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Spanish Curriculum in Cariology for undergraduate dental students: Proceedings and consensus

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Abstract

Introduction: Cariology is today a broad-based discipline and in the Spanish university teaching field, all this knowledge is not unified in a curriculum. Therefore, the aim was to develop a consensus text based on the European Core Curriculum, updated, and adapted to the characteristics of the Spanish university environment.

Materials and Methods: A Spanish Cariology Curriculum Group (SCCG) was set up with members of the Spanish Society of Epidemiology and Oral Public Health (SESPO), Spanish Society of Conservative and Aesthetic Dentistry (SEOC) and Spanish Society of Paediatric Dentistry (SEOP) and university experts to adapt the European Core Curriculum in Cariology for undergraduate dental students (ECCC) for Spain. The work was carried out online during 2018 and 2019, and also face-to-face meetings took place to obtain a draft curriculum open for discussion that was presented to all the Spanish universities. The final modifications to the document were specified in a Consensus Conference of Spanish universities offering a Degree in Dentistry that took place in Madrid on 19 November 2019.

Results: Thirty-eight university experts, under SCCG supervision, participated in the elaboration of the new framework document. A total of 16 universities, from 23 invited, reached a consensus as to the contents of the Spanish Curriculum in Cariology for undergraduate dental students. This new Curriculum emphasises learning outcomes, uses a consensus-based terminology pertaining to caries and other hard-tissue conditions, and introduces a new domain of competence in Domain III of ECCC.

Conclusion: This new Cariology Curriculum is the result of a very broad-based consensus of university experts in Spain and lays the foundation for the implementation of an integrated teaching of Cariology in Spain in adherence to Alliance for a Caries Free Future (ACFF) objectives.

KEYWORDS
cariology, consensus, curriculum, dental education, Spain

*Membership of the SCC Expert Group are listed in Appendix 1

1 | INTRODUCTION

According to the successive studies of the Global Burden of Disease (GBD), dental caries is the most prevalent chronic disease of all those that exist and affects practically the entire population at some point in their life.[1] Amongst oral diseases, untreated caries in permanent dentition is the first condition, and the tenth in primary dentition.[2]

In Spain, according to the publication: *Encuesta de Salud Oral España 2020* (Spain Oral Health Survey 2020), the prevalence of untreated caries at 15 years of age is 11.7%, whilst it is 31.9% and 40.1% in the age groups of 35–44 and 65–74 years, respectively.[3] Dental caries is defined as a biofilm-mediated, diet-modulated, multifactorial, non-transmissible, and dynamic disease that results in the net loss of dental hard tissue. It is determined by biological, behavioural, psychosocial, and environmental factors. As a consequence of this process, the caries lesion occurs.[4] The dynamic nature of this disease means that throughout life measures to limit mineral loss are necessary, as are measures to control caries that include non-surgical or non-operative interventions, which in more advanced stages need to be operative. The treatment of this disease in its classic approach, based on the restoration of the lesions, fails to address the causes of the disease and does not prevent new lesions. In the publication *The State of Oral Health in Europe* provided by the Platform for Better Oral Health in Europe, the cost of restorative treatments were evaluated for the EU to total 79 billion Euro in 2011, with an estimated cost approaching 93 billion by 2020.[5] In most countries with a medium or low level of resources available, the aforementioned costs exceed the allocated resources.[6] It is of paramount importance therefore to implement prevention and control strategies, considering that the causes of the disease are well known, as are the necessary actions required to prevent it.[5] The conceptual framework in which caries is approached and managed today has undergone profound changes in recent decades and this justifies the need to develop a new curricular model. Cariology is today a very broad-based discipline supported in part by biochemistry, microbiology, anatomy, histology, epidemiology and behavioural sciences. Clinical Cariology comprises not only risk assessment, activity assessment, diagnosis and operative therapy but also non-operative therapy with focus on caries prevention. In addition, all this is associated with individual, community, social and economic factors. Today, the synthesis of all these data leads to measures referring to control, management and treatment of the disease, both at the individual and community level.

In the university teaching field, all this knowledge was not—with few exceptions—unified in a teaching curriculum for undergraduate students in Dentistry. In the case of Spain, a Ministerial Order has set forth the requirements that must be met by a university's syllabus leading to the obtaining of the degree that qualifies one's entry into the profession of Dentistry.[7] The White Book of the Degree in Dentistry (ANECA) has established the *competences* to be acquired by the future dentist as well as the teaching *contents*. Amongst these, those that are proposed as "Compulsory Common Contents," Cariology has a minimal presence, with only two entries out of the 48 Competences spelt out.[8] It was therefore necessary to address this gap in the teaching structure of future dentists, especially considering that in Spain, with 47 million inhabitants, there is a high graduation rate for dentists: in 2019, a total of 1565 dentists graduated, of which 30.4% were citizens from the rest of the European Union and 8% from other countries.[9]

At the European level and in 2011, the joint work of the European Organization for Caries Research (ORCA) and the Association of Dental Education in Europe (ADEE) resulted in the publication of the "European Core Curriculum in Cariology for undergraduate dental students" (ECCC).[10] From then on, a movement for the adoption of Cariology Curricula took place in various countries.[11–16]

The Spanish Society of Epidemiology and Oral Public Health known as SESPO (*Sociedad Española de Epidemiología y Salud Pública Oral*) in conjunction with Alliance for a Caries Free Future (ACFF) established in 2019 the Spanish Chapter of ACFF. Its objectives include the following: "ACFF and its Chapters will work towards ensuring that ninety per cent of dental schools and dental associations accept the philosophy behind the 'new' approach of 'caries as a continuum' in order to improve dental caries prevention and management."[16] The development of a Cariology Curriculum for dental degree students is one of the objectives of the Spanish chapter of the ACFF.[17]

In order to fulfil implement a unified Cariology Curriculum, a task group was created made up of members of the abovementioned SESPO, the Spanish Society of Conservative and Aesthetic Dentistry (SEOC) and the Spanish Society of Paediatric Dentistry (SEOP) who, together with university experts, during the years 2018 and 2019 have developed a text based on the European Core Curriculum (ECCC),[10] updated and adapted to the characteristics of the Spanish university environment. The text that is presented was agreed at the "Consensus Conference on Cariology" that took place in Madrid on 19 November 2019, to which all 23 Spanish universities where a Degree in Dentistry can be obtained were invited.

2 | MATERIALS AND METHODS

Throughout 2018, SESPO took the initiative to invite SEOC and SEOP members to form a Spanish Cariology Curriculum Group (SCCG) that could contribute to the development of the adaptation for Spain of the *European Core Curriculum in Cariology for undergraduate dental students*, as had already occurred in Colombia,[11] USA,[12] Chile,[13] Italy,[14] Canada[15] and the Caribbean region.[16] At the end of July 2018, the SCCG was made up of five representatives of the aforementioned scientific societies (FJ C-M, JM A-S, L C, E M-P, M H-J). At the first working meeting that was held, the following points were agreed upon: (i) the distribution of a questionnaire on the development of the teaching of Cariology amongst different Spanish universities; (ii) the translation of the ECCC into Spanish and (iii) provision for the future setting up of working groups for each of these five domains made up of professors and senior lecturers from the different universities, called the Spanish Curriculum of Cariology Expert Group (SCC Expert Group). The five domains proposed by the ECCC were maintained. These were:

I The knowledge base of Cariology.
II Risk assessment, diagnosis and synthesis.
III Decision-making and preventive non-operative treatment.
IV Decision-making and operative treatment.
V Evidence-based Cariology in clinical and public health practice.

During the months of October and November 2018, an online questionnaire using the tool Limesurvey® was available for the 23 Spanish universities where a Degree in Dentistry can be obtained. This survey was based on the one conducted by ORCA/ADEE cariology curriculum group[18] as framework for the ECCC development.

The intention was to collect information on the teaching of Cariology in the different curricula and the willingness to support the creation of a Spanish curriculum. The main results of the survey, which was answered by professors and senior lecturers from these 23 Spanish universities, indicated:

1. The non-existence of a specific unit called Cariology in the different centres, although the term "Cariology" is used in lectures or seminars.
2. The integration of the contents of Cariology taught in different disciplines, amongst which are Preventive and Community Dentistry, Pathology and Dental Therapeutics, and Paediatric Dentistry.
3. The teaching of the theoretical contents on Cariology is distributed throughout the 5 years of undergraduate training, with a greater intensity in the 3rd and 4th years, whilst the practical contents are concentrated into the 4th and 5th years.
4. Training in Cariology includes, in addition to dental caries, other pathologies of dental hard tissues such as erosion, non-erosive wear (attrition, abrasion) or developmental defects (hypomineralisation, hypoplasia, etc.).
5. The vast majority of universities (93%) supported the creation of a Spanish Cariology Curriculum.

In February 2019, the SCCG met to analyse the results of this survey and to decide on the composition of the five working groups reporting to the SCC Expert Group; these working groups would be concerned with the design of each of the five domains of the new curriculum. It was also decided to formulate a Joint Declaration of the three scientific societies putting forward proposals (SESPO, SEOC, SEOP) in which the importance of Cariology as a very broad discipline was stated.[19] It emphasised that basic fields of knowledge such as biochemistry, microbiology, anatomy or histology are involved; further fields in the applied sciences such as epidemiology, prevention, diagnosis, risk assessment, operative and non-operative treatment, and behavioural sciences are also involved. All these areas are in turn associated with individual, community, social and economic factors.[20] This set of fields of knowledge is what today makes up Cariology.

In the following months, SCCG members coordinated the online work for each of the five expert groups, based on the Spanish translation of the ECCC. The comments and contributions were collected and shared in a workshop held in Madrid on 8 June 2019. On this day, the experts associated with each of the domains worked in groups and debated the contributions concerning their respective domain. During the debate and proceedings, a call was made to clarify the doubts that were raised in relation to defining the "learning outcomes" for each of the domains; any duplications were eliminated. The text of the curriculum prepared in this workshop took into consideration the nomenclature and terminology of the consensus report published by ORCA and the IADR Cariology Research Group.

The ECCC describes the requirements in Cariology for the graduating dentists in terms of competences, distinguishing the levels of "be competent at," "have knowledge of" and "be familiar with." However, in the present document the term "learning outcomes" has been used instead of "competences" in its different levels. In this way, the recommendations presented in the new curriculum for the European graduate dentist are met[21] as is the case in new the syllabuses already adopted for Conservative Dentistry[22] and complying furthermore with the ANECA requirements for Spain.[23] ANECA defines learning outcomes as statements of what a student is expected to know, understand and be able to do at the end of a learning period. The advantage of learning outcomes is that they promote a student-centred approach, offer clarity and transparency in the higher education system, offer better information to teachers, students and employers, and encourage the mobility of students between different countries.

The text was submitted to a terminology and language unification process. This agreed text was then sent to all 23 Spanish universities where a Degree in Dentistry can be obtained, with the invitation to participate in the Consensus Conference. This Consensus Conference was held in Madrid on 19 November 2019 and was attended by 38 professors representing 16 Spanish universities [and the participation of Prof. Andreas Schulte and Prof. Guglielmo Campus who presented the updates of the ECCC (Prof. A. Schulte) and the Italian Core Curriculum in Cariology (Prof. G. Campus)]. The document was discussed domain by domain. The representatives of the participating universities presented their comments and suggestions. Those suggestions which were unanimously accepted were included in the text. This Consensus Conference day concluded with the preparation of the final consensus document, which is the one set out below.

3 | RESULTS

Once the vast majority of the universities supported the creation of a Spanish Cariology Curriculum, a translation into Spanish of the ECCC was used as a base, and it was circulated into a group of experts determined by the SCCG. After several months of online work, a preliminary version of this Curriculum was discussed in a workshop held in Madrid on 8 June 2019, in which 23 experts participated. The new version of the Curriculum was sent again to the 23 universities that had the chance to make suggestions, corrections and changes in this document. The final version was presented domain by domain

and discussed by 38 teachers representing 16 of the 23 Spanish universities in a Consensus Conference held in Madrid on 19 November 2019.

The text of the document adopted is the following:

Domain I: The knowledge base of cariology

This domain describes the fundamentals required for Domains II through to V. A thorough understanding of each aspect of these basic skills will be required to achieve the appropriate levels of proficiency. This domain level should include pre-clinical and clinical practices.

Scope of competence: Basic knowledge

On graduation, the dentist should be able to apply the knowledge and understanding of the basic and applied biological, medical and social sciences, based on the best available evidence, thereby allowing him or her to make decisions in the prevention, diagnosis and treatment of caries and other disorders in the hard tissues of the tooth, both in individuals and populations.

Learning outcomes

Regarding the growth, development and structure of dental tissues

On graduation, the dentist should be able to:

1.1. Describe the normal development, growth and structure of oral and dental tissues at the macroscopic, microscopic and molecular levels.

1.2. Identify any macroscopic, microscopic and molecular disorders in the development of oral and dental tissues.

With respect to the aetiology and pathogenesis of caries and other dental disorders

On graduating, the dentist should be able to:

1.3. Explain the mechanisms and dynamic processes involved in the preservation of the state of health, as well as the macroscopic, microscopic and molecular response of the host to caries and other disorders of dental tissues.

1.4 Describe the different aetiopathogenic mechanisms of caries disease and other disorders of dental hard tissues.

1.5. Describe the role of oral biofilms, diet, nutrition, saliva and other host factors; fluoride, behavioural and social factors related to caries and other disorders of dental hard tissues.

1.6. Describe the production of acids and bases and the biochemical events in: oral biofilms, saliva and in dental tissues, as well as the buffer properties and the effects of saturation in saliva.

1.7. To analyse the role of fluorides in caries and in other disorders of hard dental tissues.

1.8. Analyse the role of diet in caries and other disorders of dental hard tissues such as erosion.

1.9. Describe the role of environmental factors, drugs and systemic diseases in relation to the development of caries and other disorders of dental hard tissues.

Regarding detection, evaluation and diagnosis

On graduating, the dentist should be able to:

1.10. Identify methods for determining caries risk at the individual and community level.

1.11. Describe the physical-chemical changes in dental hard tissues related to the detection and evaluation of caries and other disorders of dental tissues.

1.12. Describe the mode of action, benefits, limitations and problems of conventional and other emerging methods to detect, evaluate and diagnose caries and other dental hard-tissue disorders.

1.13. Interpret the results obtained with different diagnostic method for caries and other disorders of dental hard tissues.

Regarding behavioural sciences

On graduating, a dentist should be able to:

1.14. Apply the psychological, sociological and communication principles aimed at modifying behaviours related to the development of caries and other disorders of dental hard tissues.

Regarding the prevention and treatment of dental caries

On graduating, a dentist should be able to:

1.15. Identify the mode of action, composition, properties, limitations and side effects, both locally and generally, of biomaterials for dental use as well as the products and techniques commonly used for treatment.

1.16. Possess a theoretical basis regarding emerging strategies and biomaterials for the prevention and treatment of caries and other dental tissue disorders.

Regarding epidemiology and research methodology

On graduating, the dentist should be able to:

1.17. Interpret the epidemiological indices and indicators related to caries and other disorders of dental tissues.

1.18. Describe the research methodology in Cariology and its limitations, including study design, sampling, biases and statistical analysis.

Domain II: Risk assessment, diagnosis and synthesis

This domain is the bridge between the bases of knowledge on the diagnosis of the disease, the detection of lesions and the evaluation of the risk of having dental caries, and its application to specific clinical situations. The integration of this information should be the basis on which to select the best option for the management, prevention or control of caries, inform the patient and monitor the clinical course of the disease. This domain should include pre-clinical and clinical practices.

Scope of competence: Caries risk assessment

On graduation, the dentist should be able to properly identify a patient's caries risk based on scientific knowledge. In the absence of disease, the dentist should be able to identify and estimate the probability of developing caries lesions and, in the presence of disease, should be able to estimate the probability of progression of existing lesions or the appearance of new ones. Likewise, the dentist should be able to assess changes in caries risk over a certain period.

Learning outcomes

On graduation, the dentist should be able to:

2.1. Determine the caries risk of a patient by taking his medical history (anamnesis, physical examination and complementary tests) in which the following factors are included: medical, oral, social and economic aspects; previous experience of caries; their behaviour in relation to oral health by collecting data on their oral hygiene, eating habits and intraoral biological factors; the use of fluorides or other remineralising agents or oral antimicrobials; the patient's knowledge and preferences; and considering new risk factors that have been validated as new evidence emerges.

2.2. Communicate the results of the evaluation of caries risk to patients, or their legal guardians and offer recommendations that allow them to reduce the probability of developing caries lesions and/or the progression of existing ones.

2.3. Judge emerging information on new risk factors and indicators.

Scope of competence: Diagnosis

On graduation, the dentist must be competent in the diagnosis of dental caries, using the different existing methods, by collecting, analysing and integrating data on the signs and symptoms of the disease. The dentist must also be able to assess the state of activity of an injury that allows him or her to identify the presence, past or present, of the disease. The dentist should be able to make a differential diagnosis of caries lesions—especially white spot lesions and/or inactive lesions—with other disorders of dental hard tissues.

Learning outcomes

On graduation, the dentist should be able to:

2.4. Recognise abnormal dental tissue by differentiating between carious and non-carious lesions. This should include both, primary and secondary lesions, on coronal and root surfaces.

2.5. Record and interpret data or signs present in the different evolutionary stages of the dental caries process, and the symptoms related to it, and use this information to make reasoned decisions about treatment.

2.6. Assess the level of activity in the different stages of the caries process, as well as the state of existing restorations and assess, where appropriate, the need for their repair or replacement.

2.7. Collect and analyse the signs and symptoms of other dental hard-tissue disorders to arrive at a differential diagnosis.

2.8. Evaluate the different methods to detect and determine the stage of the caries process and evaluate the activity of the lesions.

2.9. Interpret the results obtained with the different diagnostic methods for caries and other disorders of dental hard tissues.

Scope of competence: Synthesis

Synthesis is an important step to ensure that all the information obtained from the medical history is collected in a systematic way and integrated for the benefit of a specific patient, at a specific time.

On graduation, the dentist must be able to synthesise all the relevant information obtained, as well as combine and interpret the findings to ensure the control of dental caries, thereby allowing decision-making centred on the patient and shared with him or her (or his or her tutors) based on their needs, preferences and interests, and monitoring and reviewing the findings at the individual and community level.

Learning outcomes

On graduation, the dentist should be able to:

2.10. Assess the needs, preferences and priority interest of the patient for the control of dental caries.

2.11. Make clinical decisions incorporating the outcome of monitoring, reviews and re-evaluation.

2.12. Recognise and assess other disorders of dental hard tissues, synthesising all the relevant findings from the clinical history, combining and interpreting them, to allow shared clinical decision-making focussed on the patient.

2.13. Detect and evaluate the needs, preferences and interest of the patient or their legal guardians for the management of other disorders of the hard tissues of the teeth.

2.14. Differentiate the possible treatment options in each case, including assessing when a patient should be referred for specialised medical and/or dental care, due to rare disorders of dental tissues or medical diseases that may cause disorders in them.

Domain III: Decision-making and preventive non-operative therapy

This domain deals with the management of dental caries and other disorders of dental hard tissues with special emphasis on the planning, evaluation and long-term maintenance of preventive care. This comprises the principles of primary prevention of caries or other disorders of dental hard tissues, as well as the principles of secondary

prevention which applies when the disease has already manifested. These principles can be applied in a variety of ways regardless of the age of the patient. The prevention objectives must be clearly defined in order to evaluate the results.

This domain also includes communication, which is a critical part of the decision-making process. It should include pre-clinical and clinical practices.

Scope of competence: Communication with the patient and the family in different health care settings

On graduation, the dentist must be able to communicate the aspects of prevention effectively, interactively and thoughtfully with patients of all ages, their families or guardians and/or caregivers where appropriate.

The nature of the communication must consider the age and social circumstances of the patient, the community and the setting in which it takes place, strengthening their autonomy and participation.

Learning outcomes

On graduation, the dentist should be able to:

3.1. Manage non-verbal communication skills such as intonation, body language and eye contact.

3.2. Apply behavioural interventions such as the motivational interview.

3.3. Establish an empathic and trusting relationship with the patient.

3.4. Recognise the factors related to the patient, whether physical, psychological, social or cultural, for preventive counselling and its compliance over time.

3.5. Inform the patient about the aetiology of diseases that affect dental tissues.

3.6. Motivate the patient to play an active role in prevention and treatment, as a contribution to maintaining their oral health.

3.7. Offer the information that allows the patient to recognise the association between oral and systemic diseases.

3.8. Share information and professional knowledge of Cariology with other health professionals in relation to the prevention, diagnosis, detection of injuries and control of the disease, to work together in the control of common risk factors that affect oral and general health.

3.9. Convey to the patient that even in the absence of apparent caries lesions, the disease could develop, or it may already be present in a subclinical stage.

Scope of competence: Clinical decision-making leading to preventive non-operative therapy

On graduation, the dentist should be able to make decisions efficiently and consistently about preventive strategies and preventive or operative dental procedures that are applied both, at the individual and community level, related to cavities and other disorders of dental hard tissues.

This includes a preventive care strategy based on individual, family, group or community needs, risks and compliance possibilities. This non-operative treatment of the disease should consider not only the location of the lesion, but also the factors related to the patient and their social determinants. This requires knowing the potential to change and monitor caries risk over time. In addition, the dentist must be competent in the systematic evaluation of the results of preventive treatment and in formulating alternative treatment plans when necessary.

Learning outcomes

On graduation, the dentist should be able to:

3.10. Make decisions based on the synthesis described in Domain II, considering the concept of minimal intervention and a global and integrated approach to oral treatment.

3.11. Recognise the different preventive needs of a particular patient and risk groups in general,and adapt the treatment plan to each one of them.

3.12. Assess the expectations, desires, attitudes, needs and preferences of the patient in the planning of non-operative treatment.

3.13. Establish self-care goals for the patient and transmit them to the staff in their care when appropriate.

3.14. Describe the mechanism of action of caries prevention agents (including those of recent appearance), their methods of application and administration, and their limitations and adverse effects.

Scope of competence: Non-operative therapy

A dentist must be able to establish a non-operative preventive treatment of dental caries, considering all the aspects collected in clinical decision-making and the best available scientific evidence. To do this, he or she must apply the psychological, sociological and communication principles aimed at modifying related behaviours with the development of cavities and other disorders of hard dental tissues.

Learning outcomes

On graduation, the dentist should be able to:

3.15. Educate patients to adopt dietary, hygiene and other habits relevant to oral health.

3.16. Instruct patients on the appropriate techniques and measures geared at maintaining appropriate oral hygiene.

3.17. Perform professional dental prophylaxis.

3.18. Administer biofilm chemical control agents, fluorides and other remineralising agents according to caries risk and according to available scientific evidence.

3.19. Apply fissure sealing materials considering the installation instructions and the different types of material, as well as identifying when they should be repaired or applied again.

3.20. Establish the follow-up intervals according to the patient's caries risk.

Domain IV: Decision-making and operative therapy

This domain deals with the management of caries and other disorders of dental hard tissues, emphasising the restorative treatment plan, as well as the necessary reviews to monitor its evolution and the measures that must be established to control caries. It comprises the application of the principle of maximum preservation of dental tissues and maximum longevity of restorations, through the execution of a comprehensive restorative treatment and in line with other aspects of Restorative Dentistry, Endodontics and Prosthodontics. The said operative treatment shall be carried out when non-surgical management has not been successful or is no longer considered indicated by the evolution of the lesion and/or the particular conditions of the patient. This domain should include pre-clinical and clinical practices.

Scope of competence: Clinical decision-making leading to operative therapy

On graduation, the dentist must be able to collect, interpret and synthesise all the relevant information necessary to formulate the appropriate treatment options, considering their risks, benefits and prognosis. The said options must be presented to the patient and discussed with him or her (or his or her guardians and/or caregivers where appropriate) to reach a shared treatment decision within an individualised treatment plan. This requires having the ability to decide when to undergo operative treatment for carious lesions and other dental hard-tissue disorders, and to understand the consequences and prognosis of those decisions.

Learning outcomes

On graduation, the dentist should be able to:

4.1. Select the indicated operative treatment considering the risk of caries of the patient and according to the best available evidence.

4.2 Assess the expectations, desires, attitudes, needs and preferences of the patient in planning the operative treatment.

4.3. Identify, describe and manage the consequences of the treatment.

4.4. Distinguish the possible reactions of the dentine-pulp complex and of the periodontal tissues against the carious process and restorative procedures.

4.5. Estimate the success and failure rate of restorations according to the patient's caries risk.

Scope of competence: Operative therapy

A dentist must be able to perform the operative treatment of carious lesions preserving the maximum dental structure according to the stage of the lesion and its activity, considering the best available evidence. The dentist must be capable of restoring the loss of dental tissue, recovering the form, function and aesthetics (according to the patient's preferences), considering the maximum durability of the restoration; the said treatment should also restore and promote oral health.

Learning outcomes

On graduation, the dentist should be able to:

4.6. Decide when, how and how much carious tissue to remove when performing a restoration bearing in mind histological, clinical and microbiological criteria.

4.7. Select and execute the appropriate operative techniques for each case and material.

4.8. Execute the different techniques to eliminate decayed tissue to rehabilitate the tooth, preserving the dental structure and pulp vitality as much as possible.

4.9. Select, handle, and apply restorative biomaterials correctly and safely considering their physical and chemical properties, biocompatibility and durability.

4.10. Identify the impact of restorative procedures on the oral mucosa, periodontal tissues, occlusion and oral function.

4.11. Recognise the relevance of the biomechanics of restorations.

Scope of competence: Follow-up of restorative therapy

A dentist must be able to include the sequence of post-treatment check-ups in treatment planning to detect the occurrence of secondary caries and the possible failure of restorative treatment. He must be competent in deciding whether to polish, repair or replace a restoration and instruct the patient on how to prevent deterioration of the restorations.

Learning outcomes

On graduation, the dentist should be able to:

4.12. Establish the follow-up interval for restorations according to the patient's caries risk.

4.13. Identify the different defects that restorations may present over time and assess how they affect their function, aesthetics and anatomy.

4.14. Decide if a restoration needs to be repaired or replaced.

4.15. Polish or repair restorations to extend their longevity.

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

This domain deals with the basic knowledge for the practice of dentistry that is based on evidence. It includes the double facet of Clinical Cariology (practice on individuals) and Cariology in Dental Public Health (practice on population groups or communities); it is necessary to emphasise that the latter requires additional competencies to those already mentioned in Domains II-III-IV.

This domain refers to dental caries and other disorders of dental tissues and includes concepts of oral health in general in the field of Community Dentistry and Dental Public Health.

The core competencies in Evidence-Based Dentistry (EBD), which are generic throughout the undergraduate curriculum and not just for caries care, must be integrated throughout the whole of dental education. Domains II-III-IV deal with competencies related to the management of this disease in individual patients, whilst this Domain deals with Cariology in Public Health competences. It must include pre-clinical and clinical practices, including practices in the field of public health such as Primary Health Care.

Scope of competence: Caries as a public health problem

A dentist must be competent in the prevention and control of cavities and other disorders of dental tissue at the community and group level. This requires: understanding: (i) aetiology, (ii) health determinants, (iii) epidemiology, (iv) health promotion and preventive and care strategies, (v) their integration into dental care systems, in the Health System of the country itself, including Primary Health Care and specialised care, and in addition to (vi) its interaction with other disorders of oral health, general health, diet and the socio-economic and cultural context.

It also requires work skills in multidisciplinary teams, with other health, education and social service professionals, as well as communication and social interaction skills.

The learning results will always refer to dental caries and other disorders of dental tissue.

Learning outcomes

On graduation, the dentist should be able to:

5.1. Recognise the differences in Cariology at the individual level and at the community level.

5.2. Apply basic strategies for the prevention of these oral diseases for population groups, including screening programmes or diagnostic screening.

5.3. Assess behaviours related to health and educate to introduce the necessary changes.

5.4 Apply the epidemiological method in Dental Public Health.

5.5. Diagnose and record using community indices/indicators of dental caries and other oral diseases.

5.6. Interpret these community indices/ indicators on population groups and their relationship with socio-demographic variables.

5.7. Describe the epidemiological trend in dental health and treatment needs of the community and population groups.

5.8. Assess treatment needs from a public health perspective.

5.9. Explain preventive measures within the scope of promoting the oral health of the population as part of the promotion of public health.

5.10. Identify risk groups in the population and plan specific strategies and programmes for them.

5.11. Identify common risk factors shared by caries and other oral and general diseases, including social determinants.

5.12. Describe the organisation of the different models of oral health care that exist in Spain and its Autonomous Regions, and their portfolio of services.

5.13. Explain the Primary Health Care System and the different oral health care systems at the international level.

5.14. Describe the role that health and non-health professionals play in the prevention of dental caries and other diseases at the individual and community level.

5.15. Explain the concept of equity, identify the possible existence of inequities in the population, as well as propose improvement strategies with Public Health programmes.

5.16. Explain the concept of "Quality of Life related to Oral Health."

5.17. Define Health Economics and economic evaluation techniques for oral health programmes.

Scope of competence: Evidence-based cariology

A dentist should have full comprehension of the benefits arising from the practice of Evidence-Based Dentistry (EBD).

The dentist should have acquired good knowledge and security in management applied to the field of these diseases; he/she should be able to search for evidence in available sources, in addition to applying critical judgement.

Learning outcomes

On graduation, the dentist should be able to:

5.18. Argue that all knowledge can have areas of uncertainty and is constantly evolving.

5.19. Formulate clinical questions and know how to use the appropriate bibliographic sources and databases to solve them with the available evidence.

5.20. Define the concept of EBD, the pyramid of scientific evidence, levels of recommendation, methodological guidelines and patient preferences.

5.21. Analyse the available evidence on the forms of treatment to decide whether to incorporate them into practice.

5.22. Describe the methodological principles of a research process, including the design, sampling, bias and necessary data analysis (related to Domain I; 1.18).

5.23. Consider the limitations of the research methodology.

5.24. Apply critical judgement to diagnostic and therapeutic methods.

5.25. Identify the most appropriate clinical guidelines for each situation.

4 | DISCUSSION

The results of the survey amongst the 23 universities where a degree in Dentistry can be obtained, as well as the knowledge of the university-level reality of the members of the SCCG, showed that the teaching of Cariology in Spanish universities suffers from the lack of unified criteria.

Similar surveys were performed for Spanish-speaking Latin American countries,[24] Brazil,[25] USA[26] and Canada.[27] Our survey was answered by 100% of the universities, with a similar response rate to that reached in Canada,[27] and higher than the reported for USA,[26] Spanish-speaking Latin American countries[24] and Brazil,[25] with 82.7%, 62.1% and 57% rates, respectively.

None of the Spanish Universities reported the existence of a specific subject named Cariology although the term was used in different disciplines. The contents were taught mainly by Preventive and Community Dentistry, Pathology and Dental Therapeutics, and Paediatric Dentistry Departments or divisions, in agreement with the reports for Canadian,[27] most of the Brazilian[25] and Spanish-speaking Latin American universities.[24]

In Spain, theoretical contents on Cariology had a greater intensity in the 3rd and 4th years, whilst the practical contents were concentrated into the 4th and 5th years. However, in other countries such as USA,[26] Canada[27] and Brazil,[25] the theoretical contents and pre-clinical practices predominantly occurred in the first two courses.

Also, Cariology included concepts regarding other pathologies of dental hard tissues, mainly erosion.[25,27]

Finally, the creation of a Spanish Cariology Curriculum was supported by 93% of the universities, in line with the percentages obtained in other countries surveys.[25,27]

In addition, there is a scant presence of this discipline in the specific and professional competences described in the White Book of the Degree in Dentistry as well as in the requirements established by the Ministry of Science and Innovation for the official Degrees in Dentistry in Spain.[9] Moreover, these competences and contents need updating in the light of current Cariology knowledge.

This article describes the process undertaken in Spain for the elaboration of a Cariology Curriculum for teaching students who want to obtain a Degree in Dentistry. The text is based on the curriculum proposed at the European level[10] which has had significant international acceptance; furthermore, it has formed the basis for the drawing up of similar project plans in other countries.[11–16] In the Spanish document that we now present, although the Domains-based structure of the European original has been respected, the learning requirements have been modified following the new proposed methodology.[21,23] In the case of Spain, the autonomous body known as ANECA and attached to the Ministry of Science, Innovation and Universities has the objective of contributing to the improvement of the quality of the higher education system through the evaluation, certification and accreditation of the content taught, as well as of lecturers and institutions. The original text classifies the contents of each Domain by competences, differentiating the levels of "be competent at," "have knowledge of" and "be familiar with" according to the 2010 ADEE recommendations.[28] In the Spanish text, these requisites are structured within each Domain as "Areas of Competence" and "Learning outcomes." This follows from the change in methodology that now focuses more on results rather than on content.[22,23] Also, in the Colombian Curriculum, the competences were changed into main and specific learning objectives, to avoid the criticism that the former term arises in that country.[11]

There are other changes with respect to the original text; in our text we have used the nomenclature and terminology of the consensus report of the ORCA and the IADR Cariology Group on the *Terminology of Dental caries and Dental caries Management*.[4] For example, instead of using the term "management of caries" from the original, the Spanish document uses the terminology "caries care/caries management/caries control." Likewise, the terms "surgical or non-surgical therapy" have been replaced by "operative" or "non-operative treatment." In addition, the Spanish document incorporates the dental erosion/non-erosive wear, dental fluorosis, molar-incisor hypomineralisation and external cervical resorption.[29] Lastly, Domain III included three Scopes of Competence, instead of the two described in the ECCC. Therefore, learning outcomes related with the Clinical Decision-Making leading to Preventive Non-Operative Therapy and with the Non-Operative Therapy itself were singled out. This decision responded to the relevance that non-operative management of caries lesions should be translated to future dentists.

The process of creating this Spanish caries curriculum has tried to be as inclusive as possible by inviting, all 23 Spanish universities where a Degree in Dentistry can be obtained, to participate. In its preparation, 46 professors from 16 universities and 3 scientific societies participated both in online work and in face-to-face meetings. The speakers belonged to the departments/units of Preventive and Community Dentistry, Dental Pathology and Therapeutics, Conservative Dentistry and Paediatric Dentistry. As in the case of other previous curricula, the process began by diagnosing the teaching of dental caries in the different universities (unpublished data). Although nominal participation in the survey was low (28.2%: of the 156 questionnaires sent, 49 responded), at least one response was obtained from all 23 universities (100%). The map drawn by the survey shows a high dispersion and differences between the various departments, colleges and universities in the teaching of this disease

and its treatment. Perhaps for this reason, the answer to the question about the convenience of having a unified Cariology Curriculum was accepted by an overwhelming majority (93.2%). A joint statement from the scientific societies, SESPO, SEOC and SEOP emphasised the need to develop a curriculum for the teaching of Cariology.[20]

The online work facilitated the communication of the experts amongst themselves and with the group leader, as well as the integration in the draft text of the comments and contributions in an agile and secure way; a speaker (FJ C-M) acted as coordinator of the full document. In this process, the discussion of the text with all the universities was considered very important and, in this way to give greater validity to the final document. Thus, the Consensus Conference improved some aspects of the draft, and it was approved as a consensus document: *Currículo de Cariología. Estudios de Grado de Odontología en España* (Cariology Curriculum. Degree in Dentistry in Spain).

This curriculum should not be seen as an absolutely finalised document, but rather serving as a basis for discussion and adaptation to the specific teaching programme of each Department, Faculty or University. It is a referential framework for the development of specific teaching programmes in each university, department or subject. Nor can it be exhaustive, as already stated in the original document/ECCC; furthermore, the learning outcomes described can be modulated or reformulated for each situation. And, finally, it must be open to the incorporation of new approaches, new technologies and paradigm shifts in the light of the advancement of scientific knowledge, of accumulated evidence, always promoting a critical appraisal.

The work of creating this framework for the Cariology curriculum cannot end with the publication of this final document. It must venture well beyond academia to develop, from now on, an implementation strategy in Spanish universities.

In this sense, Fontana et al.[12] point out five strategic points that must be taken into consideration based on what they call a "structure" or curriculum guide in Cariology:

1. The need to establish a well-defined curriculum. In other words, a teaching program developed from this referential framework.
2. A caries registration system that includes a classification system for the severity and activity of the lesion, determination of caries risk and a re-evaluation plan.
3. The need for training and calibration of the clinicians and teachers of the teaching units.
4. The evaluation of results (productivity).
5. The effective inter-communication between the teaching staff of Departments and Faculties; It is evident that the treatment of dental caries is taught in different departments/subjects in the case of North American universities as well as in Spanish ones and, in general, in European ones.[18]

The publication of this document marks the beginning of a process of incorporation of this corpus into the Dentistry curricula of Spanish universities that, at an academic level, will only be possible through successive modifications of the curricula by procedures that must respect university autonomy. For this reason, a follow-up and review period for all these processes is opened; it entails the re-evaluation of the curricular implementation of Cariology in the coming years.

5 | CONCLUSION

The consensus reached by the majority of the Spanish universities on the basis of the document presented by the ECC allows the presentation of this Spanish curriculum in Cariology for undergraduate dental students, which is an adaptation of the ECCC. Thus, this new teaching curriculum lays the foundation for the implementation of an integrated teaching of Cariology in Spain according to the objectives of the ACFF.

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CONFLICT OF INTEREST

The authors confirm that there are no conflicts of interest.

AUTHOR CONTRIBUTION

FJC-M: conceptualisation, writing—review and editing, supervision, project administration. LC: Conceptualisation, writing—review and editing. EM-P: Conceptualisation, writing—review and editing. MH-J: Conceptualisation, writing—review and editing. AGS: Writing—review and editing. JMA-S: Conceptualisation, writing—review and editing, supervision, project administration and funding acquisition.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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APPENDIX 1

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