BMC Oral Health

RESEARCH

Open Access

'At a tipping point': a comparative analysis of oral health coverage for children across six European countries: Denmark, Germany, Hungary, Ireland, Scotland, and Spain

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Abstract

Background Dental caries remains a significant public health problem for children with continuing calls to incorporate oral health under the Universal Healthcare domain (UHC). However, there is little knowledge on the variations in the coverage, financing, and access to child oral healthcare across Europe.

Methods This inter-country comparative analysis provides a detailed description and mapping of publicly funded child oral health coverage across six European countries: Denmark, Germany, Hungary, Ireland, Scotland, and Spain. A multiple case study approach was adopted encompassing two strands of data collection: a documentary analysis and in-depth interviews with experts from each country. The WHO Universal Health Coverage Cube was used to guide data collection and analysis.

Results Two broad models of child oral health coverage were found: those systems adopting 'universal' approaches (Denmark, Germany, Hungary, and Scotland) and those restricting coverage by 'targeting' children by age or where they live (Ireland and Spain). In countries without universal coverage (Ireland and Spain), the private sector assumed a significant role, leading to substantial out-of-pocket expenses for families. This was also evident in Hungary owing to barriers in accessing its publicly funded oral healthcare system. Preventive oral healthcare was also attributed a lower priority in these countries, however a prominent observation across all countries was the necessity for a stronger focus on prevention. Each country with universal oral health coverage (Denmark, Germany, and Scotland) except for Hungary, demonstrated a trend of expanded coverage and regulatory reform achieved using oral health data, political support and engaging the dental profession. While a failure to implement policy and system reform was evident in the remaining countries with the impact of the 2008 economic crisis particularly evident in Ireland and Spain.

Conclusions This research finds that child oral health coverage in some European countries is 'at a tipping point', with recognition of the need for reform evident in Hungary, Spain and Ireland while most 'universal' systems remain on alert to maintaining the broad coverage in place. To maintain and progress UHC for oral health there must be an emphasis on prevention, on addressing inequalities faced by children excluded from care and on advocacy using quality oral health data to engage both dental professionals and political will.

Keywords Universal health coverage, Oral health, Childhood dental caries, Oral health policy, Health service accessibility

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Background

Oral health is increasingly positioned as a fundamental human right and 'integral to general health' [1, 2]. While oral diseases are largely preventable, it is estimated that approximately half of the global population suffers from some form of oral disease [3].

Dental caries is one such condition which has an impact across all ages but particularly in children [4]. It is the most common disease of childhood and is considered a 'major global public health challenge' [5, 6]. In addition to causing pain and infection, dental caries can lead to difficulties in eating and speaking along with compromised physical development, self-esteem and lower school performance [7, 8]. The high prevalence of dental caries also has a major societal cost with the global economic burden of the disease estimated at US $245 billion [9].

Although the aetiology of dental caries is complex, influenced by biological factors and the social and commercial determinants of health, there is significant evidence supporting the impact of preventive approaches in improving oral health outcomes [10, 11]. Interventions including community water fluoridation (CWF) and the topical use of fluorides, oral health assessments in the early years, parental counselling and school-based initiatives have shown significant benefits [12–14]. Furthermore, healthcare systems that offer regular access to oral healthcare services, in combination with preventive public health measures, may lead to improvements in the prevalence of dental caries [6]. However, any 'downstream' interventions should be integrated with more radical up-, mid-stream and integrated approaches, delivered in a proportionate manner to guard against the risk of increasing rather than decreasing socio-economic inequalities [1].

Despite this strong evidence base, national governments have demonstrated 'slow, limited and uneven adoption' of policies and strategies to improve children's oral healthcare, particularly for very young children and those most socially deprived [15]. In many countries, oral healthcare services are considered a non-essential component of health systems and are consequently excluded from reform and progression towards Universal Health Coverage (UHC) [16]. This is perpetuated by a lack of political priority for oral health, poor integration of oral healthcare within the broader healthcare system and the historical consignment of oral health to the realm of 'personal responsibility' [17–20]. Consequently, children, particularly the most vulnerable, face barriers in accessing oral healthcare. Global evidence indicates that these groups are inadequately served by primary oral healthcare [11, 21]. Furthermore, there are 'substantial' inequities both within and between countries with respect to coverage for primary oral healthcare for children [11].

Based on patterns of organisation and financing, researchers identify six defined 'models' of oral healthcare delivery in Europe (Table 1) [22]. These models are the Nordic, Bismarckian, Beveridgian, Hybrid, Southern European and Eastern European models. The Nordic model (e.g., Denmark) is typically characterised by a large public dental service for children which is operated by salaried personnel and financed by taxation [23]. There is also a private, non-salaried sector, that may be subsidised by public finance [22]. In Germany, the Bismarckian model is based on statutory health insurance split into public social insurance (SHI) and private health insurance (PHI) [24]. Most oral healthcare costs are reimbursed, with services typically provided by independent (non-salaried) practice-based dentists [24]. The Beveridgian model originated in the United Kingdom (e.g. Scotland) where publicly financed dental care is delivered by independent dentists contracted and financed via the tax funded National Health System (NHS) [25].

A Hybrid model is seen in the Republic of Ireland (Ireland), which has adopted some features of the Beveridgian system. For children, emergency, and 'comprehensive' dental care at 'targeted ages' is provided by salaried dental practitioners directly employed by the state [27]. While publicly funded oral healthcare for adults is provided by independent dental practitioners contracted by the state. However, coverage limitations and access restrictions across the population mean most dental expenditure in Ireland is privately financed [19, 28]. The Southern European model (e.g. Spain) is predominately privately financed, with some publicly funded oral healthcare available particularly for children, but its provision

Table 1 Models of oral healthcare delivery in six European countries

Country	Model	Main source of general healthcare financing	Children's oral health cover
Denmark	Nordic	Tax financed	Universal
Germany	Bismarckian	Social Health Insurance	Universal
Scotland	Beveridgian	Tax financed	Universal
Hungary[1]	Eastern European	Social Health Insurance	Universal
Ireland	Hybrid	Tax financed	Targeted*
Spain	Southern European	Tax financed	Targeted*

* Targeted systems offer coverage for oral healthcare at specific ages and or in specific regions/locations

1: In Hungary the formal eligibility is that of a universal model of oral health coverage for children. However, unlike the other universal models, there is evidence that owing to practical access barriers, universal eligibility does not equate to universal accessibility [26].

is highly variable [22, 29]. Finally, in most Eastern European countries (e.g. Hungary) public provision of care is reducing having previously been considered 'universally free', with 'the majority of care now provided in the private sector' [22, 26, 30].

The World Health Organisation (WHO) has led the recent global recognition of the 'neglect' suffered by oral health and the new emphasis placed on the inclusion of oral health under the UHC agenda [2]. While the WHO Global strategy and action plan on oral health 2023–2030 has the overarching aim of implementing UHC for oral health by 2030 [31]. A 2022 report examining oral healthcare systems across Europe found there was 'little known about the large variations between countries in terms of financing, access, coverage and delivery of oral healthcare' [26]. This echoes previous evidence highlighting the lack of international comparison and 'paucity of information on how oral healthcare systems are organised, how services are delivered, the healthcare professionals responsible for providing care and access to services' [32, 33].

Previous research demonstrates the advantages of inter-country comparisons in offering insights into the prevalence of child dental caries and the impact of health policies [6]. While a detailed understanding of how different systems operate may provide greater knowledge for healthcare planning and policy-making within the UHC domain [32, 34].

Thus, the aim of this research is to provide a detailed description and mapping of publicly funded oral healthcare coverage for children across six European countries, each representative of a model for the provision of oral healthcare, and to report on that coverage in accordance with the World Health Organisation Coverage Cube [33, 35].

Methods

Overview

This research set out to perform an inter-country comparison of publicly funded oral healthcare systems for children. Marmor (2012) [36] outlined three purposes for engaging in inter-country research on health systems and policies:

- Gaining insights into the structure and policies of national healthcare systems,
- Understanding the rationale behind their configuration,
- Deriving lessons from the experiences and practices of other countries.

Effectively conducted inter-country comparisons can provide a rich source of evidence and 'exert a powerful influence' on policymakers [37]. However, comparisons can be problematic with a lack of appropriate theory guiding the identification of data, justification for country selection and analytical approach which have been identified as common shortcomings [38].

Inter-country comparisons can 'benefit greatly' from methodological triangulation to strengthen the quality of studies [39]. This research followed a multiple case study approach requiring the researcher to gather data from various sources to comprehensively capture the complexity of each system. Multiple case studies enable an understanding of data both within and across different systems with the evidence generated considered 'strong and reliable' [40]. As such there were two strands of data collection in this research (i) a documentary analysis and (ii) semi-structured 'elite' in-depth interviews with experts from each country [41]. Findings from both strands of the data were analysed and triangulated together to generate the results. Despite the initial intent to provide inter-country comparison, due to the poor quality of data available, findings are presented individually for each country with comparisons drawn where appropriate.

Data Collection

Country selection and target population

Cacace et al. (2013) [39] highlighted the importance of explicit selection of comparator countries, ensuring their justification reflects the research aim. For this analysis the following countries were chosen, Denmark, Germany, Hungary, Ireland, Scotland and Spain. To be selected, countries had to demonstrate the following characteristics:

i. be representative of the various health systems throughout Europe (i.e., social health insurance vs. tax-financed, multi- vs single-payee, centralised vs de centralised and the differing models of dental systems previously categorised across Europe [25],
ii. demonstrate effective oral health promotion and prevention regimes for children as evidenced by low $d_3$mft/D_3MFT (less than or equal to 1) and percentage with no obvious caries at age 12 (70% or greater)[1] [42] or ICDAS 0–3 [43] and
iii. have a history of or planned oral health system reform.

The study focused on publicly funded oral healthcare for children. In most countries, children are defined as

[1] Data for Ireland and Hungary did not meet these levels. However, in the case of Ireland, data comes from national survey which is more than 20 years old. While Hungary was considered a fair representation of the Eastern model as most other Eastern European countries reported similar levels.

those under the age of 18. Due to time constraints, it is beyond the scope of this research to consider oral healthcare coverage for special needs populations and other vulnerable groups.

Conceptual framework

Evidence indicates that due to the diverse nature of national health systems that whatever the purpose for inter-country comparison, a conceptual framework is needed to, 'provide clarity…and to draw meaningful comparisons' [37]. The World Health Organisation Universal Health Coverage Cube (Cube) [35] (Fig. 1) adapted to describe publicly funded oral healthcare [33] was used to guide both data collection and analysis in this research.

The three central elements of the Cube are: (i) Breath: the extent of population coverage, (ii) Depth: the share of costs publicly funded and (iii) Scope: the range of treatment/services provided.

Document analysis

A documentary analysis examined documents derived from a range of sources including publicly available information, grey literature, peer reviewed academic literature and material provided by local experts. A pre-existing data collection template, based on the Cube, was accessed and refined to guide data collection [33]. This template required in-depth information to be collated across a range of sectors in the oral healthcare system including relevant laws, regulation, organisational structures, personnel and the three core features of the Cube: the breath, depth, and scope of oral healthcare coverage.

A search strategy (Appendix A) was developed with the assistance of a specialist medical librarian with the aim of identifying the relevant peer reviewed literature that described or compared publicly funded oral healthcare systems for children under the age of 18 years in the six representative countries. Other documents were identified by searching sources including (i) Government websites, particularly Ministries of Health and legislative databases, (ii) individual country health service platforms (iii) oral health professional associations and (iv) international organisations. Documents reviewed included relevant publications by the European Observatory for Health Systems and Policies, the Council of European Dentists and the WHO, national government policies and strategies, clinical guidelines, and health service reports with no language restriction.

The completed template incorporated data derived from both academic and other documents and was presented to two experts from each country for their review, following which these experts were invited to participate in interview. Each country's data was updated in the light of the 'local' expert feedback. The detailed templates for each country are available on request.

'Elite' Interviews

'Elite' interview participants are those who have a particular professional expertise or a close proximity to roles with authority within a system or process [44]. Within health systems and policy research such interviews are beneficial for verifying information, providing access to narratives about events and sharing institutional knowledge that would be otherwise unavailable [45]. In this study, an elite interviewee was someone possessing a high level of expertise in dental public health[2] or having served as a Chief Dental Officer[3], either currently or in the past. Those individuals were purposively identified from the national documentary analysis, the knowledge of the research team or based on the recommendation of other interviewees. A piloted interview guide informed by the literature was used during interviews and was continually updated throughout the interview process.

A total of sixteen elites ($n=16$) were invited to partake and fourteen ($n=14$) consented. The sample consisted of two ($n=2$) participants from each country involved in the analysis along with two experts ($n=2$) from non-participatory countries, recruited with the aim of providing an overarching view of children's oral healthcare in Europe. The sample consisted of eight ($n=8$) dental public health experts, six of whom were at a senior position in academia ($n=6$) and two were affiliated with the health service ($n=2$). While a total of six participants ($n=6$) were present or former country Chief Dental Officers. For logistical purposes all the interviews were conducted via teleconference (MS Teams) between May and September 2023.

Data analysis

Best practice for qualitative document analysis describes finding, selecting, appraising, and synthesising data which are then organised into major themes through content analysis [46]. This approach was followed, with analysis further directed by the WHO Coverage Cube (Cube). Qualitative data analysis software (NVivo 12) was used, with the data from the documents initially recorded into the data collection template under key headings guided by the Cube. Interviews were transcribed verbatim. Operational definitions derived from the Cube, in line with the data collection template, were generated and the outcomes from the documentary analysis and the

[2] In this research a 'dental public health expert' was defined as an individual at a senior position in an academic or health service setting, with additional post graduate training in dental public health.

[3] A 'Chief Dental Officer' was the senior civil servant providing oral health advice to a Health Ministry.

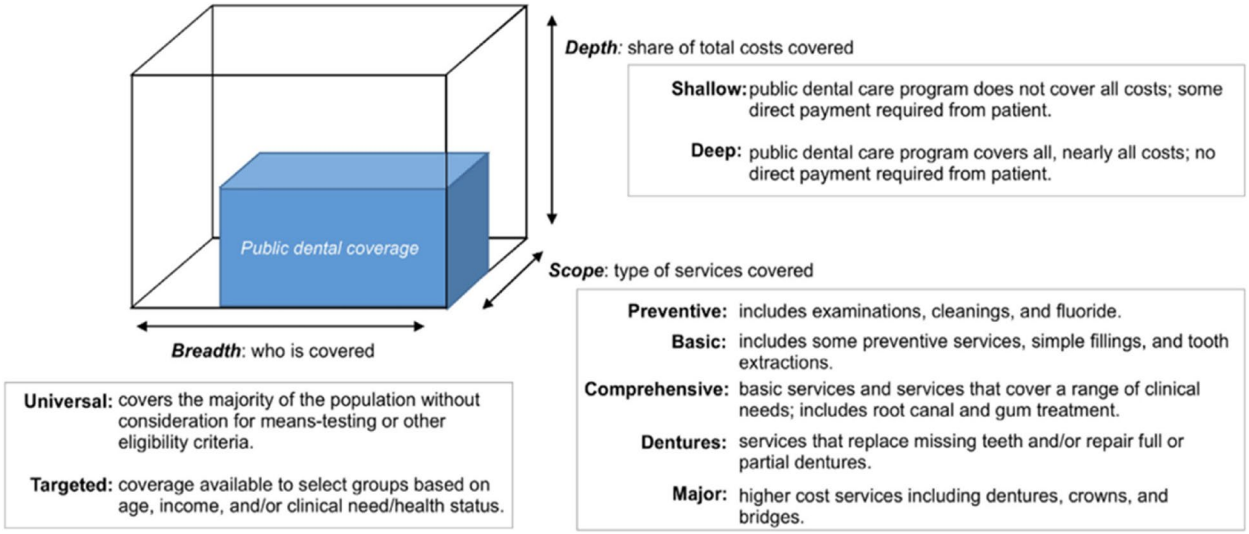

Fig. 1 Dimensions of coverage for public oral healthcare models based on the World Health Organization Coverage cube framework [33]

interviews were combined and coded together. To ensure triangulation, the findings from the documents were continually analysed together with those from the interviews.

The data from the document analysis enabled the generation of a rich description of the key features of each system [46]. However, document analysis is said to be 'powerfully' combined with other methods within qualitative research [47] and the 'elite' interviews in this study provided critical contextual information along with country specific perspectives.

Ethics approval

Ethics approval for the study was granted by the Clinical Research Ethics Committee (CREC) of the Cork Teaching Hospitals at University College Cork (CREC) (Reference number: ECM 4 (J)12/11/2019). All research practices were carried out in accordance with the regulations determined by the CREC. At all times, ethical concerns including ensuring confidentiality, obtaining informed consent, and preserving anonymity were adhered to. Informed consent to participate was granted by each participant.

Results

The results are presented according to the dimensions of the WHO Coverage Cube (Fig. 1) along with other key oral health system characteristics and include both documentary and interview findings triangulated.

Breadth of coverage: who is covered?

This analysis found two general categories with respect to the 'breadth' of oral healthcare coverage: those with 'universal' approaches and those 'targeting' specific age groups (Table 2). In all the included countries children are legally defined as those under the age of 18. A universal model was found in Denmark, Germany, Scotland, and Hungary where all children under the age of 18 are eligible for oral healthcare [24, 30, 48, 49]. While in Ireland and Spain, 'targeted' systems operate where children of specific ages are 'targeted' for emergency and routine oral healthcare, which is strongly dependant on resource availability and/or where a child lives [19, 27, 29].

There are a range of differences within and between the 'universal' and 'targeted' approaches. In Denmark, the tax-funded health system operates across three administrative and political levels: the state (holding overall regulatory supervisory responsibility), the regions (responsible for hospital and general practitioner-based care) and the 98 municipalities (responsible for primary care services including child and youth dental care) [26]. Oral healthcare for children is the responsibility of each 'municipality' and access to free preventive and curative oral healthcare is a legal obligation [48]. A distinction is required in the case of adults in Denmark where there is no 'free' dental care, rather a system of subsidies operates prioritising prevention and basic oral healthcare [26].

The 'municipality population register' is a database from which 99% of children are automatically enrolled in the Public Dental System. This is used to monitor the regularity of dental visits, with repeated absences from dental care reported to social services [50–52]. As described by an interviewee:

> *'You can say that 99% of children are actually born into the programme…it's not something that you have to seek, it is automatic…if the children don't show up, then municipalities are obligated by law to seek you.' (P3)*

Table 2 Overview of eligibility criteria for publicly funded dental care for children

Country	Eligibility criteria
Denmark	Universal population Age: All children and young people under the age of 22 via the 'Public Dental System' automatically enrolled at birth
Germany	Universal population Age: All children under the age of 18, increasing to age 23 if they are not working and age 25 if a student Insurance status: membership of 'sickness fund' enables access to SHI accredited dentists (99% of all dentists)
Scotland	Universal population Age: All children and young people under the age of 26 are eligible to receive oral healthcare Insurance status: Oral healthcare delivered via 'NHS' dentists (86% of all dentists)
Hungary	Universal population Age: All children under the age of 18 Insurance status: Oral healthcare delivered via private practitioners in contract with NEAK (31% of dentists opt into this scheme)
Ireland	Targeted population Age: Children under age 16 eligible for 'emergency' care only. 'Comprehensive' care targeted at children aged 5, 8, and 12 via a 'Public Dental Service' Location: Access varies due to resource and personnel shortages across different parts of the country
Spain	Targeted population Age: Most programmes target children aged between 6–7 and 14 and 15 years old Location: Eligibility is dependent on, and varies according to, the location in which a child lives and the target age category in operation in the individual region

In interpreting these data, it should be noted that there are a range of auxiliary oral healthcare professionals engaged in the delivery of oral healthcare for children varying in density, training and scope of practice. For example, in Spain there is no official registry of dental hygienists while in Germany there are low numbers of hygienists but instead dental assistants with additional training. Contrastingly there is mandatory professional registration of dental hygienists in the remaining four countries (Denmark, Scotland, Ireland and Hungary) who operate to varying degrees within the system

In Germany and Scotland, all children under the age of 18 and young adults up to the age of 25 and 26-years-old respectively, are eligible to receive oral health care, free-of-charge, within their broad statutory health systems i.e., in Germany under Social Health Insurance (SHI) and under the National Health Service (NHS) in Scotland. In Germany, approximately 89% of the total population belonged to 96 state-approved 'sickness funds' under SHI in 2023, while those not entitled to sickness fund membership must join private health insurance companies [53]. Membership of such a fund reimburses legally prescribed packages of care and most dentists (99%) opt in to have a contract with the SHI, resulting in 80% of 3- to 17-year-olds having at least one annual check-up [54, 55]. In 2019, the Joint Federal Committee (G-BA) largely implemented the so-called *'ECC-concept of the dental profession for dental prevention'* increasing the number of dental check-ups within SHI for very young children [56]. This expansion in population coverage was described by an interviewee:

> *'We had a big problem with early childhood caries, this gap is now closed in the social insurance system, we can do early detections from 6 months old, and we are satisfied with the offers available' (P1)*

Analysis of documents for Scotland, shows that in 2022, 86% of independent dentists had a contract with the NHS with over 65% of children receiving an examination from an NHS dentist in the last two years [57, 58]. Furthermore, it is envisioned that every child under the age of 18 in Scotland will have access to the *'Childsmile'* programme [59, 60]. 'Lifetime' registration with dentists has been in place in Scotland since 2010 [58] and was a key underlying aim in engaging all children as explained by an interviewee:

> *'We wanted to make sure that every single child could be registered with a dentist, and they had a growing relationship with that dentist' (P2).*

In Hungary, according to the *National Health Insurance Fund Manager (NEAK),* 'complete basic and specialist dental care' is available free of charge to all those under the age of 18 [61]. Between 2016–2019, according to 'individual level care data' from the NEAK, 20% of 3-year-olds, 55–60% of 5–6-year-olds and 75–80% of 9-year-olds attend the dentist annually [30]. However, oral healthcare in Hungary is undergoing 'significant change'. The proportion of dental clinics operated by the state has fallen under 10% with almost 90% of oral healthcare provided by independent dental practitioners in private practice settings. Within this cohort there are dental practices that provide publicly funded oral healthcare whereby dental practitioners enter a contractual arrangement with the state (NEAK practices) and those practices which are fully private, where the patient pays 'out-of-pocket' [62]. In contrast to the other 'universal' systems in this research, most Hungarian dental practices are privately funded, and in 2022 almost 70% of dentists did not

have a contract with the NEAK [63]. As evidenced from the documentary analysis, 'it appears that, although by legal definition children under the age of 18 are universally entitled to dental care… in practice this is not implemented', with children aged 0–3 highlighted as a group for which care does 'not systematically exist' [30]. This finding was further emphasised during interviews with one interviewee stating: *'All children under 18…it sounds great but…is it…real or not?' (P14)* and another: *'The dental care system for children is very simple…all children under 18 [are covered] but accessing it, that is the problem (P11).'*

As mentioned, Ireland and Spain are examples of 'targeted' models. In Ireland, all children under the age of 16 are eligible for emergency dental care, with 'comprehensive' care aimed at 'three designated classes in primary and secondary schools', generally corresponding to children aged 5, 8 and 12 years old [27, 64]. The basis of the current Irish system emerged from a rationing mechanism in the late 1980s implemented in response to economic constraints, where resources were directed at targeting the age ranges associated with the eruption of permanent teeth [65, 66]. This was elaborated on by an interviewee:

> *'The targeted approach wasn't going to help every individual child, but you don't have the resources for spreading out to the whole population, so you were trying to…spend what resources you had…to improve the overall standard of oral health' (P12) and another: 'It was based on the evidence of the time…if we were revisiting it today, we would do it differently' (P10).*

However, as seen in Hungary, there is also evidence in the Irish context that the intention to target children at three intervals was not fully implemented, with children struggling to access care [19, 67, 68]. Documentary evidence highlighted that due to resource limitations children's appointments are delayed or deferred with 100,000 children awaiting an appointment with the public dental system in 2023 [69]. While in some cases children are being targeted at one age only, typically around the age of 12 [69, 70]. This finding was reinforced by an interviewee: *'The whole thing [system] got reduced to one class, two classes if you were lucky, depending on the amount of staff that were available…it can be different in every region' (P12)* with the exclusion of young children particularly emphasised by a different participant: *'I have felt for a long time that we should be seeing children at a much younger age' (P10).*

For Irish adults, publicly funded oral healthcare is delivered by independent dental practitioners who have entered a contract with the state, via two publicly funded dental schemes, a dental treatment services scheme (DTSS scheme) wherein adults, mainly of lower incomes, are eligible for basic and emergency dental care annually. While the other (a Dental Treatment Benefit Scheme) entitles those with sufficient social insurance contributions to an annual dental examination and scale and polish [19, 71]. The documentary evidence found that 61% of Irish children do not access dental care before six years of age, with fewer than one in ten children accessing care between the ages of one and three. In most instances the use of services is symptom led, where parents accessed care on an emergency basis [27, 72]. This age-inequality was considered by the following comment from an interviewee: *'The Irish state is willing to pay for an annual examination for all adults [eligible for publicly funded dental care] but not for all children' (P10).*

In 2019, a new national oral health policy for Ireland called 'Smile agus Sláinte' was published seeking to expand dental coverage for children [27]. At the time of writing a 'Strategic Reform Lead' for policy implementation and a 'Policy Implementation Unit' have been established with plans to develop an implementation strategy in 2024. However, the Health Service Executive (HSE) the national government agency tasked with that reform has warned of 'challenges to implementation' citing concerns such as the recruitment pause for healthcare staff [73].

Similarly in Spain, children aged less than six years old were identified as a 'vulnerable' group largely excluded from a publicly funded dental system which has been described as 'chaotic' and lacking in organised structure [74]. In the Spanish system, for adults there is an 'absence of basic dental coverage' while coverage of dental care for children is dependent not only on the age of the child but the region of residence, resulting in notable disparities observed throughout Spain [29, 74]. This inequality was discussed by an interviewee: *'There are a lot of differences between each region…some offer treatments some didn't… if your childhood was in somewhere like Valencia, you had different dental care than a child in Murcia' (P13).*

These disparities in coverage stem from the broader structure of the health system, wherein each of the 17 regions have their own regional health system and health ministry, thereby retaining primary jurisdiction over the delivery of services [29]. This was further expanded on by an interviewee: *'We are 17 regions, and each region can develop healthcare differently, there are a lot of similarities but also differences' (P9).* Most oral health programmes target children aged between 6-and-7 years up to 14- and-15-years-old. Only Valencia, Catalonia and the Canary Islands include provision for children aged less than six years old. While in Murcia, children remain eligible for the oral health program only until age-9. Similar to Ireland, evidence from the documentary

analysis found that only 11.7% of children aged 0–4 had visited the dentist, increasing to over 69% for those aged between 5 and 14, which correlates to the availability of public dental services [75].

As observed in Germany and Ireland, there is an increasing recognition in Spain of the need to address inequalities concerning young children who are excluded from coverage. In 2022, the Spanish Government announced a plan to 'homogenise' oral healthcare services nationally to guarantee equity in access regardless of place of residence [76]. This initiative was referenced by a local expert familiar with the development of the policy:

> *'It is from the birth to 6…it comes from the National Government from Madrid, from the Ministry… and it is inside the regulation to expand primary care services' (P13).*

Scope of coverage: which dental services are covered?

The second aspect of the WHO Coverage Cube, the 'scope', illustrates what dental services are provided within the publicly funded system and an overview of all countries included in this analysis is provided in Table 3.

Each country commits to a minimum scope of public dental services for children in terms of basic care including the provision of emergency treatment, fillings in permanent teeth and dental extractions. This research found a broad, comprehensive range of services is provided by each 'universal' system (i.e. Denmark, Germany, Scotland, and Hungary) where almost all treatments including referral for specialist care are included (Table 3). This coverage was described by a German interviewee:

> *'In general, every normal care, prevention, restorative, endodontic, and so on, that's all covered by the insurances…there is very broad coverage'P4.* Similarly, a Hungarian expert described the scope of services covered in Hungary: 'Prevention, emergency, fillings in primary and secondary dentition, fissure sealing, trauma…every treatment is free' P11.

Evidence from both the documents and interviews found that in the targeted systems (i.e. Ireland and Spain) there was a priority attributed to the management of permanent over deciduous teeth. In the Irish system, except for emergency dental care, there is no publicly funded dental care for children under the age of five, while the vast majority of 'comprehensive care' is concentrated in targeted groups [27, 64]. This system, based on policy guidance from 1994 [64] was described by an interviewee: *'We had such an emphasis on permanent teeth over deciduous teeth and that became a mantra' (P10).* While in the Spanish system a 'portfolio of common services' were specified by 'Royal Decree' with certain treatments including 'restorative treatment of the temporary dentition' and orthodontic treatment, excluded from the basic package of care [77].

Access to publicly funded orthodontic care in the systems of the other included countries is restricted to those deemed of greatest clinical need. For example, in Denmark those with 'moderate or major malocclusions' are referred for an assessment by an orthodontist [48]

Table 3 Overview of the scope of public dental coverage for eligible children

Comprehensive services									Specialist care	
Country	Basic services									
	Preventive services			Emergency Care	Deciduous Tooth Tx[2]	Permanent Fillings	Extraction	Endo[3]	Ortho[4]	Other
	Scheduled Exam	Fluoride	Oral Health Promotion							
Denmark	✓	✓	✓	✓	✓	✓	✓	✓	✓ *	✓
Germany	✓	✓	✓	✓	✓	✓	✓	✓	✓ *	✓
Scotland	✓	✓	✓	✓	✓	✓	✓	✓	✓ *	✓
Hungary	✓	✓	✓	✓	✓	✓	✓	✓	✓ *	✓
Ireland	T	T*	T *	✓ [1]	T*	T*	T*	T *	T *	T *
Spain	T	T	T *	T *	-	T	T	T*	-	T *

Overview of eligibility criteria for publicly funded dental care for children

✓ = Treatment covered,— = not covered, * = covered but with restrictions or limitations, T = targeted population

[1] All children under the age of 16 are eligible for emergency care in Ireland not just the targeted population

[2] Deciduous tooth treatment

[3] Endodontic treatment

[4] Orthodontic treatment

while in Germany the need for treatment is based on five orthodontic indication groups according to clinical severity (Kieferorthopädische Indikationsgruppen, KIG) [78] with similar systems of classification in practice in Scotland and Ireland (i.e. the Modified Index of Orthodontic Treatment Need-IOTN). In Hungary, patients are required to contribute to the cost of the orthodontic appliance, but the clinical work is provided free of charge [61].

A key difference across countries, was the scope of preventive care available and the importance attributed to preventive oral healthcare. In Denmark and Scotland, prevention occupies a central role in children's oral healthcare. Over half a century ago Denmark had some of the poorest levels of child oral health in Europe and in response the 'Danish Oral Healthcare Act' was enacted, legally mandating the provision of preventive care. This yielded significant increases in the availability of preventive services and a subsequent improvement in oral health [79]. This was reflected upon by a Danish expert: *'The whole culture of prevention has been very successful…we had pioneers in oral health research, we knew the importance of fluoride and non-operative treatment…we implemented this knowledge very early, and it became so much integrated in our system' (P3).*

Similarly in Scotland, Childsmile, a multi-faceted programme delivering prevention in dental practice, in community and in education settings was established in 2005 with the aim of improving children's oral health and reducing inequalities [59]. There was a 'major' improvement in oral health following the introduction of Childsmile, with a 2013 study finding a direct association between the introduction of supervised toothbrushing and a reduction in dental decay in 5-year-olds [80]. This component of the programme was strongly emphasised as the critical element of Childsmile success by local experts: *'Childsmile getting out of dental practice and going into educational settings… that's the key message…a lot of people want to hear about fluoride varnish and it's like hold on a minute, the toothbrushing, that's where the action is.' (P8).*

In contrast, evidence from the other countries highlighted concerns with respect to the emphasis placed on treatment in comparison to prevention (Table 4). The recent expansion of coverage for preventive care for very young children in the German system was highlighted as an important step with respect to an increased emphasis on prevention [56]. This was reinforced by an interviewee: *'The German system is still very much focused on restorative dentistry and especially prosthetics, which has traditionally been very big in Germany. But there is now a focus on prevention, the numbers sealants, varnish etc. placed go into the millions' (P4).* While similar changes were sought by a Hungarian expert: *'We have to change the complete system in Hungary instead of focusing on treatment we have to focus on prevention…we need less paediatric dentistry [coverage] but more effective' P11.*

In targeted systems like Ireland and Spain, preventive interventions are primarily focused on specific age groups. These interventions are supplemented by community water fluoridation (CWF), serving as a population-wide preventive measure. In Ireland, CWF covers 71% of the population, while in Spain, it extends to only 10% [29, 72]. Findings from both the documents and interviews observed disparities within the Irish system concerning the placement of fissure sealants, the cornerstone of preventive strategy with academics and policymakers highlighting the social and geographic inequalities involved [27, 86]. This was echoed by an interviewee: *'It was a structure acceptable for its time but there was inequity…the inequity is now worse' (P12).* Similarly in Spain evidence points to a limited availability of preventive care and a social gradient evident in the use of those services which are covered [75]. This was discussed by a Spanish expert: *'Service data show the percent of prevention is very low…it is coming from a philosophical perspective…prevention is still not in the mind of all dentists' (P9).*

Irrespective of the country or system in question a unanimous finding from all participants in this research was a need for broadening the scope of preventive care and reorientating systems to ensure prevention is central at a system level but also at a professional and patient level. This was reflected on by an Irish expert: *'We need a system that explains things to parents…integral within the general health system…with an income for professionals that acknowledges that they must do prevention' (P12).* And a Danish expert: *'It's like the thinking of 'the end justifies the means'…we still scare the hell out of children having to get a filling at a young age…we need to help them in other ways and not focus on treatment at any cost' (P5).*

Depth: How much of the costs are covered?

Across the six countries the depth of coverage for eligible children ranges from predominantly deep coverage (i.e. the public programme covers most costs) to shallow coverage (i.e. the public programme covers limited costs). In the event of the public programme not covering costs then the patient must pay for dental care 'privately' which mainly equates to direct out-of-pocket payments or seeking reimbursement through dental health insurance for those who are privately insured. An overview of general, public, and out-of-pocket spending across all included countries along with other financing information is provided in Table 5.

Table 4 Role of prevention in the child oral healthcare system

Country	Approach	Legislation	Reform	Financing arrangement
Denmark[1]	-Individual prevention eligibility: Universal child population. -General prevention programmes including oral health promotion activities.	The Health Act and Dental Care Order (2023)[1]	1972: Child Oral Health Act introduced free prevention 1989: Expanded to those aged 3–18 years 1997: Included all children 2022: Increased to age 22	Publicly funded service with most care provided by salaried dentists in state-owned clinics.
Germany[2]	-Individual prevention (IP) eligibility: Universal child population. -'Group prophylaxis' (oral health promotion, fluoride applicaton, screening in schools).	Social Code (SGB) Fifth Book (V) §22[2]	1989: IP for children in SHI (12–20 years) 1991: IP expanded to those aged 6 1997–2000: IP for all children 2019: Increased package of care up to 33 months of age	Publicly funded service with most care provided by independent dental practitioners contracted by the state and reimbursed via a fee-for-service (FFS) basis.
Scotland[3]	-Individual prevention eligibility: Universal child population -Childsmile: Universal[3] Targeted (high risk population receive additional resources).	The National Health Service (General Dental Services) (Scotland) Regulations 2010[3]	2005: Action plan for improving oral health 2006–2008: Childsmile 'Demonstration phase' 2011: Childsmile nationally available and incorporated into SDR 2022: Childsmile expansion funding 2023: New SDR (payment reform)	Publicly funded service, with most care provided by independent dental practitioners contracted by the state. Dentists are reimbursed via FFS, capitation and via other grants/allowances.
Hungary[4]	-Individual prevention eligibility: Universal population -'Group preventive counselling' and school preventive services.	CXXIII of 2015 law on primary health care	Decline in the number of dentists participating in public contracts from 1995 onwards.	Prevention in theory is provided by independent dentists under a predominantly performance-based FFS model. Owing to the decline in dentist participation this eligibility does not equate to accessibility.
Ireland[5]	-Individual prevention eligibility: targeted ages. -Community Water Fluoridation (CWF) (71% of the whole population).	S.I. No. 248/2000—Health (Dental Services For Children) Regulations, 2000. The Health (Fluoridation of Water Supplies) Act, 1960.	1994: national action plan targeting eruption of permanent teeth 2010: economic crisis reduced service availability 2019: national oral health policy proposing expanded preventive care	Publicly funded prevention provided by salaried dentists in state-owned facilities to targeted ages only Community Water Fluoridation (CWF) is also state-funded. Outside of these state-funded services, individuals must cover the full cost of preventive services provided by independent dentists.
Spain[6]	-Individual prevention eligibility: targeted population based on age and/or region. -'PADI' system in operation in 10 out of 17 ACs.	Royal Decree of 15 September 2006 (1030/2006)	1989: PADI first introduced in Basque country 2003–2005: PADI adopted in 6 other regions 2008: Economic crisis halted reforms 2018: PADI adopted in Madrid 2022: Proposal for increased 'homogenised' preventive care across Spain for young children	Publicly funded care varies according to region (AC) and restricted to targeted ages. There is also variation in provider payment between contracted independent dentists largely remunerated by capitation, salaried models and so called 'mixed models'.

1 Municipal dental care. Ministry of the Interior and Health, 2023 [48]

2 Social Code (SGB) Fifth Book (V) [81]

3 It is anticipated that all children under the age of 18 in Scotland will have access to Childsmile. However, since the COVID-19 pandemic, there has been a reduction in Childsmile nursery availability and patient participation. NHS, GDS (Scotland) Regulations 2010 [82]. SDR: Statement of Dental Renumeration

4 CXXIII of 2015 law on primary health care [83]. Almost 70% of dental practices in Hungary are fully private practices and do not offer publicly funded preventive care. While with respect to the school screening programme there are geographic and social inequalities in its operation [30]

5 Houses of the Oireachtas, 2000 [84]. The primary component child preventive care is the application of fissure sealants at targeted ages which following the COVID-19 pandemic and economic crisis is suffering from limited resources nationally

6 Royal Decree. Annual report on the development of Decree 118/90 on dental care for children in the Basque Country. 2022 [85]. The priority attributed to prevention varies extensively and is entirely dependent on where a child lives and their target age group

Table 5 Financing details of six European publicly funded oral healthcare systems for children

Financing information								
Country	**Funding model**	**Children's oral health cover**	**Public spending on general healthcare (WHOLE population) (OECD, 2023 or nearest year)**	**Public spending on oral healthcare (WHOLE population) (OECD, 2023 or nearest year)**	**O–O-P as % of total oral healthcare spending (WHOLE population)**	**Annual cost***	**Estimated* spend pp covered**	**Provider payment mechanism**
Denmark[1]	TF	Universal	85%	35%	72% (HiT,2019)	€273m[1] (Aged 0–22 years)	€196[1]	Majority salaried dental practitioners employed in state owned facilities
Germany[2]	SHI	Universal	86%	67%	25% (HiT, 2019)	€16b[2] (Total population)	€183[2]	Majority independent dental practitioners contracted by the state to provide care on a FFS basis
Scotland[3]	TF	Universal	83% (UK)	41% (UK)	20%[e] ('Private' Scotland SHeS 2019/21)	€549 m (Total population)	€89[3]	Majority independent dental practitioners contracted by the state through FFS, capitation and allowances
Hungary[4]	SHI	Universal	73%	34%	54% (HiT, 2019)	n/a	n/a	Majority independent practitioners via performance-based FFS
Ireland[5]	TF	Targeted	77%	23%[e]	77%[5] (National Statistics)	€70m[5] (Children only 2018)	€66[5]	Salaried dental practitioners directly employed by the state
Spain[6]	TF	Targeted	72%	2%	98% (National statistics)	€5 m[6] (children one region,)	€43[6] (children one region)	Majority independent practitioners but variation throughoutwithsalaried and 'mixed' systems also in operation

1 Sources: HiT: Oral health care in Europe. Financing, access, and provision. 2022 [26]. 1 'Government Finances', Statistics Denmark personal communication. 2022. Calculated based on total population under age 22. Population source: Statistic Denmark. 2 Sources HiT: Oral health care in Europe. Financing, access, and provision. 2022 [26]. Total figure for all SHI spending excl. dentures. Source: KZBV. Estimated spend over total population. Cost pp is total estimated across all SHI enrolees excluding dentures as best approximation to children (2023). 3 Source: Public Health Scotland. Based on population children under age 18 in 2019. Population source: National Records of Scotland. Note: Total budget for dental care in Scotland in 2023/24 is €549 m.OOP estimate (e) based on Scottish Health Survey 'private treatment' response. 4 In Hungary OOP as a % of total dental spending is 54% in 2019. Source: HiT: Oral health care in Europe. Financing, access, and provision. 2022 [26]. 5 *Source: Central Statistics Office Ireland (2020). Estimated cost based on total population under age 16 in Ireland. Population source: Central Statistics Office. Cost €70 m in 2018. Source: Houses of the Oireachtas written statement 2018 [87] and ESRI 2019. Special needs populations not included in cost calculations but are estimated represent 5% of service activity [71]. 6 Figures based on PADI programme in The Basque Country. Source: Annual report on the development of the Decree 118/90 on dental care for children in the Basque Country. 2022 [85]

TF Tax funded, SHI Social health insurance, Salaried Dentists directly employed delivering care

* Estimated cost based on rough calculation using total population figures

The universal systems (i.e. Denmark, Germany, Scotland, and Hungary) are generally characterised by deep coverage for children, almost all care is publicly funded and available "free of charge" to the patient. As evident in previous comparisons there are distinctions required in the case of Hungary where there is a single health

insurance fund that provides almost universal population health coverage (95%) [88]. The introduction of a new health insurance system in 1992 resulted in a reduction in the coverage for dental services and an increased emphasis on 'personal responsibility'. Dental services are not fully covered under statutory benefits and fees for services not covered must be reimbursed out-of-pocket [26, 88]. Although 'all care' is free of charge for those under the age of 18, the extent to which children have access to publicly funded oral healthcare is determined by the capacity of dentists who are prepared to provide it [30]. This was emphasised by a local expert: *'The treatment is completely free, but the work is not popular, and we don't have enough paediatric dentists' p11.* There are no data available on out-of-pocket spending for children's dental care in Hungary. However, evidence suggests that privately funded provision is dominant with over 60% of dental care costs across the whole population privately funded [26].

In contrast, the other universal systems (i.e. Denmark, Scotland, and Germany) represent deep coverage with minimal out-of-pocket spending. In Denmark, 'child and youth' oral healthcare is fully funded at the municipality level at a cost of €273 m annually.[4] This includes all direct costs (including salary and pension contributions) along with indirect costs (including labour and equipment costs) funded by general taxation [48]. Oral healthcare for children is offered at public clinics by salaried practitioners, by independent dentists who have entered an agreement with the municipality or by a combination of both approaches [89]. More than 91 out of the 98 municipalities employed their own dentists in state owned practices in 2015. Once young adults reach the age of 22, they are directed to the process of securing a private, independent dentist where they may receive subsidised care that can vary from 35–62% depending on the patients age and treatment [26]. The impact of the salaried structure on the provision of child oral healthcare was discussed by a local expert: *'The subject of dentistry is the focus…not having to deal with who pays for what, but when the child gets to the clinic…it is the child who is in focus, and anyone can afford to get the treatment' P5.*

In Germany (SHI) and Scotland (NHS), children are exempt from all user charges except for orthodontic treatment outside of qualification criteria and more advanced restorative care [24, 49]. Within the SHI, payment for services is on a fee-for-service basis while in Scotland in addition to submitting itemised treatment claims for payment, dentists can also receive a range of other payments, allowances and grants including capitation payments for continuity of care [90, 91]. Many Scottish dental practitioners can provide a mixture of NHS and private (out-of-pocket) treatment. While treatment costs are free for some children and young adults under 26, other adults availing of 'NHS' services pay 80% of the cost of care which is capped at £384 for a course of treatment [91].

The significant public expenditure on dental care in Germany as seen in Table 5, was highlighted across both strands of this research. According to documents from the KZBV (National Association of SHI Dentists) in 2021 over €16.3b was spent on dental care across the population. This was discussed by a German expert: *'We have very high costs…and that is across all healthcare, dentistry is only a small part of the expenditure'.* In Scotland, the budget for oral healthcare for 2023/4 is just over £476 million [91]. While findings from the Scottish Health Survey report indicated that with respect to dental expenditure across the population, 75% of participants had NHS treatment, with 20% of people paying out-of-pocket for dental care [92].

When considering the depth of coverage, a finding common across all the universal systems were concerns about the financial sustainability of those systems into the future and maintaining political support to uphold the current depth of coverage. This was referenced by a German expert: *'I hope that we will hold what we have now' (p1)* and repeated by a Scottish expert: *'We need to hold the level that we have' (p2)* and another, emphasising a potential increase in private-only provision of dental care particularly following the COVID-19 pandemic in Scotland: *'There has been anecdotal evidence of dentists ceasing to carry out NHS work' (p8).*

With respect to the targeted systems (i.e. Ireland and Spain), most oral healthcare services are not covered by the public system and are instead primarily financed through private means across the population. In Ireland, the Public Dental System for children is entirely publicly funded and run by the HSE. This is the only state funded dental care for children and due to its targeted structure, there are significant gaps in coverage resulting in high out-of-pocket payments [27, 28]. According to the Healthy Ireland Survey 2022, over 58% of dental visits by children were paid for by their parents own funds [93]. While national statistics figures show that 77% of dental care was privately funded across the population in 2018 with research finding that out-of-pocket dental costs in Ireland cause financial hardship [28, 68, 94].

Similarly in Spain according to the National Health Accounts System, total spending on dental care in 2020 was 3.7 billion Euros, of which 98.2% was private spending [95]. This is in direct contrast to universal general healthcare in Spain which is largely free at the point of delivery. This represents a key gap in healthcare coverage

[4] Data based on personal communication from 'Government Finances', Statistics Denmark.

and originates from a long-standing tradition of purchasing dental care privately [29, 96]. This was discussed by a Spanish expert: *'Most of the dental treatments in Spain you have to pay from your own pocket, we just don't have public health dentistry…in the general population they don't even know that there is a public dental office' (P13).*

The inequalities that emerge due to large out-of-pocket expenditures were highlighted by participants from Ireland and Spain: *'The percentages might shift from decade to decade but broadly speaking the socio-economic gradient still applies to children's dental disease, poorer people have more disease than better-off people'(P10).* However, tackling inequalities was also a dominant theme across those representing universal systems with the model of oral healthcare system under consideration. This was referenced by a Danish participant: *'The ones who can navigate the system are the ones who don't need it, the socially disadvantaged are the ones who get forgotten in a more economically pressured system' (P5).*

While there were differing opinions with respect to the benefits of a salaried versus a fee-for-service model of payment, there was consensus that an optimal approach involves a combination of both elements. With respect to a salaried payment model a Spanish expert considered: *'There is a risk when you pay for treatment, of over treatment…the salaried system is better because there is no money between the patient and the professional…. especially if you are trying to get people to pay for prevention' (P13).*

The benefits of fee-for-service were considered by a German expert: *'There are pluses and minuses…it is very hard to make care profitable in paediatric practice you need to be very intense…that may drive incentives to do stuff you wouldn't have done otherwise…on the other hand in a salaried system you could end up with underperformance' (P4).* A neutral participant reflected on a combination of both models and highlighted the need for protection for vulnerable groups: *'There is a lot that you can do once it is monitored, and fee-for-service… it is more cost-effective however there is always going to be a group of society that need more time and a safety net…I think a mixture is the optimal'(P7).* While common across most participants was the need for oral health to continue to strive for integration within the general health system: *'At the minute the only ones who care about teeth are the dentists, the general system needs to do more, but dentists are so isolated and its partly their own fault…things are at a tipping point' (P7).*

Reform

A significant finding from this research was the varying successes of different systems in implementing reforms, particularly in expanding coverage for preventive measures. An overview of key milestones is presented in Fig. 2.

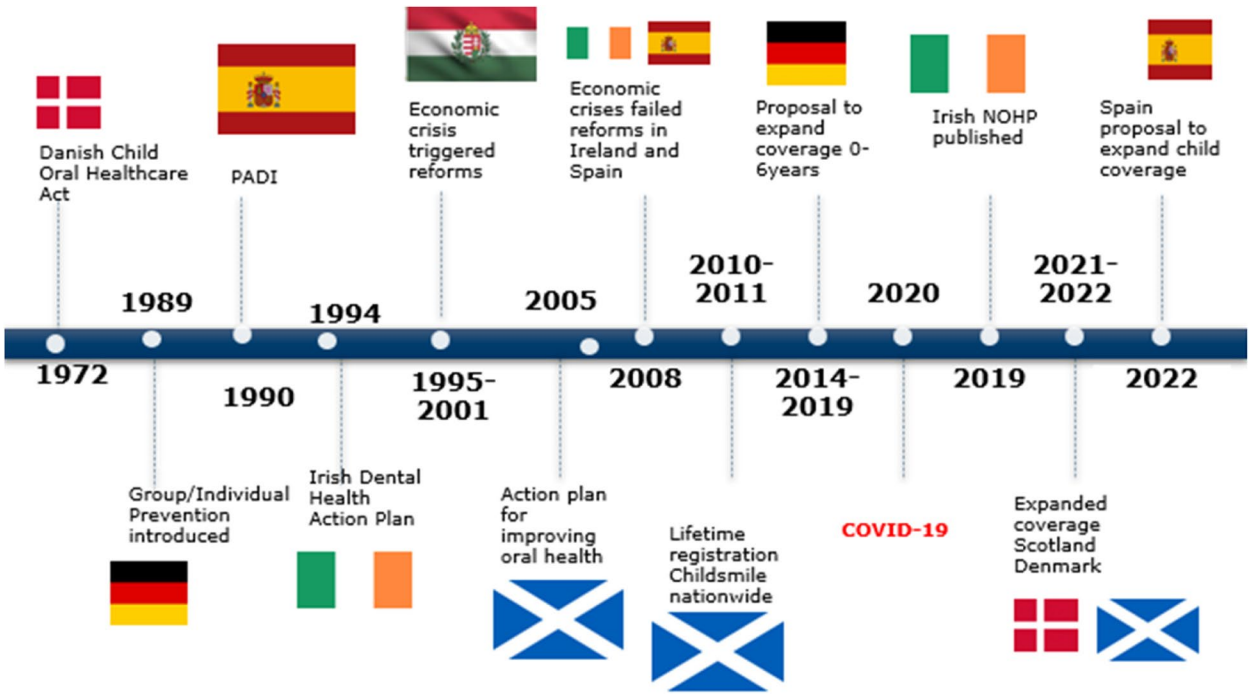

Fig. 2 Milestones- Oral Health System Reforms in Europe

In most universal systems (i.e. Denmark, Germany, and Scotland) the observed trend is one of expanded coverage with broader eligibility for children and an increased emphasis on preventive oral healthcare operating in well-regulated systems. Common factors that facilitated those successful reforms included: political will, engagement with the dental profession and academic collaboration supporting data and evidence.

In Scotland, the Childsmile programme has benefitted from 'strong and successive' government support across three different political administrations since 2005 with funding for Childsmile expansion again announced in 2022 [97]. This political engagement was considered by a local expert where the 'crisis' unfolding with respect to children's oral health was harnessed to engage politicians: *'It was almost by stealth…very slowly creeping oral health on the agenda…using crisis to our advantage and building up a critical mass of successful piloting that it became the norm and using skilled diplomacy' (P2).*

A critical element in the engagement of politicians was the ability of oral health advocates to lobby with high quality data to communicate the problem of oral disease in the child population. This was reflected on by a Scottish participant: *'People don't really understand dentistry or see the value of prevention and the programme could be threatened…one of the most valuable things in sustaining it was the academics showing both a beneficial health outcome and a cost benefit' (P2).* This was echoed by a German participant reflecting on the successful expansion of care for young children in 2019: *'They [politicians] don't really have an interest, so we had a lot of data, facts, and evidence to convince the politicians' (P1).* While in Denmark participants referenced the importance of data in terms of the establishment of the SCOR monitoring system [51] but also stemming from the collaboration between oral health research and dentists: *'The dental schools supported the municipalities the whole culture was shared knowledge' (P3).*

A common finding across countries was the importance of engaging the dental profession in proposed system reform and appealing to the profession from both a financial perspective and in the interests of their patients. This was surmised by a non-aligned participant: *'You need to attract the dentists to work in the service…the only way we can get them…is to put on another layer of attractiveness-additional funding' (P7)* and a Scottish participant: *'You need buy in…you need to meet them…just keep focusing on the patient outcomes' (P2).*

In contrast, there is evidence of a failure to implement existing oral health policies and expand oral health care coverage in recent years, most notable in countries worst affected by the 2008 financial crisis [19, 29]. An absence of political priority and a failure to engage the dental profession were identified as impediments to implementing successful reform by an Irish expert: *'I haven't seen any politician in the last 30 years trying to make dentistry included…unfortunately I don't see the political interest… and engaging the dental profession has to be a core part of delivering on any policy' (P10).* While the failure to update legislation and a regulatory basis for the dental profession were strongly highlighted by both Irish and Hungarian interviewees: *'We don't do anything about quality control and quality assurance…nobody checks is it true, is it good, is it real? (P11)'* and by an Irish expert referencing the failure to reform Irish legislation since 1985 stating: *'The legislation should be there to protect the public and it is inadequate. (P10)'.*

An overview of each child oral healthcare system in the six representative European countries is provided in Table 6.

Discussion

Two broad models of childhood oral health coverage are evident in this research: those systems adopting 'universal' approaches and those restricting coverage by 'targeting' children by age and/or location. However, there are significant nuances within and between these types with Hungary proving the exception in all types of categorisations. Healthcare 'targeting', or rationing refers to the allocation of scarce resources among a patient population [100]. International literature suggests that rising costs and demands on healthcare systems place 'significant pressure' on decision-makers to identify the most appropriate policies for allocating increasingly scarce healthcare resources.

However, critical to that process is in addition to ensuring resources are distributed in a cost-effective manner, they must be done so equitably [100]. Equity concerns arise not only in the absence of oral healthcare coverage but also where 'one part of the population has greater dental coverage than another' [101]. This was seen in both 'targeted' models: where in Ireland, all eligible adults are entitled to an annual dental examination, but children are not [27]; while in Spain the eligibility of children of the same age to care is dependent on their geographical location [29].

In the absence of universal coverage, oral healthcare must be paid for via cost-sharing, private health insurance or via out-of-pocket payments, thus increasing the role of 'private' dentistry within the system [26, 28]. In Ireland, over two thirds of children's care was reported to be privately financed, while in Spain 98% of all dental expenditures is funded via private means [93, 95]. The Hungarian system, despite offering broad coverage, was also found to be dominated by private spending,

Table 6 An overview of child oral healthcare systems in six European countries

Child oral health system overview							
Country	**Dental Caries Prevalence (Most recent D_3MFT at age 12)**	**Coverage**	**Scope**	**Prevention**	**Proportion OOP oral health care***	**Provider payment mechanism**	**Coverage trends**
Denmark[1]	0.38 (2023)[1]	Universal	Comprehensive	Publicly funded	Low	Majority salaried	Expanded
Germany[2]	0.50 (2025)[2]	Universal	Comprehensive	Publicly funded	Low	Majority PP	Expanded
Scotland[3]	0.36 (2023)[3]	Universal	Comprehensive	Publicly funded	Low	Majority PP	Expanded
Hungary[4]	2.32* (2017)[4]	Universal*	Comprehensive	Majority private- (publicly funded, limited access)	High	Majority PP	Reduced
Ireland[5]	1.4/1.8* (2002)[5]	Targeted	Basic	Majority private	High	Salaried	Reduced
Spain[6]	0.58* (2020)[6]	Targeted	Basic	Majority private	High	Majority PP	Reduced

Sources: 1 Sundhedsstyrelsens Centrale Odontologiske Register (SCOR). 2 The Sixth German Oral Health Study (DMS6). Institute of German Dentists. Institut der Deutschen Zahnarzte. Rainer et al., 2025. 3 Public Health Scotland. National Dental Inspectorate Programme. 4 Szöke and Petersen 2020. *WHO pathfinder survey. *Universal coverage but not equating to univeral accessibility. 5 North South Survey of Childrens Oral Health in Ireland. 2002. Mean $D_{3vc}MFT$ for 12- year-olds was 1.4 for those in receipt of CWF and 1.8 for those without. This is the most recently available information with respect to DMFT in Ireland. According to Irelands national oral health policy in 2019: It is estimated that one in 10 children in Ireland (or up to approximately one in five children, depending on their socioeconomic status and their access to water fluoridation) has a disproportionate level of dental decay compared to their peers' [27]. 6 Enucesta de salud oral en Espana 2020 [98]. *Diagnostic criteria used based on WHO 4th edition (1997) which considers caries to be an unmistakeable cavity [99]

* Proportion out-of-pocket spending categorised as low (0–20%), medium (20–50%) or high (> 50%)

Salaried = salaried dental practitioners directly employed by the state, PP = independent (non-salaried) dental practitioners contracted by the state to provide care via fee-for-service, capitation or other means

emphasising that universal eligibility does not equate to universal accessibility [26, 30].

High out-of-pocket payments have been shown to lead to inequalities in children's access to oral healthcare [1, 6, 102]. This research also found access based on ability to pay rather than need [28, 30, 75]. In contrast, broader oral health coverage has been shown to positively influence the use of services [103–105]. More comprehensive coverage was found via SHI in Germany and the NHS in Scotland, while the traditionally high level of subsidies common to Scandinavian welfare systems, was also seen pertaining to Denmark [48, 54–58]. In our findings, these systems had lower levels of out-of-pocket spending on oral healthcare for children and higher rates of access.

The consequences of poor access to care particularly burdens children from lower socioeconomic groups, with evidence citing that although those groups may benefit most from universal oral healthcare coverage, they remain at a disproportionate risk of developing oral disease [1, 103]. Therefore, a 'more radical preventive approach' and a shift in the dominance of treatment focused systems to an emphasis on prevention is required [1, 6, 103, 106]. This is echoed in our analysis which emphasises the need to prioritise preventive oral healthcare and careful consideration of provider payment models for evidence-based preventive techniques, a strong and persistent finding throughout this research.

Preventive oral healthcare had varying levels of priority across the included countries. Except for Hungary, countries offering 'universal' accessibility were also the countries offering the broadest coverage of preventive care. In Denmark and Scotland prevention occupies a central role in children's oral healthcare following the emergence of the Danish Child Oral Health Act and 'Childsmile' respectively, while Germany recently expanded preventive care for young children [56, 79, 97].

Provider payment models for prevention varied across countries, ranging from salaried dental practitioners providing services in Denmark to predominantly independent private dental practitioners contracted by the state and reimbursement on a 'fee-for-service' or capitation basis across the remaining 'universal' countries. A consensus from this research was that a hybrid model of payment incorporating elements of 'fee-for-service', capitation and pay for performance elements, with a 'safety net' salaried component targeting those of high risk is preferable. This reinforces international findings suggesting a risk based, combination of payment methods, is effective in designing preventively focused payment systems [107].

This study highlights the role of dentists across the six representative countries, however further research is required in determining the impact of auxiliary oral healthcare professionals in the delivery of oral healthcare for children. Evidence from the international literature and from the World Health Organisation highlights the need for 'creative workforce development' in improving population oral health and in the delivery of oral disease prevention [31, 108]. In this research, the Childsmile programme was singled out across both strands of analysis,

in terms of its clinical and cost effectiveness as an exemplar of success in oral health prevention. However, in this programme not only do auxiliary oral healthcare professionals (OHPs) but non-dental professionals also play a significant role. 'Extended Duty Dental Nurses' provide tailored oral health advice to individual patients and place regular fluoride varnish applications. 'Dental Health Support Workers' are employed by NHS boards to liaise with families, health visiting teams, nurseries, schools and dental practices. While 'Childsmile coordinators' support dental teams resolving difficulties and in maintaining standards [109]. The impact of supervised toothbrushing delivered in nursery facilities led by these groups, was particularly singled out by 'elites' as critical to the overall success of 'Childsmile'. Contrastingly, within the 'targeted systems' concerns were raised by a Spanish 'elite' participant that prevention was not a central focus within the 'dentist' centric model of care.

Our findings also suggest that an engrained culture of prevention within a system, political support, and funding, combined with good data to advocate for its importance and monitor its success, have supported the implementation of evidence based preventive policies. Furthermore, common to those countries has been the ability to proactively seek both regulatory and system reform with a focus on the expansion of prevention and achieving that success through engagement of dental professionals, oral health research and political interest.

In contrast, countries where private provision of care is dominant offer little publicly funded preventive care, have also struggled to implement reform with limited political support and have been subject to significant funding reductions. Both Ireland and Spain faced severe impacts from the 2008 global financial crisis, leading to substantial cuts in oral healthcare budgets [28, 29, 71, 110]. Subsequent policy and reform efforts in both countries were unsuccessful, resulting in increased unmet oral healthcare needs and notable socioeconomic disparities, especially among children who experienced a significant reduction in the availability of care [19, 28, 29, 96].

Both the global financial crisis and the COVID-19 pandemic can each be classified as a health system 'shock', that is 'an unexpected occurrence…that has a large negative effect on the availability of health system resources or a large positive effect on the demand for health services' [111–113]. As evidenced in this research by experiences in Ireland and Spain, oral healthcare was particularly susceptible to coverage restrictions within the broader healthcare system post the economic crisis [28, 110]. While despite being classified as 'essential' healthcare during the COVID-19 pandemic, evidence shows that across many countries there was a 'widespread decline' in children's oral health status and access to oral healthcare [114, 115]. The vulnerability of oral health within the broader health system as highlighted by the impact on oral healthcare during such 'shocks' must be recognised by oral health policy 'champions' in advocating for the wider integration of oral health within general healthcare [2, 116].

This research finds that children's oral healthcare in Europe is currently at a 'tipping point'. Within 'universal' systems there is concern about the financial sustainability of broad baskets of coverage in the context of changing socioeconomic demographics. In Scotland, registration rates of children with the NHS have failed to recover following the COVID-19 pandemic with concerns that the substantial oral health improvements gained since the advent of 'Childsmile' may have 'stalled' [91]. While in Hungary there are concerns with respect to accountability and regulation, with calls to replace the 'out-dated' children's oral healthcare system [30]. In Ireland and Spain, new national oral health policies have been published, clearly recognising inequalities that are prevailing with respect to the targeted systems for children supported by proposals to expand the availability of preventive care in line with 'universal' general healthcare policy [27, 76].

The World Health Organisation has led the recent global recognition of the neglect of oral health from a policy and political perspective, and advocates for the integration of 'essential oral healthcare' in the 'Global strategy and action plan on oral health 2023–2030' [31]. However, the global literature highlights the challenge in defining what constitutes 'essential oral healthcare' [116]. This was further reinforced in this study by highlighting the variation in the breadth, depth and scope of oral health coverage across representative European countries. The gap between those countries with very limited or any coverage of basic oral healthcare for children, compared with those providing broad and deep coverage, highlights the difficulties in achieving consensus on the definition. Participants from universal systems highlighted concerns of financial sustainability particularly from a 'fee-for-service' perspective while 'targeted' systems have struggled to expand coverage and implement reform. It is evident that defining 'essential oral healthcare' will require differing approaches at an individual country level requiring consultation with the oral healthcare profession, policymakers and evidence-based assessment of potential expanded or refined benefit baskets based on resource availability, workforce capacity and political and societal acceptability [116, 117].

This renewed focus on the incorporation of oral health within UHC however must be harnessed by countries, most especially those operating in targeted systems, to

expand coverage and implement necessary reform [26, 116]. While, across all countries, advocacy for oral health must be sustained by engaged oral health professionals, using high quality data and information while maintaining an emphasis on oral disease prevention and the inequalities burdening lower socio-economic groups.

Limitations/strengths/potential contributions

The authors wish to recognise several limitations inherent in this research. It is important to highlight the weaknesses prevailing in the study data, particularly in the comparability of data between countries. There was wide variability in data availability and reporting mechanisms across differing countries which posed challenges for direct comparison. While the lack of standardised oral health system indicators at the European level further constrained overall assessment of oral healthcare systems performance. To ensure maximum transparency, this paper reports data with identified sources and the year reported. Beyond data weaknesses further challenges pertain to the applicability of study findings. The range of differing policy contexts, government structures and financing mechanisms along with cultural influences between countries mean that while these findings offer valuable insights, direct policy transferability may be limited. While this study highlights key policy trends and oral healthcare system differences causal relationships cannot be inferred. Further longitudinal research and country-specific case studies are necessary to determine the long-term implications of different models of oral healthcare coverage. A final point of consideration is that to satisfy the research aim, 'elite' actors operating in positions of influence within the oral healthcare system were recruited for interview. As a result, almost all ($n=13/14$) 'elites' included were dentists which may have limited consideration of the roles of other oral health professionals within the wider oral healthcare system which should be a priority for future research.

Despite these limitations this study represents an important addition to the discourse on oral health coverage for children in Europe. The key strength of this paper is the use of multiple data sources and the triangulation of that data to strengthen the study findings. While the use of the WHO cube and a verified data collection template guided data collection and analysis. Inter-country comparisons have proven challenging with respect to language barriers and a failure to appropriately contextualise information. To ensure country specific data was both representative and accurate, two ($n=2$) local country experts were recruited from each country to verify the accuracy of the data and to add context. There is limited knowledge on oral health coverage for children in Europe, an evidence gap which this in-depth multiple case study analysis serves to fill. In view of the data challenges highlighted, it is incumbent on the authors of this research to call for the development of comprehensive and systematic oral health system indicators. This information will be critical to monitor and compare oral health system performance into the future and in the identification of the most appropriate oral health system interventions and policies. While the variation in oral healthcare coverage across Europe highlighted points to the need for further research on what constitutes essential oral healthcare and where oral disease prevention, and upstream interventions feature in this domain.

Conclusion

Oral healthcare coverage for children varies across the European countries analysed from those adopting universal approaches to those 'targeting' specific groups, with the financial burden assumed by the individual in countries without universal coverage. Countries adopting universal approaches demonstrated greater access to services and a broader scope of preventive care. However, a key finding was the need to shift the focus from a treatment-dominated system to one centered on preventive care. Most universal systems have successfully implemented system and policy reform through high-quality data, collaboration with dental research, political engagement, and the support of the dental profession. However, the vulnerability of oral health within the wider health system is an ongoing challenge and is most evident during times of pressurised resources such as the economic crisis or the aftermath of the COVID-19 pandemic. To progress the implementation of UHC for oral health, consideration will be needed with respect to reducing inequity from those excluded from care, the development of quality information to support advocacy, placing an emphasis on oral disease prevention and integrating oral health within the broader health system.

Abbreviations

UHC	Universal Health Coverage
SHI	Social Health Insurance
NHS	National Health System
TF	Tax Funded
WHO	World Health Organisation
HSE	Health Service Executive
CWF	Community Water Fluoridation
OOP	Out of Pocket
SDR	Statement of Dental Renumeration
CSO	Central Statistics Office

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-025-05773-1.

Supplementary Material 1.

Acknowledgements
We wish to sincerely thank the local experts who reviewed data, provided supplementary information, and participated in interview for this research.

Authors' contributions
All authors, UMA, SB, KE, MH, HW and JC contributed actively to this paper. The design of this study was developed by UMA, SB, and KE. UMA was responsible for data collection and analysis. Feedback on the analysis and the interpretation was received from all authors. UMA drafted the paper for submission and all authors approved the final version.

Funding
At the time of the research Dr McAuliffe was funded by the Irish Health Research Board (HRB) as a PhD Scholar of the HRB's Cross-Institution PhD Scholar Programme in Population Health and Health Services Research (SPHeRE). HRB Grant code: SPHeRE20181.

Data availability
The final datasets generated and analysed are not publicly available to maintain the anonymity guaranteed to individual study participants, but individual country case studies based on the documentary analysis may be available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval for the study was granted from the Clinical Research Ethics Committee of the Cork Teaching Hospitals at University College Cork (Reference number: ECM 4 (J)12/11/2019). Ethical considerations including ensuring confidentiality, obtaining informed consent, and preserving anonymity were always adhered to. Informed consent to participate was granted by each participant.

Competing interests
The authors declare no competing interests.

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Received: 25 March 2024 Accepted: 10 March 2025
Published online: 05 April 2025

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