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ESSAY

Ethical aspects of water fluoridation in pseudoscience and digital social media times

Aspectos éticos da fluoretação da água em tempos de pseudociência e redes sociais digitais

Aspectos éticos de la fluoración del agua en la era de pseudociencia y redes sociales digitales

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ABSTRACT Water fluoridation is a technology used to prevent tooth decay, which is still a major public health problem. It began to be used in 1945 in the United States. However, changes resulting from Donald Trump's 2024 election to the U.S. presidency led to a halt in its implementation there. In 1985, the city of São Paulo began fluoridating its water. Forty years later, the measure has proven effective. This critical essay analyzes ethical, or supposedly ethical, objections to the use of this technology while discussing, from the perspective of bioethics, the US decision, the results of 40 years of fluoridation in São Paulo and the possible influence of the US decision to discontinue fluoridation and its consequences, in Brazil and other countries. Certain objections are presented as ethical, but they are not, as they are based solely on scientific ignorance. Most truly ethical objections are based on principlism, which is admittedly limited when problems involving public health interventions are analyzed. One single question arises from this analysis: the ethical admissibility of forgoing the use of a technology proven to be effectual, effective, efficient, and safe for human health, without any justification on the basis of scientific evidence.
KEYWORDS Dental caries. Fluoridation. Bioethics. Health policy.

RESUMO *Fluoretação da água é uma tecnologia para prevenir cárie dentária, ainda um importante problema de saúde pública. Seu emprego teve início em 1945, nos Estados Unidos da América (EUA). Porém, mudanças decorrentes da eleição de Donald Trump à presidência (2024) levaram esse país a interromper sua implementação. Em 1985, a cidade de São Paulo começou a fluoretar as águas. Quarenta anos depois, a medida se mostra efetiva. Neste ensaio-crítico, são analisadas objeções éticas, ou supostamente éticas, ao uso dessa tecnologia, discutindo-se, à luz da bioética, a decisão dos EUA, os resultados de 40 anos de fluoretação em São Paulo e a possível influência da decisão estadunidense sobre a descontinuidade e as consequências da fluoretação, no Brasil e em outros países. Algumas objeções que se apresentam como éticas não o são, pois se baseiam apenas em desconhecimento científico. A maioria das objeções efetivamente éticas fundamenta-se no principialismo, reconhecidamente limitado na análise de problemas derivados de intervenções de saúde pública. Da análise, emerge um único questionamento: o da admissibilidade ética de renunciar ao uso de uma tecnologia comprovadamente eficaz, eficiente, efetiva e segura para a saúde humana, sem qualquer justificativa em evidência científica.*
PALAVRAS-CHAVE *Cárie dentária. Fluoretação. Bioética. Política de saúde.*

RESUMEN *La fluoración del agua es una tecnología destinada a prevenir la caries dental, que sigue siendo un importante problema de salud pública. Su uso se inició en 1945 en los Estados Unidos de América (EE. UU.). Sin embargo, los cambios derivados de la elección de Donald Trump como presidente (2024) llevaron a ese país a interrumpir su aplicación. En 1985, la ciudad de São Paulo comenzó a fluorizar el agua. Cuarenta años después, la medida ha demostrado su eficacia. En este ensayo crítico se analizan las objeciones éticas, o supuestamente éticas, al uso de esta tecnología, discutiendo, a la luz de la bioética, la decisión de EE. UU., los resultados de 40 años de fluoración en São Paulo y la posible influencia de la decisión estadounidense sobre la interrupción y las consecuencias de la fluoración, tanto en Brasil como en otros países. Algunas objeciones que se presentan como éticas no lo son, ya que se basan únicamente en la ignorancia científica. Del análisis, surge una única cuestión: la de la admisibilidad ética de renunciar al uso de una tecnología de eficacia, eficiencia, efectividad y seguridad demostradas para la salud humana, sin ninguna justificación basada en la evidencia científica.*
PALABRAS CLAVE *Caries dental. Fluoruración. Bioética. Política de salud.*

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Introduction

On October 31, 1985, the city of São Paulo began fluoridating its water supply[1], and since then this measure, which has never been interrupted, has proven effective in controlling dental caries. Both the prevalence and magnitude of the disease have decreased substantially. From 1986 to 2023, at the index age of 12 years, prevalence decreased by 51.2%, from 94.9% in 1986 to 46.3% in 2023. Since its implementation, disease magnitude has declined alongside prevalence: the mean number of teeth affected by caries decreased from 6.47 (95% CI: 6.12–6.82) in 1986 to 1.51 (95% CI: 1.03–1.99) in 2023. The use of fluoridated toothpastes, changes in oral health programs during this period, and improvements in maternal education and per capita income were factors that, together with water fluoridation, contributed to the recorded change in the epidemiology of dental caries. Nevertheless, the prevented fraction attributable to fluoridation is estimated to range from 34% to 47%[2,3].

Despite the recognized positive impact of fluoridation, political changes arising from Donald Trump's election as president of the United States (US) in 2024 led the country to reconsider its policy of expanding water fluoridation, even culminating in a recommendation that municipalities discontinue it[4].

The 2021 United States Department of Health and Human Services (HHS) report entitled 'Oral Health in America: Advances and Challenges' presents the goals of the Healthy People 2030 program, stating that public water system fluoridation coverage should increase from 65% in 2000 to 77.1% by 2030[5]. However, the current HHS leadership (2025-2028) ordered this public policy to be discontinued. There are legitimate concerns that this US government decision may influence and induce changes in public policies related to water fluoridation in other countries, particularly Brazil.

The historical context in which the US abruptly and radically changed this public policy is marked by the growing presence of digital information and communication technologies in everyday life. The emergence of digital networks as a relevant medium for social interaction has made them a focus of substantial political and electoral interest and, therefore, a strategic battleground in the contest for public opinion and voters. Within this context, issues at the interface between common sense and science gain enormous visibility.

The possibility of operating on social media as message senders rather than merely recipients has brought all types of content producers to the forefront, placing them on an equal footing and giving them equal voice. Scientific and technical topics such as vaccines and water fluoridation have migrated from laboratories and technical-administrative settings into everyday social life through digital networks, disseminated by content producers seeking audiences and recognition. Unprecedented spaces have opened for pseudoscience and post-truth, and this has inevitably affected public policies, requiring policymakers to develop the ability to address these new settings and stakeholders. This impact undoubtedly represents new challenges for contemporary public health[6].

Agnotology, a branch of science created in 1995 by Robert Proctor, professor of the History of Science at Stanford University, and Iain Boal, a linguist and professor at the University of Berkeley, studies the deliberate production of disinformation and the resulting ignorance for political and economic purposes. They analyzed the motivations underlying several cases involving the concealment of scientific knowledge: evidence of the statistical association between lung cancer and smoking by the tobacco industry; and knowledge concerning climate change by religious groups interested in the opposition between creationism and science. They concluded that concealment follows a method and identified some of its characteristics: reiterating that there will always be at least two opposing opinions

about anything; disseminating doubts about scientific conclusions, even when they are consensual within an epistemic community, thereby relativizing them; promoting artificial controversies and generating disputes with or without a rational basis; postponing decisions, including judicial decisions, by suggesting that scientific knowledge is inconclusive; and obstructing access to or discrediting consistent scientific evidence. Ignorance produced in this manner is not merely what remains unknown; rather, it is created by stakeholders who, for some reason, have an interest in preventing something from becoming known[7].

In 2019, Canadian sociologist Linsey McGoey, a professor at the University of Essex in the United Kingdom, coined the concept of 'strategic ignorance' to refer to omissions by individuals, companies, and governments that choose to ignore knowledge that may threaten them in some way, even though, strictly and technically speaking, they are not ignorant. This type of ignorance underlies a substantial amount of fake news[8].

Dental caries is a disease of multifactorial etiology and a major public health problem in several countries[9], having become a pandemic beginning in the 17th century with the expansion of the global production and commercialization of sugar, the main risk factor for the disease[10]. The enormous difficulties involved in controlling sugar consumption at the population level, arising from economic and cultural factors, have compelled decision-makers involved in public policies for caries prevention to seek protective factors to counteract these risk factors[11]. The protective factor with the greatest impact on caries prevention is public water supply fluoridation, which remains effective in the Brazilian context, including in settings with a low prevalence of the disease[3].

In Brazil, water fluoridation was first implemented in October 1953 in Baixo Guandu, Espírito Santo[12]. In 1974, the Brazilian National Congress passed a law making the measure mandatory in every operational Water Treatment Plant (WTP)[13].

This theoretical-critical essay analyzes ethical, or purportedly ethical objections to the use of water fluoridation technology. In light of bioethics, it discusses the US decision and its possible influence on the continuation of fluoridation in Brazil, considering its economic consequences and, above all, intangible consequences such as pain, suffering, and infections resulting from dental caries. Despite advances in the prevention and control of this disease, major barriers to accessing dental care persist in Brazil's largest city.

Fluoridated water and water fluoridation

The caries-preventive effect resulting from exposure to fluorides in water used for human consumption was initially hypothesized after several situations were analyzed in which children presented defects in dental enamel formation of varying severity, an anomaly now known as dental fluorosis. Once it was hypothesized that something in the water was causing the developmental anomaly, fluoride at different concentrations in the water was soon identified as the cause. Conversely, caries levels among affected children were much lower than among unexposed children.

Several studies followed, eventually establishing that there was an optimal fluoride concentration in water that produced a caries-preventive effect without causing fluorosis at aesthetically or functionally relevant levels. Once the theory had been consolidated, fluoridation began to be used as a Public Health technology in Grand Rapids, US, on January 25, 1945. Since then, no adverse effect other than very mild dental fluorosis has ever been demonstrated, and even this affects only a small proportion of exposed individuals. In 1999, the US Centers for Disease Control and Prevention (CDC) identified water fluoridation as one of the country's ten greatest Public Health achievements of the 20th century[14].

Noteworthy is the major shift in the US government's policy on water fluoridation: the measure began to be implemented worldwide under the administration of Democrat Franklin D. Roosevelt, continued for eight decades under both Democratic and Republican administrations, and is now threatened with discontinuation under Donald Trump's Republican administration. It has not merely been threatened but has effectively been discontinued in the states of Utah and Florida[15]. Once a global pioneer, the country has abruptly changed this public policy without any scientific knowledge on the subject providing a basis for the decision.

This unusual decision is, however, consistent with a weakened and dismantled CDC. Under the Trump administration, this agency – recognized worldwide as one of the pillars of Public Health knowledge and practice and as having made notable contributions to other countries – has been targeted by actions intended to conceal data and reduce transparency concerning its activities, despite transparency being an important ethical and scientific value[16].

Since the pioneering Grand Rapids experience, analyses of fluoride concentrations have been conducted in water from different sources in several parts of the world. These analyses led to the conclusion that this halogen is found in all water at varying concentrations, including in seas and oceans, similarly to chlorine. In these waters, fluoride occurs at concentrations equivalent to those considered optimal for human exposure (approximately 1.0 mg F/L of water).

The highest concentration identified in water to date was detected in Lake Nakuru, Kenya, at 2,800 mg F/L[17]. Because of this variation, and because different fluoride concentrations allow water to be classified using the optimal level for preventing dental caries as a reference[18], water containing less than 0.54 mg F/L may be classified as hypofluoridated. Water containing more than 1.44 mg F/L is considered hyperfluoridated, whereas water with fluoride levels ranging from 0.55 to 1.45 mg F/L is considered isofluoridated. Owing to climatic variation, in which the mean maximum temperature recorded at a given location over one year is a decisive factor in defining the optimal local fluoride level, this range is accepted for the optimal level. In general, countries have set this optimal concentration at 0.7 mg F/L of water, as is the case in most of Brazil and the US[19].

After nearly a century of use, and given the finding that fluorides are always found in water used for human consumption, the measure came to be regarded as a Public Health technology consisting of the deliberate adjustment of the natural concentration of the chemical element fluorine in the public water supply intended for human consumption, in accordance with technical standards and scientific recommendations, to obtain the greatest possible benefit in preventing dental caries while minimizing the risk of dental fluorosis[20-22].

Because of its characteristics, this technology is considered a typical Public Health intervention: it benefits everyone equitably; its efficacy has been demonstrated in controlled studies; it has a relatively low cost; it does not depend on actions performed individually by beneficiaries; it does not require changes in the habits or attitudes of the intervention's target population; and it is safe for human health, because its only known adverse effect, as noted above, is very mild dental fluorosis, without functional or aesthetic implications, in a negligible proportion of the target population. A typical Public Health intervention is based on the principle that

> the fewer times a health action must be performed and the greater its effectiveness – that is, its capacity to solve the problem for the greatest number of people at the lowest possible cost – the more it constitutes a Public Health action[23(126)].

As a technology, fluoridation is recommended by scientists[24], national[21] and international[25]

health research organizations, and the World Health Organization (WHO)[26].

Purportedly ethical objections

Public Health programs involve interventions whose benefits and burdens, as well as the scientific evidence supporting them, must be explicitly identified so that it can be determined whether the balance and distribution of these benefits and harms are appropriate and sufficient to justify them ethically[27,28]. For this reason, ethical questions regarding water fluoridation technology are pertinent.

Although, since Grand Rapids, a vast body of academic literature devoted to the different scientific and political aspects of water fluoridation has addressed and answered several types of questions, purportedly ethical aspects began to be included in the debate on the subject in the late 20th century, as this is a matter of public interest pertaining to Collective Health. However, the arguments presented are often not genuinely ethical but purportedly scientific. These arguments contain inconsistencies arising from poor research designs or from the misinterpretation of well-designed studies. Pseudoscience is the term that applies to such arguments.

Since the pioneering Grand Rapids initiative, political decisions on whether to implement this technology have faced obstacles in different countries that seek justification in environmental, ecological, naturalistic, epidemiological, or human health safety concerns, or in issues related to the availability and allocation of public resources. Sufficient and informative literature is available on these matters[22,29]. However, the scientific literature contains no consistent challenges to the efficacy, effectiveness, or efficiency of this technology. For this reason, this article focuses on the ethical, or purportedly ethical, aspects involved[30,31].

We refer to 'purportedly ethical' aspects because an extensive set of challenges to water fluoridation cannot be accepted as genuinely ethical objections to the technology. Rather, these challenges arise from disinformation or misinformation on the part of authors who seek to strengthen their arguments by anchoring them in bioethics, even though they are irrelevant to this field and their work is more appropriately characterized as pseudoscience. Let us consider some of these arguments:

a. There is insufficient scientific evidence of its efficacy in reducing the incidence and prevalence of dental caries[32];

b. It constitutes compulsory mass medication[33];

c. Other fluoride vehicles are available for use in Public Health programs; therefore, water fluoridation is not only costly but also unnecessary[34];

d. It causes fluorosis and potentially hypothyroidism and bone fractures, and there is insufficient ethical justification for its use[34];

e. Silicofluorides, which are widely used in water fluoridation, are unlicensed medicinal substances[35];

f. Silicofluorides have never been submitted to the US Food and Drug Administration for approval as medications, yet they are administered to large populations without informed consent or the supervision of a qualified doctor[35];

g. Water fluoridation using silicofluorides constitutes illegal medical research[35].

Because these arguments do not, in fact, contain ethical objections, as discussed below, they should not be accepted within the ethical or bioethical debate on the use of water fluoridation technology.

Genuinely ethical objections

Principlism is the bioethical approach most frequently found in the literature addressing ethical objections to water fluoridation as a Public Health technology. These objections may be summarized as follows:

a. It violates the ethical principles of autonomy, precaution, justice, and protection[33];

b. Its mandatory nature creates bioethical dilemmas because it eliminates the possibility of an individual choice to consume or not consume fluoridated water[36];

c. Individuals and communities do not participate in decisions transparently and democratically[37,38];

d. At the beginning of the 21st century, the available knowledge on water fluoridation, produced on the basis of epidemiological data collected more than 50 years ago, is insufficient to ethically justify the continued use of this technology[39];

e. Past benefits cannot be assumed, in and of themselves, to justify continuing the practice of fluoridation[39];

f. The non-erradicability of the conflict of values engendered by water fluoridation must be acknowledged, and new guidelines based on sound, current science and sound ethics are needed. In this context, sound ethics presupposes sound science[39].

Objections presented as 'ethical' challenges to the use of water fluoridation technology seek to apply, to a typical Public Health intervention, propositions that are useful within bioethics for analyzing conflict situations in clinical practice and research. In a systematic review published in two parts[40,41] that examines how the ethics of water fluoridation has been assessed in the literature, the authors conclude that

> many studies refer to biomedical ethical principles intended for clinical interventions rather than Public Health interventions and are, therefore, unsuitable for resolving the tension between the inevitable violation of individual consent and the collective Public Health benefit. [...] Although most acknowledge its complexity, those who are more supportive of fluoridation often emphasize the collective benefit, whereas those who are less supportive emphasize the violation of autonomy or personal freedom and concerns about harm[40](336).

The analytical limitations of principlist bioethics have, however, led to the emergence of critical bioethical approaches that advocate moving beyond individual issues and incorporating collective matters into their fields of study and action, such as the bioethics of protection and intervention bioethics[42].

The bioethics of protection proposes that resolving ethical dilemmas requires recognizing that they originate in conflicts of interest between "those who have the means that enable them to live their lives and those who do not"[43](11). Starting from this difference between individuals – which is not an abstraction or subjectivity but occurs concretely in everyday life – the bioethics of protection, stricto sensu, advocates considering the principle of equity so that the principle of justice may be applied to 'vulnerable' individuals who lack such means.

For this reason, equity emerges as a "*sine qua non* for the realization of the principle of justice itself"[43](17) in order to achieve equality. *Lato sensu*, however, when applied in the context of globalization, the bioethics of protection seeks to protect not only human health itself but all living beings from avoidable suffering and destruction, addressing the survival of the living world and the quality of life of its members or guests[43].

By controlling fluoride concentrations in water used for human consumption, fluoridation prevents moderate and severe dental fluorosis and enables dental caries to be prevented equitably, because it benefits the entire population and provides even greater benefits to individuals in the most socioeconomically vulnerable population groups[2]. For these reasons, water fluoridation is fully aligned with the bioethics of protection. Intervention bioethics, philosophically grounded in utilitarianism and consequentialism[44],

> advocates, as morally justifiable in the public and collective spheres, prioritizing policies and decisions that benefit the greatest number of people for the longest possible time and yield the best consequences; and, in the private and individual spheres, seeking feasible and practical solutions to locally identified conflicts, considering the context in which they occur and the contradictions that foster them[42(115)].

Water fluoridation has effects consistent with the propositions of intervention bioethics because it is consistent with requirements relating to individual and collective benefits, autonomy, justice, equity, solidarity, participation, and reductions in population levels of dental caries, which tend to be maintained as long as fluoridation continues.

Ethical context

Any Public Health problem has ethical implications for a person in several ways. This gives rise to different ethical contexts in which the person assumes positions that may be analyzed from a bioethical perspective. One such situation occurs when someone is a victim of the problem. Another occurs an individual is not a victim but is interested in the problem. A subject may also be implicated in a Public Health problem, albeit indirectly, by working professionally in a sector related to it. However, an unavoidable form of ethical implication arises when someone participates in decision-making processes concerning the Public Health problem.

At the individual level, an ethical context is characterized by a decision arising not from a legal requirement but from consulting one's own conscience about whether to do something, based on values and beliefs that generate a conviction about good and evil, right and wrong, and that underpins an act or decision. However, those who make decisions about a public policy or health program do so at a level that is simultaneously individual and collective. Even after complying with the requirements established in laws and regulations concerning the public policy or health program, as well as other requirements imposed on decision-makers – such as funds availability and acceptance of the initiative by the community or target population and by public authorities from several social life spheres – the decision-maker and others involved in the decision chain required to implement Public Health actions and programs may still be immersed in an ethical context whose dilemmas entail considering whether to do something on the basis of their convictions about good and evil and right and wrong.

In ethical contexts of this kind, beyond determining whether something can be done, the ethical question arises of deciding whether what can be done should be done[31]. Considering that, in Public Health, not every health problem is a "Public Health problem"[23(123)], and that "not everything that science makes possible should be done in Public Health"[23(124)], because implementing any public policy must simultaneously address a myriad of variables – including the economic sustainability of the actions and operations to be implemented, which always entails dealing with scarce resources and virtually infinite needs – budgetary constraints and other legal and economic restrictions are, therefore, imposed

on decision-makers. In these contexts, the ethical question of deciding whether something that can be done should actually be done is not the only problem these decision-makers face. Even so, it may be necessary to address ethical dilemmas that emerge in each specific situation[45].

The implementation of public policies, therefore, requires considering several ethical aspects. In São Paulo, for example, the continuation of public water supply fluoridation, despite its demonstrated effectiveness, may be affected by the policy change in the US recommending its discontinuation. This decision, which has global effects, also affects Brazil and its largest city, where 2025 marked 40 years since the implementation of water fluoridation.

In São Paulo, however, the issue is not deciding whether what can be done should be done, but whether a measure that has been successfully implemented from a Public Health standpoint[1] may be discontinued, as occurred in Utah and Florida.

Certainly, from an ethical standpoint as well, decisions on public policies – particularly those concerning the promotion of population health – should not be based on personal convictions or the opinions of groups or population segments, but on scientific evidence. The contemporary context is, however, marked by radical changes in social communication with the advent and consolidation of digital social networks, in which the impact of a statement often matters more than its truthfulness or scientific consistency. This characteristic has substantially affected vaccination coverage, among other public health actions, and is also affecting water fluoridation, as seen in the US.

In this regard, Goldim[28](60) states that ethical issues are usually addressed in the form of dilemmas, restricting the alternatives to only two possible solutions. However, because alternatives in health care are multiple, it would be preferable to speak of an "ethical problem rather than ethical dilemmas" so as not to restrict the reflection itself. In this article, however, we refer to an ethical dilemma because we address the application of a Public Health technology – water fluoridation – that, by its very nature, effectively requires a binary decision: yes or no. This is also the case with vaccination for disease prevention, which presents itself to many people, including health service managers, not merely as an ethical problem but as a genuine ethical dilemma. Anti-vaccination movements have adversely affected vaccination coverage in several countries, producing vaccine hesitancy among populations grounded in disinformation and deliberate misinformation that has led to thousands of deaths worldwide.

Violation of precaution, justice, and protection

Because fluorides occur naturally in all water, arguments referring to purported 'mass medication', 'compulsory administration', or the 'precautionary principle' are unfounded. Water fluoridation technology should not be equated with medication or its 'mass administration'. The opposite is true: it aims to safely provide the population with water for human consumption containing controlled fluoride levels sufficient to prevent dental caries without causing functionally or aesthetically relevant dental fluorosis. Invoking the precautionary principle is inappropriate to the subject because this principle applies to situations in which sufficient scientific knowledge is unavailable to predict, reasonably in advance, whether something will occur, as with certain natural events such as earthquakes, volcanic eruptions, and tsunamis. Dallari and Ventura[46] consider that precaution is based

> on experience in technical and scientific matters: advantages that arise in the short term are frequently followed by disadvantages in the medium and long term. Therefore, means must be established to anticipate the emergence of possible harm even before the existence of a risk is certain[46](59).

For fluoridation, however, scientific knowledge enabling its safe use for human and animal health and for the environment has been available for approximately one century. This knowledge is extensively established, and the precautionary principle need not be invoked; prudence and common sense, which should govern the use of any technology and any practice in basic sanitation, are sufficient.

An ethically relevant aspect of these objections, which has been present in the debate for several decades, is the persistent notion that fluoridation involves 'adding' something 'foreign' to the nature of water used for human consumption. It is as though 'pure, fluoride-free water' were available to people and, upon treatment, this 'purity' were lost, leaving the water 'contaminated' by fluorides that were 'foreign' to it. This argument is mistaken, however, because fluoridation technology is intended to adjust the concentration of a chemical element naturally present in all water, whether by adding or removing fluoride.

The notion of 'adding' something that laypeople assumed was absent from water, used since the pioneering Grand Rapids initiative in 1945, ultimately helped entrench this misconception in public opinion. In the early decades of the 21st century, however, there is no justification for continuing to perpetuate this misconception. Instead, it should be emphasized that the procedure entails nothing more than minimal adjustments to the concentration of this element. In these situations, rather than purported harm, threats, or risks, what concretely occurs is a protective action that prevents dental fluorosis. Thus, no ethical principle is violated.

Violation of autonomy and the right to choose

The argument concerning the 'loss of autonomy' and the 'impossibility of an individual choosing whether to consume fluoridated water'[47], which regards this impossibility as a bioethical dilemma, must consider that, as emphasized above, no water is entirely fluoride-free. Therefore, the allegation of a 'violation of individual freedom' or the 'right to choose', or the claim that individuals are forced to 'ingest medication' placed in the water they drink, should not even be entertained in bioethical reflection.

The presence of fluorides in water, with their naturally occurring concentration adjusted to prevent harm, clearly does not correspond to the presence of a medication in the water. Moreover, a claim grounded in the 'right to choose' or 'individual freedom' is equivalent to claiming the 'individual freedom' not to be exposed to sunlight or affected by wind or rain – events as natural as the presence of fluorides in water.

Nevertheless, although this argument is fallacious, it remains present in scientific publications on the subject, as Patel et al.[41] emphasize when describing a tension between the inevitable violation of individual consent and the collective Public Health benefit. This argument is similar to that concerning the non-erradicability of the conflict of values engendered by water fluoridation because of the unresolved conflict between beneficence and autonomy discussed by Cohen and Locker[39,40]. At present, however, the relevance of arguments invoking 'non-erradicability' and 'inevitable tension' should be questioned. It is true that, ethically,

> Something considered good in the eyes of one member of society may violate the rights and freedoms of another [and that] conflicts of values speak to the very nature of bioethics [48](580).

Science, however, shows that there is no longer any doubt regarding the benefit provided by water fluoridation technology. This benefit is not only individual but collective, because water fluoridation contributes to health equity by reducing inequalities in the population distribution of dental caries. It is,

therefore, a doubly just preventive measure: it protects both the individual and the population to which that individual belongs. Regarding the continued contemporary use of the argument alleging a 'violation of autonomy', it bears reiterating that no individual living in society can consume water that is entirely fluoride-free.

It is costly and unnecessary because other fluoride vehicles are available

The availability of other fluoride vehicles is a fact, but there is no reason simply to set these vehicles in opposition to one another. On the contrary, a sufficient body of high-quality scientific literature describes techniques and methods for combining different vehicles in Public Health strategies[20]. Thus, as an ethical objection, this argument has neither ethical nor scientific support.

The argument that the measure is 'costly' is unfounded in the Brazilian context[49]. Regarding claims that it is 'unnecessary' or 'based on data produced more than 50 years ago', studies conducted in Brazil in the 21st century show that fluoridation is effective and provides an additional preventive benefit even in locations where caries prevalence is low[1,3].

Arguments about the measure's lack of necessity, adverse effects, and ineffectiveness – seeking to associate exposure to fluoridated water with hypothyroidism, bone fractures, cancers, and other adverse effects on human health – are not specifically directed toward ethical issues and, moreover, have been refuted even when examined as strictly scientific questions[29].

Thus, the assertion that there is insufficient scientific evidence of efficacy in reducing the incidence and prevalence of dental caries does not arise from scientific research; it merely reflects the wishes of authors who seek to frame such assumptions, which are unsupported by scientific research, as ethical objections to water fluoridation.

The right of individuals and communities to participate in decisions

Community participation in Public Health actions and programs is not merely desirable; in Brazil, it is one of the guidelines of the health system, as established in Article 198, item III, and regulated by Federal Law N°8.142 of 1990[50]. However, participation alone, without ensuring access to information and opportunities to obtain technical and scientific clarification regarding any public health intervention – not only fluoridation but also the use of vaccines, sera, and other preventive or therapeutic resources – is insufficient to ensure transparency and democracy in the participatory process.

In the specific case of water fluoridation, individuals, including leaders of health-related social movements and managers of the Brazilian Unified Health System (SUS), have difficulty understanding what it entails. This fact highlights the need for health education initiatives to educate and inform people about the subject[51].

Final considerations

Even from the restricted perspective of principlist bioethics, emphasized here only because of its predominance in biomedicine, the purported objections to water fluoridation are not ethically sustainable, as we have sought to demonstrate in this article by refuting arguments related to purported maleficence at the expense of beneficence, violation of autonomy, and injustice. Rather, based on intervention bioethics, it is necessary to reaffirm that water fluoridation complies with the ethical requirements of providing individual and collective benefits, respecting autonomy, promoting justice, equity, solidarity, and participation, and reducing population levels of dental caries.

An ethical question of particular relevance in the context of the present analysis

is whether, on the basis of the bioethics of protection, it would be ethically admissible and just to discontinue a technology that has proven efficacy in preventing dental caries and is efficient and safe for human health, without any acceptable scientific justification, given the differences among individuals and, therefore, the conflicts of interest among them. In such contexts, the bioethics of protection advocates the primacy of the principle of equity when considering the ethical imperative of justice. In this regard, it seems appropriate to reverse the proposition: the issue is no longer whether something that can be done should be done, but whether something that has been successfully done to prevent pain, suffering, and infection should be discontinued.

Authorship contributions

Narvai PC (0000-0003-4769-6896)* contributed to the conception, planning, and writing of the text, as well as the critical review of the content for final approval. Andrade FR (0000-0001-9461-0325)* contributed to the writing of the text and the critical review of the content. ■

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