2 or more departments.

To question "In which year(s)/semester(s) do students have theoretical Cariology teaching?" 38.9% teach Cariology during 1 year, 61.1% for 2 or more years. 16.7% begin Cariology teaching the first year, 27.8% start the second year and 50% the third year.

To question "How many hours per week are the students being taught about Cariology?" 66.7% expend less than three weekly hours to Cariology teaching and 27.8% between 4-7 weekly hours.

To question "Which caries textbook is recommended for Cariology teaching at your Faculty/School?" 55.6% recommended more than one Cariology textbook, 55.6% recommended just textbooks, while 22.2% a combination of textbooks and articles. Fejerskov and Kidd textbook (Dental caries: the disease and its clinical management) is used in 72.2% of universities.

To question "Indicate the topic(s) being taught in your Faculty/School curriculum" 100% of universities teach theoretical contents about caries classification, etiology, clinical/histological appearance, detection, diagnosis, risk assessment, early caries management and dental hard tissues removal. Behavioral sciences are the less taught topic in their curriculum (44,4%) (Table 1).

Table 1. Frequency of universities teaching each theoretical topic

THEORETICAL TOPIC	TOTAL	%
Caries classification	18	100
Dental caries etiology	18	100
Clinical/histological appearance of carious lesions	18	100
Caries detection and diagnosis	18	100
Caries risk Assessment	18	100
Early caries management (prevention/arrestment/remineralization)	18	100
Removal of dental hard tissues affected by caries	18	100
Anatomy and histology of dental hard tissues	17	94,4
Caries epidemiological description/analysis	16	88,9
Caries detection, risk assessment, and management considerations in young children	16	88,9
Considerations for caries associated with restorations	16	88,9
Considerations for root caries	14	77,8
Dental erosion	12	66,7
Caries management in populations	11	61,1
Behavioral sciences	8	44,4

To question "Do your students have preclinical practice workshops about theoretical concepts before their first contact with patients?" 77.8% of universities include preclinical practice.

Caries Diagnosis. To question "Which caries detection method(s) is/are being taught at your Faculty/School?" 100% of the universities teach visual techniques and activity assessment, 88.9% radiographic detection, 83.3% ICDAS while 22.2% non radiographic (Fluorescence based) methods (Figure 1).

To question "If caries risk assessment is taught in your Faculty/School, please indicate which risk factors are considered" all universities teach caries risk assessment (Figure 2).

To question "At which clinical visual/tactile severity stage of the lesion does your Faculty/School indicate operative treatment?" 38.9% of universities teach that operative treatment is indicated when underlying shadow, 33.3% when enamel microcavitation and 27.8% when there is dentin exposed cavity. No universities indicate operative treatment in non cavitated lesions.

To question "When do patients have bitewing x-rays taken?" 61.1% of

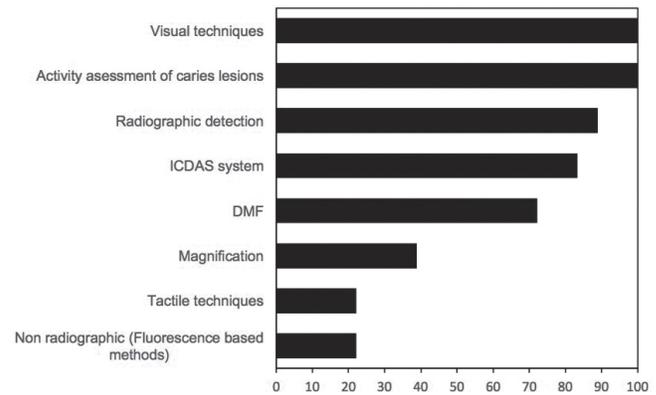


Figure 1. Frequency (%) of universities by caries lesion detection method

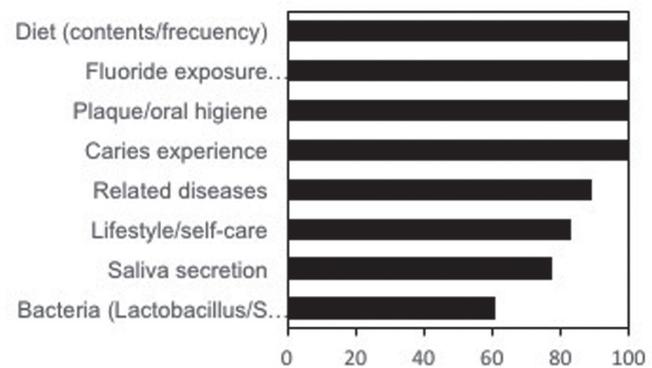


Figure 2. Frequency (%) of universities by caries risk assessment factor

universities regularly request bite wing x-rays in diagnostic appointment for every patient, 55.6% for monitoring purposes, 44.4% depending on the patient's cariogenic risk and 33.3% to confirm visual/tactile diagnosis.

To question "From what radiolucency depth (caries severity stage) of the lesion does your Faculty/School indicate operative treatment?" 66.7% teach that operative treatment is indicated when the radiolucent lesion is in the external dentin third, 22.2% in middle or inner dentin third, and 5.6% in the inner enamel half and enamel- dentin junction.

Caries Management. To question "If early caries management (caries prevention, arrestment, remineralization) is taught in your Faculty/School, please indicate which topics are considered" more than 90% of universities teach fluoride, cariogenic diet management, dental sealants and oral hygiene instructions. Calcium and xylitol-based strategies are the less taught topics (Table 2).

To question "How often are non-operative caries management strategies (no bur) being implemented at your Faculty/School clinic?" 55.6% implement regular non operative caries management strategies, while 44.4% occasionally. To question "In which way is oral health education communicated to patients being treated at your Faculty/School clinic?" 72.2% of universities answered that most patients received specific individual oral health education, while 27.8% received a combination of individual and collective oral health education. To question "How often does the risk assessment drive caries management in the clinical practice of your Faculty/School?" in 66.7% risk assessment regularly drives caries management and 33.3% occasionally.

To question "Within caries associated with restorations considerations, does your Faculty/School teach how to repair/reseal restorations as alternatives to operative treatment?" 77.8% teach to repair/reseal restorations.

To question "Does standardization exist between theoretically taught Cariology and clinical management in your Faculty/School?" 72.2% answered that there is no standardization. To question "Do you believe Cariology is being taken into account in an appropriate way within your Faculty/School curriculum?" 50% responded that Cariology is not being taken into account in an appropriate way.

To question "Add any comments on how Cariology is taught at your institution (achievements, shortcomings, improvement proposals, deficiencies, barriers, etc.)" 61.1% mentioned achievements emphasizing Cariology integration in their curricula and development of multidisciplinary Cariology unit. The 66.7% mentioned deficiencies or barriers highlighting

Table 2. Frequency of universities by early caries management topic taught

EARLY CARIES MANAGEMENT TOPICS	TOTAL	%
Fluoride	18	100
Cariogenic diet management	18	100
Dental sealants	17	94,4
Oral hygiene instructions	17	94,4
Professional plaque removal	16	88,9
Hyposalivation management	12	66,7
Lesion progression monitoring	12	66,7
pH neutralization strategies	10	55,6
Antibacterial strategies	9	50
Calcium-based strategies	7	38,9
Xylitol-based strategies	6	33,3

the impossibility of ensuring that what they theoretically teach is similar to what is clinically taught and difficulty of implementing conservative measurement strategies in clinical studies because the tendency to evaluate students for restoration of tissue damage.

DISCUSSION

This is the first Cariology teaching study that includes 85.7% of Chilean universities. Martignon et al.⁽¹¹⁾ studied Cariology teaching in SSLA dental schools including four Chilean universities, however, the results were analyzed in a global context, therefore it was not a complete analysis of Chile's situation.

We collected information through a questionnaire, similar to previous reports⁽⁷⁻¹¹⁾. Our response rate (85.7%) is high compared to several studies⁽⁷⁻¹¹⁾, providing a representative view of Chile's situation.

Regarding Cariology curriculum, Cariology is recognized as a key issue in undergraduate training in Chile, consistent with other studies^(9, 11). In 66.7% of Chilean universities Cariology teaching is the axis of a course, higher than reported in Japan⁽⁶⁾, North America⁽⁷⁾, Colombia⁽¹⁵⁾, and SSLA⁽¹¹⁾, but lower than Europe⁽⁹⁾ and Brazil⁽¹²⁾.

In Chile, as previously reported^(7-9, 11, 12), various departments/areas are responsible for Cariology teaching, predominating individual clinical disease management by restorative/conservative/operative dentistry departments over social/community/public health focus⁽⁷⁻¹²⁾. Cariology is a field with multiple connections between basic, preclinical and clinical subjects^(7, 9, 12), therefore has traditionally been taught in different courses across the curriculum. No core curricula explicitly recommend that these contents must be taught in an independent Cariology course/department and it has been speculated that an independent course would not be advisable as it may represent a fragmentation/barrier to interdisciplinary teaching-learning promotion and generate a sense of lack of accountability in teachers not directly involved in the issue⁽¹²⁾.

Time devoted to Cariology teaching varies, however, workload must be carefully analyzed. Questionnaire responses by Cariology teachers, as mentioned in other studies⁽⁷⁻¹¹⁾, does not allow the quantification of total hours devoted to different Cariology topics in other courses, nor differentiate between theoretical, preclinical, or clinical hours⁽¹²⁾.

Eleven of the 15 theoretical topics highly matched in Chilean universities (Table 1), similar to SSLA⁽¹¹⁾. Dental erosion is less frequently taught in Chile and SSLA⁽¹¹⁾ than Europe⁽⁹⁾. While ORCA ADEE⁽¹³⁾ and U.S. core curricula⁽¹⁴⁾ includes dental erosion, given its particular pathogenesis and clinical manifestations, its inclusion as part of Cariology is questionable. In Chile, the less frequently taught subjects are caries management in populations and behavioral sciences. It is noteworthy that despite the consensus on the importance of caries prevention, behavioral sciences

are not incorporated to a greater extent as undergraduate topic.

Inclusion of preclinical practices in Chilean universities is similar to previous U.S.⁽¹⁰⁾ and SSLA reports⁽¹¹⁾; however, given the questionnaire characteristics, it is not possible to determine the type of activities undertaken. It has been suggested that, for generations, students used their preclinical work to learn stereotypical preconceptions of caries invasive management in natural or artificial teeth, therefore it seems advisable to analyze the activities and their effect on the expected competencies development throughout the curriculum.

Regarding caries diagnosis, the carious lesion detection methods most frequently taught worldwide are the visual/visual-tactile and radiographic methods^(7, 8, 11). All Chilean universities taught visual detection method and lesion activity assessment. ICDAS is taught more frequently than U.S.⁽¹⁰⁾ and SSLA⁽¹¹⁾. It should be noted that these responses can range from mere theoretical instruction to clinical implementation. Tactile method is the least commonly taught method in Chile, consistent with the recommendation to avoid the use of explorer for primary lesions detection, given the inherent risks and limited contribution to diagnostic accuracy⁽¹⁶⁾.

All Chilean universities teach cariogenic risk assessment, similar to the U.S.⁽¹⁰⁾ and SSLA⁽¹¹⁾. The least taught risk factors are salivary secretion and specific bacteria such as *Lactobacillus* and *S. mutans*; the latter can be explained by the adoption of ecological plaque theory over specific plaque theory.

A wide variation in surgical treatment threshold has been reported⁽¹⁰⁾. When inquiring about the carious lesions clinical severity stage threshold in Chile, no university indicated operative treatment of white/coffee spot lesions. One-third of Chilean universities taught to use surgical treatment for microcavitation (loss of enamel surface integrity), similar than reported in SSLA⁽¹¹⁾, which is associated to traditional caries management approach. There is a growing consensus that these lesions require a comprehensive individual assessment and, depending on the lesion activity, radiographic depth and patient cariogenic risk, many of them can be non-invasively (biologically) managed. The questionnaire does not allow the determination of whether the proposed operative treatment is microinvasive, minimally invasive, nor invasive.

Sixtyone percent of Chilean universities taught to regularly request bitewing X-Rays in diagnostic appointment for every patient. Considering the legal requirement of avoiding patient exposure to unnecessary radiation, and radiograph prescription must be based on individual assessment, we think that initial radiological examination for all patients is an error as it contributes to, but does not replace thorough clinical examination.

Regarding radiographic threshold, one Chilean university indicates operative treatment when the radiolucency is between middle enamel and enamel-dentin junction, lower than reported in SSLA⁽¹¹⁾, while two thirds of Chilean universities indicate surgical treatment when radiolucent lesions in the dentin outer third, similar than reported in North America⁽⁷⁾ and Japan⁽⁸⁾. Restorative treatment must be indicated when lesions are cavitated, given the impossibility of achieving good hygiene and biofilm metabolism change⁽¹⁷⁾. X-rays cannot identify cavitation. It has been reported that in inner enamel half lesions, only 10.2% are cavitated⁽¹⁸⁾, in the outer dentin third, 32% are cavitated⁽¹⁹⁾ and in the inner dentin half, 41% are cavitated⁽¹⁸⁾. This limits operative treatment indication based exclusively on radiographic images.

Concerning caries management, all Chilean universities teach prevention, arrestment and remineralization of early lesions. Professional removal of plaque, oral hygiene instruction, use of fluorides, dental sealants, and cariogenic diet management are taught in more than 90% of Chilean universities. Nevertheless they are regularly implemented in slightly more than half of them, showing discrepancy between topics theoretically taught and clinically implemented.

Hyposalivation management and pH neutralization strategies are taught in between 50-70% of Chilean universities, similar to previous reports from U.S.⁽¹⁰⁾ and SSLA⁽¹¹⁾. Xylitol based strategies, taught by more than 80% of U.S. dental schools⁽¹⁰⁾, are taught in a few Chilean and SSLA universities (Table 2)⁽¹¹⁾. Additionally, 50% of Chilean universities taught antibacterial strategies, less than reported in SSLA⁽¹¹⁾.

Even though more than half of Chilean universities regularly implement nonoperative caries management strategies in clinical practice and two thirds of Chilean universities plan dental treatment based on cariogenic risk on a regular basis, higher than reported for SSLA⁽¹¹⁾, a high percentage of universities still adhere to traditional "old-fashioned" caries management. Data suggests, consistent with previous reports^(11, 20), that non-invasive measurements are not properly implemented in clinical teaching, although they are theoretically taught.

Approximately 80% of Chilean universities teach students to repair/reseal restorations, higher than reported for SSLA⁽¹¹⁾, Japan⁽⁶⁾ and North America⁽²¹⁾. Given multiple described advantages for this procedure

(e.g. dental tissue preservation, increased restoration longevity, good patient acceptance and lower pulp damage risk, pain, iatrogenic damage to adjacent teeth, time and cost of treatment)⁽²²⁾, it seems advisable to include it in the curriculum, carefully considering its indications and technical procedure.

Questionnaire answers regarding curriculum, diagnosis, and treatment reveal a mix of traditional and modern Cariology concepts and suggest efforts to adopt the new paradigm⁽²³⁾. It is important to highlight, that these results correspond to theoretical aspects. Half of Chilean universities considered that Cariology is not appropriately implemented in their curricula, and almost two thirds answered that no standardization exists between theoretical teaching and clinical management, higher but consistent with previous reports^(10, 11, 20, 24). This is probably because nonoperative management is not encouraged nor properly evaluated as a clinical activity in undergraduate curricula^(15, 20, 24), and students are still evaluated for tissue damage restoration (issue not studied in this questionnaire). Moreover, some clinicians still show resistance to noninvasive philosophy adoption^(7, 15, 20, 24). We think these reasons explain why students have difficulties to learn these important issues and delay the acceptance of the new caries paradigm. Standardized education seems relevant in establishing a knowledge base among undergraduates⁽¹³⁾, as well as adopting a core curriculum based on the best available evidence⁽²⁵⁾.

These results will allow the revision and improvement of current

curricula. Also, future educational studies should assess the implementation and learning outcomes of those curriculum changes.

CONCLUSIONS

This is the first Cariology teaching description that includes all Chilean universities. It identifies strengths and weaknesses in the Cariology Curricula in Chile. Answers revealed that while Cariology is a key issue in undergraduate education, a mix of traditional and modern concepts is being taught. Furthermore, while nonoperative management with a multifactorial approach is theoretically taught in all universities, it is not properly clinically implemented nor treatment planning based on individual risk. Future studies should evaluate how this could be changed and implemented across the university system.

DISCLOSURE

The authors confirm no conflicts of interest.

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