

Fluoride and caries prevention: a scoping review of public health policies

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Abstract

Background. Dental caries is the most common infectious disease, affecting approximately 60 to 90% of the world population, especially young children, and disadvantaged communities. Due to the extremely high prevalence and the significant negative impact on general health, well-being, and quality of life it is considered a global public health problem. Despite the improvement of policies to promote oral health care in the past decades, dental caries is still a healthcare challenge, characterized by increasing disparities among different social groups between and within countries. Fluoride-based prevention of dental caries is a cost-effective approach, that has been implemented since 1940's. It includes systemic and topical administrations, through community-based or individual programs. Preventive interventions should be tailored to individual and community caries risk assessment and estimate of cumulative fluoride intake, in order to maximize the preventive effect and avoid the risk of potential adverse effects associated with excessive fluoride exposure. Regulation of public health policies plays a major role in this context.

Study design. Scoping review.

Methods. The aim of this scoping review was to report an overview of current guidelines regarding fluoride-based preventive strategies for dental caries and relevant policies on the matter, as well as to address current issues related to public health aspects of dental caries prevention. We searched for the relevant literature on the matter, focusing on policy documents, such as recommendations, position papers and guidelines, issued from the major scientific and regulatory institutions involved in oral health promotion and on publications concerning relevant aspects of public health law.

Results. Prevention of dental caries through fluoride can rely on topical fluorides for home-use (toothpastes and mouthrinses), professionally applied topical fluorides (gels, varnishes, silver diamine fluoride, fluoride-releasing restorative materials and sealants), fluoride supplements (tablets and drops), and community-based strategies (community water fluoridation, fluoridated salt and milk). Current relevant guidelines for all these preventive aids are outlined in the paper. A significantly greater preventive

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effect of topical fluorides has been widely established in the recent past, as compared to systemic effects. Furthermore, increasing concerns have emerged on potential adverse effects on general health associated with early and excessive systemic exposure to fluoride, especially for children, supported by recent meta-analyses. Also, community water fluoridation has raised significant aspects of relevance for health law and policies. In a public health perspective, healthcare policymakers should tackle social inequities by promoting information and oral health literacy, through community and school-based programs, ensuring access to early dental visits and basic dental care and improving availability and affordability of fluoride topical products.

Conclusions. *Fluoride-based prevention can provide a simple and cost-effective approach to reduce the incidence of dental caries and the associated social burden. Among fluoride-based preventive strategies, systemic community-based administration of fluoride should be considered with great caution, due to the unfavorable risk-benefit ratio currently established. Topical fluoridated products are generally preferred, given the optimal risk-benefit ratio. Further efforts must be made to identify and tackle the barriers to dental caries prevention and related social inequities from a public health perspective. Policies and laws on oral health should promote access to caries prevention with targeted comprehensive strategies.*

Introduction

Dental caries is the most common infectious disease, affecting approximately 60 to 90% of the world population, especially young children (1,2). Moreover, the prevalence of early childhood caries (ECC) affecting children under 6 years of age, is reported to be up to 70% in groups with socioeconomic disadvantages (3–5). Untreated caries can progress to disabling clinical situations, with pain, local and systemic infections, early teeth loss, causing difficulties in eating, sleeping and performing daily activities. Moreover, dental conditions are responsible for more than two million missed school days per year in the United States, and consequently lost work hours for the caregivers and parents are five times more likely to seek urgent medical attention for their children due to dental pain compared to other health issues (6,7). Dental caries is therefore considered a major public health issue.

Dental caries is a multifactorial non-communicable disease, caused by a complex interaction of bacteria, fermentable carbohydrates, and host factors over time (8). Additionally, socio-behavioral risk factors play a significant role, including low education background, poor living conditions, poor dietary habits, high consumption of sugars, limited tradition and access to general and oral health care (9–11). Dental caries is however largely preventable, by modifying risk factors, identifying social barriers to oral care and establishing effective preventive measures on an individual and community level.

Fluoride (F) has played a central role in the prevention of dental caries since 1930 and its appropriate use is considered a major breakthrough and one of the most successful public health interventions (12). F exerts anti-cariogenic action through three mechanisms:

inhibition of tooth demineralization, promotion of tooth remineralization, and inhibition of bacterial metabolism and acid production (13,14). Both systemic and topical prevention have been reported, being the latter more effective (14–16). As a matter of this, systemic F exposure in early tooth developmental stages can result in formation of fluorapatite crystals in the enamel structure, which are much more resistant to acid dissolution than enamel hydroxyapatite. Nevertheless, this does not have a sufficient effect on the surface acid solubility of enamel (13). Conversely, F ions in the oral environment adsorb into the crystal structure of the enamel surface and effectively protect it against demineralization (17,18). Demineralization and remineralization processes occur continuously in the oral environment (19). During demineralization, F rapidly adsorbs on the partially demineralized enamel crystals and attracts supersaturated calcium and phosphate ions, promoting remineralization preferentially in the form of fluorapatite (18). Finally, F exerts a direct antibacterial effect against cariogenic species by interfering with their enzymatic activity and causing cell lysis.

Current F preventive strategies include individual and community-based measures that rely on systemic or topical delivery. Topical strategies include F toothpastes, F gels and varnishes, silver diamine F application, fluoridated mouth rinses, and specific F-releasing dental sealants and restorative materials (20–23). Individual systemic strategies include the administration of F supplements in the form of drops or tablets, while community-based interventions involve the artificially controlled addition of F to commonly consumed products such as milk, salt, and more importantly, drinking tap water. Therefore, public health policies play a major role in orienting choices of individuals and communities and in increasing the

accessibility of dental caries preventive measures.

This scoping review aims to provide an overview of current guidelines regarding F-based preventive strategies for dental caries and relevant policies on the matter, as well as to address the most relevant issues related to public health aspects of dental caries prevention.

Methods

We searched for summary evidence, such as systematic reviews and meta-analyses, related to F-based preventive strategies for dental caries. Additionally, we focused on publications concerning relevant aspects of public health law, and on policy documents, such as recommendations, position papers and guidelines, issued by the major scientific and regulatory institutions involved in oral health promotion, including World Health Organization (WHO), European Academy of Pediatric Dentistry (EAPD), American Academy of Pediatric Dentistry (AAPD), International Association of Pediatric Dentistry (IAPD), American Dental Association (ADA), and UK National Health Service (NHS).

Results and Discussion

Topical fluorides for home-use

The ratio of using fluoridated home-products is to maximize the amount of time F is in direct contact with the tooth surface, with a "low-dose, high-frequency" approach (24). This has proven effective in reducing the prevalence of dental caries in industrialized countries (21,25). Although rare, acute toxicity can occur in young children, from the accidental ingestion of topical Fs in the amount of one to two-thirds of a standard 125 g toothpaste tube (containing 1100 ppm F or 1.1 mg F/g of paste), being the toxic dose approximately 5 mg F/kg body weight (25,26). To optimize preventive effectiveness and low risk of excessive F intake, the current guidelines on toothpaste use recommend brushing for 2 minutes, 2 times a day, with the following dosage: from 6 months to 3 years, toothpaste containing 1000 ppm F, with a "rice-size" dose (0.1 mg F); from 3 to 6 years: toothpaste containing at least 1000 ppm F, with a "pea-sized" dose (0.25 mg F); over 6 years: toothpaste containing at least 1000 ppm F (1350-1500 ppm recommended), "2 cm" dose (0.5-1 mg F) (16,27,28). Parents are also advised to assist/supervise brushing in children until at least 7 years of age (16). High F

toothpastes, containing more than 1500 ppm F, are available on prescription for patients with increased caries risk, but there is no conclusive evidence of their superior effectiveness (16,29).

Fluoridate mouth rinses, generally containing 230 ppm F/10 mL of rinse volume at 0.05% sodium F, are available for daily home use or used in school-based prevention programs (30). In combination with fluoridated toothpaste, they can provide additional protection in children at high risk of caries, with 1-2 minutes of rinsing per day. They are only recommended in children over 6 years, supervised by adults, due to the risk of accidental ingestion in younger children (16,27).

Professionally applied topical fluorides

Professional products for topical application of F include gel, varnish and silver diamine F and are typically recommended in subjects at high risk of caries (16). F gels are available in concentrations ranging from 5,000 to 12,300 ppm. They are applied in disposable trays in the dental office to prevent caries and remineralize incipient lesions. They are contraindicated in children under 6 years of age due to the risk of ingestion, with an unfavorable risk-benefit ratio. They can be applied to children over 6 years twice to 4 times per year, according to caries risk (16,27).

F varnish is a concentrated topical product (typically 22,600 ppm F) that is applied to the teeth and sets in contact with saliva. Since the risk of ingestion is extremely low, it is recommended also for young children under 5 years (21,31). Among its advantages, it has a prolonged release and therapeutic effect, and can be applied by both dental and nondental health professionals. The application of F varnish in community-based settings is an effective preventive strategy, especially for those children with limited access to dental care (32). Current guidelines recommend F varnish application for children at high risk of caries, every 3 to 6 months (16,33).

Silver diamine F, available at a concentration of 38% (44,800 ppm F), is a compound similar to a varnish, that is applied on the tooth and rapidly sets. Thanks to its antibacterial and remineralizing properties, it has proven highly effective both in preventing and arresting carious lesions in very young or uncooperative patients (34). Following the publication of relevant guidelines by the AAPD in 2017, it has been widely used in Asia, Australia and the United States, but has only recently spread to Europe. It is considered a highly cost-effective strategy, especially in low-income populations or in settings with limited access

to dental care (35). Unfortunately, it has aesthetic drawbacks as the treated surfaces develop a permanent black pigmentation. Current guidelines recommend an application two to four times per year, as part of a comprehensive caries management program in high-risk patients, especially when definitive restorative procedures may be limited or preferentially postponed for a variety of reasons (33,35).

F-releasing dental materials have also been developed to enhance local F delivery and are specifically used in pediatric preventive and restorative dentistry (36,37). These materials are capable of releasing F into the oral environment for a long time after placement and can be recharged by Fs present in saliva, acting as reservoirs (38). In addition to a general preventive effect in the oral cavity, F-releasing sealants and restorative materials have shown positive results in counteracting bacterial colonization of the restoration and surrounding tooth structure, thereby reducing the risk of developing primary and secondary caries (20,22,39). Unfortunately, these materials may be expensive and are not widely available in disadvantaged communities or oral health care settings nonspecialized in pediatric dentistry.

Fluoride supplements

F supplements in the form of tablets and drops were originally introduced where fluoridated water was not available to provide optimal F exposure. At that time, the superior effectiveness of topical Fs over the limited systemic effects had not been firmly established (40). F supplements have also been prescribed to pregnant women to prevent caries in their offspring, but are no longer recommended because no evidence has been found to support this measure (41,42). Therefore, F supplementation is currently very limited, reserved for consideration on an individual basis for high-risk patients or when other topical F applications cannot be achieved, and only when the F concentration in tap water is less than 0.6 mg/L (43). The recommended dosages in these cases are as follows: 6 months to 3 years of age, 0.25 mg/day F; 3 to 6 years of age, 0.50 mg/day F (16,33,44). It is fundamental that all potential sources of F are evaluated before prescribing a supplement, also in light of the fact that even where water is not artificially fluoridated, natural levels of F are highly variable (45–47).

Community-based strategies

Community water fluoridation (CWF) consists of the controlled addition of F to drinking water, at varying concentrations according to national policies,

up to a maximum of 1.5 mg/L (48). Currently, CWF is deployed in 25 countries worldwide, covering approximately 75% of the US population, but only a small portion of the UK and European populations (49–51). The goal is to provide optimal systemic and topical exposure to F through a widespread, equitable, and cost-effective strategy. Water fluoridation was first introduced in the US in the 1940s and has shown significant effectiveness in reducing caries incidence in the US by 25% to 60% (52,53). However, this remarkable decline in caries incidence occurred at a time when toothpaste and other topical products were not widely available, and the superior effectiveness of topical Fs was not firmly accepted. Because drinking water is now only one of multiple sources of F, the US Department of Health and Human Services revised the guidelines in 2015, lowering the recommended level from 0.7–1.2 mg/L F to a standardized 0.7 mg/L F to balance the benefits of caries prevention with the risk of dental fluorosis (54). Nowadays, CWF is a controversial topic: while still supported by the main scientific societies of the field and by national entities opting for this community-based strategy, it is raising increasing concerns on a risk-benefit balance (15,55). In addition, F levels in natural drinking water vary widely within and across countries, thus CWF cannot be enforced as a public health measure on a global scale.

Both fluoridated milk and salt are available in some countries and are typically applied in school settings, implemented in health and nutrition programs (56). They have been regarded as successful community-based strategies in dental caries prevention, particularly among children, but the low quality of evidence prevents from drawing definitive conclusions (57–59). Additionally, some concerns emerged related to the risk of hypertension associated with the promotion of salt consumption. Overall, fluoridated milk and fluoridated salt could be part of community health programs in target high-risk groups, in areas with non-fluoridated water and limited use of fluoridated toothpaste (16).

Possible adverse effects of excessive exposure to fluoride

The major usual source of F intake is water, including foods and beverages prepared with fluoridated water; secondarily, foods and beverages naturally rich in F, such as certain types of fish or teas, may be an important source of F, while only a minor amount may come from the unintended ingestion of topical dental products (49). Considering all sources of F, the

EFSA Adequate Daily Intake for adults and children of 1 mg/day (i.e., 0.05 mg/kg) can easily be exceeded (60). Therefore, in light of the potential adverse effects associated with excessive F intake, systemic intended exposures, such as supplements or artificially fluoridated water, should be considered with great caution, and after careful evaluation of the cumulative F intake and thorough consideration of the risk-benefit ratio, especially when other topical sources of F are regularly used. In recent years, increasing concerns have emerged on possible adverse health effects associated with excessive systemic exposure to F and have been investigated in animal and human studies.

Dental fluorosis (DF) is a dental developmental defect deriving from excessive exposure to F in the pre-eruptive period, by the age of 6 years, which causes the formation of more porous enamel with reduced mineral content. Although often limited to cosmetic defects, the clinical appearance varies with the severity of the condition, ranging from mild opacities and whitish spots to brown pigmentation, corroded appearance, severe hypoplasia, and increased risk of fracture (61,62). The prevalence of DF of aesthetic concern has been estimated to be 12% at a water F level of 0.7 mg/L and an average daily F intake of 0.04 mg/kg body weight (53,63).

Another well-recognized F-related disease is skeletal fluorosis (SF), which is a progressive and disabling condition caused by chronic accumulation of F in bones and joints, resulting in altered calcium levels in bone tissue, bone resorption, imbalance in mineral metabolism, bone deformities, and impaired function. However, SF is rare in Western countries and usually occurs as an endemic disease in regions such as Asia, India in particular, with extremely high F exposure, whether due to geological factors (mean water F levels of 4 mg/L), or cultural traditions associated with extensive consumption of highly fluoridated teas (64–66).

Prenatal and early overexposure to F have also been associated with impaired cognitive and behavioral functions in children (67,68). While this is a long-standing controversial issue, the results of recent meta-analyses suggest support for these associations (69–71). Finally, recent meta-analyses and dose-response assessments suggest that excessive F exposure negatively affects thyroid function in both adults and children, as well as blood pressure (72,73).

Public health policies and normative aspects of fluoride-based prevention

Oral health is an essential determinant of general health, well-being, and quality of life. Despite

improvements in recent decades, oral diseases remain a global public health problem characterized by increasing disparities among different social groups between and within countries (74). Disparities in oral health care have been ascribed to factors regarding race/ethnicity, socioeconomic status, insurance status, health literacy and educational level, homelessness, living in rural areas, immigration status and presence of cultural and language barriers (75). Billions of people result unable to access even basic oral health care because the current dental and public health response is largely inadequate, inequitable and costly (76).

Laws and policies have a major impact on the health of individuals and communities. They define standards of practice, set the framework within which clinicians and healthcare providers operate, establish health and safety expectations, as well as fundings and accountability structures. Health policy and legislation are important upstream measures to target oral health and should support the implementation of community-based programs and healthy nutrition policies to create a supportive environment that promotes oral health (74,77). Public health policies are not fixed in time and can vary from country to country, depending on many factors. The constant interaction between national and international health organizations, scientific knowledge and experience is the main factor contributing to set the direction regarding F use policies, in addition to stakeholder pressure, social judgment and the local political model (78). Social barriers to oral healthcare and F-based prevention can be effectively addressed by targeted law and policies (79).

In this context, it is primarily critical to enhance promotion of oral health education and health literacy through community and school-based programs targeting both children and their families (4). This will help individuals improve their ability to upload basic health information, navigate the health care system and make appropriate decisions. Information should focus on healthy dietary habits, risk factors and available preventive strategies for dental caries, using appropriate linguistic and cultural approaches (9,80).

Overall, F-based prevention is a simple and cost-effective strategy that, unfortunately, is often poorly known and therefore underutilized in socioeconomically disadvantaged contexts. Among available preventive strategies, water fluoridation and F supplementation could pose further public health issues and they should be considered with caution, due to the potential harmful effects associated and to the current risk-benefit ratio. Conversely, affordability and ready access to topical fluoridated products, such

as toothpastes, should be promoted, especially in underdeveloped countries and disadvantaged communities. The removal of taxes for oral health products is a fundamental step to avoid health inequities (10). Additionally, preventive interventions, such as the application of sealants, F gels and varnishes in children should be included in basic health insurance plans and primary healthcare programs. In primary care settings, the need for additional equipment and materials (e.g., F topical products, F releasing sealants and restorative materials) should be tackled by appropriate financial policies.

Furthermore, there is an urgent need for public health policymakers and health care providers to ensure basic dental care, consistently with the infrastructure capacity and oral health status of the local communities (75,76,81–83). Early and frequent dental visits in children should be prompted by pediatricians, and made accessible, maybe even mandatory (27). Follow-up visits in children cause limited financial burden on the healthcare system, but have an enormous positive impact in promoting appropriate oral care habits and preventing caries, or, at worst, intercepting early lesions that can be managed through simple, minimally-invasive and economic approaches, including F-based treatments (84). This strategy alone could lead to remarkable improvements in caries incidence, especially when associated with correct and routinary oral home-hygiene procedures (75). In this regard, the quality and quantity of workforce required to provide this level of service must be carefully considered in the implementation and revision of current health policies (85,86). The new technologies that enable the use of tele-dentistry and improve additional training of health professionals, could significantly increase access to the preventive action. The role of non-dental health professionals, including pediatricians, physicians, nurses, and social workers, should also be considered in order to provide topical F-based preventive interventions on a broader scale (87). This, for example, largely depends on the local laws or regulations, which generally restrict certain procedures to dental professionals. However, there is currently no evidence available on the effectiveness, reliability and feasibility of such interventions delivered in primary care settings (75).

Even when financial and workforce issues have been addressed, a large portion of the population still faces significant barriers to oral healthcare. These include lack of transportation and language and cultural gaps (88). Public policies should consider ensuring convenient and affordable transportation,

implementing clinical infrastructure and telemedicine allowances, and increasing the cultural and linguistic competence of healthcare providers through financial incentives and specific training (89).

Another key aspect is reorienting oral health research on the relevant aspects of healthcare system, social determinants and preventive strategies to target this global public health challenge (12).

Finally, given the apparent concerns about possible adverse effects associated with systemic F exposure, it is valuable to take into consideration the intersection between the risk management aspects and some basic public law tenets. Water fluoridation programs are one of the most discussed policy actions in public health law, since they are capable of colliding with several constitutional rights, such as freedom of choice (90–92) and freedom of religion (92–94). The most evident problem is that the decision to fluoridate public waters curtails the freedom of the minority of individuals who oppose the policy (15,95,96). For these reasons, water fluoridation has been described as a form of “mass medication” (92), and to the extent that general public health considerations outweigh individual rights to medical self-determination, water fluoridation is akin to compulsory vaccination (90,97,98). Unsurprisingly, water fluoridation was also singled out as a form of state paternalism (99). However, other legal aspects are relevant to water fluoridation programs, one prime example being the federal nature of several health systems, which may lead to major differences in fluoridation policies. It is no accident, in this respect, that unsuccessful caries prevention programs can at times be explained by the “lack of national policy for oral health” (10,100).

Conclusions

Dental caries still represents a global public health problem, especially in children and disadvantaged populations. The current pattern of dental caries mostly reflects the risk profiles of countries and communities in relation to lifestyles, living conditions and the existence and accessibility of preventive oral health systems (4,74). Serious efforts must be made to identify the barriers to dental caries prevention and to tackle social inequities and lack of information on this matter (12). It is imperative that pediatricians and physicians inform parents and caregivers of children seeking medical attention on oral preventive opportunities and relevant recommendations, supported by

healthcare policies that ensure access to educational and basic dental care programs.

F-based prevention, when appropriately implemented, can ensure a simple and cost-effective approach to reduce the incidence of dental caries and the associated social burden. Among F-based preventive strategies, systemic community-based administration of F should be considered with great caution, due to the unfavorable risk-benefit ratio currently established. Systemic administration of F supplements on individual base can be a valid alternative for high-risk patients unable to use other F-based measures. Overall, topical fluoridated products are generally the best choice for all patients, given the optimal risk-benefit ratio. F-based preventive strategies should be tailored on individual's risk factors for dental caries, also considering caries experience, and on the estimate of cumulative F intake. Relevant guidelines and recommendations on their appropriate use are publicly available for consulting by patients, children's caregivers, and healthcare practitioners. Public health policies and laws should focus on improving affordability and access to basic dental care and prevention, by tackling social inequities.

Riassunto

Fluoro e prevenzione della carie: una disamina delle politiche di sanità pubblica

Introduzione. La carie dentale è la malattia infettiva più comune e colpisce circa il 60-90% della popolazione mondiale, soprattutto i bambini e le comunità svantaggiate. A causa dell'altissima prevalenza e del significativo impatto negativo sulla salute generale, sul benessere e sulla qualità della vita, la carie è considerata un problema di salute pubblica globale. Nonostante il miglioramento delle politiche di promozione della salute orale negli ultimi decenni, la carie dentale è ancora una sfida sanitaria, caratterizzata da crescenti disparità tra i diversi gruppi sociali tra i Paesi e all'interno degli stessi. La prevenzione della carie dentale basata sul fluoro è un approccio efficace dal punto di vista dei costi, attuato fin dagli anni Quaranta. Include somministrazioni sistemiche e topiche, attraverso programmi di comunità o individuali. Gli interventi preventivi devono essere adattati alla valutazione del rischio di carie individuale e della comunità e alla stima dell'assunzione cumulativa di fluoro, al fine di massimizzare l'effetto preventivo ed evitare il rischio di potenziali effetti avversi associati ad un'eccessiva esposizione al fluoro. La regolamentazione delle politiche di salute pubblica svolge un ruolo fondamentale in questo contesto.

Disegno dello studio. *Scoping review.*

Metodi. Il fine di questa *scoping review* è quello di fornire una panoramica delle attuali linee guida relative alle strategie di prevenzione della carie dentale basate sul fluoro e delle relative politiche in materia, nonché dei relativi aspetti di salute pubblica. Abbiamo cercato la letteratura pertinente sull'argomento, documenti politici, come raccomandazioni, documenti di posizione e linee guida emessi dalle principali istituzioni scientifiche, normative coinvolte nella

promozione della salute orale e pubblicazioni riguardanti gli aspetti rilevanti del diritto della salute pubblica.

Risultati. La prevenzione della carie attraverso il fluoro può avvalersi di fluoruri topici per uso domiciliare (dentifrici e colluttori), fluoruri topici per uso professionale (gel, vernici, fluoruro di diammina d'argento, materiali da restauro e sigillanti a rilascio di fluoro), integratori di fluoro (comprese e gocce) e strategie di comunità (fluorizzazione dell'acqua comunitaria, sale e latte fluorati). Le linee guida attuali per l'utilizzo di questi ausili preventivi sono delineate nel presente lavoro. Da diversi anni è stato ampiamente dimostrato un effetto preventivo significativamente maggiore dei fluoruri topici rispetto a quelli sistemici. Inoltre, sono emerse crescenti preoccupazioni sui potenziali effetti negativi sulla salute generale associati ad un'esposizione sistemica precoce ed eccessiva al fluoro, supportate da recenti meta-analisi. In quest'ottica, la fluorizzazione dell'acqua comunitaria presenta anche aspetti significativi di rilevanza per il diritto sanitario. In una prospettiva di salute pubblica, i responsabili delle politiche sanitarie dovrebbero affrontare le iniquità sociali promuovendo l'informazione e l'alfabetizzazione alla salute orale, attraverso programmi di comunità e scolastici, garantendo l'accesso alle visite odontoiatriche precoci e alle cure odontoiatriche di base e migliorando la disponibilità e l'accessibilità economica dei prodotti topici al fluoro.

Conclusioni. La prevenzione basata sul fluoro può costituire un approccio semplice e conveniente per ridurre l'incidenza della carie dentale e l'onere sociale associato. Tra le strategie preventive basate sul fluoro, la somministrazione sistemica di fluoro deve essere considerata con grande cautela, a causa dello sfavorevole rapporto rischio/beneficio attualmente riconosciuto. I prodotti fluorati topici sono generalmente da preferire, dato l'ottimale rapporto rischio/beneficio. È necessario dunque compiere ulteriori sforzi per identificare e affrontare gli ostacoli alla prevenzione della carie dentale e le relative disuguaglianze sociali in una prospettiva di salute pubblica e promuovere politiche e leggi relative alla salute orale finalizzate a favorire strategie mirate ed efficaci.

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