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The Future of Children Oral Health: Key Trends in Pediatric Dentistry

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Dear Editor,

In recent decades, the World Health Organization has highlighted the significance of dental care for children, pregnant women, and elderly populations. Unfortunately, in developing countries, conventional monitoring methods cannot be applied successfully to these target groups because of financial difficulties and resource scarcity (1). I believe that the key developments aimed at enhancing children's oral health will feature: (1) The application of artificial intelligence (AI) tools; (2) the recent developments in preventive materials; (3) the influence of communicable diseases on children's dental health; (4) the emergence of tele-dentistry; (5) the impact of dental experiences on mental health; and (6) sustainable and eco-friendly practices.

As we address the multifaceted issues of modern healthcare, it is necessary for pediatric dental practices to adjust and innovate to effectively serve the needs of our youngest patients. This article aims to review the innovative trends in pediatric dentistry (PD) that have the potential to enhance children's oral health.

The application of AI tools is transforming the field of PD. Innovations such as three-dimensional imaging and AI-driven diagnostics are significantly increasing the precision of assessments and treatment protocols, which leads to enhanced care quality (2, 3). For instance, AI can detect early signs of dental problems, promoting timely intervention to stop them from worsening into larger challenges. Research indicates that AI algorithms (Apox and Denti.Ai) can identify dental anomalies and caries with a level of accuracy comparable to that of seasoned pedodontists (4-6). Consequently, less experienced pedodontists who utilize AI technology will demonstrate a satisfactory level of diagnostic proficiency.

The nnU-Net, machine learning algorithms, and deep learning systems significantly enhance support for individuals and communities by accurately identifying and categorizing children into various risk categories, while also addressing issues such as tooth numbering, early diagnosis of ectopic eruptions, and age assessment (3). Utilizing these resources (such as CNNs) can significantly contribute to the design and evaluation of oral health programs in educational settings, increasing children's awareness of their dental hygiene (7). A significant difference was not observed between the AI model and specialist. A CNN-based model demonstrated high accuracy in detecting plaque in comparison with the pediatric dentist (8). As a result, children can independently recognize the presence of dental plaque, reducing the necessity for a pedodontist to conduct plaque assessments.

The relatively low cost of operating AI technologies allows it to serve as a valuable resource for economically constrained or sanctioned countries, which urgently require efficient surveillance systems to improve their healthcare services in a timely manner (1).

Recent developments in preventive materials have attracted increased focus. The widespread occurrence of dental caries constitutes a significant public health challenge (9). As a result, there is an emerging trend that emphasizes the importance of preventive care. Implementing these preventive approaches is essential for addressing the increasing prevalence of dental caries among children. The application of nanotechnology has resulted in substantial advancements in the prevention, diagnosis, and therapeutic interventions for oral diseases (10, 11). The implementation of nanomaterials represents a newly established method that provides various benefits. The impressive fluoride uptake provided by nano sodium fluoride indicates that it may be quite feasible to reduce the fluoride dosage

administered during each dental visit. This strategic adjustment could lead to superior results in the prevention of cavities, enhancing overall dental health (12, 13). Furthermore, it may be advantageous to extend the time intervals between fluoride therapy sessions, particularly for young children who may not provide the required cooperation (12, 13). Therefore, the use of nano sodium fluoride varnish offers a non-invasive solution for the treatment of dental caries in young children who may be anxious or resistant to standard dental treatments.

Communicable diseases significantly influence the dental health of children. The pediatric dental health landscape has experienced considerable changes due to the COVID-19 pandemic in multiple aspects. The pandemic-induced lockdowns forced many dental practices to limit their services or temporarily close, leading to an increased demand for both routine and urgent dental care among children. There was a significant drop in dental services offered in both clinics across all dental groups in the post-COVID period [on average, 77 (39.44%) fewer services per day] (14). The COVID-19 pandemic significantly impacted the mental and emotional well-being of both individuals and communities (15). Factors such as social isolation and uncertainty played a critical role in negatively affecting mental health, leading to increased anxiety, feelings of loneliness, depressive disorders, sleep disturbances, and, in some instances, self-harm tendencies (15). A notable fraction of the population faced unemployment and financial hardships, which intensified existing mental health challenges (16, 17).

The tendency to defer preventive dental care, including regular cleanings and examinations, resulted in a greater risk of experiencing dental issues. Moreover, families' approaches to oral hygiene have been shaped by the effects of the pandemic. Spending more time at home enabled parents to supervise their children's brushing and flossing more closely. Nevertheless, the stress and disruptions to their usual routines caused some children to engage in poorer hygiene practices, such as snacking more frequently and overlooking their oral health. Additionally, the pandemic has adversely affected children's mental health, which may be linked to a decrease in attention to oral care. Children's dental health can be compromised by stress, anxiety, and modifications in family dynamics, potentially resulting in a greater risk for caries and gingival diseases. Consequently, the emergence of communicable disease pandemics has the potential to reshape children's oral health conditions.

According to Tiwari et al., mental health status, age group, race/ethnicity, education, and last dental visit were all significantly associated with oral health status. Mental health status, age group, and income groups were all significantly associated with unmet oral health needs (17). Moreover, various dental complications, notably bruxism related to stress and anxiety, have been documented, and findings reveal that these psychological elements can adversely affect oral health (18).

Tele-dentistry has revolutionized access to dental care by eliminating geographical limitations. This innovative approach enables families residing in rural and underserved areas to obtain specialized dental services that were previously inaccessible. Remote consultations and follow-up interactions enable timely responses, particularly for health issues that require immediate attention. Implementing successful tele-detection strategies and referral pathways within oral healthcare systems can lead to better oral health outcomes for children (19). The analysis of in-person assessments versus tele-dentistry yielded encouraging findings (20). Furthermore, this approach demonstrates reliability when compared to face-to-face assessments (20). Ultimately, the adoption of tele-dentistry has produced efficiencies in time and cost, reduced the necessity for travel (21), improved the quality of care provided (21), and promoted timely treatment by early diagnosis (22). Furthermore, the use of tele-dentistry can result in a significant decrease in healthcare costs and promote more effective resource use (23). Research from Australia demonstrates that the integration of tele-dentistry in screening practices could yield financial savings of around 40 million dollars per year (24). By utilizing telemonitoring, healthcare providers can conduct virtual consultations instead of in-person visits, facilitating ongoing assessment of treatment efficacy and disease progression. Evidence indicates that this approach effectively reduces costs and shortens the duration of patient wait times (23).

The systematic review and meta-analysis findings revealed that the accuracy of teledentistry assessments, based on intraoral photographs taken with smartphones or intraoral cameras, is comparable to that of traditional clinical examinations in identifying and evaluating carious lesions. Analysis of the four studies quantitatively indicated that no significant differences were present ($P = 0.09$). The observed mean difference of 0.64 [95% confidence interval (CI): -0.10 to 1.38] indicates that both clinical examinations and teledentistry assessments are equally effective in identifying dental caries (25).

Understanding the impact of dental experiences on mental health is a crucial element in current PD practices. By designing a friendly and supportive space for children, dental anxiety and pain can be significantly reduced, which in turn encourages a positive outlook on oral health from a young age. The application of laughter therapy before dental procedures has been shown to markedly decrease anxiety and pain experienced by children during their treatment (26). This approach is crucial in promoting sustained oral hygiene practices throughout life.

Ultimately, the focus on sustainability and eco-friendly practices is transforming the future of pediatric dental practices. By utilizing environmentally friendly resources and methods, we actively contribute to the health of our planet and encourage families to adopt similar values. The 2030 Agenda for Sustainable Development emphasizes the necessity for dentistry to align its daily practices with sustainable development goals (SDGs) and to contribute to the advancement of a green economy (27). The United Nations has developed a framework of 17 SDGs to effectively advance global peace, prosperity, and well-being through sustainable practices. These objectives signify a joint effort to tackle a range of social, economic, and environmental issues encountered by communities across the globe. The international community aims to achieve a balanced and sustainable future for everyone by actively working towards these objectives (28).

According to the United Nations' SDG 6, it is imperative to guarantee that all people have access to clean water, sanitation, and hygiene (WASH), which are fundamental for health, well-being, and living with dignity. Early childhood caries (ECC) constitutes a preventable health issue that adversely influences the quality of life and health of numerous young children internationally. The outcomes of a study advance the understanding of the obstacles faced when attempting to directly link water access to the incidence of ECC. The complexities revealed emphasize the critical need for comprehensive strategies that consider diverse influences, aligning with the broad aims of SDG 6 (29).

It is crucial for oral health professionals to actively work towards reducing their dependency on natural resources, while also encouraging high standards of oral health practices for their patients. Professionals in PD must remain updated on contemporary developments and incorporate cutting-edge methodologies as we progress into the future. Through this action, we can assure that our children benefit from exemplary care, promoting a generation that is committed to maintaining high standards of oral health.

Footnotes

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