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Patel, B. and Dyer, T.A. (2025) The ethics of community water fluoridation: part 2 - how has the ethics of community water fluoridation been appraised in the literature? A scoping review. *British Dental Journal*, 238 (5). pp. 336-343. ISSN: 0007-0610

<https://doi.org/10.1038/s41415-024-8057-5>

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The ethics of community water fluoridation: Part 2 – how has the ethics of community water fluoridation been appraised in the literature? A scoping review

Bhavini Patel¹ and Thomas Anthony Dyer^{*2}

Key points

Justifying the introduction, maintenance and cessation of community water fluoridation requires the consideration of its ethics. This paper summarises the different approaches used to appraise its ethics in the literature.

The paper reports that most studies used approaches conceived for medical rather than public health interventions. These were unable to adequately resolve the tension between the infringement of individual consent and collective benefit associated with community water fluoridation.

The paper also identifies other multidimensional approaches conceived for public health interventions with more utility for appraising the ethics of water fluoridation.

Abstract

Aim To examine how the ethics of community water fluoridation has been appraised in the literature.

Method A scoping review using an updated Arksey and O'Malley framework. Six electronic databases were searched: Medline via OVID; Scopus; Web of Science; Cochrane Library; StarPlus and Google Scholar. Grey literature and reference lists of included studies were also searched.

Results In total, 51 studies from 15 countries were included. Many referred to biomedical ethical principles intended for clinical rather than public health interventions. Some primarily aimed to appraise its ethics whereas others considered it as part of more general discussions on fluoridation. While most acknowledged its complexity, those more supportive of fluoridation often emphasised collective benefit and those less supportive emphasised infringement of autonomy or personal liberty and concerns about harm. Few referred to public health ethics principles and frameworks available in the literature.

Conclusion Different approaches have been taken to appraise the ethics of fluoridation. Frequently, these were conceived for individual medical rather than public health interventions and are inadequate to resolve tension between inevitable infringement of individual consent and collective benefit in public health. Other approaches conceived specifically for public health exist that have more utility in debates and ethical decision-making.

Introduction

In the 1930s, evidence emerged that there was an inverse correlation between naturally occurring fluoride in water and dental caries. This led to the addition of fluoride to public drinking water supplies. There is a large body of evidence that supports community water fluoridation

(abbreviated to fluoridation in this paper) in terms of its effectiveness,^{1,2} cost effectiveness³ and sustainability,⁴ while acknowledging an increased risk of dental fluorosis.^{1,2} However, despite a lack of evidence to support them,^{1,5} there have been concerns that fluoridation may have other negative health impacts and has been linked to a range of health conditions, including some cancers. Consequently, as seen with other public health measures, fluoridation remains controversial, highly emotive, and its ethics are questioned.

Public health measures, such as fluoridation, differ from clinical interventions, as they aim to address multiple factors that determine population health, prevent disease and promote health. This involves multi-agency working and legislation and consequently, consideration of their justification requires a different approach to

clinical interventions. In addition, public health's aim to improve population health and reduce inequalities, particularly for vulnerable groups within society, can generate tensions between perspectives on the rights of individuals versus the responsibility of society for its individuals or the needs of a community.^{6,7,8,9,10,11,12}

The first paper in this series explored public health ethics in general but used fluoridation to illustrate the concepts and principles discussed.¹³ Public health ethics is a branch of medical ethics that focuses on population rather than individual health, while still taking the latter into account when considering whether a measure is fair and just. It aims to provide approaches that examine the justification of interventions by balancing the need to improve the health and wellbeing of populations with any perceived infringement of personal freedoms or risk of

¹Dental Practitioner and Alumnus, School of Clinical Dentistry, University of Sheffield, 19 Claremont Crescent, Sheffield, S10 2TA, UK; ²Senior Clinical Teacher, School of Clinical Dentistry, University of Sheffield, 19 Claremont Crescent, Sheffield, S10 2TA, UK.

*Correspondence to: Thomas Anthony Dyer
Email address: t.dyer@sheffield.ac.uk

Refereed Paper.

Submitted 19 August 2024

Revised 4 October 2024

Accepted 8 October 2024

<https://doi.org/10.1038/s41415-024-8057-5>

harm. Given the complexity of such decision-making, frameworks have been proposed to guide ethical deliberations which attempt to include the various relevant moral, ethical and political theories and perspectives.^{10,12,14,15,16,17,18} Arguably, this broader approach is essential as a part of any open, accountable, democratic process.^{6,15}

Despite being a long-established public health measure, relatively little has been written on the ethical implications of fluoridation, from the perspective of different moral, ethical and political philosophies. The aim of this scoping review is to examine how the ethics of fluoridation has been appraised in the literature.

Method

Given the likely breadth and nature of the available literature on the topic, a scoping review was considered appropriate to meet the objectives of the research, which were to identify: how the ethics of fluoridation has been discussed; what branches of ethics have been considered; and any knowledge gaps relating to the ethics of fluoridation. The method used a modified framework proposed by Arskey and O'Malley,¹⁹ with developments by the Joanna Briggs Institute,^{20,21} and Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews (PRISMA ScR) (see online Supplementary Information).²² It comprised seven main stages: identifying the research question; searching for and identifying relevant studies; selecting relevant studies; extracting, analysing, and collating data; summarising the results; discussion; and conclusions from the findings.

Data sources

Key terms were identified relevant to the review by undertaking an initial search. These included 'public health ethics', 'biomedical ethics', 'bioethics', 'community water fluoridation' and 'fluoridation'. The title and abstract of articles identified were analysed for terms to develop a comprehensive search strategy and Boolean operators (AND and OR) were applied. A broad cross-disciplinary search was undertaken by adapting the search strategy (Table 1) across six electronic databases: Medline via OVID; Scopus; Web of Science; Cochrane Library; University of Sheffield StarPlus; and Google Scholar. Several other sources of information were searched, including: reference lists of articles identified from the database search; hand-searching of key journals, websites of relevant networks and

Table 1 Search strategy for electronic databases

Database	Search terms
Medline via Ovid Scopus Web of Science Cochrane Library Google Scholar University of Sheffield StarPlus	Ethic* OR bioethics* OR medical ethic* OR biomedical ethic* or public health ethic* AND Fluoridation OR water fluoridation OR community water fluoridation

organisations; and conferences. A grey literature search was undertaken on OpenGrey.

Records obtained from database and other searches were entered into reference manager software (EndNote 20) and duplicates were removed.

Data selection

All relevant literature considered from searches were considered with the following inclusion criteria:

- Literature including ethics and fluoridation
- Literature available electronically with full text
- Literature written in English.

There was no restriction on literature type or study design. However, the search included literature published in the last 60 years, as it was postulated that any before this may not be relevant to contemporary populations and a preliminary search found no studies available electronically before this. Literature in languages other than English were excluded for reasons of practicality and feasibility. Literature meeting the inclusion criteria was analysed in two steps: title and abstract screening, then review of the full text, as shown in the PRISMA diagram (Fig. 1).²⁰ Both authors (BP, TD) screened studies for suitability for final inclusion. Where there was doubt on the relevance to the aim of this review, this was discussed and resolved by the two authors.

Data extraction

Relevant data were extracted and recorded in a data extraction table using Microsoft Excel by one author (BP). This included: authors; year of publication; title; journal or organisation; country of origin; source of literature; and an overview of each record, including ethical principles considered and apparent stance on fluoridation. In addition, observations of strengths and limitations of the studies were recorded.

Data analysis and collation

Given the nature of the literature and its heterogeneity, extracted data were analysed thematically and a narrative synthesis was produced. The included studies were also summarised in table form (Table 2).

Results

The findings are reported in three parts. First, an overview of the included studies is provided. This is followed by a description and analysis of the moral, political and ethical principles identified in the literature. The final part categorises the included studies based on the apparent stance on fluoridation.

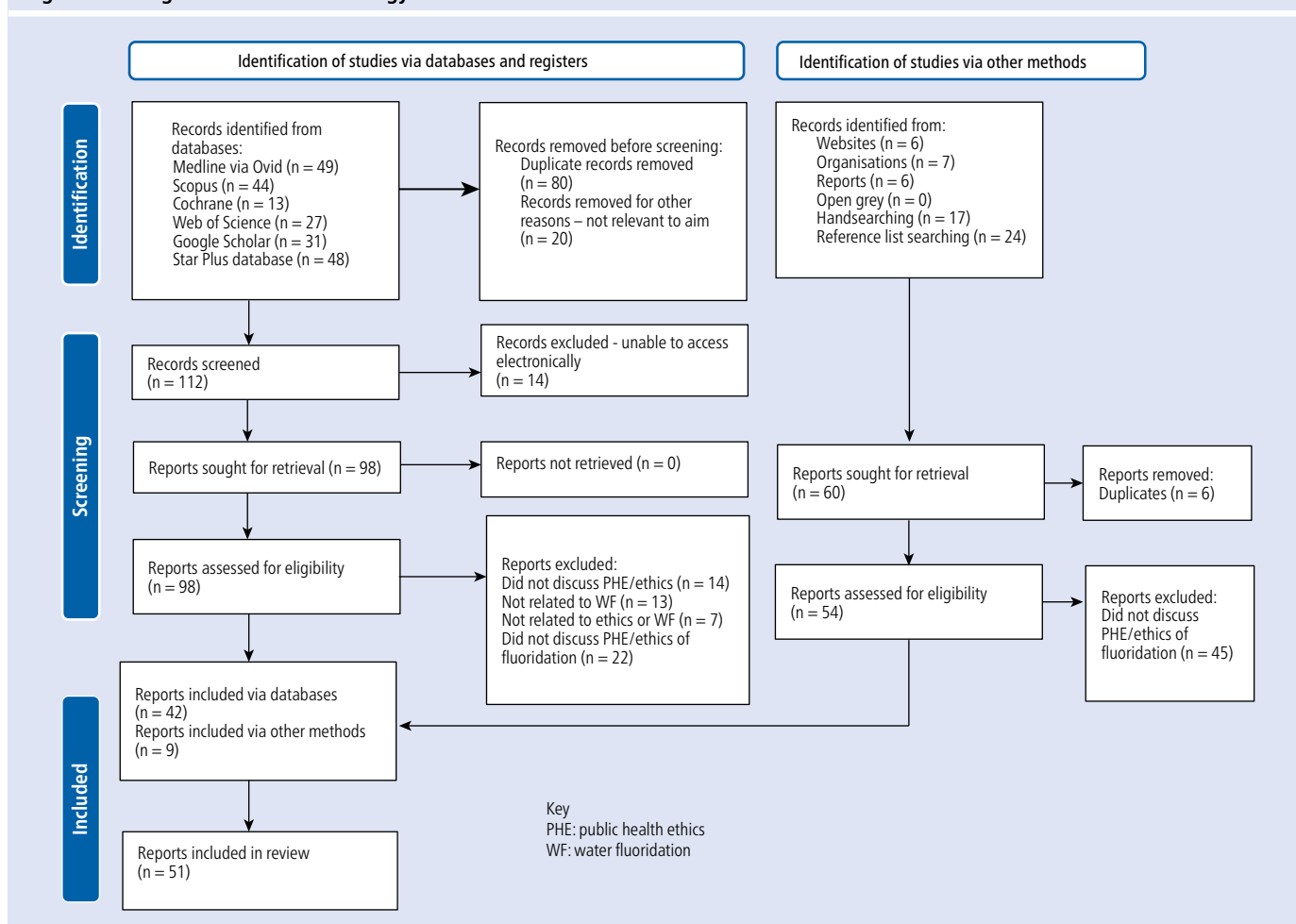
Overview of included studies

Database searching (April 2024) identified 212 records. Initially, 80 duplicates were removed and a further 20 studies were removed that did not meet the inclusion criteria. Titles and abstracts of the remaining 112 records were screened, of which 70 did not meet the inclusion criteria, leaving 42 records from databases to be included. Additionally, 60 records were identified from other methods. From these, six duplicate records were removed and a further 45 were excluded, leaving nine further records to be included. In total, 51 records were included in the review (Fig. 1).

Various study designs and types of publication were included: conceptual reviews (n = 10); qualitative studies (n = 30); position statements/reviews/reports/recommendations (n = 9) and books (n = 2).

Studies from 15 countries and five continents were included: United Kingdom (UK) (n = 15); United States (USA) (n = 8); Canada (n = 8); Australia (n = 6); India (n = 2); New Zealand (n = 2); Brazil (n = 2); United Arab Emirates (UAE) (n = 1); Turkey (n = 1); South Korea (n = 1); Italy (n = 1); Chile (n = 1); Israel (n = 1); Switzerland (n = 1); and Ireland (n = 1).

Fig. 1 Flow diagram of the search strategy²²



Findings by theoretical and philosophical basis

Most studies discussed the ethics of fluoridation in terms of various moral theories and political philosophies (Table 2), often citing or implying several principles, and very few discussed fluoridation in terms of one ethical principle alone. However, the stance taken was often not explicit in the papers and some adopted multiple stances. For example, Song and Kim²³ considered principlism alongside utility and liberty and the involvement of stakeholders to encourage democratic decision-making.

Moral-based theories

The review identified 11 studies that were informed by or implied consequentialist theories in varying depth. For example, Atchison discussed fluoridation from a utilitarian perspective, arguing it is morally right if it prevents caries and has more value than alternative actions.²⁴ The author also questioned the ethics of choosing not to act, arguing to do so would not be morally right unless caries is no longer a public health problem.

Table 2 Theoretical and philosophical basis of ethical appraisal of community water fluoridation

Basis of ethical appraisal	Descriptor
Moral theories	
Consequentialist theories	Whether an act is morally right depends only on its consequences: an act that brings about more benefit than harm is good, while one that brings more harm than benefit is not. Example: utilitarianism
Non-consequentialist theories	Morality of an act depends on more than just consequences. Actions themselves are good or bad based on whether they obey or violate moral rules, duties, or principles. Examples: deontology, rights-based theories and principlism
Political and social philosophies	
Liberalism	Based on the rights of the individual, liberty, consent of the governed, political equality, and equality before the law
Communitarianism	Aims to counter individualism by emphasising a balance between individual and collective goals and values, including health and wellbeing

In total, 40 studies referred to or implied non-consequentialist theories. One discussed this in terms of deontological theory and held that fluoridation violates international agreements on human rights and biomedicines.²⁵ Principlism and public health principlism proposes ethical principles to consider beyond

merely their consequences. Beauchamp and Childress' principles for medical care²⁶ of autonomy, non-maleficence, beneficence and justice were most frequently cited. A total of 36 studies discussed fluoridation in relation to these, either citing autonomy alone (n = 4),^{27,28,29,30} or arguably implying

the principle of autonomy in terms such as ‘infringement of personal freedom’ or ‘violation of civil or individual liberties’ (n=6).^{31,32,33,34,35,36} Furthermore, 22 discussed or implied autonomy and/or non-maleficence, beneficence and justice,^{17,24,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55} and six referred to all four principles.^{23,56,57,58,59,60} Public health principlism was applied in six studies,^{17,23,42,44,45,59} referring to Childress *et al.*¹⁴ (n=5)^{17,23,42,44,45} or Klugman’s (n=1)⁶¹ ethical principles.

Political philosophies

In total, 17 studies discussed or implied liberalism, by referring to it directly or indirectly with reference to liberty and freedom.^{23,25,27,28,31,33,36,37,39,42,58,59,62,63,64,65,66} No studies referred to communitarianism directly but five implied its principles.^{36,37,51,58,60}

Other theories and models

Four studies considered fluoridation in terms of violation of medical ethics and the Nuremberg code.^{17,33,67,68} Ten appraised fluoridation using the Nuffield Bioethics report^{17,38,42,47,52,58,63,64,66,69} for public health measures and the stewardship model, which proposes an intervention ladder that encourages approaches that are less intrusive (lower on the ladder) and allow for public consultation in decision-making.¹⁵

Findings by stance on fluoridation

Three apparent stances were identified in the literature: supporting, opposing and neutral to fluoridation (Table 3). Each is described in the next section with reference to the ethical approach cited or implied. Those studies that considered the ethics of fluoridation more extensively are summarised in more detail.

Supporting fluoridation

A total of 15 studies assessed as supporting fluoridation referred to the ethical positions of principlism in terms of benefit (beneficence) and minimising harm (non-maleficence), utilitarianism (the moral duty of the policy [fluoridation] is determined by its consequences [prevention of caries] or its utility), or implied communitarianism (common good).^{24,27,36,37,38,39,40,41,42,43,56,58,63,64,70}

McNally and Downie discussed autonomy, benefits and harms of fluoridation, arguing the ‘common good’ should be placed above individual desires.³⁷ The authors also advocated the importance of taking into consideration the voice of society, and particularly those who

are disadvantaged. Similarly, Curtin argued that individual and religious liberty are not absolute, and that professional freedom is also a right, stating that fluoridation is not unduly restrictive to society and serves the temporary common good and should be lawfully regulated.³⁶

Several studies used utilitarian arguments, with some referring to the principles of the Nuffield framework.^{15,42,52,63} Democratic decision-making was also seen as important in implementing public health measures and that liberal emphasis of individual autonomy should not prevent community health benefit and reduction of inequalities.^{38,39,63,69} In addition, Jiang *et al.*⁶³ argued that fluoridation is not coercive as it does not require a lifestyle change when compared to alternative measures, and that the imperative of individual consent can be argued both ways: it should be required if fluoridation is to be ceased as well as introduced.

In discussing public health measures, including fluoridation, Gostin and Gostin drew on communitarian and utilitarian principles by arguing that ‘well-directed paternalism promotes a “broader freedom” for the many’.⁷⁰ They questioned Mill’s theory of liberty in public health measures, which promotes individual autonomy as essential for happiness.⁷¹ The authors argue that Mill promotes utility of freedom at all costs, which could be detrimental, as it may lead to more ill health, greater inequalities and a community void of shared values and spirit.⁷⁰

In supporting fluoridation, Quinteros debated the perspective of liberalism versus utilitarianism and emphasised that bioethics has developed in countries that are economically developed with good access to information.⁴² Consequently, they argue ethical debates may not be culturally consistent or relevant to other countries where information needed for informed choice may not be accessible.

Opposing fluoridation

Seven studies assessed as opposing fluoridation mostly cited individual ethical principles within principlism. However, some cited moral-based consequentialism and non-consequentialist theories.^{25,44,45,46,47,67,68} For example, Cross and Carton⁶⁷ opposed fluoridation on the basis that it violates deontological principles and individuals should not be treated as means to an end.⁷² They argued that it is part of a biased

utilitarian agenda and that public opposition has led to governments using paternal libertarian approaches, such as ‘nudging’ – an approach that cajoles the public to change behaviours – to enable administrations to achieve health goals.⁷³

Awofeso *et al.* espoused alternative caries prevention approaches, arguing that fluoridation infringes the principle of autonomy and violates the principle of non-maleficence given dental fluorosis and other putative health risks. They concluded there is insufficient ethical justification for fluoridation in Australia.^{44,45}

Two studies saw fluoride as a medicine (defining this as a substance to prevent disease) according to European and American pharmaceutical codes.^{67,68} For them, fluoridation is morally and ethically unacceptable and fails to comply with the Nuremberg code of practice and other medical codes and regulations, which propose that consumers should be fully informed of risks and benefits. In this case, they argue the public is not fully informed of what they are consuming.⁶⁷

Neutral to fluoridation

In total, 29 records were assessed as neutral to fluoridation in approach, citing mixed ethical viewpoints, including principlism,^{17,23,28,29,30,31,32,33,34,35,48,49,50,51,52,53,54,55,57,59,60,62} utilitarianism,^{23,49,52,62,74} liberty,^{23,28,31,59,62,65,66} and the Nuffield approach^{17,52,66,69} in their discussions. Most were qualitative papers. The primary aim of some was to appraise ethics^{17,23,29,35,48,49,50,53,55,57,59,60,61} but others considered fluoridation more generally and in which ethics was discussed.^{2,28,30,31,32,33,34,50,52,54,62,66,69,75,76} The tension between autonomy and beneficence in public health interventions was frequently highlighted, plus the need for public debate in decision-making processes. For example, Anand *et al.*⁵⁷ discussed all four of Beauchamp and Childress’ principles²⁶ and highlighted the conflict between autonomy and beneficence with fluoridation, and advocated debating ethical consideration in public health policymaking.

Cheng *et al.*⁵⁰ argued that anti-fluoridation arguments overstated any controversies with identifying harms and seeing fluoridated water as a medicine. However, they also proposed that the UK Department of Health’s funding of organisations that support fluoridation, and selective reporting of research findings, undermined its scientific independence. In addition, they highlighted the limitations of studies used to support the safety of fluoride,

Table 3 Overview of included studies appraising the ethics of fluoridation (cont. on page 341)

Authors	Country	Apparent stance	Moral and ethical principles identified*
Anand <i>et al.</i> ⁵⁷	India	Neutral	Principlism (autonomy beneficence, non-maleficence, justice)
Armfield ²⁷	Australia	Supportive	Freedom, liberty, principlism (autonomy)
Atchison ²⁴	USA	Supportive	Principlism (autonomy and beneficence), veracity and justice, utilitarianism, paternalism, distributive justice
Ateş A and Özer ⁵¹	Turkey	Neutral	Principlism (autonomy and beneficence), 'common good'
Awofeso ⁴⁴	Australia	Opposed	Principlism (autonomy and beneficence), public health principlism (Childress <i>et al.</i>) ¹⁴
Awofeso <i>et al.</i> ⁴⁵	UAE	Opposed	Principlism (autonomy and beneficence), public health principlism (Childress <i>et al.</i>) ¹⁴
Ballantyne ⁵⁵	New Zealand	Neutral	Principlism (autonomy, beneficence, justice)
Botchey <i>et al.</i> ⁴⁰	USA	Supportive	Principlism (autonomy, benefits)
Bradley <i>et al.</i> ⁵⁶	UK	Supportive	Principlism (autonomy, beneficence, non-maleficence, distributive justice)
British Fluoridation Society ⁵⁸	UK	Supportive	Principlism (autonomy, benefit, justice) avoidance of harm, common good, paternalism, liberalism, Nuffield framework ¹⁵
CADTH ⁵⁴	Canada	Neutral	Implied principlism (autonomy, beneficence)
Calman ⁶⁹	UK	Neutral	Nuffield framework, ¹⁵ Mill's harm principle
Cheng <i>et al.</i> ⁵⁰	UK	Neutral	Principlism (autonomy, harm, benefit)
Coggon and Cooper ⁶⁵	UK	Neutral	Liberty
Coggon and Viens ⁶⁰	UK	Neutral	Principlism (autonomy, benefits, harms, justice), implied communitarianism (common good)
Cohen and Locker ⁴⁸	Canada	Neutral	Bioethics, principlism (autonomy, beneficence)
Cross ²⁵	Switzerland	Opposed	Deontology, paternalism, utilitarianism, libertarianism
Cross and Carton ⁶⁷	UK	Opposed	Nuremberg code
Curtin ³⁶	Ireland	Supportive	Implied principlism (implied autonomy), liberty, 'common good'
Dickinson <i>et al.</i> ⁴³	Canada	Supportive	Implied utilitarianism, and implied principlism (benefits, harms, individual choice)
Gannon ⁶⁸	Australia	Opposed	Nuremberg code
Garbin <i>et al.</i> ⁵³	Brazil	Neutral	Principlism (autonomy, non-maleficence)
Gibson <i>et al.</i> ³⁰	UK	Neutral	Principlism (autonomy)
Gooch ⁴¹	USA	Supportive	Implied principlism (discuss autonomy, benefits)
Gostin and Gostin ⁷⁰	USA	Supportive	Mill's harm principle, paternalism, utility, social justice
Iheozor <i>et al.</i> ²	UK	Neutral	Ethics of mass medication
Jiang <i>et al.</i> ⁶³	New Zealand	Supportive	Libertarian, utilitarian, principles approach of the Nuffield framework ¹⁵
Kalamatianos and Narvai ⁴⁹	Brazil	Neutral	Social utility, principlism (autonomy, benefit), 'greatest good'
Lucyk and McClaren ⁵²	Canada	Neutral	Principlism (autonomy, beneficence, non-maleficence), utilitarianism, Nuffield framework ¹⁵
Klugman ⁶¹	USA	Neutral	Public health principlism – solidarity, efficacy, integrity, and dignity
Knox <i>et al.</i> ³⁴	Australia	Neutral	Implied principlism (implied autonomy, right to choose infringement on individual rights)
Lang ⁶⁶	Canada	Neutral	Nuffield framework, ¹⁵ liberty
Leeder ⁵⁹	Australia	Neutral	Principlism (implied autonomy, beneficence), liberty
Lennon <i>et al.</i> ³⁸	UK	Supportive	Nuffield framework, ¹⁵ principlism (autonomy, benefit)
Lowery <i>et al.</i> ⁶²	UK	Neutral	Utilitarianism, principlism (implied autonomy (freedom of choice), benefit), 'attack on liberty', 'mass medicalisation'
Martin ²⁸	USA	Neutral	Liberty, principlism (autonomy [violation of human rights])
McLaren and Petit ⁶⁴	Canada	Supportive	Liberty, Nuffield framework ¹⁵
McNally and Downie ³⁷	Canada	Supportive	Freedom of choice, principlism (autonomy, benefit, harm), 'common good'

Table 3 Overview of included studies appraising the ethics of fluoridation (cont. from page 340)

Authors	Country	Apparent stance	Moral and ethical principles identified*
Michels ⁷⁴	USA	Neutral	Utilitarianism
NICE ³²	UK	Neutral	Freedom, principlism (autonomy (violation of human rights), benefits, harms)
O'Neill <i>et al.</i> ⁷⁵	Canada	Neutral	Ethics of mass medication
Peckham and Awofeso ⁴⁷	Australia	Opposed	Principlism (benefit, harm), Nuffield framework
Pizzo <i>et al.</i> ³³	Italy	Neutral	Implied autonomy (freedom of choice), violation of medical ethics and human rights
Pratt <i>et al.</i> ³¹	USA	Neutral	Implied autonomy (violation of rights), liberty
Quinteros ⁴²	Chile	Supportive	Liberalism versus utilitarianism, principlism (autonomy, benefit, non-maleficence), public health principlism (Childress <i>et al.</i>), ¹⁴ principles of Nuffield framework ¹⁵
Rajaran <i>et al.</i> ³⁵	India	Neutral	Implied principlism (implied autonomy – freedom of choice and infringement on individual rights)
Shakeri <i>et al.</i> ¹⁷	UK	Neutral	Principlism (autonomy, beneficence), public health principlism (Childress <i>et al.</i>), ¹⁴ Nuffield framework, ¹⁵ Nuremberg
Shaw ⁴⁶	UK	Opposed	Principlism (implied autonomy, ['encroach on human rights'], harm, benefit)
Shaw ²⁹	UK	Neutral	Principlism (autonomy)
Song and Kim ²³	South Korea	Neutral	Principlism (autonomy, beneficence, non-maleficence, justice), utility, liberty, public health principlism (Childress <i>et al.</i>) ¹⁴
Zusman ³⁹	Israel	Supportive	Freedom (liberty), principlism (benefit)

Key
 * = Unless otherwise indicated, 'principlism' refers to the four biomedical principles identified by Beauchamp and Childress²⁶
 CADTH = Canadian Agency for Drugs and Technologies in Health
 NICE = National Institute for Health and Clinical Excellence

such as small sample sizes, and postulated that selective use of evidence can lead to public mistrust.

In a similar context, Shakeri *et al.*¹⁷ presented a neutral analysis of food fortification and fluoridation using two public health ethical frameworks: the justificatory approach of Childress *et al.*¹⁴ and the Nuffield stewardship model.¹⁵ They argued, although supporting fluoridation overall, that there are aspects of both frameworks that are not fulfilled. For example, if consumers are unaware of the composition of water, accusations of deception and passive consumption might be made. They also considered whether fluoride is seen as a medicine and the associated ramifications in relation to the Nuremberg code. Given its complexity, they concluded the ethics of public health interventions such as fluoridation need to be revisited regularly.¹⁷

Klugman ethically appraised fluoridation by applying principlism but using notions of efficacy (scientifically sound with a significant chance of meeting goals), integrity (inclusion of the community), solidarity (community comes together) and dignity (respecting the community using the least restrictive principle). Klugman proposed that efficacy may be unclear; while acknowledging its evidence of effectiveness, he questions whether it is feasible in the prevailing

political and social climate. However, he saw fluoridation as favourable for solidarity (in terms of equity for all the community), and unclear for integrity (as it depends on the level of community engagement in decision-making) and dignity (as there are other, less restrictive means of fluoride delivery).⁶¹

Taking a different approach, Ateş and Özer⁵¹ considered ethical arguments related to fluoridation while reflecting on the impacts of different social, cultural and religious philosophies in Turkey. From the perspective of autonomy, they considered whether responsibility should be shared, individual, professional, or state, concluding that the crucial importance of any policy includes both ongoing engagement with the public and the transparency of government intent. In addition, they considered beneficence and maximising common good from a more utilitarian perspective but also discussed the influence of professional power in this process.⁵¹

Discussion

This scoping review aimed to examine how the ethics of fluoridation has been appraised in the literature. It searched six databases, grey literature and reference lists of included studies. Overall, it identified that there is a relatively small

body of literature on the topic from a range of countries that has taken different approaches to its appraisal, frequently using those intended for individual medical care rather than for public health interventions. The ethical approach taken was rarely stated and was often implied, with limited reference to moral or political theory. The literature could be categorised as appearing to be supporting, opposing, or neutral to fluoridation in its standpoint (Table 3).

Like medical ethics, public health ethics developed from bioethics.⁶ However, it differs in that it is underpinned by moral and political theories to reflect that the focus of public health is for population rather individual benefit.^{6,13} However, many included studies adopted ethical principles intended for medical care, often implicitly without reference to moral theory or ethical frameworks, which are constructed from liberal values that centre on autonomy. Arguably, these are inadequate for examining whether fluoridation is ethically justifiable, taking into account the inevitable infringement on individual consent and evidence of population benefit and risk.⁵⁷

Consequently, a multi-dimensional approach to guide ethical decision-making in public health has been recommended, for example, using principlism or frameworks proposed for public health interventions.^{10,14,15,18,60,61,76}

Utilitarianism and the ethical principle of beneficence were frequently emphasised by those supporting fluoridation. Fluoridation was discussed as a utilitarian intervention protecting population health, but the 'liberal objection' to utilitarianism raises the argument of infringing individual liberties, yet it is seen as justified if its implementation avoids harm to others.^{24,42,63} There is evidence that fluoridation benefits oneself, as it reduces the risk of dental caries and avoids pain, discomfort and treatment, and this may include children and socioeconomically deprived and other vulnerable groups.^{77,78} However, harm to oneself and others could include the increased risk of dental fluorosis and any associated treatment costs,⁷⁹ especially in areas where caries levels are low or topical fluoride levels are high.

Opponents of fluoridation often centre their concerns on infringement of choice and individual consent, especially if it is mandated policy.⁸⁰ Such ethical challenges can become highly emotive in the literature and vociferously argued as against human rights by anti-fluoridation activists.^{46,67,68,81} The Nuremberg code is also commonly cited in anti-fluoridation literature as fluoride is viewed as a medicine and hence, in this conception, fluoridation is seen as mass medication.^{67,68} The controversy arises as the consumer may not be fully informed of this addition and therefore is unable to consent. Others argue that fluoride is not a medicine as it occurs naturally in similar concentrations to those in fluoridation schemes.⁵⁰ Although this debate is beyond the scope of this review, legislation and medicines regulatory bodies ultimately define medicines and their use, and this may vary internationally and be subject to change. In the UK, the Medicines and Healthcare products Regulatory Agency licences medicinal products and has stated that fluoride in water is outside its remit as fluoride forms part of the diet and does not regard it a medicinal product.

Authors adopting a more neutral standpoint on fluoridation often used a combination of principles and frameworks, including utilitarianism, principlism and public health principlism.^{10,17,23,26,49,52,57,59,61,62} Discussions centred on the conflicts of the different ethical principles to each other on fluoridation, for example, autonomy (fluoride as mass medication) opposing the communal positive effects (beneficence).^{57,62} The use of frameworks specifically intended

for public health has been recommended to address these challenges and to advance ethical appraisal,^{60,76} particularly by shifting the focus away from individual focus toward public benefit, trust, proportionality and accountability, and judicious use of research data.⁵⁵ However, concerns have been expressed about the power of science in such assessments. Martin argues that fluoridation supporters can dominate debates, particularly when supported by evidence of effectiveness, funding and professional accreditations, and risk overwhelming other potentially legitimate arguments.^{28,82} A related concern is risk of unconscious or conscious bias in studies evaluating fluoridation that are led by dental public health specialists, the findings of which influence ethical decision-making.^{27,47,83} This reinforces the view of the Nuffield Council on Bioethics who asserted: 'the only ethical solution in a liberal democracy is to continue a public debate which aims to be transparent and should be undertaken with scientific objectivity, rigour and integrity so a balanced decision can be reached'.¹⁵

Although this review followed methodological frameworks and comprehensively searched the literature, some relevant studies may have been missed, including any published in languages other than English. In addition, literature was included on the basis of relevance rather than quality, with the latter not being formally assessed. Consequently, the review may provide breadth but not depth of analysis. A related problem was that studies frequently implied moral, political and ethical theory, and principles of these were interpreted subjectively, including their apparent stance on fluoridation, and therefore may misrepresent the intended meaning.

Conclusion

A range of approaches have been taken to appraise the ethics of fluoridation in the literature and these were frequently conceived for individual medical rather than public health interventions. Consequently, they often emphasise certain principles or theories that may suit a particular stance but are inadequate to resolve tension between inevitable infringement of individual consent and collective benefit in public health. Other approaches conceived specifically for public health interventions exist and they have more utility in debates and ethical decision-making.

Ethics declaration

The authors declare no conflicts of interest. None of the authors hold advisory or consulting for companies or organisations. Ethical approval and consent was not required as the study is a scoping review and as such did not involve the collection of primary data; all data were derived from previously published studies.

Data availability

Any data included in the study are available in the cited papers.

Author contributions

BP and TD conceived and designed the work that led to the submission, acquired data, and played an important role in interpreting the results, drafted the manuscript and approved the final version.

See Part 1 of this two-part paper at <https://doi.org/10.1038/s41415-024-8058-4>.

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