REVIEW ARTICLE

Future Perspectives in Pediatric Dentistry: Where are We Now and where are We Heading?

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Abstract

Oral diseases in children are still a major public health problem that can negatively impact parents and their children's quality of life. Even though oral diseases are largely preventable, initial signs of them can be detected in the 1st year of life, and its severity might increase with time if no preventive measures are taken. Based on this, we aim to discuss "where is pediatric dentistry now?" and "where is pediatric dentistry heading?" Early life oral health conditions are a good predictor of oral health status in adolescence, adulthood, and elderly people. A healthy childhood provides the foundation and opportunities for life; therefore, pediatric dentists have the unique opportunity to identify the presence of unhealthy habits in the 1st year of life and educate the parents and family members to change them for life. If all educational and preventive strategies fail or are not put into practice, the child might present oral health problems, such as dental caries, erosive tooth wear (ETW), hypomineralization, and malocclusion, that could have a great impact on other stages of life. At the moment, in pediatric dentistry, there are many alternatives to prevent and treat these oral health problems. However, if prevention fails, minimally invasive approaches, and new dental materials and technologies have been developed recently and will be important tools available in the near future in order to enhance children's oral health.

Keywords: Dental caries, Dental treatment, Pediatric dentistry, Prevention of dental caries.

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Introduction

Predicting the future is not a simple task in life since it is subject not only to knowledge but also to a whole range of conditions outside of our control. Even though we can look at trends and curves and we can do some estimations, no one will successfully plan the future by imagining it as a linear and gradual extension of the most recent events. A good example is the "black swan event" that reached us in 2020 by spreading the coronavirus all over the world. No one could predict it, and suddenly the pandemic started changing our lives in unimaginable ways disrupting all the plans that were made in our societies and personal lives.

On the other hand, imagining the future and thinking about different scenarios is worthwhile, especially when it allows us to reflect more in the sense of a broad contour than the precise details. In this way, thinking about the future might be helpful in possibly finding ways to improve some specific conditions we are dealing with at the present moment.

In health care, the future is also approaching in a rapid way, and the "new normal" have brought upon us new concepts and developments, which are changing right in front of our eyes. New digital technologies have been constantly tested and introduced to the market, aiming to assist health workers, such as artificial intelligence, medical decision support, nanotechnologies, three-dimensional-printings, genomic analysis, and robotics.

Not only are new technologies changing fast in health care lately, but also the communication strategies between healthcare workers and patients have been put at the center of the discussion. Digital platforms such as social media have become an important (and also dangerous) source of health information. Therefore, healthcare workers must be aware of and follow with caution the introduction of all these new approaches as well as the innovative ways of communication in order to learn how to embrace it and how to improve the way they diagnose, prevent, and treat oral diseases.

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In pediatric dentistry, this is not different. As a matter of fact, it is not a simple task to predict its future; however, we might be able to use the present knowledge and interconnect the information based on the widespread scientific evidence available in order to foresee the future. In terms of children's oral health, a notable example is the impact that the first 1000 days of a child's life might have on oral health during the life course. Early life oral health conditions might predict the oral health status to adolescence, adulthood, and later life.

This first 1000 days period is a great "window of opportunity" for preventing not only oral health problems but also systemic chronic noncommunicable diseases such as overweight, obesity, diabetes,

and cardiovascular diseases that have common risk factors which lead to oral and systemic outcomes. During the period that involves pregnancy and the first 2 years of life, healthcare providers must be able to identify unhealthy behaviors and their determinants, and bearing in mind contextual factors; they can work together with the family involved to identify opportunities to adopt healthier habits that might last throughout the life of the expected or newborn child.

If all educational and preventive strategies that might be carried on during the first 1,000 days of life fail or are not put into practice, the child might present oral health problems, such as dental caries, ETW, hypomineralization, and malocclusion that could have a great impact on the other stages of life.

Considering the challenges described above and the importance of adopting evidence-based clinical decisions, we aimed to discuss "where are we now?" and "where are we heading?" in pediatric dentistry knowledge.

Where are We Now?

Children's Oral Health

Early childhood caries (ECC) is still a prevalent disease and certainly impacts oral health status during the life course. In fact, recent global data shows that dental caries is mostly untreated in the first 2 years of life and has already a greater problem in the coming years of a proper childhood. Data from 72 worldwide epidemiological studies show that 17% of 1-year-old children have dental caries and substantially rising up to 36% for those children 2-year-olds and then 43, 55, and 63% in the 3, 4, and 5-year-olds, respectively band.[1] Despite the worrying situation on ECC, there is evidence that the weight of untreated caries lesions has not been only in early childhood but spread along the life course, with the highest prevalence at ages 6, 25, and 70 years.[2]

Erosive tooth wear (ETW) data among children and adolescents and its incidence over a lifetime are uncertain. Although current evidence shows that ETW is a common problem in primary dentition, a high prevalence of the condition has also been detected in primary dentition; however, the parents do not recognize it as an oral health issue. An epidemiological review revealed that a range from 1 to 79% of children from 2 to 5-year-old had ETW in primary teeth. Moreover, 14% of children from 5 to 9-year-old had at least one erosive lesion on permanent teeth. The prevalence in adolescents from 9 to 20-year-old ranged from 7 to 100%. Incidence data showed an annual median of 3.5–18%.[3] For permanent teeth of 8–19-year-old, a systematic epidemiological review, and meta-regression analysis found that the estimated prevalence was 30.4%.[4] ETW must be considered a significant oral health problem for the planning of having a healthy dentition along the life course since erosive lesions, like caries lesions, cause injuries to the patient's dentition for the whole life.[5]

Enamel hypomineralization is of increasing concern and is becoming highly prevalent worldwide, mainly in permanent molar and incisor teeth; according to a meta-analysis, its prevalence ranges from 2.8 to 40% in children and teenagers and a mean prevalence of 13.1%.[6] This enamel defect is also present in primary teeth, especially in second primary molars and canines, and its prevalence has been described in a systematic review as 11.2%.[7] Regarding the life course, the presence of hypomineralization in primary teeth is predictive of having this enamel defect in permanent teeth due to overlapping of the mineralization of the second primary molars and the first permanent molars during the 1st year of life. One of the main concerns about enamel hypomineralization is the fact that a systematic review found a significant association between this defect and dental caries in permanent teeth; however, this data should be carefully explained due to the absence of high-quality studies.[8]

Malocclusion in the 1st years of life might be considered a relevant risk factor for future occlusion problems in mixed and permanent dentitions. According to a meta-analysis, the worldwide prevalence of malocclusion is 54% for both primary and permanent dentition.[9]

Dental caries, ETW, hypomineralization, and malocclusion are oral health problems that might occur in the 1st years of life and have an impact throughout life. Pediatric dentists might be able to diagnose the first signs of these oral health problems onset from the earliest age and prevent their incidence and impact during the life course.

Among these oral health problems, dental caries is undoubtedly the greatest concern. Untreated dental caries remains highly prevalent worldwide, and ECC affects >600 million children.[1] It is a disease that has a significant expense to societies all over the world and has an expressive negative impact on both children's and families quality of life. Therefore, dental caries is the main discussion focus of this paper.

Managing Dental Caries

It is evidence-based that low and middle-income countries face the highest burden of oral diseases, especially dental caries. With limited resources for prevention and control, the number of untreated lesions is still rising. Preventing dental caries means avoiding caries-free children having their first lesion or caries-affected children developing new lesions on sound surfaces. Managing dental caries might include several noninvasive and invasive strategies besides their association.

Strategies that focus on major common risk factors and social determinants, implemented in important social environments such as schools and communities, are not often a priority in government actions to prevent oral diseases. The use of fluoride toothpaste is not affordable to many people in unprivileged countries.

Population and Individual-based Strategies

Community water fluoridation (CWF) is considered one of the most important measures for the prevention of dental caries, and it is truly equitable public health practice. The benefits of this practice reach all individuals, regardless of their age group, socioeconomic and educational background, and oral hygiene and nutritional habits or access to dental care.[10] Recent systematic reviews evaluated the preventive effect of CWF in populations where fluoride toothpaste use is also common, and even then, studies reported greater caries reduction in CWF areas in children and adult populations.[11–13] There is also inadequate data to conclude the effect of stopping CWF on dental caries level. It seems reasonable to improve both strategies since the preventive effect of fluoride toothpaste has increased in CWF areas.[12]

Fluoride toothpaste is considered the most effective way to guarantee the daily amount of fluoride and control biofilm through brushing; the evidence is related to several systematic reviews, and all have ratified its effectiveness in preventing dental caries in children and adolescents. On young children under 3-year-old, the risk of fluorosis should be balanced against their risk of dental caries. Dental care professionals should, therefore, give adequate instructions to parents on the right amount of fluoridated toothpaste to be used depending on the child's age to decrease the

risks of fluorosis while increasing caries protection.[13] Stakeholders, industry, and public health institutions should be motivated to provide these instructions. The correct amount of fluoride toothpaste is a grain of rice for children under 3 years of age or pea size for children older than 3 years. Biofilm controls twice daily with fluoridated toothpaste, in combination with diet control (reducing frequency of sugar intake), are the basis of any program for caries prevention, regardless of the child's caries risk.

Alternatives to Fluoride

Due to concern about dental fluorosis, a large number of studies testing alternatives to fluoride for caries prevention and arrestment have been developed. In a recent systematic review, studies that looked at xylitol, chlorhexidine, casein phosphopeptide-amorphous calcium phosphate (CPP-ACP), triclosan, and arginine were evaluated.[11] The authors reported that for arresting dental caries in primary dentition, the use of xylitol might be effective; however, they also alerted to the fact that the clinical and methodological heterogeneity of the studies and small sample size could not allow some quantitative synthesis. To prevent dental caries, chlorhexidine and CCP-ACP presented better results than placebo; however, their effectiveness is almost similar when compared with fluoride. Other compounds were evaluated in studies classified with a high risk of bias. So, although 0.3% triclosan varnish and arginine-containing mint confection were shown to reduce caries development in primary teeth, they should be used as an adjunct method.

Sugar Intake Restriction

The association between dental caries and sugar was established at the end of the 1990s. There are some factors that influence this relation, such as acidogenic bacteria in the dental plaque, the accessibility of sugar for bacterial digestion, and the capacity of fluoride and saliva to neutralize the acids. When sugar consumption is poorly investigated, some people could report a similar amount of sugar-containing products and present a significantly different amount of caries lesions. Recommendations not only on the amount of daily sugar but also on the frequency of sugar intake are essential for the control of this etiological factor.

There are some guides developed by the world and national health organizations that support the reduction of sugar intake to under 10% (daily dietary energy percentage consumption per capita); however, adopting this rule might be a challenge for many people, and community-based strategies, like taxes on unhealthy food and beverages, that aim to decrease the amount and frequency of sugar intake are needed.[14]

Managing Non-cavitated Enamel Carious Lesions on Smooth Surfaces

Fluoride has been considered a noninvasive treatment alternative to slow down the tooth decay process since it decreases demineralization and increases remineralization. Acidulated phosphate fluoride (APF) is a topical professional product that has been mostly recommended. For a noninvasive treatment, the use of topical fluoride products with high concentrations is advocated during 4–8 weekly or fortnightly sessions. However, based on only two double-blind, randomized controlled trials in children 7–12-year-old it has been shown that no further benefits were shown after treating initial carious lesions with APF when fluoride toothpaste was also being used, considering lesion as the main outcome.[14–16] A randomized placebo-controlled parallel clinical trial[16] assessed in children 3–12-year-old the efficacy of the association of the following methods: use of fluoride dentifrice, weekly professional prophylaxis, diet orientation, and APF on the arrest of active non-cavitated lesions in primary and permanent teeth. This study showed no additional effect of the association of fluoride dentifrice, weekly professional prophylaxis, diet orientation, and APF on caries arrestment, confirming the importance of the frequency of toothbrushing with 1100 ppm fluoride dentifrice and the reduction of plaque accumulation in the control of caries activity.

Managing Non-cavitated Enamel Carious Lesions on Proximal Surfaces

The effect of infiltrating lesions on proximal carious lesions in permanent and primary teeth was systematically reviewed, and the authors found that the application of resin infiltrant combined with oral hygiene measures is more effective in controlling proximal lesion progression than oral hygiene measures alone.[17] However, only one study included in this review involved children,[18] and it was a randomized clinical trial with a split-mouth design. The aim was to evaluate the development of early carious lesions, and the results showed that infiltrating proximal lesions arrested radiographic caries progression in primary molars after a 2-year follow-up period.

Managing Dentin Carious Lesions

Silver diamine fluoride (SDF) is a colorless alkaline solution whose components have a synergistic effect in stopping the process of the development of dentin-carious lesions, which provides the SDF with the capacity to cease demineralization and to preserve the dentin's collagen from degradation. The SDF has different concentrations; the ones which have 44800 ppmF (38% concentration) have been indicated to arrest dental caries lesions in America, Asia, and Australia, although in Europe, its use has been rarely indicated to arrest or prevent. The number and quality of recent studies are increasing, but till the moment, based on a systematic review[19] and using the Grading of Recommendations Assessment, Development, and Evaluation system, this indication has been based on low-quality evidence.

Evidence suggests that the best way to arrest dentinal carious lesions in primary teeth is the use of SDF. It has a better outcome than the use of fluoride varnish or atraumatic restorative treatment (ART) sealants or even restorations.[20] Furthermore, a study has shown that the 38% SDF is more effective than the 12% SDF for arresting active cavitated carious lesions in primary teeth.[21] The positive aspects of the use of SDF are the facility to apply, the low cost, and the painless procedure. Moreover, it is possible to apply SDF without removing carious dental tissues before the application; thus, it is a simple technique that reduces the patient's discomfort. Therefore, SDF is a good strategy for controlling dentin carious lesions, mainly in difficult-to-manage children. Oliveira et al.[22] found that applications of SDF can arrest dentin caries progression, however, with limited evidence. The ideal frequency of SDF applications still remains in debate.

Besides conventional restorative procedures after selective caries removal, ART, and Hall technique (HT) has been studied as options for the treatment of cavitated dentin carious lesions, mainly because both are non-aerosol generating and more friendly procedures. ART have shown similar survival rates when compared to conventional restorative approaches on occluso-proximal lesions of primary teeth.[23] It is known that the operator (dental student

or dentists) and the sort of restoration (single or multiple-surface) might be considered relevant components that influence the percentage of success of ART restorations.[24]

Recently, in a school setting, Araujo et al.[25] made a comparison between the HT and ART restorations placed in occluso-proximal carious lesions. After a follow-up of 36 months, the authors found that HT had a survival rate three times higher than ART (93.4% compared to 32.7%). Therefore, the use of HT might be recommended when compared to other restorative options.[26]

In a more conservative approach, according to a cariology document,[27] microcavitated carious lesions with or without shadow in dentin can be sealed (mechanically blocked) without removing any caries tissue in order to preserve tooth structure for as long as possible. In primary teeth, this approach is very applicable since these teeth have a shorter life span in comparison to permanent teeth. Although insufficient, the dental literature has shown that the possibility of sealing the outer half of dentin carious lesions can also be efficacious. The use of flowable resin composites in primary teeth with no removal of caries tissue has been shown to be effective.[28,29] For the dentin caries lesions involving the inner and outer half, the use of sealant can be effective for the arrestment.[28,30,31] Besides, the decision between sealing or restoring a cavitated carious lesion in dentin implies that the patient should be very closely monitored for as long as the sealant or restoration remains in the mouth. Glass-ionomer sealants in dentin require periodic preventive maintenance since they might fail and may need to be repaired or replaced. For this decision, cavity size must be considered depending on the time the teeth must remain in function.

Where are We Heading?

This paper showed how much pediatric dentistry has changed over the past decades in terms of diagnosis, prevention, and treatment. It is time to focus on what we can do in the present to decrease the most prevalent disease found among the pediatric population in the future (Fig. 1).

All dental professionals that are involved in the provision of dental treatment for children should keep up to date with the current scientific evidence, and this is not an easy task. Government policies must involve programs that help to reduce the consumption of sugary products (diet counseling, higher taxes, parental education, and local policies). At the same time, a multidisciplinary approach must be taken into consideration when dealing with multifactorial diseases and their control.

Our access to information and technology, with the advance of artificial intelligence, computer-assisted tools, and online learning, is increasing the speed of scientific advance and international collaboration.

Implementation of Evidence into Practice

It is undeniable how much the level of scientific evidence has increased in the last few years.[32] However, there is still a gap between what we know (scientific evidence) and what we do in dental practice. This can result from multiple factors, including mainly educational deficiencies related to the dental curriculum, and even though there is high-quality evidence to conduct many dental clinical procedures, they may not be used in ordinary clinical practice. Thus, the key for any future planning is to evaluate how the implementation of the current scientific evidence is going to

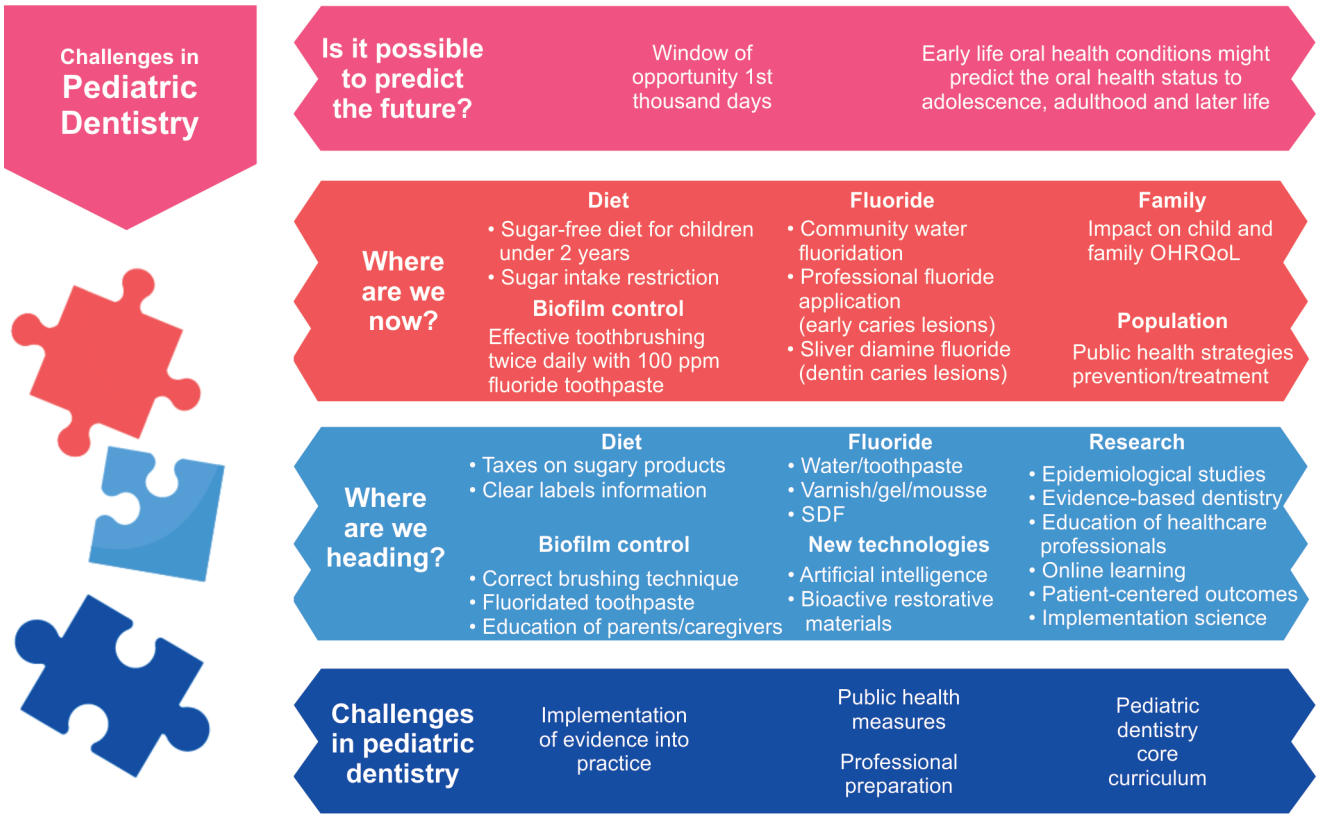

Fig. 1: Challenges in pediatric dentistry—summary

take place and what factors may be contributing to its delivery to the young population in each specific location/scenario.

The future of pediatric dentistry lies in the professionals responsible for the provision of dental treatment for children in dental practice, and therefore, their adequate training in keeping up to date on the relevant scientific literature is as important as their clinical skills. Although there are several documents on the standards for dental education around the world, there is still a need for the development of a core curriculum in pediatric dentistry. This could be the next step for a new generation of dental professionals, competent at applying evidence-based scientific knowledge, understanding the applied clinical sciences, and making decisions on disease management always with empathy and recognition of the patient's needs.

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