# An investigation into the factors influencing decision making regarding the management of carious primary teeth under general anaesthetic

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The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others.

# Dedication

To my family, and to every child who cried from a toothache.

# Acknowledgments

As I reach the end of this long and humbling journey, my heart overflow with gratitude for the people who stood beside me with unwavering love, and the constant blessings that carried me through.

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# Abstract

Caries in primary teeth remains a common reason for Paediatric Dental General Anaesthesia (PDGA) in the United Kingdom (UK). Different treatment options are available for carious primary teeth under general anaesthesia (GA), ranging from restorative treatments to extraction. Variation in treatment planning has been observed in practice, but the reasons underlying these decisions are not well understood.

**Aim:** To explore the factors that influence paediatric dentists' decision-making, when planning treatment for children with carious primary teeth under GA in the UK.

**Method:** A qualitative cross-sectional study, informed by an interpretivist- constructivist approach. using focus groups was conducted with paediatric speciality trainees, specialists and consultants within the UK, who were all recruited through the British Society of Paediatric Dentistry (BSPD). Focus groups were conducted online and recorded, then transcribed. Data were analysed using reflexive thematic analysis to explore clinicians' reported views and experiences of treatment planning carious primary teeth under GA.

**Results:** Nineteen participants took part in three focus groups. Participants described variation in treatment planning under GA, which they related to different treatment philosophies, training backgrounds and organisational arrangements. Modified Hall technique, was the treatment of choice, when aiming to preserve teeth. Participants described reluctance to provide vital pulp therapy (VPT) under GA, despite supportive evidence-based guidelines, because of predictability concerns and risk of repeat GA. Decision making was reported to be influenced by experience, workplace hierarchy and service pressures, including waiting lists, workforce limitations and the type of GA list available. Participants also emphasised the importance of parental expectations, shared decision-making and perception of families' ability to maintain oral health.

**Conclusion:** Treatment planning for carious primary teeth under GA was described to be influenced by interactions between clinical, family and service-related factors. The findings provide insights into how UK paediatric dentists explain their decision-making and highlight the importance of aligning treatment planning with current evidence, supporting shared decision-making and address organisational barriers to comprehensive care.

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## List of Abbreviation (A-Z)

| | |
|---|---|
| AAPD | American Academy of Paediatric Dentistry |
| ASA | American Society of Anesthesiologist |
| BMI | Body Mass Index |
| BSPD | British Society of Paediatric Dentistry |
| DMFT | Decayed, Missing, Filled permanent teeth |
| dmft | Decayed, Missing, Filled primary teeth |
| DMP | Data Management Plan |
| EAPD | European Academy of Paediatric Dentistry |
| ECC | Early Childhood Caries |
| ECOHIS | Early Childhood Oral Health Impact Scale |
| FG | Focus Group |
| GA | General Anaesthesia |
| GDC | General Dental Council |
| LA | Local Anaesthetic |
| NICE | National Institute for Health and Care Excellence |
| OHRQL | Oral Health Related Quality of Life |
| PDGA | Paediatric Dental General Anaesthesia |
| PHE | Public Health England |
| SHCN | Special Health Care Needs |
| SSC | Stainless Steel Crown |
| VPT | Vital Pulp Therapy |

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# 1. Introduction

The goal of paediatric dentistry is to deliver a high standard dental treatment that removes the disease while ensuring the safety, comfort and overall well-being of the child throughout the treatment process. Dental caries in primary teeth is still a very common problem in childhood, and if left untreated can lead to pain, infection, disrupted sleep and difficulty eating and speaking, and a negative impact on the child and their family (Pahel et al., 2007). Therefore, providing effective and timely dental treatment for children is an essential part of maintaining both oral and general health.

Some dental treatments can be painful and anxiety-provoking without using any source of pain relief, especially for young children or those with previous negative experiences in the dental environment (SDCEP, 2025; NHS, 2023). In paediatric dentistry, there are various methods and techniques used to ensure minimal or no discomfort during dental treatment. These methods fall into two broad categories: non-pharmacological and pharmacological methods. Non-pharmacological methods include communication and behavioral management techniques, such as tell-show-do, positive reinforcement, distraction and desensitization, which aims to help the child understand what is happening and to cooperate in the dental chair. Pharmacological methods include the use of local anesthetic (LA), sedation and general anesthesia (GA), which acts directly to control pain (LA), or pain and anxiety (sedation and GA) (Dean, McDonald and Avery, 2016; SDCEP, 2025; EAPD, 2024).

The use of LA and behavioural management techniques is commonly used for children who are able to co-operate throughout the process in the dental chair. Unfortunately, for many children this is insufficient to allow safe and effective treatment delivery, so more advanced techniques are sometimes required. The literature suggests common characteristics of these children include being very young and pre-cooperative, children with extensive caries affecting multiple teeth, severe dental anxiety, medically compromised, developmental or behavioural conditions (Colak etal., 2013). In these

situations, sedation or GA may be considered to enable dental treatment to be completed in a single visit safely.

While the goal is to deliver safe and effective dental treatment, there might be differences in the type of dental treatment being provided when different methods are being used. Treatment plans under GA maybe different from the treatment plans under LA. In the UK when commencing a treatment under GA it is unclear why one treatment is chosen over the another, as some children receive comprehensive dental treatment under GA, while other receive extraction even when the teeth may be restorable (Sanders et al., 2019; Alkhouri et al., 2022).

It has been shown that in the UK some services have different arrangements for GA lists (Sanders et al., 2019; Alkhouri et al., 2022). Some services provide comprehensive GA lists where restorative and preventive procedures can be performed, while other provide exodontia only lists. This means that some children might be offered different treatment plan depending on the service they are referred to, and the type of GA list available. As a result, there is potentially variation in the management of carious primary teeth under GA (Sanders et al., 2019). This variation has been described as “postcode lottery”, where treatment options are influenced by where an individual lives and the service they visit.

The literature review confirms that different treatment modalities are available for managing carious primary teeth. National and international guidelines in paediatric dentistry describes when to use the different treatment options and support an individualised treatment planning. However, there is limited literature specifically exploring the factors that contribute to the treatment plan decision-making process under GA within the UK, and the reasons for choosing one specific treatment over the other when children are planned for GA.

Most of the existing research studies focus on treatment outcomes after PDGA, characteristics of the child having a PDGA, anxiety after PDGA, or waiting times for PDGA, rather than on how pediatric dentists actually think and justify their treatment plan in their setting. It is unclear how the clinical factors, child- and family-related factors, and service-related factors all together play a role in shaping the final treatment plan.

This research aims to address this gap by understanding which factors are important and how they contribute to the decision-making process when paediatric dentists choose their treatment plans for carious primary teeth under GA in the UK. The study used focus groups with specialty trainees, specialist and consultants in paediatric dentistry who are currently practicing in the UK, to explore their experience, views and reasoning when planning dental treatment for children under GA. By gaining these insights, this research will hopefully provide a clearer picture of current practice for PDGA treatment planning and identify potential areas for supporting better decision-making processes.

# 2. Literature review

In this chapter, the research literature concerning caries, the impact of caries on the child, and different treatment modalities for managing caries in primary teeth was reviewed, with a particular focus on paediatric dental treatment under GA.

## 2.1 Dental Caries

Dental caries is currently defined as “A biofilm-mediated, diet modulated, multifactorial, non-communicable, dynamic disease resulting in net mineral loss of dental hard tissues.” (ORCA, IADR, 2020). This contemporary definition reflects a shift away from older models that describes caries as purely infectious process caused by individual pathogens, toward a broader understanding of caries in which it arises from an imbalance between the pathological and protective factors.

This shift in the literature led to different types of evidence in caries, ranging from microbiological mechanisms to behavioural, environmental and social determinants. As a result, the evidence base for caries aetiology includes laboratory, epidemiological and public health research, varying in methodological strength and relevance in clinical decision-making.

### 2.1.1 Caries aetiology

The aetiology of dental caries is multifactorial, arising from an interaction between dental biofilm, fermentable carbohydrates, host factors such as the oral microbiota, salivary flow, tooth morphology, and a wider behavioural and social influences (Pitts et al., 2017; Machiulskiene et al., 2020). Although these determinants are well recognised, the supporting evidence vary. Biological mechanisms are usually experimental, laboratory and clinical research, whereas behavioural and socio-economic determinants are supported by mainly observational evidence, which are valuable for identifying associations but remains at risk of confounding variables (Kirthiga et al., 2019; SDCEP, 2025).

#### 2.1.1.1 Oral microbiota and dental biofilm

Earlier cariology literature was mainly emphasising on specific organisms, particularly Streptococcus mutans and lactobacilli, in the initiation and progression of caries (Loesche,1986). Suggesting that early transmission from mothers or other primary caregivers, may contribute to increased caries risk (Caufield et al., 1993; Berkowitz, 2006; Gussy et al., 2006). These organisms remain important because of their acidogenic and aciduric properties and their association with a cariogenic biofilm environment (Pitts et al., 2017). However, this model has been challenged by contemporary evidence, which suggests that caries is not only caused by the presence or absence of a single bacterial species. Instead, the current understanding favours an ecological view in which frequent exposure to sugar promotes a biofilm environment that is susceptible to deminarlisation (Marsh, 2006; Pitts et al., 2017). In this view, dental plaque is now understood as a structured biofilm on the tooth surface rather than an accumulation of deposits, and its cariogenicity depends more on its ecological balance and metabolic activity than on its presence only (Marsh, 2006; Nobbs et al., 2011). This broader understanding helps explain why caries may occur in absence of traditionally emphasised species and why the caries preventive strategies used now targets the biofilm environment through dietary control, fluoride exposure and mechanical biofilm removal rather than microbial eradication alone (Takahashi et al., 2011; Pitts et al., 2017).

#### 2.1.1.2 Dietary sugars and substrate

Frequent consumption of fermentable carbohydrates particularly mono and disaccharides, is a well-established contributor to the development of dental caries. These sugars are metabolised by bacteria within the dental biofilm, producing acid as a by product that lowers the PH and promotes demineralisation (Pitts et al., 2017; WHO, 2025). The frequency of intake, not the quantity is the main reason for the initiation and progression of caries as it causes a constant drop in the pH level (Tinanoff et al., 2000).

#### 2.1.1.3 Saliva and host protective factors

Saliva is an important host protective factor against invading microorganisms by oral clearance, the buffering capacity which neutralise the pH level within the oral cavity and reminaralisation of the enamel (Pitts et al., 2017). Additionally, saliva acts as a lubricant which facilitates speaking, eating and swallowing, so its role in oral health extends beyond caries prevention (Lenander-Lumikari et al., 2000). Earlier literature emphasised on the salivary flow rate and buffering capacity, and this was known as “salivary clearance” (Lagerof et al., 1994). This biological rationale remains valid; however, the relationship between salivary parameters and caries risk is more complex than what it was described earlier. Although the reduction in salivary flow and impaired buffering capacity are associated with increased caries risk such as in those who have xerostomia, medical conditions or other causes of salivary dysfunction, the evidence in healthy children is less consistent and is derived largely from observational studies (Cunha-Cruz et al.,2013: Pitts et al., 2017). This is important to consider, as salivary flow, PH and buffering capacity are biologically risk indicators, which means they may have limited predictive value when considered in isolation, as caries is also influenced by other factors simultaneously such as diet, fluoride exposure, oral hygiene and other social determinants (Simon-Soro et al., 2018; Pitts et al., 2017).

#### 2.1.1.4 Tooth morphology

The morphology of the tooth may increase caries, such as deep pits and fissures, as they can retain biofilm and can be difficult to clean. In a five year follow up study, it has been reported that children with deep molar fissures were more likely to develop caries lesions, compared to children with shallow fissures (Sánchez-Pérez et al., 2019). Dental enamel defects are also considered as a risk factor in caries risk assessment according to AAPD (AAPD, 2025).

#### 2.1.1.5 Behavioural and socio-economic factors

Behavioural and socio-economic factors are strongly associated with childhood caries, particularly early childhood caries (ECC). The enamel of the newly erupted teeth is still

immature, so adding sweeteners to bottles and continuous bottle feeding throughout the night without any preventative measures will increase the risk of ECC in 12-month infants (Gussy et al., 2006; AAPD, 2025; WHO). ECC was strongly linked to the inappropriate use of baby bottle especially at bedtime (Gussy et al., 2006; Çolak et al., 2013). However, this maybe confounded by other factors such as fluoride exposure, oral hygiene, diet, parental/ caregiver health literacy and socio-economic disadvantages. Recent literature has therefore suggested that these behaviours should be interpreted within a broader social determinant such as poverty, lower parental education, deprived locations, access to preventive care rather than as an isolated parental choice (El Tantawi et al., 2024; WHO, 2025).

### 2.1.2 Caries prevalence

According to the latest epidemiological statistics from Public Health England (PHE, 2020), 10.7% of 3-year-old children had dental caries with an average of three affected teeth. Children in the most deprived areas were three times more likely to experience dental caries, thus, 1 in 10 children had dental caries. In some areas it was as high as 1 in 4. Salford had the highest prevalence 27.5%, although these statistics were terminated 3 months before the end of data collection due to the outbreak of Covid-19 so results might be underreported (PHE, survey of 3 years old,2020).

Caries rates in 5-year-old children showed a small improvement in 2024 compared to 2022 (PHE, 2024). The proportion of children who had early enamel and/or dentine caries decreased from 29.3% to 26.9%. While the mean decayed, missing, filled teeth (dmft) among the affected children remained at about 3.5 affected teeth. Socio-economic and ethnic inequalities still persisted, with children from the most deprived areas still being more than twice as likely to have caries as those from the least deprived areas.

These surveys are important because they provide population level estimates of disease burden. However, they are epidemiological studies and therefore describe the distribution of disease rather than explaining why some children develop severe caries, why inequalities persist. Additionally, prevalence statistics may underestimate the complexity

of disease experience, as children may differ considerably in terms of symptoms, lesion activity and access to dental care.

### 2.1.3 Impact of caries

Caries isn't only an oral disease but can have consequences for the child, family and health economy. The literature suggest that its impact extend beyond clinical symptom and include reduced quality of life, disruption of daily activities, family burden and healthcare cost.

#### 2.1.3.1 Quality of life

Numerous studies have evaluated the impact of oral health on quality of life. Pahel et al. (2007) developed a validated scale, the Early Childhood Oral Health Impact Scale (ECOHIS), which remains one of the most widely used measures for assessing the effect of oral health problems and treatment on the quality of life of preschool children and their families. Although ECOHIS provided a structured and validated parent reported outcome measure, it's based on parental reporting which may not capture the child's own experience, such as pain, embarrassment or social impact.

Poor oral health in children has been associated with pain, infection, difficulties eating, sleeping, socialising, and absence from school. National reports in England highlight these impacts, including care givers absence from work to attend dental appointments (PHE, 2020). Pahel et al. (2007), found that there was a significant association between reduced quality of life and poor oral health in children. A recent systematic review and meta-analysis combining eight studies investigating the impact of ECC on oral health related quality of life (OHRQoL) in 5,154 children with ECC and 4,954 controls, found that children with severe ECC reported substantially great negative impact on their OHRQol compared to caries free children (Zaror et al., 2022). This provides stronger evidence than individual cross-sectional studies alone because it combines findings across multiple studies. However, there are heterogeneity across the included studies, and many of the evidence included were observational and parent reported, which may limit causality and

may dilute or amplify the measured effect depending on the study setting and population characteristics.

The indirect effect on the child's family quality of life is recognised as well. The Family Impact Scale (FIS) was developed to measure the impact of child health on families (Abanto et al., 2012). Study results show that childhood caries had a negative impact on their parents' quality of life. The parents feel more emotional because the severity of caries often leads to a noticeable appearance which raises concerns for the child's future opportunities, feeling guilty or blamed for their child's dental caries, and missing work to attend dental visits with their child. Additionally, the child may need extra attention from the parent to alleviate discomfort associated with the condition. These factors combined, means that dental caries has a negative impact on the child and their family, both during childhood and the long term (Steele et al., 2015). More recent studies report similar findings, suggesting that severe caries can affect both the child and family beyond the immediate clinical consequences. However, much of this literature is cross-sectional, which means that even when the associations are consistent, it is difficult to separate the effect of caries itself from wider social and economic pressures faced by families (Abanto et al., 2012; BaniHani et al., 2018; Abed et al., 2020).

#### 2.1.3.2 Economical impact

Caries is a common reason for hospital admission for children in some developed countries (WHO,2007). In England, dental extractions under GA were the most common reason for children being admitted to hospital in England (Levine, 2021; OHID,2024). A UK hospital series has reported that around 85% of teeth extracted under GA were primary teeth rather than permanent (Raja et al., 2016). This means dental caries has a considerable economic impact for healthcare services, arising from both the treatment costs and indirect costs like absence from work and reduced productivity.

At a global level, it has been estimated that in 2010 dental diseases accounted for approximately US$298 billion in treatment costs, representing an average of 4.6% of the total global health spending. Additionally, the yearly indirect costs linked to dental diseases totalled US$144 billion, equivalent to economic losses comparable to the top 10

most common global causes of death (Listl et al., 2015). These figures were influential in drawing attention to the significance of oral disease. However, Listl et al. (2015) generated these figures using a cost of illness approach, direct treatment costs were estimated by gathering national outpatient dental expenditure data and scaling these to global totals, as the expenditure data was not identifiable for all countries, and therefore relied on estimations rather than actual measures. More recent modelling using Global Burden of Disease 2019 data suggested that the worldwide economic impact of oral conditions has increased to around US$710 billion, which reinforces the arguments about oral diseases creating substantial and growing economic burden (Jevdjevic et al., 2025). The more recent modelling remains useful for understanding the scale, but like all global burden models, it depends on assumptions.

In terms of population health, oral conditions are responsible for a large number of children who are living with diseases. Kassebaum et al., (2017) showed that between 1990 and 2015, the number of people with untreated oral conditions has risen from 2.5 to 3.5 billion, with 64% increase in the disability related to oral diseases. The overall health impact linked to oral conditions is comparable to that of major non-communicable diseases such as hypertensive heart disease, schizophrenia, and the combined impact of all maternal conditions (Kassebaum et al., 2017). These findings are important because they position oral disease within the wider burden of non-communicable diseases. However, these studies aren't specific to caries in primary teeth, and therefore, their relevance to paediatric dental caries is indirect rather than direct.

In the UK, treatment of dental caries in children represents a high recurrent cost for the NHS. The national report of 2012/2013 shows dental treatment is costly for the NHS, with £30 million spent on hospital-based tooth extractions for children, rising to £50.5 million in 2015/2016 (Kirby et al., 2020). The most recent figures in 2024 report there were 49,112 hospital GA extractions in young people aged <19 years, with 62% due to dental caries. The associated cost was £74.8 million for all extractions and £45.8 for dental caries-related cases (OHID, 2025). While these findings provide up to date national estimates cost, they do not capture the societal costs of disease such as parental work absence or longer-term consequences for children and families.

## 2.2 Caries management

### 2.2.1 Prevention

Caries prevention is a fundamental part of dentistry. There are different ways to prevent caries including diet control, use of fluoride, oral hygiene and provision of interventions by dental professionals. Contemporary guidance continues to support prevention as the first line approach to caries management; however, the strength of evidence differs between the different preventive strategies. For example, the evidence about fluoride use, especially fluoride toothpaste, is stronger and more consistently supported by systematic reviews and guidelines more than other behavioural interventions (Pitts et al., 2017; Delivering Better Oral Health, 2025).

Fluoride can be delivered systemically through water fluoridation, and topically by health professionals and oral hygiene products. Ingestion of water containing fluoride has historically been considered to allow the dental tissue to become more resistant to demineralisation (Gussy et al., 2006), current understanding places greater emphasis on the topical effects of fluoride at the tooth surface and within the dental biofilm rather than on the systemic ingestion alone (Pitts et al., 2017). Fluoride can be supplemented in different concentrations such as Sodium Fluoride (NaF), Stannous Fluoride ($SnF_2$) or acidulated fluorophosphate (APF), and most commonly delivered in the form of toothpaste. Current UK guidance states moderate to high certainty of evidence on fluoride toothpaste containing 1,000 ppm fluoride or above, in preventing dental caries in both primary and permanent dentitions, with recommendation of adjusting the amount of fluoride according to age (Delivering Better Oral Health, 2025).

This is also supported by systematic review evidence. A Cochrane review found that fluoride toothpaste reduces caries compared with non-fluoridated toothpaste (Marinho et al., 2003), and a later Cochrane review on fluoride toothpaste of different concentrations, concluded that toothpaste containing 1,000 ppm fluoride or higher are more effective in preventing caries in children and adolescents, although the quality and amount of evidence varies between concentration comparison (Walsh et al., 2019). This is important

as it shows that fluoride toothpaste is not simply one preventive options among many, but is in fact one of the most strongly supported intervention in the evidence base.

High concentrations of fluoride (>2,500 PPM) which is delivered professionally, may enhance remineralisation and reduce demineralisation, some laboratory and clinical studies suggest additional effects on bacterial metabolism within the biofilm (Pitts et al., 2017). But the evidence for a clear bactericidal effect is less certain than the evidence for fluoride remineralisation effects. Therefore, topical fluoride is best understood as an agent that shifts the balance to remineralise rather than an antimicrobial agent (Pitts et al., 2017; Delivering Better Oral Health, 2025).

Water fluoridation has long been considered as an important population level caries prevention measure. The 2015 Cochrane review in water fluoridation concluded that water fluoridation was associated with reduction in children's' caries (Iheozor-Ejiofor et al., 2015). Although much of the available evidence came from older studies, conducted before 1975, the applicability of some findings was limited. The updated 2024 Cochrane review, similarly, reported that adding fluoride to water may lead to slightly less dental caries in children's primary teeth (Iheozor-Ejiofor et al., 2024), which reflects a more cautious interpretation of the evidence than older review suggestion.

It is important to note that all the UK's water is fluoridated. In England, the most recent health monitoring report states that about one in 10 people live in areas where is added to public water supplies, and approximately 85% of the population live in areas with average drinking water fluoride concentration below 0.40 mg/L. Long standing fluoridation schemes are concentrated mainly in large part of West Midlands, with smaller schemes in parts of the North East, East Midlands, Eastern England, North West, and Yorkshire and the Humber (PHE, 2018; Fluoridation Toolkit, 2022; UKHSA, 2026). These data are important in illustrating that fluoridation is targeted and not widely available within the UK, and therefore some epidemiological findings about caries cannot be generlised across the UK population.

Other preventive measures include professional detection of early signs of caries (Colak et al., 2013), diet counseling and modification by eliminating night feeding and reducing the frequency of sugar intake, and introducing toothbrushing as soon as teeth erupt (Delivering Better Oral Health, 2025).

### 2.2.3 Minimally invasive dentistry

Minimally invasive dentistry is an approach that is based on preserving the healthy teeth structure as much as possible by minimising the cutting of teeth. The primary goal is to defer any intervention as long as possible while controlling the disease (Murdoch-Kinch et al., 2003). More recent literature has refined this concept by emphasising that minimally invasive dentistry is not simply “doing less treatment’’, but about selecting the biologically appropriate, evidence-based startigies to arrest, reminarlise, seal or restore lesion while preserving tooth structure and pulpal health (BaniHani et al., 2022). This reflects an important debate in the field, as minimally invasive approaches are not considered temporary treatment to defer conventional treatments but is in fact considered as definitive treatments in their own.

Basic principles follow a systematic approach of correct diagnosis of lesion, prevention, arresting active lesions, remineralisation and monitoring non-cavitated lesions then finally, restorations with minimal cutting and using durable restorative materials (Arrow et al., 2017). Current evidence supports a range of minimally invasive options in primary teeth, including fissure sealants, selective caries removal, atraumatic restorative treatment (ART), the Hall technique and silver diamine fluoride (SDF) (BaniHani et al., 2022; SDCEP, 2025), although the quality and quantity of evidence varies between techniques and clinical indications.

Hui and colleagues in 2019, investigated the difference between traditional treatments and minimally invasive modality and concluded that there were no difference regarding microleakage, secondary caries, and restorative failure while the minimally invasive procedures were superior in patient’s anxiety control, treatment time, pain sensation and plaque control. Clinically, this finding is important, particularly in paediatric dentistry,

because reducing procedural discomfort and enhancing cooperation are highly relevant outcomes. This is supported by (Mackenzie et al., 2017) who found advantages of this modality include minimising unnecessary tooth structure loss, prevention of caries progression, reducing the risk of iatrogenic damage to adjacent teeth and soft tissue, maximising the strength of remaining teeth structure by using an optimal restoration, restoration of function and aesthetics and reduction of patient's anxiety. However, studies that compares minimally invasive and conventional approaches, often include different lesion types, operator experience and restorative materials, which can affect comparability. Therefore, while these findings support minimally invasive techniques, they should be interpreted within a broader context of patient care.

The importance of minimally invasive and biologically oriented care was also highlighted by the FiCTION trial, which was multi-centre randomised controlled trial conducted in UK primary care, the trial compared conventional management with prevention (C+P), biological management with prevention (B+P), and prevention alone for carious primary teeth. The trial found no clear evidence that one strategy was superior to the others in terms of preventing dental pain or infection over the study period (Maguire et al., 2020). This trial challenged the assumptions that conventional treatments are always superior, however, the FiCTION trial was conducted in primary setting so it may be limited to certain patient's characteristics as opposed to those with extensive disease requiring specialist care under GA. Moreover, the outcomes were measured largely through parent reported questionnaire and modified child anxiety scale, which may limit true presentation of child's own experience (Freeman et al., 2020).

Minimally invasive techniques would be beneficial in very young patients with early childhood caries as it reduces dental anxiety with minimal intervention and incorporates preventive caries management (Arrow et al., 2017). However, there are some limitations to minimally invasive dentistry as it is operator dependent, meaing that the success of the procedure depends on the clinician's judgment and technique, and it also relies on the hardness of remaining dental tissue and the type of material used (Weisrock et al., 2011).

### 2.2.4 Caries removal and restoration

Restorative materials in dentistry are continuously advancing with a variety of materials available on the market. The material of choice depends on multiple factors such as age, caries risk, longevity, and cooperation of the child (Mahoney et al.,2013). When treating a child under GA, the material of choice should always be the highest standard of material that is known to have longevity with minimal future intervention, as failure of the material would put the patient at risk of further decay and potentially another PDGA. Current literature suggests that no single restorative material is universally superior in all clinical situations, and outcomes depend on the tooth involved, cavity type, pulpal status, operator technique and follow up period (Chisini et al., 2018; Amend et al., 2022). Recent review developed to support the European Academy of Paediatric Dentistry Guidance have also highlighted that, despite the wide range of restorative materials available, the evidence base remains heterogeneous and often with moderate to high risk of bias, therefore, limiting the strength of recommendation of one material over another (Amend et al., 2022).

Balkaya et al. (2019), conducted a randomised, prospective clinical trial evaluating the one year clinical performance of three materials in class II restorations in permanent teeth. In total, 109 restorations were placed in 54 patients using bulk fill composite, conventional composite and reinforced glass ionomer. Both bulk fill and conventional composite had higher performance than reinforced glass ionomer. While this study is useful in demonstrating the performance of materials under controlled clinical conditions, its relevance to the present topic is limited because it involved permanent teeth and was not taken in the context of treatment under GA.

Tate et al. (2002) performed a retrospective review of 504 paediatric dental rehabilitation records under GA at two children's hospital in USA, they have found that stainless steel crown (SSC) had the least failure rate compared with amalgam and composite restorations, and composite strip crowns had the highest failure rate, the authors concluded that SSCs were the most reliable option and composite being the least for treatment under GA. Similarly, when Hutcheson et al. (2012) evaluated the success

between conventional composite and stainless crown following pulpotomy, it was found that composite restoration had lower durability and therefore SSC was more favourable. These findings are clinically important as they support long standing view that SSCs provide durable coronal coverage for primary molars, especially when longevity is a priority. However, both retrospective studies following pulp therapy should be viewed with considerations of potential confounders such as case selection, operator preference and skills, variations in tooth condition at baseline.

In contrast, for a class II restoration in a primary first molar, Habel (2018) found that both SCC and composite were equally acceptable. Only one randomized clinical trial was found in the literature comparing composite bulk fill and SCC following pulpectomy with a 1 year follow up (Olegário et al., 2022). This showed no significant difference between the two treatments, with a success rate of 86.7% and 82.6% respectively, bulk fill composite showed promising results in permanent teeth but further studies to evaluate its performance in primary teeth is needed. These studies offered prospective comparative evidence and also evaluated child and parent acceptance; but the follow up period was relatively short, and the second study was on permanent teeth and therefore, may not be applicable for primary teeth.

Chisini et al. (2018), in a systematic review of longitudinal clinical studies evaluating survival and reasons for failure of restoration in primary teeth, suggested that the high failure rate of restorative materials in paediatric dentistry is due to the lack of a controlled environment or child behaviour. Gao (2018), in an evidence based dentistry commentary summarising the finding of the Chrisini et al. (2018), highlighted that the high success rate of restorations was correlated with the use of rubber dam which is a more controlled environment for placing moisture sensitive materials. This is particularly relevant to treatment under GA, as treatment under GA controls these factors and allows the clinician to optimally deliver the treatment, therefore, it may be expected that restoration placed during PDGA could achieve better survival rate than those placed in conventional setting. However, this remains as an expectation rather than direct conclusion from current evidence, because most available studies do not specifically isolate the effect of GA environment itself on restoration longevity and this remains as a knowledge gap (Amend

et al., 2022). Additionally, Chisini et al. (2018) found substantial variation in annual failure rates, noting that many of the included studies were at high risk of bias, meaning their findings are useful in identifying trends but are less reliable for making definitive treatment recommendations.

### 2.2.5 Pulp therapy

Pulp therapy in the primary dentition is indicated when caries or trauma have compromised the pulp of a restorable primary tooth. The principal aim is to maintain the primary tooth in a asymptomatic and functional state, which preserves the arch length and support occlusal development until physiological exfoliation (AAPD, 2025; SDCEP, 2025). Available guidance on pulp therapy for primary teeth, stresses the choice of technique shall be driven by the pulp diagnosis, normal or reversible pulpitis versus irreversible pulpitis or necrotic pulp, as well as the restorability of the tooth (Rodd et al.,2006; Duggal et al., 2022; AAPD, 2025). Pulp therapy in primary teeth is divided into vital and non-vital pulp therapy.

#### 2.2.5.1 Vital pulp therapy

The AAPD best practice guidelines defines vital pulp therapy (VPT) for primary teeth with a normal pulp or reversible pulpitis as comprising of protective liners, indirect pulp treatment (IPT), direct pulp capping (DPC) and pulpotomy, all of which they aim to preserve a vital pulp and maintain the tooth until exfoliation (Coll et al., 2024; AAPD, 2025).

In a normal pulp or reversible pulpitis in a primary tooth that has no clinical or radiographic signs of infection or pathology, the exposure of the pulp during caries removal will require the removal of the coronal pulp and filling the pulp chamber with a suitable material followed by sealing the tooth from microleakage (Fuks, 2000; AAPD, 2025). The current guidelines reported that for deeply decayed primary teeth, indirect pulp treatment (IPT) and pulpotomy with calcium silicate cement have the strongest evidence of succed at 24 months, highlighting that complete caries removal is not necessary before VPT (Coll et

al., 2024). This is an important shift in dental caries removal, as it shifts from the complete caries removal toward selective caries removal.

Appropriate case selection and management technique are key determinants of the success of VPT and pulpectomy and may be more influential than the pulp filling material itself (Boutsiouki et al., 2018). Nonetheless, restoration integrity is critical as its failure can compromise coronal seal which allow bacterial leakage and subsequent pulpal complications (Boutsiouki et al., 2018). This is supported by current restorative guidance, which emphisise that the success of pulp therapy is closely linked to maintaining an effective coronal seal, which often a full coronal coverage (AAPD, 2025).

While there are many material options that have shown high success rates, the filling material of choice have evolved to have better performance and biocompatibility. Traditionally, different dilutions of formocresol were the gold standard (King et al., 2002) This has changed substantially, as more resend evidence-based guidance  no longer recommend the use of formocresol due to concerns about potential toxicity and biocompatibility (Coll et al., 2024).

Other materials were subsequently used, such as ferric sulphate and calcium hydroxide (Bossù et al., 2020), but recently, calcium silicate-based cements such as mineral trioxide aggregate (MTA) and tricalcium silicate cements (Biodentine ™) have been used most frequently due to their high performance. This shift is supported by more recent systematic review evidence. Coll et al., (2024) reported high certaintity evidence supporting IPT or pulpotomy using MTA or Biodentine ™ over 24 months, whereas formocresol, ferric sulphate, sodium hypochlorite and other agents were generally supported by lower certainty or less consistent evidence. This is an important distinction, as many individual clinical studies reports high success across different materials, but guidline level recommendations give attention to the certainty of evidence and comparison than isolated success figures alone.

Celik et al., (2019) conducted a randomised controlled trial in 44 mandibular primary molars with carious pulp exposure, allocating teeth to MTA or Biodentine ™, and reviewed their outcomes clinically and radiographically over 24 months. At 24 months, both

materials achieved high success. Similarly, Niranja et al. (2015) reported in vivo comparative study where 60 primary molars were randomly assigned to MTA, Biodentine ™ and laser, and all teeth received SSCs for crononal coverage. Clinical and radiographic outcome at 3 and 6 months were comparable across groups, supporting similar short-term performance. Rajasekharan et al. (2017) have also reported in a parallel-design randomized controlled trial that included 58 patients, comparing MTA, Biodentine ™ and Tempophore ™ at 6,12 and 18 months, a high success rate and suggested that all of the materials that they have included, had high and broadly comparable clinical outcomes. These studies are valuable because randomised trials provide stronger evidence than retrospective case series. However, they also have some important limitations, such as small sample sizes, different follow up periods, heterogeneity in outcome measures. Many studies evaluate both clinical and radiographic success, but these are not always defined consistently between trials, limiting a direct comparison for meta-analysis studies (Coll et al., 2023; Coll et al., 2024).

Pulp therapies are an attractive option for treatment since they maintain both functional aspects as well as space maintenance. However, the current debate remains to recognise that much of current evidence base, remains influenced by trial heterogeneity, varying risk of bias and differences in restorative protocols.

#### 2.2.5.2 Non-vital pulp therapy

Root canal therapy is indicated when a pulp tissue is irreversibly infected or necrotic due to trauma or caries. In primary teeth, AAPD guidance states that non-vital pulp treatment is indicated for teeth with irreversible pulpitis or necrotic pulp, and also notes that the diagnosis of irreversible pulpitis cannot be based solely on bleeding that cannot be controlled within five minutes, therefore case selection should be on the overall clinical and radiographic findings (AAPD, 2025). This guidance and systematic review advice on caution when planning pulpectomy, as the outcomes are highly dependent on accurate diagnosis, restorability of the tooth, and whether the tooth can be predictably maintained until exfoliation (Coll et al., 2024; AAPD, 2025). This is an important current debate, because the question is often not simply whether pulpectomy can be successful, but in

which teeth and under which clinical conditions it is preferable to other alternative managements such as extraction.

The literature evaluating the success of pulpectomy mainly evaluates the success of different techniques or different filling materials. For instrumentation technique, Morankaretal et al. (2018) reported in 24 months randomised clinical trial of 60 primary second mandibular molars of children aged 4-7 years, comparing manual versus rotary instrumentation, both approaches showed similar high clinical success (manual 92.3% and rotary 85.2%) and radiographically (manual 65.4% and rotary 66.7%), the main practical difference was that rotary instrumentation reduced procedural time. Clinically, this suggests that either approaches can be acceptable, and that factors beyond filing systems may generate different outcomes, including case selection, canal anatomy, root filling material, coronal seal and follow up criteria. However, although randomised trials provide stronger evidence, this study was small and conducted in a single tooth type, which may limit generalisation of its finding to all primary teeth and clinical settings. Additionally, the discrepancy between the higher clinical success and lower radiographic success, is an example of recurrent issue in pulpectomy research, because studies report different success rates, depending on whether the outcome measure was symptom based or radiographic, therefore, complicating the interpretation across the literature.

For filling materials, several studies reported broadly comparable outcomes between the most commonly used obturating materials. Pramila et al. (2016) conducted a double blinded RCT on 129 primary mandibular molars with necrotic/irreversible pulp in children aged 4-9 years, and they have compared three filling materials (RC Fill™ [Zinc oxide eugenol (ZOE)+ iodoform], Vitapex™ [Calcium hydroxide + iodoform], and zinc oxide eugenol). In 30 months, the success rates were 94%, 90% and 97% respectively. Clinically, all three materials achieved high success rate, however, the authors highlighted that follow up until exfoliation would be needed for more definitive conclusions. Although the trial offered comparatively strong evidence through randomization and blinding, pulpectomy in primary teeth is ultimately judged over the remaining lifespan of the tooth, a shorter follow-up may fail to capture late failures or effects on physiological root resorption.

Trairatvorakul et al. (2008) compared ZOE with Vitapex™ in 54 infected mandibular primary molars and all received SSC. In 12 months both materials had similar performance. However, the follow up was short in this study and therefore limits conclusions about long-term effectiveness. Silva et al. (2022) conducted a systematic review and meta-analysis and included randomised clinical trials with a minimum follow up of 6 months, comparing iodoform based versus non iodoform root filling materials in deciduous teeth. They concluded that iodoform based materials showed better performance in the short term, but long-term performance was similar for both. Authors have emphasised that the certainty of the evidence was low to very low, as many of the included studies had unclear or high risk of bias. It is important to consider that although some studies report high success rate for some materials, the overall evidence base remains limited by small sample size, methodological heterogeneity and inconsistent outcome definitions.

In Coll et al. (1996), the success rate of anterior and posterior primary teeth pulpectomy was 77.7% and in Pramila et al. (2016) study success rate ranged between 90% to 97% depending on the type of filling material, Mendoza et al. (2010) had only two extractions of failed pulpectomies out of 308 treated teeth. However, these studies differ in design, baseline diagnosis, tooth type, root filling material, follow up duration and the definition of success (clinical versus radiographic), which make a direct comparison difficult.

Nonetheless, these studies showed much higher success than Dou et al. (2022) study which had the lowest success rate for pulpectomy. Their results showed that pulpectomies failure rate in anterior primary teeth was significantly lower when performed under GA due to technique sensitivity. Moreover, the success rate of primary anterior teeth pulpectomy was 58.8% which is higher than primary molar teeth 37%. However, not all posterior primary teeth in their study received a full coronal coverage or a restoration that prevents microleakage, as some received only Glass ionomer restoration. Although they stated that treatment was performed according to the AAPD guidance they did not seal the tooth with a restoration that prevents microleakage as the AAPD recommends for which this might be a reason for the high failure rate (AAPD, 2025). This is an example of why pulpectomy studies should not be interpreted solely in relation to the root filling

material or canal technique used. As there may be major confounders that may affect the outcomes and success between studies.

There are various controversies regarding the success of pulpectomies, however, wide range of reported outcomes appear strongly influenced by case selection, treatment technique, restoration integrity, follow up duration and study design. Therefore, evidence-based dentistry and performing the treatment according to the guidelines is an important factor in the success of treatment.

### 2.2.6 Extraction

Extraction of primary teeth may be indicated when the tooth is non restorable (e.g., due to extensive caries) or when infection couldn't be managed and retaining the tooth would compromise the child's health and function (SDCEP,2025). Current SDCEP guidance places extraction within a broader decision-making pathway, noting that it may become necessary when other management options are not feasible or not in the child's best interest, particularly for teeth with poor prognosis or when pain/infection cannot be predictably controlled (SDCEP, 2025). In some situations, extraction maybe planned for orthodontic reasons such as balancing and compensating to reduce occlusal asymmetry or midline shift during development (Proffit, 1993).

Caries remains a leading reason for primary tooth extraction. Alsheneifi et al. (2001), in a retrospective dental records review of children aged 3-13 years, who were treated at a paediatric hospital clinic in Boston, reviewed 2000 records and analysed 567 extracted primary teeth, they have reported that caries and its sequelae were the main reason for extraction in their cohort. Similarly, Lesolang et al. (2009) in a retrospective review of 3,793 patients records in primary dental care, found that the main reason for extraction was dental caries, with almost 60% of the extracted teeth being primary molars, suggesting that posterior primary molars were commonly lost and caries being the main contributor. These studies remain useful to demonstrate that caries has long been the dominant indication for primary teeth extraction. However, the findings does not reflect on the treatment thresholds, service availability or preventive measures opportunities.

Early loss of primary teeth is common in many populations, and is clinically important as it may lead to arch length disruption and contribute to occlusal changes (Proffiit, 1993). Murshid et al. (2016), Ahamed et al. (2012), Jayachandar et al (2019), are cross-sectional studies investigating the prevalence of premature loss of primary teeth, each study was based on different population, of children aged 5-10 years old. In the first study, lower left primary second molar was most frequently missing, the second study, lower right primary first molar and the third study, first primary molar. Difference between prevalence estimate across studies are expected based on population, access to care, caries experience, and may be the threshold for what is considered as ‘’premature loss’’. These cross-sectional prevalence studies can identify the scale and pattern of tooth loss, but cannot determine causality and highly sensitive to local demographic and service factors.

Premature loss of primary teeth has been linked to behavioural and disease related factors. Lopez et al. (2016) analysed data from a cross-sectional study of 833 Mexican schoolchildren aged 6-7, they found an association between premature loss and indicators such as worse oral hygiene, higher soft drinks consumption and need for dental care and increase in dmfs. These findings are consistent with current understanding of caries risk. But they demonstrate association rather than causation, and it cannot determine whether these behaviours preceded the tooth loss or were corelated with a broader pattern of disadvantage and disease burden. This is an important distinction, as behavioural cooralation of extraction often overlap with socieo-economic and service-related factors that are difficult to separate in observational studies.

Importantly, the clinical concern is not about how often primary teeth are lost, but what it may lead to. A recent systematic review and meta-analysis of observational studies reported that premature loss of primary teeth was associated with a higher likelihood of overall malocclusion in the permanent dentition (Shakti et al., 2023). Zhao et al. (2023) have examined space changes after premature loss of primary molars in 11 split mouth studies with 6-24 months follow up period, they reported the mean space loss was approximately 0.65mm in maxillary first and second primary molar space, and 1.24mm in the mandibular first and second primary molar space, with no significant changes in arch width, arch length, or arch perimeter over this timeframe. These findings are useful

because split-mouth studies can reduce between-subject variability; however, the follow up period was relatively small and the space changes although statistically demonstrable, it may not always mean that they are clinically significant for every child. Although space loss might be perceived as small, this may be more clinically relevant in children with pre-existing arch length deficiency and crowding tendency (Tunison et al., 2008).

## 2.3 Pharmacological pain management during dental treatment

### 2.3.1 Local anaesthesia (LA)

Local anaesthesia (LA) is one of the least invasive methods of pain control in dentistry, using a solution of chemical agents including either amides or esters with or without a vasoconstrictor (SDCEP, 2025). LA causes loss of sensation and consequently inhibits pain sensation. Clinical standards for dental anxiety management support the use of LA as first-line management for dental treatment (NHS,2023). In NHS England guidance, anxiety management, should use the simplest and safest technique that is likely to be successful, and GA referral should only occur after careful consideration of the less restrictive options such as behavioural management and/or conscious sedation.

The ability to use LA depends on a variety of factors including, age and level of understanding of the child, medical status, the behaviour and anxiety of the child, operator experience and equipment availability and parent's behaviour and acceptance (EAPD, 2023). A child's cooperation is highly influential on whether LA can be delivered safely and treatment performed. Baire et al. (2004) conducted a cross-sectional observational study across 21 private paediatric dentistry practices in USA, to investigate children's fear and behaviour in clinic, they noted that children with higher dental fear, younger age and children whose treatment included the use of LA has higher odds of showing negative behaviour during dental treatment. Therefore, LA should be interpreted as one factor within a wider behavioural context rather than as a direct cause of stress. In a study that investigated the factors that influence children' ability to tolerate LA, Jones et al. (1995) conducted a comparative study of 308 children aged 3-26 years, and used visual analogue scale to record children's pain rating during injection and treatment, they found that slower delivery of LA was associated with lower pain rating, inferior alveolar nerve

block were rated more painful than buccal infiltration. This is an old study, and included a wide age range, also it doesn't reflect the more recent adjuncts such as computer-controlled LA delivery, the findings are useful to some extent but doesn't fully reflect current advancements. Berge et al. (2016), surveyed 1,441 schoolchildren aged 10-16 years using a validated fear scale, it was reported in their study that 13.9% had high fear of LA, 10.6% reported they would avoid dental treatment. This provides important evidence that fear of LA can in itself cause avoidance to dental care.

Finally, even when LA was successfully administered, effectiveness matters because painful of ineffective anaeasthesia could affect child's future acceptance. Nakai et al. (2000) evaluated the effectiveness of LA in preventing pain during dental procedures for children in paediatric dental practices, they found that 14 out of the 17-dentist included in the study had at least one patient experiencing ineffective LA and experienced pain and discomfort. This study highlights that the successful administration of LA does not necessary mean it will be effective in pain control, which is clinically an important distinction. However, as a practice based observational study, the findings may be influenced by operator variations and procedural differences. Pain control is very important to consider as having a painful experience during dental treatment has been shown to cause avoidance of seeking dental care (Berggren et al., 1984; Heyman et al, 2016) and can contribute to long term dental anxiety. More recent evidence also suggest that children who experience pain during dental treatment were reported to have higher dental fear at subsequent visits, which highlights the importance of preventing the negative experience in the first instance (Clow et al., 2023).

A Cochrane review by Monteiro et al., (2020) found a number of interventions could improve child's acceptance of LA, but no single best method was identified. The review reported that evidence was limited and heterogenous, with overall low certainty, as there was variation in interventions and outcome measures. It is important to note that although there is some evidence to support different approaches, the current literature does not provide conclusions about which strategy is superior. Therefore the most appropriate interpretation, is that a level of cooperation from the child is necessary and following a practical approach where LA acceptance could be improved by combining, behavioural

techniques such as distraction, optimised injection technique and communication, the use of topical anaesthesia, and where possible, using computer-controlled delivery an such as topical anaesthesia, distraction, computer- controlled delivery, which are also supported by SDCEP (2025) guidance.

### 2.3.2 Sedation

Sedation is the use of drugs to induce depression of consciousness and there are different levels of sedation (Ashley et al., 2021).There are different levels of sedation (minimal, moderate and deep); In minimal sedation the patient would be calm but fully responsive and able to respond to verbal commands. In moderate sedation, patient would have depressed consciousness but able to respond purposefully to verbal commands or light tactile stimulation. In both minimal and moderate sedation, the patient is able to maintain their airway. Deep sedation is the highest level of sedation, in which there is marked depression of consciousness and difficulty maintaining airway, deeper than that would be considered GA (Ashley et al., 2021). The differentiation between the different levels of sedation is important for the safe delivery and patient assessment (NICE, 2010). Although the NICE guidelines was published in 2010, a 2018 surveillance review concluded that its recommendation remained current. More recent UK standards have reinforced this framework, in relation to training, monitoring, governance and accreditation of conscious sedation services (IACSD, 2020; SAAD, 2026)

The most commonly used technique for sedation in paediatric dentistry is inhalation sedation using nitrous oxide with oxygen, and this is often the first line for children with mild or moderate anxiety (Ashley et al., 2021). Treatment using inhalation sedation is difficult for children who have cognitive disabilities and are unable to comply with instructions (Manley et al., 2000). Other techniques, such as oral sedation using midazolam or intravenous sedation, can be used if inhalation sedation was not sufficient. A current debate in the field is whether alternative routes and agents may improve access to care for children who cannot tolerate inhalation sedation, while maintaining an adequate safety margin. However, more recent UK standards continues to stress that conscious sedation techniques in dentistry should maintain verbal contact and reinforcing

the distinction between conscious sedation and deeper levels of consciousness depression (IACSD, 2020; SAAD, 2026).

UK guidance recommends sedation when behavioural and non-pharmacological management techniques have failed, for children with significant anxiety or fear, children with developmental delay or neurodiversity that limits cooperation, where the procedure is painful or prolonged, or for people with medical conditions that require stress reduction (NICE, 2011). Sedation may not be appropriate in some medical conditions with airway risks such as in severe systemic diseases with severe respiratory effects, conditions with aspiration risk or known allergy to sedation (Ashley et al., 2021). This important because it shows that sedation is not simply a substitute for behavioural management, but an adjunct that require careful balancing of the benefits, cooperation needs and medical risks. It also reflect a wider debate which is that sedation may reduce the need for GA in some children, but it is not suitable for all, especially where cooperation is very limited, treatment complexity is high, or when there is airway safety concern.

UK guidance stresses the importance of the safe delivery of sedation which requires appropriate patient selection and written consent, careful patient monitoring using pulse oximetry, trained staff in both sedation and paediatric advanced life support, and recovery facility (NICE, 2018; IACSD, 2020).

### 2.3.3 General anaesthesia (GA)

GA is defined as a drug induced, controlled and reversible loss of consciousness, in which the person becomes unaware and does not feel pain nor respond to verbal or physical stimulation. The person loses their airway reflexes and therefore breathing and airway need to be supported by an anesthetist. In the UK, dental GA must be delivered in a hospital setting by an anesthetist with immediate access to critical care facilities (RCoA,2025;RCS, 2008). Although the Royal College of Surgeons guideline remains an important historical document, the more recent Royal College of Anaesthetist guidance provides the current governance framework and reinforces that all dental work that requires GA should be undertaken in hospital setting with appropriate perioperative support (RCoA, 2025). It is important to note the the strongest evidence in this area

doesn’t relates to trials in GA itself, but to safety measures, service organization and standard of delivery.

After NHS began in 1948, dental extractions under GA became widely available in community and general dental practice settings. Unfortunately, there was a worrying number of deaths associated with dental GA in the subsequent decades, which triggered reviews about where GA should be delivered, who should deliver it, and the necessary safety standards (Roberts et al., 2020). The current UK requirement for hospital-based delivery of dental GA, developed after a series safety concerns, the Poswillo report (1990) chaired by Professor David Poswillo, was a major milestone, aimed to reduce death and serious harm from dental GA. The Poswillo report highlighted the adverse outcomes in dental GA, which was often linked to the variability in standards, training, monitoring and emergency preparations. Following the UK policy changes in 2000, there were very low mortality and improved when GA became only confined to hospital settings (Roberts el al., 2020). This historical evidence remains important to show how policy review, audit and mortality surveillance are an integral part in health care, to ensure patient safety is maintained. Therefore, the rational of hospital based GA is rooted primarily from patient safty and system learning rather than trial evidence.

A level of cooperation is required to deliver dental treatment in the dental chair. Very young children, children who are unable to cooperate or extremely anxious, chronically ill children and those with special healthcare needs, may not be able to tolerate treatment in the dental chair.  An inability to withstand extensive dental procedures may mean GA is essential to provide efficient, safe and effective treatment (Steele et al., 2015; Dean, McDonald and Avery, 2016; Sevekar et al., 2021). When considering a treatment plan under GA, a range of interrelated factors influence the treatment planning to minimise the risk of needing a further PDGA. These factors include child's age, behavior, disease progression, and medical history (Colak etal., 2013) as well as the expected success of treatment in terms of durability. The risk of further caries, oral hygiene and opportunity for follow-up are important to consider European and UK guidance supports the use of GA for delivering necessary dental care when appropriate (EAPD, 2021) (NHS England, 2023).

MacCormac et al. (1998) investigated reasons for GA referrals and found that the main reason, was the need for multiple extractions, followed by anxiety and fear of dental treatment and young age. Other studies support that multiple extraction and young age are the main reasons for referral to GA (Carson et al., 2001; Macpherson, et al., 2005; Fox et al., 2022). In contrast, Ramdawi et al. (2017) found family socioeconomic status, dental visits and country of residence are among the main reasons for GA, more than other factors like age, anxiety level and dental status. Other reasons for referral reported in the literature were parent and child preferences, history of poor cooperation, poor attendance records, likelihood of LA being ineffective, family lack of interest in achieving good dental health and difficult extractions anticipated. Consideration of clinical and social factors were noted by practitioners (MacCormac et al., 1998). Most of the studies on referral reasons are observational, retrospective or service-based, they are useful for identifying patterns but do not determine causal importance of individual factors. The difference between study findings may reflect local referral pathways, service configuration and population characteristics.

Some of the expected post-operative symptoms include nausea and/or vomiting, sore throat from intubation, drowsiness and pain (Pawar et al., 2012). Bridgman et al. (1999) identified various degrees of adverse effects following dental extractions under GA, ranging between physiological symptoms (nausea and vomiting), pathological complication (prolonged bleeding), psychological/behavioural effects (distress during induction and recovery, continued crying on the journey to home and at home, nightmares, bad memories), or social effects (distress for family). These studies remain useful in showing that GA has consequences beyond the procedure in itself. However, most of the literature on post operative outcomes are based on parental report and short term follow up, which may overestimate or underestimate some symptoms depending on the timing of recall.

In contrast, studies have shown that OHRQoL was immediately improved after receiving a single complete dental treatment under GA because there was relief from pain that affected sleeping and eating. (Anderson et al., 2004 & de Souza et al., 2017). More recent evidence support this finding; In a 2025 systematic review and meta-analysis, they

concluded that children receiving dental treatment under GA experienced short-term improvement in QHRQoL (Alghofaily et al., 2025). While the literature is clear on relief of pain and infection post GA, much of the OHRQoL is based on parental reported measures that are also assessed in short term. There is uncertainty in terms of longer-term effects on dental fear, future attendance or other oral health behaviours.

## 2.4 Making decisions about management of caries

The NHS advocates shared decision making as the approach for choosing non-urgent healthcare. Therefore, this should be the preferred approach for making decisions about management of carious primary teeth and the use of GA (NICE, 2021; NHS England, 2023). However, it is important to recognise that the support for shared decision making comes from a broader healthcare evidence rather than from dental trials that are specifically focused on management of carious primary teeth.

Shared decision making in paediatric dentistry means that the dentist, child and parents (which also include any primary care giver) decide together their treatment choice after looking at the evidence and what matters to the family. When choosing care it is fundamental to discuss all the options available along with their risk and benefits so the child and parents/carers are included in the decision making. In the UK, the NHS emphasises that the clinician should set out the choices clearly and fairly using the best available evidence on potential benefits and risk of different treatment options, and consider the patient's preference and personal circumstances, values and beliefs before agreeing a plan (NICE, 2021). The 2021 NICE guideline describes how this conversation should happen and highlights that the conversation should give space for the child and parent to express their views and allow enough time to consider what is best for them at that time. The clinician should also check that the patient and family understand everything in plain language and confirm that the family has enough information to make an informed choice (GMC, 2024).

Paediatric decisions usually involve the child, parent and clinician. Children should be involved to the degree to which their maturity allows. In an experimental study to assess competency in understanding treatment information between different age groups (9, 14,

18, 21-year-olds), it was found that children aged 9 years old were significantly less competent than adults, while 14 years old did not differ from adults in terms of understanding (Weithorn et al., 1982). This study was experimental, not dental specific and reflects hypothetical decision making rather than real clinical encounters which ma be different. The UK General Medical Council (GMC) advice to include children and young adult in treatment decisions and measure their competency in understanding the risks and benefits of all treatment options.

Good, shared decisions depend on fair open conversations. Ineffective conversation can arise from biases or assumptions, for example, a clinician might skip an option because they think a particular risk is not important, or withhold discussion of an option entirely because it is only available in private practice. This can limit choices for the patient and create distrust so being transparent about all reasonable options and any uncertainty is part of ethical family centered care (NICE,2021; Barber et al., 2023). This an important critical issue in the literature, because shared decision making is often promoted as ideal model, yet it's true implementation maybe constrained by service limitation, time pressures, professional bias and inequity to access treatment options.

A systematic review and metal analysis to evaluate the impact of shared decision making (SDM) found that SDM improves knowledge, sets more realistic expectations and families generally prefer being involved (Wyatt et al., 2015). Most of the literature included in the review was drawn from general medicine rather than paediatric dentistry. While shared decision making is strongly justified and supported by broader healthcare evidence, the literature is unclear on how it may change treatment outcomes specifically for children with carious primary teeth or in decisions about GA. This gap is particularly relevant to the present study, where treatment planning involves balancing clinical evidence, parental preferences, child factors and service constraint.

### 2.4.1 Roles of different decision-makers

#### 2.4.1.1 Dentist decision-making

Dentist decision-making usually combines information from a number of sources. The dentist has expert knowledge in the diagnosis and prognosis, treatment options and likely consequences from different treatments including the decision to have no treatment. The first source used provide information to patients and parents/carers is evidence arising from research, which may be combined into evidence-based guidelines (Sackett et al., 1996). In the UK this usually means following NICE, RCS, SDCEP, EAPD and BSPD, or other national guidance.

The second source of information is clinical expertise, which arises from the dentist own knowledge and skills, their previous experience and their recollection of the outcome from previous treatment. The dentist also has a good understanding of local services and navigating these services. This is highly important, particularly where service access, referral pathways and waiting time may influence what is realistically available to the child. At the same time, current shared decision making guidance (NICE, 2021) makes it clear that professional judgement should not replace a fair discussion of the reasonable options, but should be used to help families interpret choices in context.

Personal beliefs and unconscious bias may also influence professional judgment about the effectiveness of a treatment, patient suitability for a treatment or a family's ability or willingness to manage treatment. These beliefs may be based on misinformation, assumptions or their own biases. The GMC (2024) warns clinicians to not let that influence the care they provide and assess each child and family indivisually rather than relying on assumptions. Systematic reviews of implicit bias among healthcare professionals, have shown that healthcare professionals commonly exhibit biases that can affect clinical decisions (Fitzgerald et al., 2017; Hall et al., 2015), and more recent oral health literature suggest that implicit bias among is also relevant in dentistry(Martin et al., 2025), although this evidence base is still emerging and remains less developed than in medicine.

#### 2.4.1.2 Parent- child decision making

In paediatric SDM, parents are described as “experts by experience”, as they have detailed knowledge about their child’s symptoms, behaviour and family circumstances that clinicians cannot directly observe. The SDM literature recognises that parental and child preferences should shape treatment choice alongside the clinical indications (Wyatt et al., 2015; Jonas et al., 2022). Reviews of SDM in paediatric care shows that effective decisions depend on combining clinical evidence along with parents’ experiential expertise, especially in children with medical complexity where parents notice the subtle changes in their child’s condition and the implications of different treatment options for family life (Wyatt et al., 2015; Jonas et al., 2022), However, it is important to note that much of this evidence comes from paediatric healthcare literature rather than paediatric dentistry specifically. Therefore, while the principle is relevant to dentistry, direct evidence in caries management and GA decision-making is more limited.

Another important aspect of SDM is assessing the family’s and child’s ability to accept a proposed treatment and their ability to manage the ongoing self-care. The AAPD behaviour management guidelines recommend tailoring both behaviour management techniques and treatment plan to the child’s development level, medical status and family’s ability to support care afterward, rather than adopting a one size fits all approach (AAPD, 2025). This is particularly important in paediatric dentistry, where success often depends on not only the procedure itself but also on attendance, home call and recall.

Systematic review evidence suggested that parental beliefs about the importance of dental care, socioeconomic status, previous dental experience and other barriers such as cost, access difficulties (waiting list and travel time), communication problems, were all influential on whether children maintain recall appointments and preventive care (Badri et al., 2014). This means that when discussing treatment options, paediatric dentists should explore what the family can realistically manage at home and in the clinic. Parents’ and older children’s views about their capacity in maintaining oral health care should shape treatment planning to increase the likelihood of successful long-term self-care and maintenance (Alzahrani et al., 2024). This is also consistent with more recent AAPD

policy, which emphasise the important of access barriers and social vulnerability in children's oral health outcomes (AAPD, 2025).

## 2.5 GA decision making

Different factors have been identified that influence the decision about whether to use GA to deliver dental treatment, the factors are multifactorial and influenced by both parent/carer factors and clinician/service factors. Across different studies, parental emotional response is prominent, parents frequently report anxiety, stress and guilt regarding their child's GA, and this can be experienced before and during GA pathway (Baghdadi et al.,2021; AlQhtani et al., 2019). Parental anxiety for during GA decision making is not static and evidence suggest that this anxiety decrease when parents/carer have prior GA experience (either their child or a child they know), which potentially increases their familiarity and reduce their fear (Djalali et al., 2023). Parental acceptance also appear to be influenced by how urgently they perceive the need for the dental treatment, for example, acceptance may be higher when their child is in acute pain or require an extensive treatment such as multiple extractions (Djalali et al,, 2023). These studies are based on cross-sectional or qualitative studies, which are valuable for understanding experiences and perceptions, but are less able to determine the relative weight of each factor in decision-making.

Practical factors could also influence parental preference for GA. Parents may favour GA because it enables completion of all dental treatments in a single visit, especially when cooperation is difficult, where parents wish to avoid potential pain and distress, or when travel distance and access makes attending multiple appointment challenging (Kotian et al., 2020). This highlights that GA decision making process, reflects a judgment about what is feasible and acceptable by the child and family and not only what is clinically indicated.

From clinician's perspective, decision making appears to be influenced by clinicians' knowledge and confidence regarding GA indications and risks. Greater clinicians' knowledge have been associated with improved ability to explain GA to parents and greater parental acceptance, whereas limited knowledge may cause concerns and

reluctance to recommend GA (Rajbanshi et al., 2019). Clinical needs also matters, dentist show greater acceptance of GA for special health care needs children and when the disease burden is higher (Djalali et al,, 2023). Table 1 summarises the included studies and the factors that have been reported to influence GA decision making in paediatric dentistry.

Most studies of GA decision-making often combine clinical, social and organisational influences, making it difficult to isolate a single dominant factor. Therefore, the current literature supports the view that GA decisions are not only determined by disease severity. This section also reveals an important gap in the literature. Most of the evidence for GA decision making comes from observational studies, service evaluations and policy guidance. There remain limited qualitative research that specifically explore how paediatric dentists weigh these factors in real practice for carious primary teeth, particularly in UK setting. This gap provides part of the rationale for this study.

Table 1. A summary of papers investigating factors influencing the decision to provide a dental GA.

| **Study** | **Year** | **Study participant** | **Factors reported** |
|---|---|---|---|
| Djalali Talab Y, Geibel MA. Comparison of parental and practitioner's acceptance for dental treatment under general anaesthesia in paediatric patients. | 2023 | Comparative study of parents Vs Practitioner acceptance | *Parent/ child factor:*<br>• Parents more emotional when child is young.<br>• Previous GA experience reduce fear.<br>• Acceptence higher when child in acute pain, or when mutlple extraction required.<br>*Practitioner factors:*<br>• Greater acceptance for GA in children with SHCN<br>• Greater acceptance when multiple teeth affected<br>• Child acute pain did not influence dentist decision |
| Baghdadi ZD, Jbara S, Muhajarine N. Children and parents perspectives on children's dental treatment under general anesthesia: a narratology from Saskatoon, Canada. | 2021 | Qualitative study with children and parents | *Parent/ child factor:*<br>Parent report feeling guilty, anxiety and stress<br>Child anxiety and stress was also observed |
| Kotian N, Gurunathan D; EMG Subramanian.(2020). Parental Preference for treatment under general | 2020 | Parent preference study (for children 2-5 years) | *Parent/ child factors for GA preference:*<br>• Single visit completion<br>• Difficult cooperation<br>• Painless treatment<br>• Perceived better quality of life |

| | | | |
|---|---|---|---|
| anaesthesia for children between 2-5 years of age, European Journal of Molecular & Clinical Medicine, 7(1), pp. 1197-1203. | | | *Service factors:*<br>Living far from practice influenced GA preference to avoid travel difficulties. |
| Rajbanshi G, Liang Y, Nong X, Qiu R, Shen H, Chen A. Practitioners' knowledge and acceptance of paediatric dental procedures under general anaesthesia. | 2019 | Clinicians' focused study | *Clinicians' factor:*<br>• Knowledge of GA indication/risk, associated with greater condifedence and greater parental acceptance.<br>• Lack of GA knowledge was associated with concerns and reduce ability to choose GA. |
| AlQhtani FA, Pani SC. Parental anxiety associated with children undergoing dental treatment. | 2019 | Parent anxiety study | *Parental factors:*<br>GA decisions was associated with increased parental stress before and during GA. |

### 2.5.1 Factors influencing dentist's choice of treatment under GA

After agreeing GA is required for delivery of dental treatment, consideration is given to the type of treatment to provide under GA, wither extractions and/or restorations. An overview of these potentially important factors is shown in Table 2 (Sanders et al.,2019; Large et al,.2021; Alkhouri et al., 2022; SDCEP, 2025)

Table 2. Factors influencing choice of restoration or extraction under GA

| Patient | Clinical | Service |
|---|---|---|
| • Age<br>• Cooperation<br>• Medical history<br>• Social history | • Caries extent<br>• Dental history<br>• OH<br>• Clinicians' skills | • Workforce<br>• Accessibility |

#### 2.5.1.1 Patient-related factors

Children who are planned to have dental treatment under GA often have extensive caries, severe dental anxiety or behavioral problems (AAPD, 2025; SDCP, 2025). Age and cooperation affect how feasible future maintenance will be because very young or highly anxious children and those with additional need are less likely to tolerate restorative care in the chair. This may mean the plan under GA may favour more predictable options, such as extractions (Adewale, 2012; Campbell et al., 2018). This reflects an important clinical debate in the literature, although extraction may be perceived as more predictable to avoid repeat GA, contemporary guidance emphasis that treatment planning should not be based on cooperation alone, and should also consider restorability, prognosis, social history and whther comprehensive care is realistically acheievable (SDCEP, 2025; AAPD 2025).

#### 2.5.1.1.1 Ability to perform full examination

Preoperative assessment can change the plans, as some of these children do not have pre-operative radiographs. Radiographs would therefore be taken under GA, and this could lead to changes in the treatment plan and treatment choice (Campbell et al 2018). This is clinically an important point, however, much of the studies in this area is very limited and comes from retrospective service evaluations. Therefore, while the incomplete pre-operative assessment is recognised as a practical challenge, the extent to which it independently changes the treatment outcome remain less understood in the literature.

#### 2.5.1.1.2 Socioeconomic status

Children from more deprived areas have higher rates of caries related extraction under GA, which sometimes push clinicians toward extraction when disease is advanced (Firrman et al., 2024). More recent national survey, also show that deprivation is strongly associated with both higher disease burden and higher dental extraction (OHID, 2024). However, deprivation should be interpreted as a factor rather than a direct indication for extraction. It is likely that deprivation operate through multiple ways, including more severe disease presentation, and barriers to preventive care such as irregular attendance to dental visits and absence of oral home care.

#### 2.5.1.1.3 Medical history

Medical status influences the choice of treatment, for example people with respiratory risks, some syndrome which can limit procedural time and complexity under GA can limit the treatment choice under GA (Adewale, 2012).

In a retrospective study comparing the dental treatment under GA in healthy children versus children with special needs Sevekar et al. (2021) found that treatments for special health care needs (SHCN) children were mainly extractions due to poor oral hygiene and to avoid any retreatments or complications as opposed to pulpotomies, pulpectomies, SSC, and restorations in healthy children, furthermore, the age of healthy children treated under GA were younger than SHCN children, authors acknowledges that a more

comprehensive approach should always be considered when treating under GA. This study highlights how medical and children with additional needs may shift planning toward more definitive care.

Camilleri et al. (2004) analysed the dental care provided under GA and the extent of dental disease in two different hospitals. They found that the values of dmft and DMFT in ASA III and ASA VI were significantly lower than the ASAI and II, and the treatment undertaken for primary teeth was extraction mostly. Radical approach appeared to be taken to avoid GA repeat. However, when it came to permanent teeth there was a variance in the treatment provided, chronically sick children received restoration more than extraction and the opposite for healthy children. This may have been due to operator variation, policy difference between hospitals, and the possibility that medically compromised children were under closer specialist follow up. This is an important example of why hospital-based studies should be interpreted with caution, as they are highly relevant to particular service, and reflect local policies than universally applicable treatment principles.

#### 2.5.1.2 Clinical factors

Teeth related factors also influence clinicians' choice of treatment under GA, mainly restorability, lesion extent, pulp status and time to exfoliation, which are all weighed against the risk of treatment under GA (SDCEP, 2025). Under GA, clinicians usually prefer high longevity restorations where feasible, such as the use of stainless steel crowns and vital pulp therapy for primary molars because these outperform multi-surface direct fillings and reduce the chance of repeat GA (Schüler et al., 2014; Sabbahi et al., 2022).

In terms of past dental experience, Large et al,(2021) found in their retrospective study about children's attendance and experience of preventive and operative interventions before and after caries management under GA, the results for pre-GA procedures were few restorations placed for 4 years old children and younger, while for children aged 5-14 primary teeth restorations were more frequently done, restoration of permanent teeth were greatest in children aged 10-16, however, post GA there were lower restorations

placed except in 10-16 years old children which was the same modality. These findings show how treatment patterns differ by age and dentition stage and support the idea that previous attendance and dental history, may shape both the perceived prognosis of teeth and expectations of future maintenance visits. However, the study cannot determine whether these patterns reflect clinician preference, disease presentation, or practical limitations of treatment before and after GA.

#### 2.5.1.3 Service-related factors

Service factors can also shape what gets done, as access to GA across England vary, some have extraction only lists while other have mixed list which can influence clinicians to choose one treatment over the other (Alkhouri et al., 2022). This is a particularly important issue in the UK, because it suggests that treatment planning under GA is highly influenced by what type of service available. Creating an important debate, children with similar dental needs may receive different treatment, depending on geography than purely clinical grounds.

Currently, two different types of lists provide PDGA: a comprehensive list which provides restorations and extractions, restorable carious teeth will be saved, the other list is an exodontia list in which any teeth carious teeth will be extracted including the restorable ones (Sanders et al., 2019). The decision between comprehensive care or exodontia is unfortunately not only influenced by treatment needs but by what is available. Therefore, when looking at studies that report treatment patterns under GA, they may be describing differences in service models rather than differences in clinician treatment philosophy alone.

Sanders et al. (2019) discussed inequalities in access to comprehensive care under GA within the UK, which was due to regional disparities. A study conducted by (Ní Chaollaí et al., 2010) in Yorkshire and the Humber shows the average waiting time for general anaethesia ranged from three to 84 weeks. Both authors mentioned the that the following were perceived as access challenges:

- Lack of paediatric specialists

- Referral protocols
- Variation of treatment modalities
- Lack of comprehensive treatment plan
- Location because some hospitals have more patients than others.

These studies are highly relevant because they identify real organisational constraints on care. Although they are based on surveys, regional analyses and service evaluations, which are useful to understand variation and access related issues, they are less able to determine the direct effect of each service factor on the final treatment decision.

### 2.5.2 Repeat PDGA

One of the most unfortunate scenarios is to have a child in a second round of GA due to caries relapse, given the inherent risk of GA and psychological and economic burden for families and health services. Longitudinal data by Large et al. (2021) showed that after comprehensive GA, many children remain at high caries risk. They reported that the decline in regular examination and preventive intervention post-GA was suboptimal; consequently, six months post GA up to 37-52% developed new carious lesions, and within three years post-GA, almost half required further operative interventions, restorations in 44.5% of the cases, 15% extractions and 10% endodontic treatment. These findings suggest that GA often resolve the immediate treatment need without necessarily changing the child's caries risk. However, the study cannot fully determine whether poor follow-up, baseline disease severity or social factors were the main causes of the ongoing disease.

There are a number of studies that highlights restoration failure as key drivers of repeat GA. Li et al. (2023) followed children with severe ECC after DGA and found that almost 60% required repeat GA for treatment, most commonly because of restoration failure and development of new carious lesions; in their findings, anterior and maxillary teeth were the teeth that were most susceptible to failure, while teeth restored with SSC had better survival rates than those restored with composite and amalgam. Similar conclusions in a different study in Saudi Arabia, the prevalence of repeat GA over five years was relatively low (0.63%), children who did not require repeat GA had received more SSCs at the first

GA than those who had repeat GA (Alzahrani et al., 2022). Earlier work by Harrison et al. (2000) suggested that being “too optimistic” in attempting to save restorable but poor prognosis teeth accounted fir 85% of repeat GA, subsequent studied had similar findings, concluding that overly conservative treatment plans at first GA can increase the risk of a second GA (Podesta et al., 1996; Albadri et al., 2006; Kirby et al., 2020). In this view, a definitive treatment with the use of SSC for multi surface lesions and extractions of poor prognosis teeth is key to reduce the risk of repeat GA. This reinforces current guidance that advice that full coverage SSCs are the restoration of choice in multi surface lesions in high caries risk children under GA (AAPD, 2025). Most of the evidence linking restoration choice to repeat GA comes from retrospective studies and service evaluations rather than prospective comparative studies, so although the pattern is persuasive, the strength of casual inference remains limited.

On the other hand, several authors have argued that new caries rather than failed restorations, were the main reason for repeat GA. Kakaounaki et al. (2011), reported that among the children who required repeat GA, the indications was new dental caries in most of the cases, and in these cases most of the carious teeth that have been extracted in the repeat GA, were reported as sound or unerupted in the first GA. A service evaluation in Sheffield, found a very low overall repeat GA rate (0.63%), and the repeat GA was mainly due to new dental caries, rather than failure of previous restorations (Kirby et al., 2020). Other studies had similar findings, repeat GA was often due to new caries lesions in previously unaffected teeth or newly erupted teeth (Bucher et al., 2016; Azadani et al., 2021). These findings emphasise that high caries risk, inadequate preventative measures and poor recall are main reasons of repeat GA, rather than treatment failure alone. This represents an important debate in the literature, whether repeat GA is primarily due to insufficient radical treatment plan or whether it mainly reflects ongoing disease activity in children who remain at high caries risk. The current evidence suggests that both of these explanations may be valid in different settings, and that variation between studies may partly reflect differences in service models, follow-up systems and baseline disease severity.

On this basis, several studies have highlighted the importance of behavioural and preventive factors. Poor attendance post GA and recall, and the low use of fluoride have been repeatedly associated with increased risk of repeat GA. Kakaounaki et al. (2011) reported that the children who were irregular attenders were around four times higher risk of repeat GA compared to regular attenders. These findings align with service evaluations in UK, which consistently identifies younger age, high baseline caries experience, special healthcare needs and low socio-economic status as important predictors for repeat GA (Kirby et al., 2020; Firman et al., 2024).

Taken all of this together, the literature suggest that repeat GA is actually multifactorial. In some settings it is driven by restoration failure and conservative treatments at the initial GA, while in others its reflecting new caries in children who have high caries risk and received limited preventative follow up. Importantly, much of this evidence is observational, retrospective and service-based, meaning they are useful to identify associations and recurring patterns but less able to determine relative contribution of each factor with certainty. Therefore, the critical debate is not simply whether repeat GA is caused by failed restorations or new disease, but how treatment planning, prevention, follow-up and service context interact to influence the likelihood of a further GA.

# 3. Aims and objectives

## 3.1 Aim

To explore paediatric dentists' decision-making for the management of carious primary teeth under general anaesthetic.

## 3.2 Objectives

The objectives were to explore:

1. Factors that influence the decision to undertake treatment under general anaesthesia.
2. Factors that influence the choice of treatment for carious primary teeth when treatment is being provided under GA.
3. How parents and other stakeholders influence clinicians' treatment decision.

# 4. Materials and methods

## 4.1 Study design and perspective

This was a qualitative cross-sectional study. The perspective of interest was Paediatric Dentistry specialists and trainees working in the UK.

The study took an interpretivist-constructivist qualitative stance. It adopted a constructivist ontology, assuming there are multiple socially constructed realities and that clinician's clinical experience are shaped by their personal, professional and organisational context. The epistemological position was interpretivist, as it viewed knowledge through an interaction between research facilitators in the focus group (BA) and (RB) and participants through the interactions within the focus group, focusing on understanding clinicians' experience. This approach helped explore participants' opinions and experience in depth and to understand the different views and experiences among participants.

## 4.2 Materials and Methods

### 4.2.1 Sample

Eligible participants included qualified Paediatric Dentistry specialists and speciality trainees working in primary and secondary care settings in the UK including general dental practice, community dental service (CDS) and hospitals. General dentists and other types of dental professionals were excluded.

The target sample size was not predetermined as the study followed an interpretivist-constructive qualitative stance using focus groups and reflexive thematic analysis. We aimed to collect rich and relevant data to our study, rather than a fixed numerical target.

The decision of when to stop recruitment, was determined by thematic saturation and meaning saturation. Which was determined by analysis after each focus group and finding no new insights were developed and no new ideas were generated that changed our understanding and the meaning of the developed themes.

### 4.2.2 Recruitment and enrolment

Participants were identified and recruited from the British Society of Paediatric Dentistry (BSPD). Following permission from the BSPD administrator, an invitation email was sent by the BSPD administrator to all BSPD members. The email included a brief explanation of the study, the eligibility criteria and the Participant Information Sheet (PIS) (Appendix III). The email included a link to a Microsoft form where members were able to register their interest. The form collected their name, geographical location, preferred contact details, job title and years of experience as a Paediatric Dentistry specialist or trainee. The Microsoft form was open for 1 month, from 18th October–15th November 2024. A reminder email was sent 2 weeks after the initial email.

If there were more participants than needed, it was planned that participants would be purposively sampled to give diversity in job title, work setting, geographic location and years of experience.

For enrolment, selected participants were contacted through email to arrange a suitable time and date for the focus group. The focus group was scheduled outside work hours to avoid any disruption to clinical services. Participants were sent a consent form to complete and return by email. This was securely stored as a PDF in University of Leeds OneDrive. In case of withdrawal prior to the focus group, the reason for withdrawal was recorded.

### 4.2.3 Data collection

Focus groups were conducted using Microsoft Teams and were video- and audio-recorded. The lead researcher (BA) and a supervisor (RB) co-facilitated the focus groups. A topic guide was used to guide the discussion. Participants were sent a brief information about the expected discussion in advance along with guidance about participating in a focus group (Appendix V). Each focus group was planned to include 5-7 participants as per Kreuger (1994) and to last a maximum of 90 minutes with breaks offered as needed.

#### 4.2.3.1 Facilitator credentials

The lead researcher (BA) studied dentistry in Saudi Arabia and worked in the Ministry of Health in a primary health care centre for two years. Primary health care centres are available in every neighbourhood across Saudi Arabia, and these deliver dental care for children and adults under LA only. There are no other pharmacological methods for managing pain or anxiety other than LA and behavioural management techniques. BA is interested in caries management in children and different techniques to manage children and deliver treatment safely. BA has completed 3 years of clinical training in Leeds Dental Institute and was awarded the Tri-Collegiate Membership in Paediatric Dentistry in May 2025. BA has also completed training related to qualitative research and focus group facilitation (Appendix 1).

RB is a Professor and Honorary Consultant in Paediatric Dentistry with extensive experience in the planning and delivery of dental treatment of children under general anaesthetic. RB is experienced in the facilitation of groups of clinicians through several national roles. RB has supervised a number of qualitative research projects.

SKB is a consultant orthodontist so has clinical understanding of the topic but less direct experience in treating children with caries. SKB is experienced in qualitative data collection and analysis through training during her PhD and subsequent experience in delivering qualitative studies.

#### 4.2.3.2 Facilitator reflexivity during data collection

The focus groups were co-facilitated by BA and RB. Regular meetings were held with academic supervisors (SKB and RB) who are experienced in qualitative research. In the meetings, there were discussions after each focus group to discuss facilitation.

Reflexivity was maintained throughout data collection to ensure that the researcher's own background and training did not influence participants' responses. The researcher kept brief notes after each focus group about her personal thoughts and possible assumptions, these were shared with supervisors in each focus group debrief meeting.

Open-ended questions were used all the time to enable participants to express their views freely on their own way, and co-facilitator (RB) provided support in managing the discussion and rephrasing the questions if they were not clear to participants, ensured that all participants had opportunity to contribute.

### 4.2.4 Materials

Materials were developed by BA for recruitment and data collection.

The topic guide was developed through a process involving:

1. Literature review to identify possible topics, this involved searching available papers through (MEDLINE, Embase, Google Scholar, PubMed) using combinations of terms such as paediatric dentistry, PDGA, decision making, shared decision making, general anaesthesia, restoration versus extraction, OHQL, UK paediatric GA, caries management in primary teeth, children dental anxiety, sedation, stainless steel crown, pulp therapy primary teeth. UK based studies and guidelines were prioritised as the main focus of our study is clinicians within the UK. The search generated topics that were important to be explored more in our study such as (child related factors, treatment philosophy, service-related factors, teeth-related factors, family values).

2. Detailed analysis of the results of a previous questionnaire (Factors affecting UK Paediatric Dentists' treatment decisions for carious primary second molars under GA) (Appendix VII) , which was undertaken by the same research team. BA reviewed the findings and conducted a detailed analysis to identify areas to explore in the focus groups.

3. Expert input was sought from a supervisors, who have both experience working in PDGA services and experience in qualitative research, to refine topics and questions.

4. Piloting and amendments to ensure the questions in the topic guide were clear and able to bring rich discussion.

The topic guide had open-ended questions, with each question focusing on a specific area of the research. Leading phrases in the question and prompts were avoided.

### 4.2.5 Pilot study

Two pilot focus groups were conducted to:

1. Test and modify the topic guide.
2. Support facilitator training through review and debrief of the focus group recording with supervisors.

The first pilot focus group was conducted with paediatric dentistry postgraduate students in the University of Leeds. This involved seven participants and lasted 90 minutes. The focus group was facilitated by BA then the video-recording was reviewed with supervisors.

The key findings that led to changes were:

- Some questions were not clear to participants and needed clarification. These were revised following discussion with the research team.
- General introductory questions took a long time, leaving less time for the important questions for the study. These were revised to be more concise.
- Co-facilitation generated a better discussion because it enabled more field notes to be made to identify areas to probe.
- Inclusion of participants from one region limited the diversity in views so it was felt that geographical variation in participants would be helpful.

A second pilot focus group was then undertaken with specialty trainees working the UK. The second pilot focus group was undertaken to allow further testing of the topic guide and provide additional practice for the lead researcher (BA). Participants were recruited through the BSPD.

Review of the recording found that the focus group generated valuable discussion, which had not been expected when planning the pilot focus groups, so it was agreed that the data generated would be valuable to the study. Permission was sought from the Dental Research Ethics Committee at the University of Leeds (DREC) to gain retrospective consent for use of this pilot data in the study. This was approved and consent was gained from participants. Subsequently, this focus group was then labelled as Focus Group 1 (FG1) for the study.

### 4.2.6 Data management

Personal or identifiable data was included in the Microsoft form recording contact details, and in consent forms, video and audio-recordings and non-anonymised transcripts. These were collected by the lead researcher (BA) and stored securely on the University of Leeds OneDrive. This data was only kept during the data collection period then deleted.

The video and audio-recording were collected and stored securely by BA and then transferred to a University of Leeds-approved transcription service. The audio was transcribed then returned to BA to check and correct as necessary using the recording. Transcripts were pseudoanonymised using a unique study identifier for each participant. Once transcripts were finalised, all recordings were deleted.

### 4.2.7 Data analysis

NVivo 14.24.0 software was used to manage data during analysis. A reflexive thematic analysis method was used (Braun et al., 2022) as follows:

1. BA familiarised herself with the data by reading through the transcripts for each focus group.
2. BA initially coded the first transcript based on her own interpretation of the discussion.
3. BA and the supervisors (RB and SB) then met to discuss and revise the codes used in the first transcript.

4. These codes were then used to code subsequent transcripts, with additional codes used as needed where new content was identified.
5. BA then grouped the codes into initial topics. The topics were discussed and revised with supervisors.
6. Topics were then discussed and grouped to develop themes.
7. The research term discussed the topics and themes further to reach agreement on what each theme meant and to make sure it was accurately representing the participants discussion.
8. BA selected illustrative quotes to support the reporting of themes.

BA kept a reflexive diary during data collection and analysis. BA also logged the decisions throughout the analysis process to encourage transparency.

### 4.2.8 Ethical approval

Prior to commencing the study, ethical approval was sought from the Dental Research Ethics Committee at the University of Leeds (Reference: **240424-BA-014 on 31st May 2024).**

Consideration was given to:

- Fair and non-coercive recruitment through voluntary participation and time to decide whether to take part.
- Information about scope to withdraw after the focus group.
- Support for managing any distress during or after the focus group.
- A point of contact to raise any concerns about the research

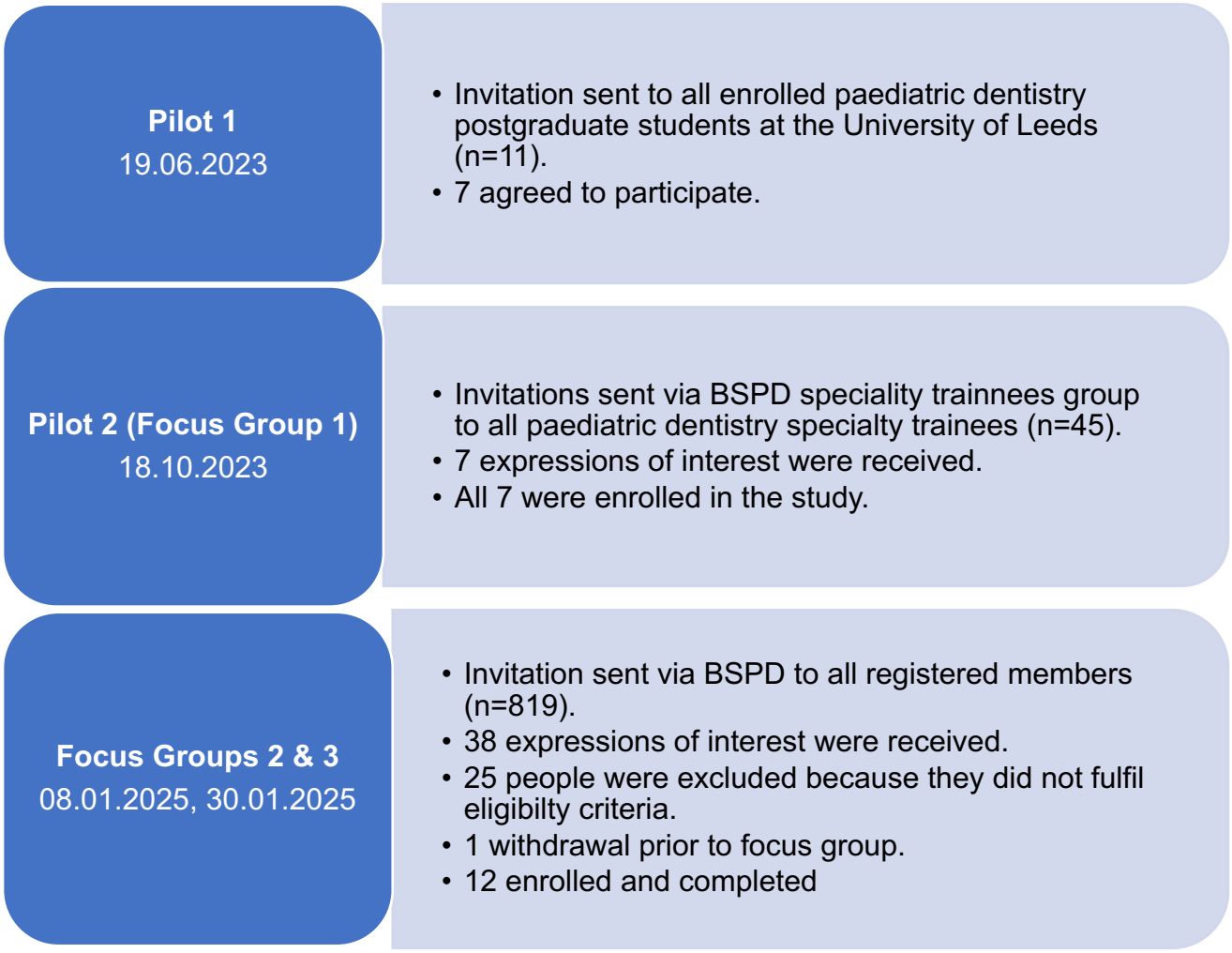
A process for the researcher (BA) to manage any concerns about the content discussion within the focus groups, for example around standard of care.

# 5. Results

## 5.1 Recruitment

Figure 1 summarises the recruitment process. In total, three focus groups with 19 participants provided data for analysis. Data saturation was evident by completing the analysis of the third focus group, and therefore, no further focus group was needed.

Figure 1. Recruitment process.



## 5.2 Participant characteristics

Participant characteristics are shown in Table 3.

Table 3. Participants characteristics

| | Focus Group 1 | | Focus Group 2 | | Focus Group 3 | |
|---|---|---|---|---|---|---|
| **Number of participants** | 7 | | 6 | | 6 | |
| **Location** | North East<br>West Midlands<br>Yorkshire and Humber<br>Scotland | 2<br>1<br>2<br>2 | East Midlands<br>London<br>North West<br>Yorkshire and Humber<br>South East | 2<br>1<br>1<br>1<br>1 | East Midlands<br>London<br>South West<br>Yorkshire and Humber<br>Scotland | 1<br>1<br>1<br>2<br>1 |
| **Type of Practice** | Hospital<br>CDS* and Hospital | 4<br>3 | Hospital<br>CDS*<br>CDS* and Hospital | 4<br>1<br>1 | 3 Hospital<br>2 CDS*<br>1 CDS* and Hospital | 3<br>2<br>1 |
| **Level** | Speciality trainees | 7 | Specialists<br>Consultants | 3<br>3 | Specialist<br>Consultants | 1<br>5 |
| **Years of Experience** | < 5 years | 7 | > 10 years<br>< 5 years | 5<br>1 | > 10 years<br>5-10 years<br>< 5 years | 3<br>2<br>1 |

*CDS= Community Dental Service

## 5.3 Development of themes

After coding each transcript, BA met with supervisors (SKB and RB) to discuss the ideas. These meeting were used to think about each code and examine any perspectives that might be influencing the coding, then reach agreement on a code that was felt to accurately capture what the participant was saying. BA then grouped the codes into topic

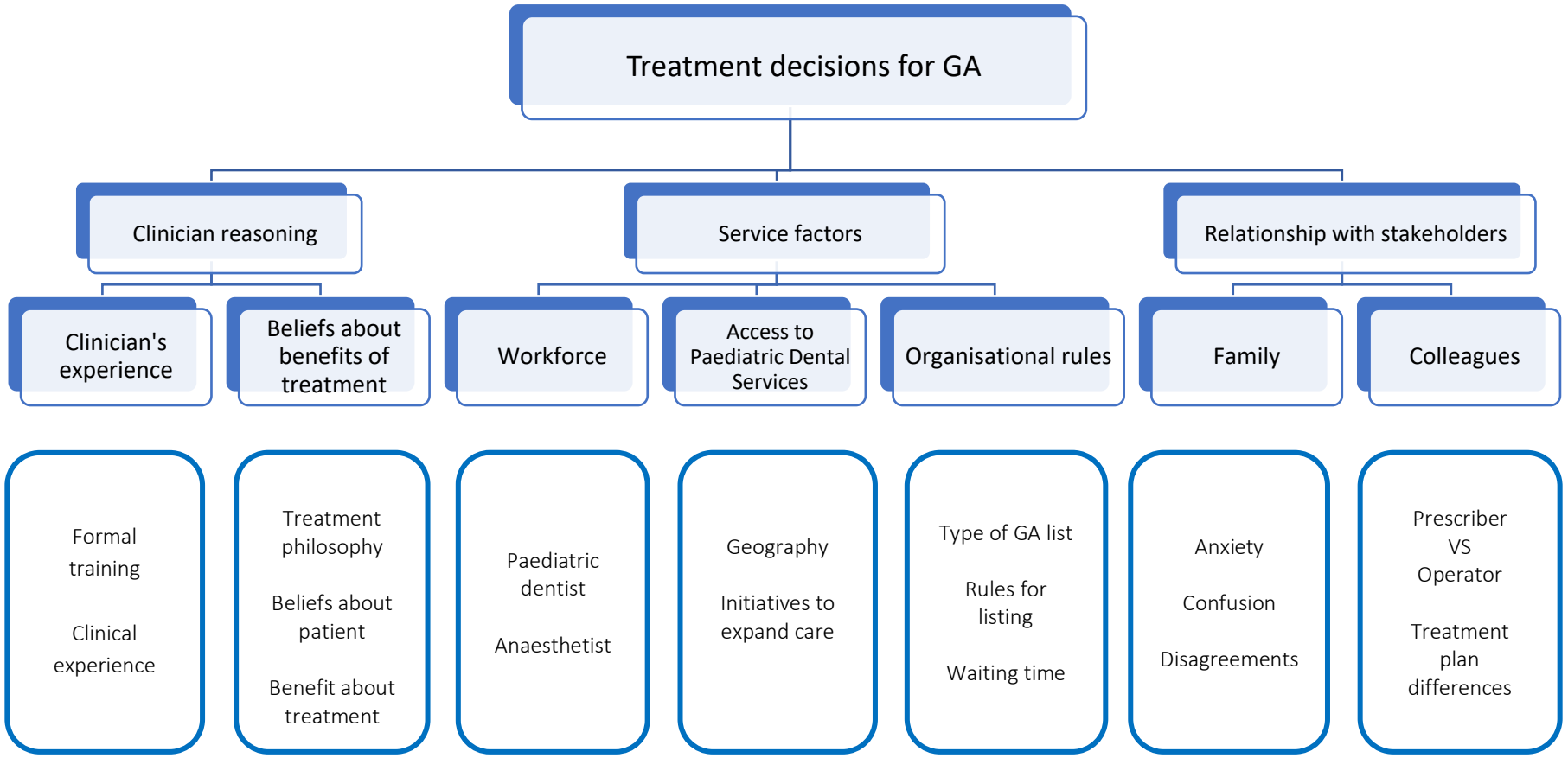
areas by moving back and forth between the data and codes, then this was again discussed as a group to ensure the topics reflected the data.

BA lead the process of developing codes and topics and then shaping them into different themes and subthemes. BA reflected that her background mattered because from her training in Saudi Arabia, she was curious about the difference between services and types of treatment provided under GA. BA read a lot about paediatric dental services in the UK and had difficulty understanding why clinicians tended to avoid certain treatments. Discussion about any misunderstandings, beliefs and assumptions during meetings in the analysis phase helped BA focus more on what participants are saying and adjust themes when her own assumptions were getting in the way.

### 5.3.1 Overview of themes

Finally, three main themes were developed to describe participants experience of making decisions about treatment of carious primary teeth under GA (Figure 2). The first theme described clinician's reasoning behind their decisions and incorporates both their experience and their beliefs about the benefits of different treatment options. The second theme described how treatment decisions were influenced by workforce, access to GA for paediatric dental care and the rules governing the use of GA in their service. The third theme describes the relationship between the clinician making decisions and the child and family, as well as colleagues.

Figure 2. Overview of themes and subthemes that described participants' reasoning behind treatment decisions for GA.



### 5.3.2 Theme 1: Clinician reasoning

The first theme captured the internal frameworks clinicians use when determining care pathways. Clinical reasoning here involved balancing ideal treatment for the patient with the reality of what is possible, acceptable, and realistic to the patient's needs. The theme explored relationships between professional values and knowledge, formal training, experiential learning, judgment of the child's best interests, and different philosophies of treatment, whether conservative or interventionist. It also reflected the flexibility in care planning.

#### 5.3.2.1 Clinician experience

Clinicians' own experiences shaped how they interpreted patient behaviour, managed parent-child expectations, and their approach to risk. Their accumulated experience played a role in guiding their clinical philosophy, especially when deciding whether GA was appropriate and the type of treatment to offer. This resulted in contrasting treatment philosophies between clinicians, even within the same institutions. Some clinicians advocated for minimal intervention and specific restorations, while others favoured extraction due to predictability. These differences emerged from differences in training background, departmental culture, and traditional types of treatment. Participants described having to adapt their reasoning when moving between NHS Trusts with different expectations.

*"…within the department, we've got quite a number of consultants, and I think our treatment planning practises are all different"* -P 1, FG 3.

*"I'm much more of an extraction person. I'm much more what we call pragmatic. But I think that just comes down to the types of patients that we're seeing."* -P 6, FG 1.

*"My approach is very based on the individual basis case, what I have in front of me"* -P 5, FG 2.

Participants emphasised that their clinical judgment developed over time and enabled them to assess children's cooperation and anxiety quickly and accurately, minimising wasted appointments. It also informed their understanding of when behavioural

management techniques were likely to fail**,** particularly with complex social, medical, or developmental needs.

*"I use my own judgement and advise on what I think they might be able to try."* -P 2, FG 1.

*"I guess my style of treatment planning has become a little bit more flexible overtime"* -P 4, FG 2.

Participants felt that learning from experience never stopped and evolved throughout their career, particularly when dealing with post-COVID-19 changes. The COVID-19 pandemic created new challenges that had not been experienced before and had lasting effects**.** Clinicians reported that after the pandemic, children presented with increased levels of dental anxiety and more advanced dental disease. Participants expressed that the pandemic changed how they plan GA because they saw a lot of the children with advanced dental diseases who were asymptomatic, indicating that preventive intervention could help some children avoid GA by stabilising asymptomatic teeth. Subsequently, some clinicians reported adopting the idea of stabilisation of asymptomatic carious primary teeth instead of opting for GA interventions. However, others still preferred to add the child to a GA waiting list because the asymptomatic teeth could become symptomatic and the child would have to wait longer.

*''…treatment under general anaesthetic is completely different to how it used to be before COVID. How lists have changed dramatically, how many we book on our lists and what we do on those GAs as well''* - P 5, FG 2.

*"I think we found that COVID changed our practise quite significantly on how we manage asymptomatic primary care. "* - P 3, FG 3.

*''I think whereas before COVID we might have said, yeah, these teeth are all unrestorable but they're asymptomatic but we'll take them for GA before they cause problems, now we're much more likely to go in and slap some SDF on them and see what happens.''* - P 6, FG 2.

Participants indirectly suggested their experience was shaped by their training institute, however, training itself was not explicitly discussed in detail in the focus groups. Differences in treatment rationale appeared to reflect different educational backgrounds and exposure to clinical procedures during training. For example, more senior and experienced clinicians were more open to the different advanced restorative techniques

such as pulp therapy (although chairside) and reported to be confident in performing such procedures. In contrast, junior clinicians indicated they had limited or no experience of some procedures, which translated to less confidence in performing the procedures chairside. This meant that these procedures would not be considered as a treatment option that could be offered under GA. Senior clinicians described how postgraduate and specialty trainees have limited exposure to advanced restorative techniques in primary teeth, which was attributed to children becoming more anxious so some of these advanced treatments would have been only performed chairside under LA and not under GA. Senior clinicians recalled that in earlier years they were able to perform quadrant dentistry, including pulp therapy. With the increasing use of the Hall crown technique, it was felt that this had replaced many of the traditional advanced restorative intreventions.

*'I've never seen a pulpotomy, I've never done a pulpotomy, so if someone was to put that even in my local anaesthetic diary, to do a pulpotomy, I'd be like, I don't even know where to start or where to finish."* -P 1, FG 1.

*''about the pulpotomies. So, I've never done them under general anaesthetic in 26 years because I think the patients that I see where the level of decay is such that it might merit a pulpotomy''* -P 3, FG 3.

*" I've done one pulpotomy in the last eight years"* -P 4, FG 3.

*"I used to love doing pulpotomies and pulpectomies under GA, rubber dams and all the stuff. I cannot remember how long ago it was the last one I did. Treatment planning under GA is more radical. If I can save, I will save, as long as I feel comfortable."* -P 5, FG 2.

*''…when I was training you could do quadrant dentistry. You could get extractions done. You can't even get them in the chair now is literally for GA where in the past we used to be able to do quite a lot of work.''* -P 1, FG 2

*"Certainly when I was training, if a child came in with caries, even if they're asymptomatic, you'd treat it all. Now we just keep going with high prevention, Yeah, much more likely to leave them than we would have done historically"* -P 6, FG 2

#### 5.3.2.2 Perceived benefits of different treatments

When participants were explaining their treatment rationale, the perceived benefits of a particular treatment, both in itself and in relation to the individual child and family, guided which treatments clinicians believed were most appropriate. Clinicians emphasised that treatment should be durable, predictable, and individualised to the patient. Some highlighted that over-treatment under GA can be as problematic as under-treatment, especially where it may not be feasible to maintain restorations post-operatively..

*''I just want to make sure someone is safe and I wouldn't want them to go through something that had risk unnecessarily''* -P 6, FG 1.

*"When it comes to GA, I do treatment plans slightly differently. It's all about I want that to be the one-off."* -P 2, FG 2.

*"as long as I feel absolutely confident and comfortable that what I do will last until exfoliation."* -P 5, FG 2.

*"We sometimes think, oh, this child is drinking coke non-stop and doesn't brush their teeth, what's the point in restoring any of these baby teeth because they're just going to get new caries"* -P 3, FG 3.

Clinicians reported that the benefits of active interventions under GA to the child should outweigh any risks from monitoring their asymptomatic teeth. Their ability to review the patient promptly, whether by retaining them for follow-up or if monitored by GDP after discharge, re-accessing the service without prolonged re-referral time, was a determinant of whether they would benefit from an active intervention or not.

*"we can control getting patients back in again, even if they have been discharged, more quickly, whereas previously, as we've all talked about, we might have been more inclined to do interventive treatment."* -P 3, FG 2.

Factors that were considered when assessing planned provision of treatment included the child's age, anxiety, past dental history including dental anomalies, current symptoms

and social factors. The possibility of acclimatisation was a strong determinant of whether or not teeth can be restored before extractions under GA.

*‘’I offer patients predominantly exodontia for primary teeth, to be honest. We will do some restorative treatment in the chair if the patient can cope with it. But if they can’t, I’d be pushing more towards exodontia because I think that that is the most sort of efficient way of treating the primary teeth’’* -P 1, FG 3.

*“I’m thinking if you’ve got a patient with an anomaly like severe hypodontia, I would consider a pulpotomy for that patient.”* -P 2, FG 3.

*“I very rarely see strip crowns under GA and only on our patients with dental anomalies, like amelogenesis imperfecta.”* -P 1, FG 1.

The individual family’s situation also guided treatment decisions. For example, a high treatment burden from multiple dental visits for acclimatisation and quadrant dentistry for a family with competing demands such as frequent relocations, parental illness, large families, safeguarding concerns, may encourage clinicians to prefer GA.

Perceived cultural and language barriers also influenced clinician’s treatment plan. Several participants highlighted how working in ethnically diverse communities where English is not the first language influenced their decision to opt for GA sooner, due to limited capacity for behavioural acclimatisation. The perceived benefit to the patient and family of having the treatment completed in a single visit under one GA influenced clinicians’ decision-making.

*“When you've got children recently come into the UK… they’re not going to understand the acclimatisation process. That would push me towards GA”* -P 1, FG 3.

“*I've just finished working in xx and we had a significant population there where English was not their first language at all. Actually, it definitely did lean us towards GA more than it didn't, because like xx said, to get an interpreter in and try and do inhalation sedation and acclimatisation would be hours in the chair and hours of everybody's time”* -P 3, FG 2.

Finally, while participants reported feeling confident about the benefits of the treatment they provide under GA, the decision for GA in itself was not taken lightly. Some participants expressed their personal anxiety regarding prescribing treatments under GA due to GA risks and how GA might instil dental anxiety, and how they would avoid it had

it been their relative or their own child. Some participants felt that paediatric dentists may become desensitised from the number of children they see.

*"if that was my son, probably would I have wanted an SDF instead and avoid the risk of a GA. So, that's probably the times where I've felt my own judgement has been different for what I'd want for a relative. Everyone values things differently. My number one priority is safety."* -P 5, FG 1.

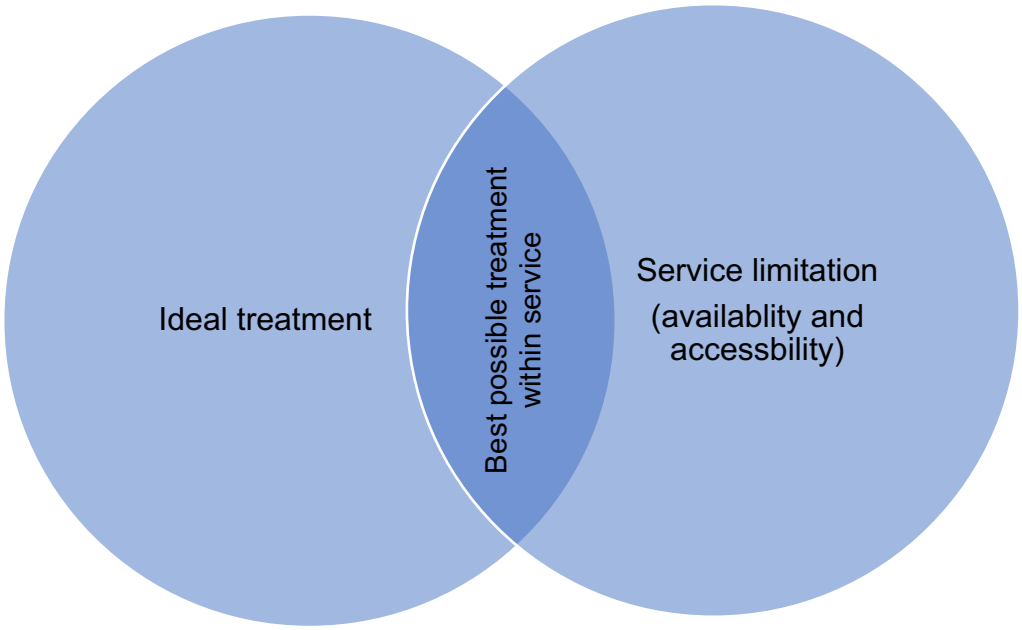
*"… I'm quite desensitised but when it comes to my family member, I probably wouldn't. I'd try and do other things first."* -P 4, FG 2.

*"I'm maybe more anxious about medical procedures or general anaesthetic or that sort of thing"* -P 2, FG 1.

### 5.3.3 Theme 2: Service factors

The second theme described how treatment decisions were influenced by the available workforce, access to PDGA services and local rules governing the use of GA services in the specific facility. This highlighted how service delivery shaped and constrained clinical choices. Participants felt in some circumstances the ideal treatment did not align fully with what was possible in their service, resulting in somewhat of a compromise where they offered the best possible treatment given the service limitations (Figure 3).

Figure 3. Best possible treatment plan in paediatric dentistry facilities.




#### 5.3.3.1 Workforce

Participants reported variation in service delivery and staffing across the different areas in which they worked. Workforce shortages, particularly of anaesthetists and paediatric dentists, were felt to be a barrier to ideal care. While some areas had GA lists available, there were limited staff available to utilise them. Others described being overburdened by cross-region referrals due to a lack of staff in other areas to provide care.

Participants highlighted that sometimes GA lists were cancelled due to a lack of an anaesthetist, which further increased existing pressures on waiting lists. This shortage also meant that participants sometimes felt obligated to consider adjustments in their treatment plan to create shorter individual slots to accommodate more patients in each GA session. Consequently, the anaesthetist shortage was reported to cause some participants to think about exodontia rather than restorative care, because exodontia takes less time per patient meaning more children could be treated in each GA session. Anesthetist preference for nasal intubation also affected the treatment plan because some clinicians in the focus group believed that nasal intubation precludes any restorative treatment that uses water.

*"if I know that I will be working with an anaesthetist that uses a nasal circuit, we know there's going to be an open airway, so you can't use anything with water in it because then it's obviously going to go into their lung."* -P 5, FG 2.

*"I'm like, oh, this tooth is restorable. It really bothers me. But there isn't time on those lists either because they've got seven patients on a session, which is not the correct thing to be doing, I understand, but that is what it is"* -P 3, FG 2.

In some community dental services there was limited or no availability of paediatric dentistry specialist or consultant. This meant that children had to travel further to receive care and waiting times were longer. One participant reported that in their area, they were the only specialist available, which meant they were the only one able to provide comprehensive care, limiting treatment options for children in their area.

*"we're having a few issues at the moment with a couple of our community dental services not being specialist or consultant-led."* -P 4, FG 3.

*"I'm the only specialist or consultant in the whole of xx and so I'm the only person that really can do comp care GA."*- P 6, FG 2.

To navigate this workforce shortage, in some areas the GDPs or oral surgeons performed treatment for children under GA, with or without prior input in the treatment planning from a paediatric dentistry specialist. While this had drastically reduced waiting time, with children waiting only one month to receive care, participants acknowledged that ideally they should be specialist or consultant-led.

*"I used to work for…. community services, and they had a specific theatre which was on the site of the main hospital but it wasn't in the hospital and it was just for paediatric dental general anaesthetics and their waiting times were only like a month for comprehensive care and exodontia. And it wasn't consultant or specialist, it did work on the majority. Obviously, in an ideal world it would be specialist or consultant led"* -P 4, FG 2.

#### 5.3.3.2 Access to paediatric dental GA

The pathway for referring a patient for GA was the same amongst participants. A child is referred from their GDP for advice and treatment by a paediatric specialist in CDS if a specialist paediatric dentist was available or hospital.

Across all focus groups, participants suggested that while there is access paediatric dental GA services, the type of treatment that is available under GA and waiting times for different types of treatment varied. Participants described these variations in GA services across different locations. Even in geographically close locations, there were differences in availability and access to PDGA services. Participants felt that the treatment a child can receive depended on their postcode, and the availability of different type of GA list was influential during treatment planning.

*"I think that they're the main factors - the age, medical history, amount of treatment, access to lists and also the social factors and their past dental history and cooperation."* -P 2, FG 2.

*" very close geographical areas but what children might be offered is very different, just depending on their postcode"* -P 5, FG 1.

*"if you then go to another hospital not so far away from me, they don't have the same access to comp care lists and they are mainly exos and they'll have one list a week which they prioritise for the medically comp."* -P 4, FG 2.

Participants were supportive of initiatives that could help decrease waiting times and increase access to GA services in their region. An example that was mentioned was ''Project Tooth Fairy'' in London, which provided comprehensive care and exodontia for children. Participants expressed their interest in adopting the same project in their region, but worried about funding and staffing. Another initiative in Yorkshire focused on providing comprehensive care by using an extended slot in the exodontia list where only Hall crowns on primary second molars could be performed.

#### 5.3.3.3 Organisational rules

Participants explained different types of lists were available in their service and the rules around use of different lists influenced choice of treatment under GA. The type of GA lists were separate lists for exodontia only and for comprehensive care, one GA list regardless of treatment plan, and in some locations there were only exodontia lists.

The criteria specifying the type of list a child could be offered were similar. Many restricted comprehensive care GA for primary teeth to children younger than 3 years old, children with additional needs, those with 99th centile BMI, children with dental anomalies or medically complex. Medically fit children were often restricted to exodontia lists. Mixed lists, where both exodontia and comprehensive care were performed, was perceived to be beneficial because treatment planning was based solely on patient needs without the influence of list availability.

*"where I work now, we always have the option to offer everyone comp care. They always get generally the same treatment."* -P 5, FG 3.

*" I think I'm in a very fortunate position that I have access to comp care lists. So, I'm in a very fortunate position. I know that's not the same everywhere."* -P 2, FG 2.

*"I've always very strongly believed that every child should have access to comprehensive care, because at the minute it's very much via postcode and where you are in the country, and maybe a national guideline that perhaps justified certain reasons for types of treatment"* - P 3, FG 3.

Participants discussed that the option of comprehensive care under GA is shared with parents, but due to the fact that comprehensive care lists are used for those who are not suitable for exodontia lists making the waiting time for comprehensive care lists much longer, often parents accept exodontia because they do not want their child to wait if there is existing pain. Similarly, long waiting lists sometimes encouraged participants to make compromises in their treatment plan to avoid deterioration in the child's dental health and quality of life during the waiting period. Others felt the waiting lists did not influence their treatment plan.

*"Depends on what symptoms the child has; mild symptoms tend to give parents more options to choose from".* -P 4, FG 3.

*"I know we shouldn't and you're not supposed to but we do have a separate exodontia list and a comp care list. And we have got criteria about who can go on what."* -P 2, FG 1.

*"So, you want me to save that one upper C or that one upper B, actually you're going to have to wait a long time for us to do that and I'm not going to prioritise your care in order for you to have one or two teeth saved"* -P 3, FG 2.

Availability of time on the operating day also affected the choice of treatment under GA. Participants shared that if they had extra time such as a last-minute cancellation, they would consider placing Hall crowns because some of the time pressure was removed. The use of pre-operative medication also influenced how many children could be treated because a pre-surgical medication required longer admission time and therefore less capacity to accommodate more children.

*"If I've got a little bit more time to play with, and there was a training need for someone who was in theatre with me, I might go back to the parent and offer them restorative treatment if we had previously talked about exodontia only."* - P 1, FG 3.

*"I'm like, oh, this tooth is restorable. It really bothers me. But there isn't time on those lists either because they've got seven patients on a session, which is not the correct thing to be doing, I understand, but that is what it is"* -P 6, FG 2.

"If the child needs a pre-med… they'll be potentially waiting a little bit longer depending on availability of slots." -P 4, FG 2.

Waiting times were reported to vary between participants. One of the services that provided comprehensive care for all children had the longest waiting time (12-24 months), while in other services the average was around 8 months wait for exodontia and 12 months for the comprehensive care. All participants were able to access an urgent GA list with a waiting time of 1-2 weeks.

The ability to review the child and ease of re-referral following discharge from the serivce also impacted on decisions. Participants reported their services had different rules

regarding the process for re-referral and this impacted on how quickly a child could be seen again.

*"I think one of the big issues certainly we face is, again, that we can't keep patients on for review and discharging patients."* - P 3, FG 2.

*"We do maybe bend the rules a little bit and say, look, if you've got pain in the next six or 12 months, give us a call and we will get you back in more quickly"* - P 5, FG 3.

### 5.3.4 Theme 3: Relationship with Stakeholders

The third theme describes the influence of the relationship between the clinician making decisions with both the family and colleagues. It explores the emotional and communication skills involved in gaining trust, resolving conflict, and making shared decisions collaboratively. Participants spoke of the difficulties in managing family expectations and finding a mutually acceptable solution when family or colleagues had different perspectives.

#### 5.3.4.1 Relationship with the family

Shared decision-making was seen as a fundamental part of a child's care across all participants. Time pressure, language barriers, or conflicting views sometimes made decision-making challenging. Participants discussed parental influence and conversations they frequently saw in their practice, and how they felt it affected treatment planning. Participants felt they often had to balance their professional judgment and their own beliefs about the preferred treatment approach and type of treatment with parental views, which may not align, sometimes due to parents' past experiences, anxiety, cultural beliefs.

*"I want it to be shared decision-making but I want to make sure they understand the practicalities of all options."* - P 4, FG 1.

*''…in your head you're thinking, oh, you've just set me up to fail, no matter what I say now. You've kind of said that it will not work, there's no chance of it, and the child is very perceptive to what's being said, even when you think it's a parent to adult conversation.''* - P 4, FG 2.

Participants reported that one of the difficult conversations was when parents expected GA from the outset and felt that GA was 'normal', then were reluctant to consider other options that could be offered. Participants felt that these expectations arose for a number of reasons: firstly, parents expected GA because they understood from their rereferring dentist that this would be given and the wait for assessment and further wait for GA caused frustration, which made explanation of other options such as acclimatisation or sedation challenging; secondly, parents' personal anxiety and their experience as a child had normalised the use of GA for dental treatment and their anxiety was often perceived to have been passed to their children with an expectation that their child would not be able to tolerate any treatment in the dental chair; thirdly, parents with another child who had previously undergone a dental GA experience often assumed this would be the approach for other siblings.

*''…maybe not knowing that there's other options that might be appropriate and sort of coming in with a very set mindset, perhaps the GDP said from the beginning, we're referring you for a general anaesthetic''* - P6 FG 3.

*''So, we get so many patients attending the first appointment, fasted, starved, thinking they're having the extractions done on the first visit''* - P1, FG 3.

*''…parental previous experience. So, a lot of our patients' parents have experienced extractions under general anaesthetic as youngsters themselves. So, they very much sway towards that as being expected and that's what happens.''*- P 2, FG 2.

*"They'll say their older one had GA and expect the same even if the case is different."* - P 4, FG 1.

Participants reported these expectations created pressure to offer GA even when it conflicted with their preferred treatment option based on their clinical judgement. These tensions often required clinicians to use their communication skills and emotional resilience to reach shared decisions, particularly when dealing with anxious families or children with previous traumatic dental experiences.

Participants also reported there was a contrasting scenario, where parents refuse GA entirely, often due to safety concerns. In these sitituations, parents may have unrealistic

expectations about what their child would be able to cope with under local anaesthetic, then clinicians felt they had to prove to parents that chairside treatments were not feasible before the parents would agree that GA is in their child's best interset. Clinicians reported that the end result of parental refusal for GA was sometimes that parents would not bring their child to their GA appointment even after providing consent. In these situations, the dentist was obliged to raise safeguarding concerns.

*"You can explain as much as you like… but occasionally you get overridden by what parents think is right,"* -P 2, FG 3.

*"one of the problems we had was you would disagree with the parent in terms of going for GA or not going for GA and then the problem would be they wouldn't turn up to whatever appointment you'd agreed."* -P 5, FG 1.

*"if you list them for GA because they need complete clearance, sometimes the child isn't brought"* -P 7, FG 1.

Disagreement on the type of treatment provided under GA were reported to be relatively common with families from a high socio-economic status, where family prefer to retain their child's teeth for aesthetics. Moreover, one participant mentioned that this disagreement tended to occur more with parents from the Orthodox Jewish community who often refuse extractions, or from families with a different cultural background, where the family's experience of GA abroad was considered to be a more conservative dentistry such as multiple pulp therapy and crowns, rather than the UK focus of reducing the risk of repeat GA. Consequently, some parents preferred to retain as many teeth as possible and this meant clinicians needed to spend more time discussing the risks and possible consequences of different options. It was reported that sometimes in these situations, some parents still refused exodontia and instead returned to their country of origin for the GA treatment, but this occasionally meant the child returned later with further dental problems.

*" we have a very large Orthodox Jewish community and from a background point of view, they are generally very hesitant to have teeth removed and then obviously we're saying teeth are going to be removed, then there's that clash between what your viewpoint is as a healthcare*

*provider and what's actually really important to some people in their personal lives. So, I think it's important that we, wherever we work, identify all the important communities in our areas and then try and tailor our services for it, and that will be different, depending on where you work*." -P 6, FG 1.

*"the judgement we'd make from a child from a more affluent area that maybe has two carious teeth, three carious teeth, would you restore something then because there's maybe social embarrassment associated with it from that background."* -P 4, FG 3.

*"…parents still choose to go back to their home country to have the restoration done, but then you put them at risk of a repeat general anaesthetic in six to 12 months "* -P 7, FG1

#### 5.3.4.2 Relationship with colleagues

Participants explained that the clinician who plans the treatment under GA is not always the one who will ultimately deliver the treatment. This sometimes created the pressure for the treating clinician to adapt the treatment plan to something that they perceived as acceptable to their colleagues. Participants emphasised that for this reason, it was important to keep the consent more flexible to allow for changes.

*"you might have one person who's planned something who's worked in different units and then another person who's worked in other different units and there's different skills, so it's very difficult as the prescriber to impose what you would want on the operator, if that makes sense."* -P 6, FG 1.

*"I know that within the department, we've got quite a number of consultants, and I think our treatment planning practises are all different and we don't really have a set plan that we follow, we treatment plan whatever we think is appropriate based on what we've discussed with the parent."* -P 1, FG 3.

*" we might all have a different style and treatment planning. The other consultant or person is not going to be with you at the time to know how different we are."* -P 6 FG 3

*"also think there's an element, under GA, of almost not wanting to commit, so it gives you the opportunity to change the plan, even if it is the same people"* -P 7, FG 1.

Speciality trainees discussed that there were differences in treatment planning between consultants. The trainees described being more cautious in their planning and they relied on taking direction from the consultant.

*“well, Consultant X on clinic, I think they’re going to take this up and they’re going to do this and I think that really changes my treatment plan.”* -P 7, FG 1.

*‘’you would potentially restore an E if it had small occlusal caries but, again, that’s consultant-dependent.’’* -P 6, FG 1.

*“If I was to look at every single tooth or I could do anything I wanted at any time, might I do things a bit differently? Probably yes from my perspective, you get ten different dentists, you get 11 different treatment plans is the common saying.”* -P 4, FG 1.

# 6. Discussion

## 6.1 Overview

The study explored how paediatric dentists within the UK make decisions about managing carious primary teeth under GA. Clinical guidelines and evidence provide a range of acceptable options, but participants’ accounts showed that treatment plans vary across regions, between clinicians, and even within the same trust. These inconsistencies suggest that what is perceived as best care under GA is shaped not only by clinical factors but also by treatment philosophy, service, and expectations about family's ability to maintain oral health postoperatively.

### 6.1.1 Discussion structure

The discussion chapter is organised into five main parts as below:

1. The methodological approach and its influence on our findings.
2. The novel contribution of this study to paediatric dentistry.
3. Key results from the three main theme, interpreted in relation to existing literature.
4. The implications of these findings for practice, service structure and patient.
5. Suggestions for future research and conclusion.

## 6.2 Methodological approach

### 6.2.1 Qualitative design

The study used a qualitative cross-sectional design, with an interpretivist constructivist stance, designed to explore how paediatric dentistry specialists and trainees choose their treatment plans under GA for carious primary teeth in their daily practice. An interpretivist-constructivist approach assumes that reality is socially constructed, and that clinician's decisions are shaped by experiences, interactions and the context in which they work, which makes it very suitable for research that aims to understands meaning and reasoning in health care (Green et al., 2018; Otani, 2020).

In a previous survey project with undergraduate students (Appendix VII), suggested that there was variation and uncertainty around the management of carious primary teeth under GA, but the survey data could not show in details how clinicians weighed up the different options, which highlighted the need for this project.

A qualitative approach was therefore chosen as the study aimed to understands how clinicians give their reasons and justify their treatment decisions, rather than measuring how often different types of treatment are used. As this will not show us why particular options are chosen or how clinicians reach their decisions. Qualitative methods are widely recommended when the research questions focus on exploring "how and why" (Hamilton et al., 2019), decisions about managing carious primary teeth under GA are complex and requires an in depth qualitative data to capture it and help understand it.

### 6.2.2 Focus group

Focus group were selected as the primary method of data collection as they enable participants to compare experience, share each other's assumption and the norms within their practices that may not surface in an individual interview or other methods of data collection (Kitzinger, 1995; Wilkinson, 1998). A previous work with undergraduate students shown in Appendix (VII) using survey, highlighted areas within the topic that required further exploration by using an in depth qualitative design.

For this project, focus groups was particularly appropriate because we were not only interested in individual views, but also shared norms about what is considered appropriate under GA are discussed within the different paediatric dentists levels and from different regions and type of services. This has helped to explore participants opinion and experience in depth and to capture similarities and differences in views across different regions within each group.

### 6.2.3 Material

The focus groups were conducted online using Microsoft Teams, which allowed the participation of clinicians from different geographical areas within the UK and from different type of practices (community and hospital), online focus groups are increasingly used in health research and considered to be a practical way to reach busy clinicians from different areas, while enabling a group discussion (Tuttas, 2015; Abrams et al., 2020). Without an online format, it would have been very difficult to bring together all clinicians from multiple regions and service types within the time and resources available. Face to face focus groups would likely required participants to travel and take time off from work to attend in a single location, which may have reduced participation and diversity of the sample. Using Microsoft Teams enabled clinicians to join from their usual preferred place whther their workplace or home, which helped in maximising participation and including a wider range of views. Furthermore, the diverse perspective in the sample would likely have been narrower if it was face to face.

### 6.2.4 Recruitment

The recruitment was through BSPD mailing list and included paediatric dentistry specialists and speciality trainees. These groups were targeted as they are the clinicians who are directly involved in planning and delivering treatment under GA within NHS hospital and community services, and therfore were the clinicians' of interest to reflect on routine clinical decisions-making in this context. This would therefore be considered as a form of purposive sampling, which is commonly used in qualitative research when the aim is to access participants with specific knowledge and experience that is relavent to research question (Green et al., 2018; Palinkas et a., 2015). The BSPD mailing list was

the most reliable and practical way to reach a large number of paediatric dentistry specialist and trainees across the UK who were also likely to be interested in contributing to research in this area, and has been used in previous studies to recruit participants from this group.

In terms of sampling,

### 6.2.5 Analysis

The data was analysed using reflexive thematic analysis (Braune and Clarke, 2006 and 2019). This involved repeated reading of the transcript and line by line coding, then developing and refining the themes. The researcher (BA) and supervisors (SKB) and (RB), met several times to discus the codes and theme meanings, which helped overcome how (BA) background and assumptions might have influenced the interpretation, and adjust themes when necessary. Reflexive thematic analysis was chosen because it allowed an in depth look at how clinicians talked about treatment planning under GA and help identify both similarities and differences in their reasoning.

Alternative analysis approaches such as content analysis is often used to summarise large amount of transcripts and to describe the main catogeroies that are present within the data, this can be useful when the aims of a study are to describe what is being said or to how often certain ideas appear, but it usually relies on more structured, pre-defined coding and tend to produce more descriptive findings which is less suitable to our study that focus on understanding how clinician make their treatment decisions (Vaismoradi et al., 2013). Another approach would be framework analysis which is commonly used in applied health research, it provide a clear way of charting data across cases and topics. However, it's helpful when there are specific questions or domains to compare across a team, it can also encourage a more fixed structure based on those pre-defined categories (Gale et al., 2013).

In contrast, reflexive thematic analysis is more flexible and fits within the aims of the study. As in any interpretive qualitative studies, the findings reflect views that were developed between researcher and participants, as opposed to an objective description of practice.

This approach also meant that the analysis focused on clnicians' meanings that they attached to their decisions rather than counting how often particular options were mentioned, also, different analysis might have produced a more descriptive findings but less interpretive.

## 6.3 Novel contribution

This thesis provides new knowledge by qualitatively exploring how paediatric dentists in the UK make treatment decisions for carious primary teeth under GA. As pervious literature on paediatric dental GA has mainly focused on disease burden, service structure, treatment outcomes, repeat GA and oral health related quality of life, while giving limited attention to clinician's decision making. The study adds a contextual understanding of variation in care that is not captured by epidemiological, guidelines, or outcome focused research alone.

## 6.4 Key findings

### 6.4.1 Treatment philosophy

Participants treatment philosophies and beliefs about what constitutes best care under GA strongly influenced whether they priorities tooth preservation or extraction. Many described weighing the benefit and risk of extractions versus restorations, and choosing options that they felt families could realistically maintain. This aligns with current SDCEP, 2025 guidance which emphasises prevention and minimally invasive approaches such as Hall technique crowns. The SDCEP 2025 guidance doesn't distinguish between treatment in the chair or under GA. However, this guidance helps to explain why participants frequently selected minimal intervention (Hall technique) when they judged the tooth to be suitable. In the next subsections, the rational of their treatment philosophy is further explored to understand why minimal dentistry seemed as the preferred choice and the impact of that.

#### 6.4.1.1 Stabalisation of asymptomatic teeth

Participants described a growing willingness to stabalise asymptomatic caries, to avoid or at least differ GA when possible. SDF in particular, was reported to be used more frequently during and post COVID-19 which is supported by BSPD guidance and standard operating procedures. COVID-19 was an experience that prompted clinicians to revise the way they approached carious teeth, encourgaging them to be less interventionist. But this strategy was approached with caution, particularly in the context of GA, concerns about long waiting lists and uncertainty for re-access which led some clinicians to place children on a GA list as a precaution. This suggests that decision for GA planning is sometimes shaped as much by assumption about service access and continuity of care as by the clinical condition of individual teeth.

Another possible obstacle for this decision is parents acceptibality, parents in previous studies (Tims et al., 2025) have been shown to generally accept SDF for posterior teeth while expressing more concern about black staining in anterior teeth, which reflects the careful conversations about this treatment option that participant described having with families. This also means, treatment choice under GA is not only about pathology, but also about clinicians' beliefs regarding patient's treatment acceptability, maintenance and the feasibility of follow-up in cases where stabalisation was an option.

#### 6.4.1.2 Restorative treatment evidence versus real life practice

Across all focus groups, there was general agreement about the restorative treatments under GA with clinicians avoiding VPT (indirect pulp therapy or pulpotomy) for teeth with deep caries close to the pulp when planning treatment under GA. Instead, they described either extracting such teeth or using a modified Hall technique in which caries is completely removed to confirm the pulps were not involved followed by the placement of stainless-steel crown. This pattern contrasts with all national and international contemporary guidelines, which recommends VPT as an evidence-based option for carious primary molars with vital pulp and deep lesions (AAPD, 2024; SDCEP, 2025; EAPD, 2022). These guidelines developed using systematic reviews and all newer guidelines reflect on the newer materials that are currently present, emphasising the high

success rate of indirect pulp treatment and pulpotomy when appropriate materials and good coronal seal are used.

High level evidence supports VPT in primary molars when bioceramic materials such as MTA or Biodentine ™ are used followed by stainless steel crowns. Meta analysis report more than 90% clinical and radiographic success at 12 - 24 months for MTA pulpotomies (Güven et al., 2017; Duggal et al., 2022; Laser et al., 2024; Lu et al., 2025). Therefore, an “extraction if caries is into the pulp” policy, may sacrifice teeth that could be predictably maintained until exfoliation, provided case selection and coronal seal are adequate.

Despite this guidelines and evidence, participants explained their concern from such intervention and choosing extraction over them remains common under GA. First, they emphasised the need for predictable definitive outcome particularly for children with poor oral hygiene and high caries risk or irregular attendance. Even if the expected success per VPT treated tooth is high 90 to 95% treating several molars in one GA could theoretically increases the commutative risk that at least one tooth would later fail. For example, if four teeth were treated with VPT, a 90 - 95% success rate per tooth means approximately 66 - 81% probability that all four succeed, and a 19 - 34% chance that at least one fails. Although this is a theoretical calculation rather than evidence from longitudinal studies, it illustrates how clinician might perceive the risk of a repeat GA to be high when multiple VPT are planned. Historically, earlier guidance (Rodd et al., 2006; RCS, 2008) explicitly advised caution with pulp therapy under GA and suggested a threshold (e.g. maximum of three primary pulpotomies), reflecting the material and evidence available at that time. None of the recent guidance retained this numerical threshold, yet participants practice appears to follow older norms more than current evidence. Another important note is that the assumption that any failure of VPT will necessarily require re-intervention and repeat GA is very pessimistic according to current guidelines. EAPD guidance for deep carious lesions in primary teeth recommends that clinicians prioritise clinical success and that treated teeth should remain asymptomatic and functional until exfoliation. There is explicit advice against taking further intervention on the basis of radiographic change alone( AAPD, 2025). Likewise, the AAPD guidance notes that internal root resorption following pulpotomy may be self-limiting and stable and

should be monotired rather than doing any interventions, unless there is the development infection. Numerous studies discuss that radiographic signs of failure such as internal resorption or accelerated root resorption could be a common finding after VPT but doesn't necessary means re-intervention as the tooth remains asymptomatic and functional (Boutsiouki et al., 2021; Duggal et al., 2022; Ebrahim et al., 2022).

Secondly, participants highlighted practical constraints, including limited procedure time under GA and pressure on list. Importantly, these constraints are intersected with another very important key finding, many participants reported limited skills and confidence in performing VPT on primary teeth. Consequently, even if time and waiting list pressures were not in the picture, there will be still insufficient number of clinicians who are able to provide these interventions, owing to also the limited opportunities for training in these procedures. Moreover, as these procedures aren't routinely carried out, participants will feel that they could take long procedural time to perform, but with appropriate training, these treatments will be less time consuming over time.

#### 6.4.1.3 Hierarchy in treatment planning

As one of the focus groups was entirely with specialty trainees, they have described treatment planning as something that is strongly influenced by the consultant supervising the clinic. Their view suggests that rather than using one fixed approach, they often adjust their proposed treatment depending on the consultant's usual preference and how they typically managed similar cases. This fits with wider idea of "authority gradient" in healthcare teams, where the difference in seniority level could shape how comfortable junior staff feel to suggest alternative treatment options and how decisions are made in practice (Okuyama et al., 2014). Trainees experience also links hierarchy to the variation in care. In dentistry, research shows that dentist can disagree on when to intervene restoratively even for the same type of lesion (Heaven et a., 2013).

The reliance on consultant direction may be protective and promotes patient safety and is supporting learning, however, this could also have an implication for the consistency of care and trainees' development of independent clinical reasoning, and could also discourage trainees from speaking up if they felt that the proposed treatment wasn't in

their patients' best interest in cases where they have been seeing the patient for multiple visits with different consultants.

### 6.4.2 Guidelines on caries management under GA

Taken together, the above section, suggests that reluctance to provide restorative interventions other than modified Hall technique under GA may not be simply a rejection of the evidence, but reflect clinicians attempt to adapt guidelines recommendation with their concerns about treatment failure, list pressures and family's capacity to attend follow up. The main national guidance that actually has a part about restorative treatment, is the Royal College of Surgeons of England guideline on the use of GA in paediatric dentistry (RCS, 2008), is now relatively dated and does not fully reflect the contemporary restorative materials or reflect on the current success rates. As a result, there remains a lack of up-to-date, GA specific guidance on restorative treatment, in primary teeth. All the national and international guidelines on caries management on primary teeth do not distinguish between treatments under LA versus GA setting. However, if extraction becomes the default whenever a deep caries is present, families may never be offered VPT as an option in shared decision making despite its potential to maintain arch integrity and function.

### 6.4.3 Family and shared decision-making

In our findings, participants shared how treatment decisions were also shaped by parents' beliefs, previous experiences and cultural background. Participants described different scenarios where parents are expecting specific outcome from the consultation visit, due to past sibling experience, or being told from their GDP that their child will likely need GA for treatment. This may have effects beyond the consultation visit in itself, prior information about GA given in primary care can strongly influence families' expectations, creating tension and reducing the likelihood of shared decision-making with the specialist.

Another issue raised by participants, was parental reluctance to accept the proposed treatment plan under GA, especially when the treatment plan was extractions, and this was mainly seen in patients from different cultural beliefs and values. This aligns with

evidence that parents can experience worry and struggle to accept the idea of dental GA or extractions which gives them a sense of ‘’loss’’ that could be emotional for families (Amin., et al 2006). Parental acceptance of advanced behaviour management techniques including GA, varies by cultural background and ethnicity (Chang et al., 2018; Al Zoubi et al., 2021). The AAPD, 2025 guidance highlighted that cultural and linguistic factors can shape selection and acceptability of the chosen behaviour management technique and that clinician should practice cultural sensitivity to ensure communication is appropriate (AAPD, 2025).

At the same time, there is a risk that clinicians could also bring their own assumptions into these conversations. Some participants appeared to generalise that certain cultural or socio-economic groups will generally refuse extractions or will prefer particular type of treatments, based primarily on their background. This can be seen as a form of unconscious bias, which is a recognised phenomenon in healthcare professionals, associated with differences in communication and aspects of clinical decision making (FitzGerald et al., 2017; Gonzalez et al., 2024). In dentistry, there is evidence that suggests that racial characteristics can influence clinicians’ treatment recommendation, with greater likelihood of recommending extraction rather tooth preservation options in black patients scenarios (Cabral et al., 2005; Patel et al., 2019). These biases may influence how options are presented, and how strongly some options are recommended or not discussed, impacting on the opportunity for shared decision making.

### 6.4.4 Variation in paediatric dental GA provider

Participants described variation in who planned and delivered paediatric GA lists, including paediatric dental specialists, oral surgeons and general dental practitioners. This is consistent with recent UK surveys that found only around 1/3 of lists were planned by paediatric specialists (Alkhouri et al., 2022). Paediatric dentistry specialists are likely to have greater experience in managing primary teeth than non-specialist, this could influence treatment options that are offered to patients. National standards recommend specialist lead planning for paediatric GA to ensure safe anesthesia and appropriate

treatment planning, and participants expressed concern about lists that were not consultant or specialist led.

### 6.4.5 Paediatric dental GA lists

In terms of access to different types of GA lists, access varied by geography. Clinicians described that some hospitals offered only exodontia while others provided a comprehensive care GA. UK service survey show the same, indicating that in some areas there is only extraction list and comprehensive care restricted to children with special needs and a few regions had no paediatric GA provision at all (Alkhouri et al., 2022). This means that there is a limitation to what clinicians could offer to children due to the service structure, and perhaps what they can discuss with parents in terms of what and why they are planning their treatment plan a certain way.

From NHS commissioning perspective, extraction only GA list would be less costly and less use of resources than comprehensive list, because it requires less clinical time and equipment (Knapp et al., 2017). Under the NHS payment scheme, the 2025/26 pay-award unit prices show higher prices when multiple restorative dental procedures are done versus multiple extraction (NHS, 2025).

## 6.5 Study limitation

Several limitations are found in the study. Participants were recruited from BSPD membership mailing list, and we have only included those who are training in paediatric dentistry or were already specialists/ consultants. There are other essential providers who provide paediatric dental GA such as GDPs and oral surgeons in some regions within the UK, who might have different views about primary teeth caries management under GA.

Another essential view is that the study did not capture the NHS management perspective. This matters because the paediatric dental GA service arrangement (extraction list versus comprehensive list) appeared to influence practitioners' treatment decisions. Consequently, without the input from the commissioners and service managers within the NHS, the study could not fully explain why service models differ between hospitals and regions.

Although every effort was made to include a range of regions and service types, the sample did not reflect all UK services, such as private services that provide dental paediatric GA. This is important because private care may involve different referral routes, eligibility criteria, costs, waiting times and communication methods, which could influence families' expectations and decision-making compared with NHS. Therefore, the findings maybe transferable within the UK NHS services to some extent, but internationally it is more limited. In many healthcare systems, dental care is predominantly privately delivered, through insurance coverage, or out of pocket payment, and provider choice may alter access to GA and the factors associated with treatment planning and decision-making.

The focus groups were conducted online, in the 2nd and 3rd focus groups there were consultants and specialists with different years of experience, this may have affected some to disagree openly. Hierarchical relationships may affected which views were voiced. Moreover, non-verbal cues were not considered in the analysis.

Lastly, as in all qualitative research, the findings are based on interpretations. While all efforts were made to overcome differences on the interpretations, there is always a chance that there might be an emphasise of some aspects more than the others.

## 6.6 Study recommendations

The study highlighted several recommendations for clinical practice and service organisation.

- It suggested a need to support paediatric dentists to align treatment planning under GA more closely with current evidence on VPT and other treatment option while still acknowledging the concerns about predictability, list pressure, and family's ability to attend follow up. This means, there may be a need to include targeted training in VPT and other evidence-based treatment options for managing caries in primary teeth under GA in appropriately selected cases.

- The study highlights the importance of shared decision making, and managing the expectations set in primary care. Better alignment between referring dentists and specialist on how GA is framed, alongside accessible information resources for families, may help to ensure that these decisions reflects both clinical needs and family values.

- The findings point to service changes that could reduce the extent to which treatment decision are driven by organisational constraints. Variation in access to comprehensive GA lists and the presence of exodontia only lists in some regions mean that children's treatment options may depend more on where they live rather than on their clinical presentation. Implementation of national recommendation that all dental service should have access to comprehensive care GA list is likely to be important in reducing these inequalities. Clearer pathways for children who have had their caries stabalised with prevention alone, including an easy pathway for quick re referral if active treatment become necessary, may also help clinician feel more confident in choosing less radical options in high-risk cases and reduce pressure on GA waiting list.

- The findings reinforced that prevention and post GA follow up are central to long term outcomes. In some scenarios, clinician decision to favour extractions were often driven by concerns about the risk of repeat GA in the context of poor attendance and limited preventive support rather than by the actual failure of restorative treatments. Implementing a pathway post GA to ensure that children who have had treatment done under GA receive enhanced preventive care, regular recall and support to overcome these barriers to attendance, could reduce the pressure to choose the most radical treatment at the initial GA.

- There is a need for an updated guideline or statement that clearly address whether a separate restorative treatment recommendation under GA is needed or relying on the existing guidelines for primary teeth caries management and assume that it apply regardless of the modality (LA and GA).

## 6.7 Future research

Future research could usefully extend this work in several directions. Firstly, by exploring the perspective of parents or carer whose children are referred for GA for carious primary teeth would help to clarify how they understand caries management options, what information they recall being given, and how expectation about treatment is formed. This would address the gap suggested by participants reporting that VPT is rarely discussed explicitly with families and the parental/carer expectations sometimes appear to reflect older extraction focused modality of care.

Second, comparative qualitative or mixed method study involving other professional groups such as general dental practitioner, community dentist, oral surgeons and anesthetist could potentially show how roles responsibilities and service structure influence decision- making in different points in the child's care pathway.

Thirdly, studies are needed to evaluate strategies designed to support evidence-based decision making and shared decision making, in this context these might include decision aid for families training and communication about risk and uncertainty or service level intervention that integrate enhanced prevention program following GA.

Fourthly, include stakeholder perspectives from commissioning and service management to better understand system level determinants for the provision of extraction only GA list versus both types of GA lists.

Finally longitudinal research could explore how clinicians' practices and belief about VPT, GA and prevention change over time as new materials, guidelines and service models are introduced.

## 6.8 Conclusion

- This study shows that paediatric dentists' decisions about treating carious primary under GA in the UK, is shaped by a complex interaction of clinical evidence, personal treatment philosophy, parental/carer expectations and service constraints.

- While guidelines support minimally invasive approach, it also supports other restorative interventions to maintain carious primary teeth, which are not always reflected in practice, particularly where workforce shortage, list pressure and limited follow-up capacity favour an extraction-oriented treatment plans.

- Clinician's concerns regarding repeat GA and family's ability to maintain oral health add another level of complexity to the treatment planning under GA.

These challenges will require addressing in different aspects, strengthening training and confidence in evidence-based restorative care under GA, including a genuine shared decision-making that include a full range of treatment options, ensuring an equal access to both lists regardless of geographical location, and the implementation of a preventive pathway after GA. This would move services in the UK to a place where what is "best" under GA doesn't only reflect system constraint, but also the best available evidence and the values of children and their families.

# Appendix I

Training plan for the research.

| Training need | Course name | Source | Date |
|---|---|---|---|
| Managing references | Reference manager | University of Leeds Library | 01 Nov 2022 |
| Writing academically | Scientific writing | FutureLearn | 23 Oct 2022 |
| Managing research data | Data management | University of Leeds Library | 17 Nov 2022 |
| Literature search | Literature searching | University of Leeds Library | 18 Jan 2023 |
| Qualitative research method | Qualitative research method | Coursera | 26 March 2023 |
| Facilitating a focus group | Conducting an online focus group | Social Research Association | 30 August 2023 |
| Qualitative data analysis | NVivo Part 1 and Part 2<br>4 sessions | University of Leeds Library | 29 Jan 2024<br>31 Jan 2024<br>05 feb 2024<br>07 feb 2024 |
| Qualitative research methods and analysis | Applied Qualitative Health Research module | University of Leeds | 07 Oct 2024<br>To 10 Oct 2024 |

# Appendix II

**BSPD Invitation email for FG** **V0.1** **04.12.2023**

**Re: Invitation to take part in a focus group about dental general anaesthesia**

Dear BSPD colleagues,

My name is Bushra Almohammed. I am undertaking focus groups to explore paediatric dentists'decisions about treatment of dental caries under general anaesthesia (GA). This is part of my Professional Doctorate research at the University of Leeds. A participant information sheet with more details is attached to this email.

The date for the focus group will be arranged later but it will be outside working hours to avoid any impact on patient care. We will give all participants a £20 Love2Shop voucher to thank them for their time.

Your participation is optional but would be very much appreciated.

You can register your interest in taking part using this Microsoft form:https://forms.office.com/e/PTWPc12zaTi

If you have any questions, please do not hesitate to contact me.

Thank you and best wishes,

Bushra Almohammed
Postgraduate in Paediatric Dentistry, School of Dentistry
University of Leeds

Supervisors: Sophy Barber, Kate Kenny & Richard Balmer

# Appendix III

**Participant information sheet** **V.04** **29.05.2024**

## Focus Group Participant Information Sheet

**Research title:** **An investigation into the factors influencing decision making regarding management of carious primary teeth under general anaesthetic.**
**Researcher:** **Bushra Almohammed.**
**Supervisor:** **Dr. Sophy Barber, Dr. Richard Balmer.**

This research is being undertaken to explore decision-making about the management of carious primary teeth under general anaesthetic. Currently, there are different ways how practitioners decide on a treatment plan under general anaesthetic. We hope to find out more about how different factors influence the decision to undertake dental treatment under general anaesthesia and how the treatment plan is decided.

This research will form part of Bushra Almohammed's Professional Doctorate at the University of Leeds.

### Why am I asked to participate?

We are inviting you to take part because you have experience in this area, and you have decision-making responsibility in this field due to your qualifications.

Before you decide whether to take part, please read the information below.

### What will I be asked to do?

The research will involve focus groups on Microsoft Teams. This will allow in-depth discussion of your views and experience of this topic along with other members with similar levels of experience. The focus group will be led by a postgraduate student facilitator using a topic guide and there will be a maximum of 6 people in each focus group. Before the focus group, you will be provided with further guidance and technical support as required.

### What are the advantages and disadvantages of taking part?

A benefit of taking part in a focus group is to share your knowledge and experience with your peers and engage in an interesting discussion.

The disadvantage, it will take some of your time (up to 90 minutes). The focus group will be arranged outside working hours to avoid any impact on clinical care.

After the focus group, you will receive a £20 Love2Shop voucher as an appreciation for your valuable time and contribution.

**Can I withdraw if I change my mind?**

You are free to withdraw without giving any reason up until the point of anonymisation and analysis stage.

**What will happen to my data?**

I will require your name and contact details to arrange the focus group. This will be kept confidential and not shared with anyone outside the research team. Contact details will only be stored for the period of data collection.

Recordings of the focus group will be transcribed, and each participant will be given a unique identifier. After this, the recordings will be deleted. The transcripts will be stored and analysed anonymously.

Anonymized research data will be kept for up to 3 years to allow for thesis preparation and publication. Data will be processed and stored in accordance with Data Protection Act 2018, below is a copy of the University of Leeds Participant Privacy Notice: https://dataprotection.leeds.ac.uk/research-participant-privacy-notice/

**Confidentiality**

All information discussed should be confidential and not shared with anyone, participants who wish to participate will be asked to consent to not disclose any information discussed within the focus group.

**How do I take part?**

If you are interested in taking part, please complete the expression of interest form https://forms.office.com/e/PTWPc12zaT

After this, I will contact you to provide any further information and make sure you wish to take part.

**Further information**
For further information about this study, or if you have any questions or concerns, please contact me:
Bushra Almohammed (Postgraduate student in Paediatric Dentistry, University of Leeds).
dnba@leeds.ac.uk

Or you could contact research supervisor Dr. Richard Balmer: R.C.Balmer@leeds.ac.uk
If you have any concerns about any part of this research and would like to raise it to someone independent of this research, please contact:
The University Research Integrity and Governance Team
Email: FMHUniEthics@leeds.ac.uk

# Appendix IV

**Participant Consent Form** **V.02** **31.01.2024**

## Participant Consent Form

**Research title:** An investigation into the factors influencing decision making regarding management of carious primary teeth under general anaesthetic.
**Researcher:** Bushra Almohammed
**Supervisor:** Dr. Sophy Barber & Dr. Richard Balmer

Your initials, please.

1. I confirm that I have read the **Participant Information Sheet** V.04 29.05.2024 sent with this email as a separate attachment, I had the opportunity to decide and ask questions and received answers. ☐
2. My participation is voluntary and I can change my mind and withdraw at any time up until the point of analysis. ☐
3. I am happy for the focus group to be video- and audio-recorded to allow transcription. ☐
4. I am aware that direct quotes might be used in the report of the study, however, these will be fully anonymized. ☐
5. I consent to the confidentiality of the focus group by not disclosing any information discussed in the focus group with anyone. ☐

**For participant:**

Name:……..

E-mail:……..

Date:……..

Signature:……..

**For researcher:**

Name:……..

Date:……..

Signature:……..

# Appendix V

**Focus Group Guidance** **V.01** **04.12.2023**

## Focus Group Guidance

Thank you for agreeing to take part in the focus group on **xxxx.**
An invite from Microsoft Teams have been sent to you. The link is also provided here xxxxx
Your facilitators will be Bushra Almohammed (postgraduate student researcher) & Dr. Richard Balmer (Consultant in Paediatric Dentistry and research supervisor).
The purpose of the focus group will be to discuss the factors that influence your decision to treat a child under general anaesthetic and how you decide your treatment plan. This is a broad topic, and we are keen to hear from everyone.

To ensure our focus group runs smoothly, some guidance is included below:

- Please let Bushra and Richard know your preferred name and pronouns.
- Please use your chosen name in your Teams ID so we address you correctly.
- Please keep your camera on because this will help make sure everyone is included.
- Please raise your hand if you wish to say something then the facilitator will come to you.
- Please respect everyone's different views and opinions. There will be no judgement and all discussion from the focus group will be kept confidential.
- Please listen to each other and do not talk over each other. Please do not raise your voice or use offensive language.
- If we have not heard from you, we might ask your opinion directly. This is to encourage your participation but if you do not wish to contribute, please say so.
- If you needed any clarification or rephrasing from facilitators or your colleagues, do not hesitate to ask.
- Please let us know if you need a break by raising your hand or adding it to the chat facility.

### Recording via Microsoft Teams

We will video- and audio-record the focus group to facilitate transcription and analysis of the discussion.
Recordings will be securely stored on the University of Leeds OneDrive and only accessible to the research team. More information is included in the Participant Information Sheet.

Bushra Almohammed
Paediatric Dentistry Postgraduate
dnba@leeds.ac.uk

# Appendix VI

**FG topic guide** **V.04** **21.09.2023**

## Focus Group Topic Guide

Opening information:

**As all of you are aware, there are differences on how clinicians decide to refer a patient for GA, and there also differences on the types of treatment provided under GA. This cany be due to different factors that plays a role in such decisions, today we would like to explore these factors together to better understand them, in which this would hopefully aid in standarisation of care or guidelines in the future. Your contribution is highly appreciated.**

1. **Please could you start by telling me about paediatric dental services in your area?**

Information being sought:
- Patient's care pathway – reason for referral, triage and assessment
- Access to GA.
- Availability of paediatric dentists in their area.

2. **For the management of carious primary teeth, how do you decide if general anaesthesia is needed? (not the type of treatment)**

Information being sought:
- Reasons for use of GA.
- Patient-related factors considered when GA is planned (like age, MH, anxiety..etc)
- Who makes the decision to use GA
- Any concerns with availability or accessibility to GA services.
- Guidelines used to support the decision.

3. **Please could you tell me a bit about how you decide the treatment plan under GA, for example, whether to restore or extract?**

Information being sought:
- Patient-related factors associated with the choice of treatment.
- Service-related factors (e.g., type of lists available).
- Guidelines used to support choice of treatment.
- Opinions on current GA practices.

4. **How do you approach talking to parents about the need for GA and the treatment type under GA**

Information being sought:

- How they find out what is important to the parent / child
- How they explain more complex info, like risk (e.g. risk of failure of restorative treatment) or future impact of tooth extraction (e.g. crowding and need for ortho)
- How they reach agreement with parents who might have different wishes to their recommendations

5. **If you could change current Paediatric Dental GA services, what would you change and why?**

Information being sought:

- Potential current issues with GA services in their area.
- How changes could improve care for patients.

6. **Is there anything else that we have not covered that you would like to discuss?**

## Closure

Thank you for participating in this focus group.
Please feel free to contact me if you have any questions about the study.

***END***

# Appendix VII

**FYP Manuscript**

Factors affecting UK Paediatric Dentists' treatment decisions for carious primary second molars under GA: a cross-sectional study.

Bushra Almohammad
Lilianna Saidamova
Alice Ella
Richard Balmer
Sophy Barber

**Abstract**

**Background:** The provision of different types of dental treatment under general anaesthetic (GA) for paediatric patients varies across the UK. There is limited evidence about how paediatric dentists make decisions about the use of GA and the approach to treatment planning for management of carious primary second molars under GA.

**Aim:** To investigate which factors influence paediatric dentists' decisions about treatment of carious primary second molars under GA.

**Design:** Cross-sectional survey using an online questionnaire.

**Participants and setting:** Paediatric dentistry specialists and specialty trainees in the UK.

**Materials and methods:** Ethical approval was granted by the University of Leeds Dental Ethics Committee. A bespoke questionnaire was designed and tested with representatives from the target group. Participants were recruited through the British Society of Paediatric Dentistry (BSPD) and asked to complete the online questionnaire. Questions pertained to a) respondent demographics b) local paediatric dental GA services; c) decision-making about use of GA and treatment of carious primary second molars when using GA. Descriptive statistics were used for the quantitative data whilst the free text comments were analysed using content analysis.

**Results:** Online survey was distributed to all members of the British Society of Paediatric Dentistry (BSPD), 82 responses were received, and 7 responses were excluded so a total of 75 were included in the study. Most respondents reported that comprehensive care under GA and exodontia GA were both widely available; Child cooperation was considered the most important factor when deciding whether to treat under GA. The extent of caries and the presence of infection were the most important factors determining how carious primary second molars should be treated under GA. Service-related factors, such as the waiting list size, were also important. Most respondents used guidelines but felt they were outdated and could be more specific, and there was general support for standardisation of assessment.

**Conclusions:** Despite the availability of comprehensive and exodontia lists, there is a perceived lack of access to comprehensive dental care under GA. Both patient and service-related factors influenced the decision to treat under GA and the type of treatment provided.

**Key words:** Paediatric Dentistry, Paediatric Dental General Anaesthesia, Treatment Planning, Carious Primary Second Molars, Comprehensive Care, Exodontia.

## Background

According to epidemiological statistics by Public Health England, 10.7% of 3 year olds (PHE, 2020) and 23.7% of 5 year olds have dental caries in England (PHE, 2022). Children who experience caries are more prone to experience pain and infection whilst poor oral health is associated with a lower quality of life (Pahel et al., 2007; Zaror et al., 2022). Families are also impacted by caries in their children, particularly feeling guilty or blamed and incurring the financial burden from missing work and travelling to dental visits (Abanto et al., 2012). In England, dental treatment costs the NHS £3.4 billion per year (NHS, 2014).

Dental treatment under general anaesthesia is commonly used in the UK and is the most common reason for hospital admission in England (Levine, 2021). Given the rare but significant risks that general anaesthesia poses to patients, such as risk of death (estimated to be between 1:100,000 and 1:1 million), risk of severe allergic reaction and brain damage (National Health Service, 2020) as well as the potential psychological impact of a paediatric dental general anaesthetic, there is great responsibility in using GA. It would therefore be expected that there are clear guidelines or clinical consensus about when and how PDGA should be used.

The 2011 guidelines from the Association of Paediatric Anaesthetists of Great Britain and Ireland provided indications for dental GA, which included severe pulpitis requiring immediate relief and substantial soft tissue swelling due to infection and allergies to local anaesthesia (APA, 2011). It explicitly stated that decisions required a degree of judgment from the clinician and no indication was absolute. According to the literature, many factors influence the use of paediatric dental general anaesthesia (PDGA), which can lead to variation in practice amongst paediatric specialists. Common influencing factors were child's age, behaviour, the extent of caries, the requirement for multiple extractions, and medical history (Colak et al., 2013; MacCormac et al., 1998). Other factors include socioeconomic status and parental occupation, number of required dental visits, poor attendance records and geographic location (Ramdawi et al., 2017).

There is also evidence of variation in the dental treatment provided under GA. For example, when six hospitals were compared within the Northwest of England some areas were only offering extraction, with limited opportunity to restore teeth (Goodwin et al., 2015) as opposed to comprehensive care including restoration of teeth. In this study the reason for the variations was not explored. This was also similar to the findings of Alkhouri et al., 2022 in which they found over

one third of providers delivered exodontia lists only. Another problem identified by Mills,2020 was that 54 of 124 postal areas within the UK had no specialist in paediatric dentistry.

## Aim

To investigate factors that influence paediatric dentists' decisions about treatment of carious primary second molars under general anaesthesia.

## Design

This was a descriptive cross-sectional survey using an online questionnaire. Ethical approval was granted by the University of Leeds Dental Ethics Committee (ref FYP2022Paediatric-GA approved 31/10/2022).

## Population and setting

Paediatric dentistry specialists and specialty trainees currently working in the UK in both primary and secondary care.

## Methods

**Recruitment:** British Society of Paediatric Dentistry (BSPD) members were invited to take part via email sent by the BSPD administrator following the necessary approvals. The recruitment email included a Participant Information Sheet and a link to the questionnaire. Consent to participate was confirmed at the start of the questionnaire.

**Data Collection:** An online questionnaire was developed and used for this research through OnlineSurveys. The questionnaire development process and content are described below. The online questionnaire was open for 6 weeks and reminder emails were sent at 2 and 4 weeks. The questionnaire collected responses anonymously.

**Data management:** Responses were automatically collated in Microsoft Excel by the survey tool. Data were exported for descriptive analysis.

## Materials

No tool currently exists for this topic, so a bespoke questionnaire was developed based on a literature review and expert opinion. The questionnaire was tested with representatives from the

target population to assess the validity of the questions, the wording and to identify any technical issues.

The questionnaire included six sections (Table 1). The questions included both closed questions and free text boxes to allow the participant to provide additional information. The full questionnaire is included in the supplementary material.

## Data analysis

Data were analysed descriptively to summarise:

1. The response and sample characteristics
2. Paediatric dental general anaesthetic (PDGA) services across the UK
3. Support for making decisions about paediatric dental general anaesthetic
4. The importance of different factors on the decision to treat under GA
5. The importance of different factors on the decision about treatment type for carious primary second molars

Quantitative data were analysed using IBM SPSS 28 software and Microsoft Excel to create figures. Free text comments used to provide additional context and depth to quantitative ratings they were coded and categorized using NVivo 14 software to identify common topics. Illustrative excerpts from the free text comments are included.

## Results

The questionnaire was open for 6 weeks and 82 responses were collected, seven responses were excluded as they did not meet the inclusion criteria (respondents were practicing outside the UK or were not paediatric specialists), leaving 75 responses for analysis. The study included 60 specialists/consultants, representing 24% of the estimated 250 pediatric dental specialists on the GDC specialist list (Jo et al., 2021), and 15 trainees, accounting for 33% of the 45 currently registered trainees.

### Respondent characteristics

Characteristics of the study participants are presented in Table 2. Most of the respondents were female (79%) and were consultant paediatric dentists (52%). Majority of the respondents completed their specialist training in Yorkshire and the Humber (33%) or London and the

Southeast of England (20%). Over half (52%) of the respondents had more than 10 years of experience. Most respondents were practicing in Yorkshire and the Humber (29%) followed by London and the Southeast of England (24%). Many respondents worked in more than one setting, with nearly half (49%) of respondents worked in a dental hospital, (46%) in a general hospital and (41%) in the community dental service (CDS).

Paediatric Dental General Anaesthesia (PDGA) services across the UK

The majority of respondents reported good availability of comprehensive care and exodontia services (Figure 1). Comprehensive care was reported to be mostly provided by Paediatric Dental Specialist in Dental Hospitals and Community Dental Services (Figure 2). Exodontia services were also provided by oral surgeons (44%) and occasionally by GDPs (4%).

Support for decisions about PDGA

The majority of respondents (61%) reported to use all the three UK guidelines (Scottish Dental Clinical Effectiveness Programme (SDCEP) -Prevention and Management of dental caries in children, RCS England UK National Clinical Guidelines in Paediatric Dentistry -Guideline for the use of General Anaesthesia in Paediatric Dentistry, Association of Paediatric Anaesthetists of Great Britain 2011(APA) -Guidelines for the management of children referred for dental extraction under General Anaesthesia) to support decision-making; however, 8% reported not using any guideline and 3% reported the use of local guidance (Figure 3). While the majority of respondents (68%) felt guidelines were satisfactory, 27% felt they were not. Free text comments relating to the guidelines suggested that many respondents felt there was a lack of information about services and that this could be a barrier to accessing care. Others felt that improvements to the existing guidance and making them more specific would improve the quality of the assesssment for PDGA.

*"Current guidance lacks information about the organisation and structure of general anaesthetic services. whether paediatric dentistry specialist-led or whether there is access to comprehensive care facilities"*

*''I don't know if further guidance could be any more specific about the decisions we have to make I still use the current guidance and think it still applies but it needs to be updated regularly.''*

*''The Royal College of Anaesthetists guidance is out of date and requires updating.''*

*"It would be helpful if all guidance documents were specific in that all cases should be planned by a specialist/consultant in Paediatric Dentistry."*

When asked whether assessments for PDGA should be standardised, the majority of the respondents (68%) were in support and emphasised that this would invariably improve the number of available services in referrals and others believed that this is needed to have a common approach to treatment and to be able to give adequate care for the patient.

*"I think there should be a need for set standards for referral. For example in my current unit we will routinely list for GA exodontia of carious primary teeth even if asymptomatic. Whereas at a previous unit I worked at, only symptomatic patients warranted a GA."*

*"It would be good to have a more standardised approach to treatment planning and when/how/what material to restore teeth under GA."*

Those who did not want standardisation or improvement of the assessment, had an existing standardised service in their workplace so felt there was no need to improve the process.

*"We have already standardised in our service. The CDS staff have all been trained to the standards agreed nationally and with specialists locally"*

An alternative view was that standardisation of the assessment might be too restrictive and be unable to account for the unique and varied clinical, psychological and social circumstances that influence these decisions In addition, there was acknowledgement that the care a child received varied depending on their location and service availability. Below are some of the responses gathered:

*"I think that it would be very difficult to standardised care - each child and parent are unique"*

*"Children receive different care depending on where they live and what services they have access to"*

<u>The influence of patient and service-related factors on the use of GA</u>

The child's cooperation was considered to be the most important when determining if general anaesthetic was needed (Figure 4). Other important factors were the extent of caries, medical history and the presence of other carious teeth. Occlusion was not considered to be important. The availability of services for exodontia and restorative care were considered highly important

but the perceived importance of other service factors was mixed. Free text comments showed other factors to be important, such as availability of sedation services, the possibility to treat some carious teeth prior to the PDGA, and the patients' circumstances in terms of their ability to access services.

*"Availability to treat other teeth pre GA and availability and access to sedation services"*

*''Availability of other services such as IHS, clinical team members trained to manage children ''*

*"Availability to treat other teeth pre GA and availability and access to sedation services"*

*"Accessibility to GA service, eg social barriers in travelling for treatment, language barriers and solutions, etc. This is especially with reference to the"*

Patient-related factors like oral hygiene, previous PDGAs, and tooth conditions like ankylosis were often mentioned in the free text box.

<u>The influence of patient and service-related factors on the type of treatment offered for carious primary second molars under GA</u>

The most important factor influencing decisions about the type of treatment for carious second primary molars was the extent of caries followed by presence of infection, pain history then medical history (Figure 5). The least important patient-factors were occlusion and the child's social history. Dental anomalies, such as hypodontia, ankylosis and molar incisor hypomineralization (MIH) were identified as being important in the fee text comments, particularly the extent or severity and need for treatment. Other patient-related factors that were highlighted include children's age, the number of teeth, caries rate in siblings, acceptance of pre-formed metal crowns, root resorption, post-operative plan and the clinical skills of practitioners.

Service-related factors were generally not rated as high as patient related factors, but greatest consideration was given to the size of the waiting list; however, comments in the free text box suggested that the availability and access to comprehensive care was important to some repsondents.

*"…I probably opt to extract more second primary molars than I would if comp care was more readily available…"*

*"We do not have the capacity to restore deciduous teeth under GA except in very occasional cases for children with special needs of some sort. Waiting list is long"*

*"… A higher abundance of specialist and level 2 led GA services in community would massively help with provision of these services."*

## Discussion

In the UK in general there are two types of dental GA lists – a list which only provides exodontia and another that provides comprehensive care (Alkhouri et al.,2022). Exodontia list are generally for healthy patients, are able to accommodate more patients and in general have shorter waiting times. Comprehensive care list accommodate fewer patients, allow for the full range of restorative care and can accommodate children who are medically compromised. In practice this means that for UK paediatric dentists, treatment planning for GA is intrinsically linked with the type of list that the patient will be going on. Ideally dentists should devise a treatment plan and then place the patient on the most appropriate list. There is always the possibility however that the list availability will dictate the treatment plan.

In our findings, PDGA comprehensive services were offered mainly by Paediatric Dental Specialists in Dental hospitals and Community Dental Services, but there was a recognised shortage of paediatric dental specialists in the UK with a recent report estimating that by 2030, approximately 40% of paediatric dentistry specialists will be aged 60 years or older (Mills, 2020). Earlier research also supported this potential shortfall in the current UK paediatric workforce as a high proportion of paediatric dental specialists work only part-time (Hunter et al., 2010), potentially limiting access to paediatric dentistry. The Mills (2020) paper used only the GDC register to estimate the retirement age of current paediatric dental specialists so there may be some invalidity in their data, however, both studies were also supported by a report by the Royal College of Surgeons (RCS) investigating the condition of children's oral health which stated "'The […] shortage […] of specialist dentistry services […] must be addressed to ensure all children with advanced tooth decay have timely access to specialists" (RCS, 2015, p.3). This may explain the lack of comprehensive care access as perceived by the participants as specialist input is required for GA comprehensive care treatment planning (NHS England, 2018).

In contrast, a small percentage (4%) of General Dental Practitioners and a good proportion (44%) of oral surgeons were offering exodontia services, which means a wider number of healthcare

providers can offer this type of service. But it's important to consider that according to the General Dental Council (GDC, n.d.) guidance, GDP are expected to only perform simple extractions. If the tooth is impacted, infected, or otherwise difficult to remove, the GDC recommends that the patient be referred to specialist care.

However, variations in opinion regarding access to local paediatric dental specialists and access to local community services suggested that while these factors influence practitioner decisions, they are localised to specialist access and facilities. Hua & Keightley (2022) and Broomhead et al. (2020) attributed these variations to geographical and socioeconomic issues such as language barrier, cost of procedure, and travel costs that influenced access to dental services. Access to comprehensive care influenced by waiting lists and travel time or location also influenced practitioner decisions as some community service centres lacked specialists. As such, access to a full range of dental services influenced treatment decisions. These results reflect Lau et al. (2020), Bekes et al. (2020), Kirby et al. (2020), and Grinderfjord et al. (2018), who note that access to specialised and comprehensive care influences practitioner's decisions as some areas are not serviced by specialised dental practitioners.

If there is inadequate access to restorative care under GA, a paediatric dental specialists may need to place the patient on an exodontia-only list instead. Studies looking at provision of DGA such as Alkhouri et al. (2022) found that 38% of DGA providers performed only exodontia lists with no available comprehensive care. These findings are supported by Sanders and Ashley (2019) which found that only 73% of DGA providers had unrestricted access to comprehensive care. Lack of comprehensive care can have detrimental long-term effects for the patient. This may lead to restorable teeth being extracted and premature loss of teeth. Premature loss of teeth has been shown to increase the risk of class II malocclusion, overbite, overjet, cross-bite and midline displacement in the permanent dentition (Pedersen et al., 1978), leading to a possible 18% increase in orthodontic need in the future for every primary tooth lost prematurely (Bhujel et al., 2014). This comes at an increased cost to an already burdened NHS with primary orthodontic treatment costing the NHS approximately £250 million a year (NHS Digital, 2016), as well as aesthetic and functional concerns for the patient.

In terms of patient-related factors, the study revealed that child cooperation was the number one consideration for PDGA, this is unsurprising because the cooperative ability of the child is listed as the first indication for GA by the RCS' guidelines (2008), which are reportedly used by 79% of participants. These findings reflect the challenge dentists encounter in children with anxiety. Hua

and Keightley (2022) also confirmed that child anxiety is a significant determiner of the approach to managing caries. Other factors that also inform PDGA use include the child's medical history, the extent of caries, and other carious teeth. Here, the severity of dental caries influences the complexity of the procedure to handle the patient, which leads to practitioners adopting GA. Medical history is vital as children with underlying conditions require specialised management. Kirby et al. (2021), López-Velasco et al. (2021), and Hua and Keightley (2022) also affirm that the presence of other carious teeth and a child's medical history were critical in determining the use of PDGA. Finally, while occlusion is an essential consideration in dentistry, our finding suggested that, in the context of carious primary molars, other factors, such as cooperation and extent of caries, were more critical in decision-making.

In addition, the responses in this study suggested that although comprehensive care and exodontia services were widely available across the UK, access to services was a challenge for some. The long waiting list compelled clinicians to prioritise extraction over restoration of carious primary second molars, even when a comprehensive list was available, due to the shorter waiting times for exodontia. This trend is evident in the data (Figure 5). A recent study by Goodwin et al. (2015a) revealed that children in the North-West had to wait an average of eight months for treatment under general anaesthesia. During this period, patients often endured pain, sleepless nights, and missed school days (Goodwin et al., 2015b), outcomes we aim to prevent.

The long waiting time for GA also influenced GDPs to use non-GA approaches to manageable cases, Rogers et al. (2018), Broomhead et al. (2020), and Lau et al. (2020) noted that the availability and timely access to GA services influenced practitioner decisions.

Clearly GA in paediatric dental services is essential. Decisions by practitioners to use PDGA are influenced by the child's behaviour, complexity of the caries, medical history, previous GA services, and other carious teeth as the primary patient factors. At the same time, exodontia and restorative care availability were the main service factors influencing practitioner decisions. Although local paediatric dental specialists and access to local community services were also reflected in the responses, they were less influential in PDGA decisions among practitioners.

In terms of guidance, the 2015 SDCEP guidelines entitled 'Prevention and management of dental caries in children' was used by 81.7% participants. It is aimed at primary care practitioners although was extensively used by respondents in this study. Clarity as to whether Paediatric Specialists can and should use this guidance is needed. Additionally, the guidance calls for the

need for an ‘experienced’ clinician to decide to carry out and plan the DGA (SDCEP, 2015). Relying on experience will not lead to standardised care which participants felt is needed.

Almost one quarter of participants thought that current guidance was not satisfactory. 68% called for better standardisation of care; one way of ensuring such, might be to renew or produce new guidelines.

**Limitation of the study**

The absence of exact numbers of specialists/ consultants and trainees from BSPD made calculating the response rate through assumptions of registered GDC specialists list, this may result in over or under-estimation of the true response rate. Moreover, the perspective of parents’/carer wishes for dental treatment under GA which was not explored in this study, could contribute highly to the findings of the study.

As some questions were limited to only a few choices this might have limited the scope of data.

**Conclusions**

There is a perceived lack of access to comprehensive dental care under GA by paediatric dentists despite its availability. Both patient and service-related factors influence the decision to treat under GA and the type of treatment provided.

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# Appendix VIII

## Tables and figures for Manuscript

**Table 1: Summary of the questionnaire**

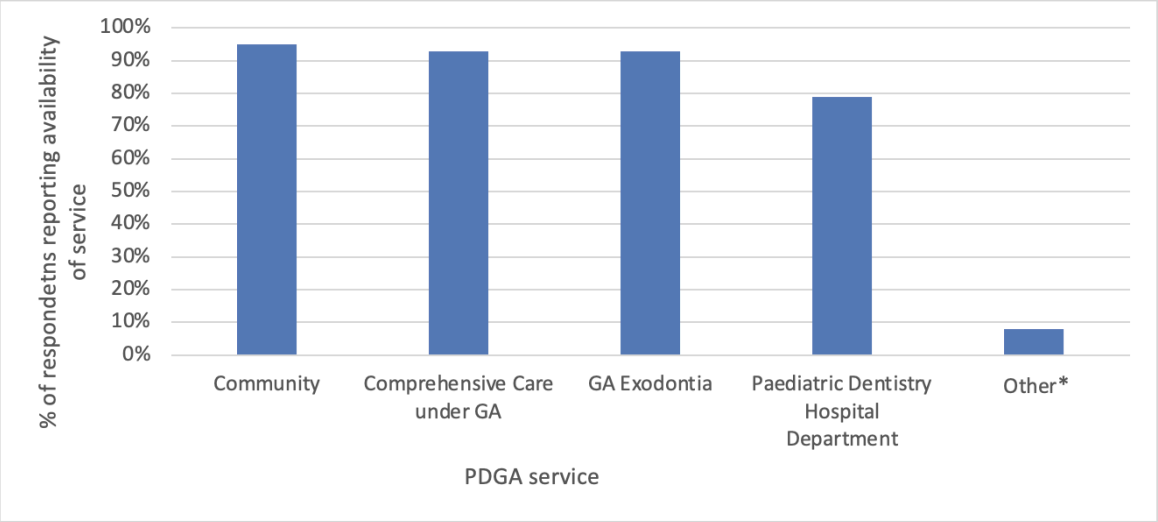
| Section | Content | Format |
|---|---|---|
| **Introduction** | Information about the study | Text information |
| | Screening questions to confirm eligibility | Yes/No question |
| | Confirmation of consent to participate | Yes/No question |
| **Participant information** | Gender | Multiple choice |
| | Location & year of completion of specialty training | Multiple choice |
| | Current job title | Multiple choice |
| | Location and type of workplace | Multiple choice |
| **Local Paediatric Dentistry General Anaesthesia (PDGA) services** | Availability of different PDGA services | |
| | Local providers of PDGA | |
| | Presence of MCN | |
| **Decisions about dental treatment under General Anaesthesia (GA)** | Use of guidelines | Multiple choice |
| | Rating of the importance of different patient-related and service factors on decision **to treat under GA** | Likert scale |
| | Rating of the importance of different patient-related and service factors on the treatment provided under GA **(extract/restore)** | Likert scale |
| | Other important factors in decision-making | Open question |
| | Changes to dental services that may affect treatment decisions | Open question |
| **Closure** | Acknowledgement of participation<br>Contact details for raising any concerns | Text information |

Table 2. Respondent characteristics

| **Characteristic** | | | **Number** | **%** |
|---|---|---|---|---|
| Gender | Female | | 59 | 79% |
| | Male | | 14 | 19% |
| | Did not disclose | | 2 | 3% |
| Role | Specialist Paediatric Dentist | | 21 | 28% |
| | Consultant Paediatric Dentist | | 37 | 49% |
| | Specialty trainee | | 14 | 19% |
| Where did you complete specialty training? | England | London and South East | 14 | 19% |
| | | Midlands and East | 6 | 8% |
| | | Yorkshire and Humber | 25 | 33% |
| | | North West | 5 | 7% |
| | | North East | 1 | 1% |
| | | South West | 1 | 1% |
| | Scotland | | 10 | 13% |
| | Wales | | 5 | 7% |
| | Ireland | | 0 | 0% |
| | Overseas | | 3 | 4% |
| Years as a specialist | Still in training | | 11 | 15% |
| | <5 years | | 10 | 13% |
| | 5-10 years | | 11 | 15% |
| | >10 years | | 41 | 55% |
| | Did not disclose | | 2 | 3% |
| Workplace location | England | London and Southeast | 18 | 24% |
| | | Midlands and East | 5 | 7% |
| | | Yorkshire and Humber | 22 | 29% |
| | | North West | 7 | 9% |
| | | North East | 3 | 4% |
| | | Southwest | 5 | 7% |
| | Scotland | | 7 | 9% |
| | Wales | | 4 | 5% |
| | Ireland | | 1 | 1% |
| | Did not disclose | | 3 | 4% |
| Workplace type (including more than workplace) | General Hospital | | 35 | 46% |
| | Dental Hospital | | 37 | 49% |
| | Community Dental Service | | 31 | 41% |
| | Primary care | General practice | 1 | 1% |
| | | Specialist practice | 1 | 1% |
| | Private Specialist Practice | | 10 | 13% |
| | Other* | | 4 | 5% |

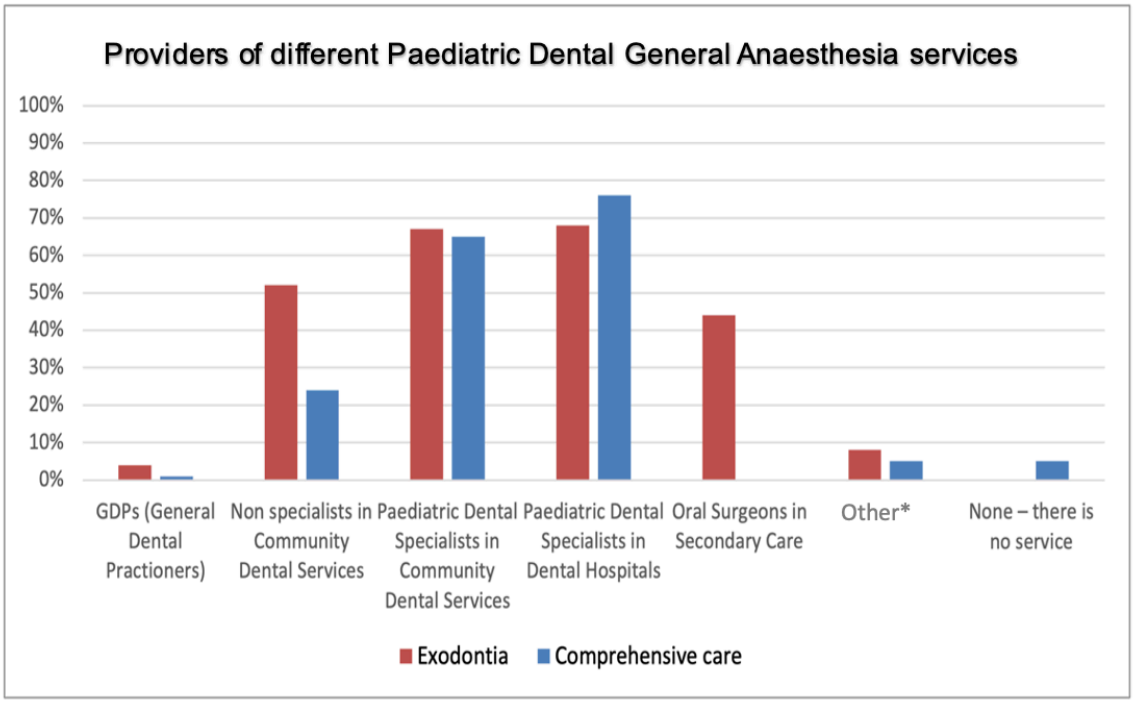
(*Own practice, GA exodontia clinic privately owned with an NHS contract to provide paediatric exodontia lists, University)

**Figure 1: Paediatric Dental General Anaesthesia (PDGA) services available to respondents in their local area**



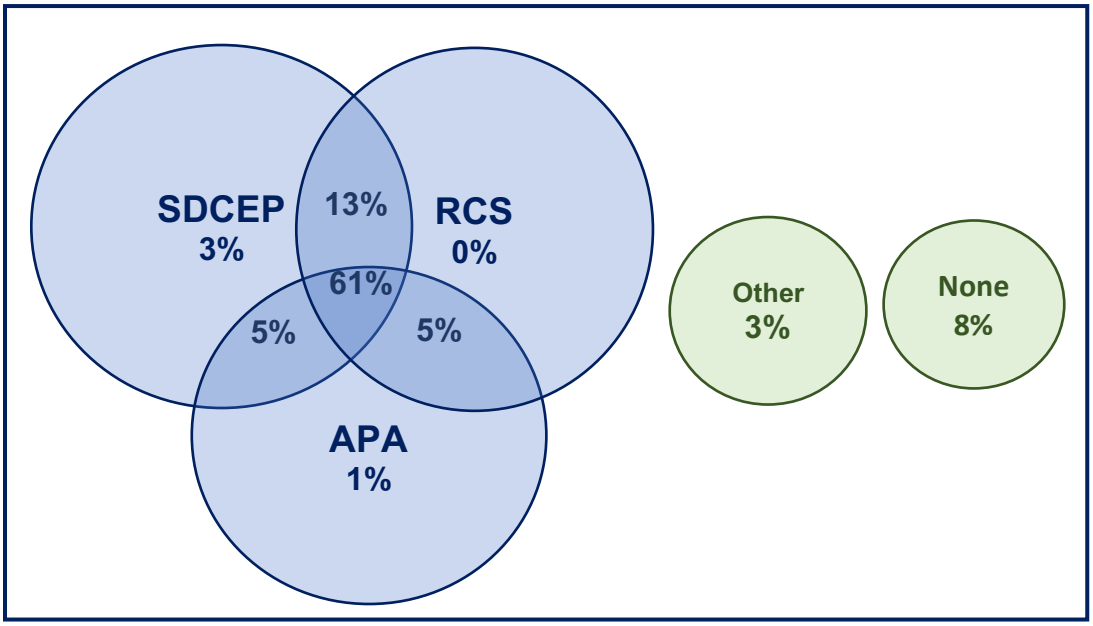

(*Tertiary Children Hospital, Propofol IV sedation, Specialist Private Practice)

**Figure 2: Providers of different paediatric dental general anaesthesia services.**




(*Exodontia GA: Consultant Paediatric Dentist led assessments but XGA carried out by non-specialist dentists, Specialty dentist in hospital. Comp GA: Non-specialists under direct supervision, Consultants in Paediatric Dentistry, Paed dent in a children's hospital)

**Figure 3: Reported use of guidelines to support decisions about Paediatric Dental General Anaesthesia (PDGA)**




**(SDCEP = Scottish Dental Clinical Effectiveness Programme *Prevention and Management of dental caries in children*; RCS = Royal College of Surgeons of England *UK National Clinical Guidelines in Paediatric Dentistry - Guideline for the use of General Anaesthesia in Paediatric Dentistry*; APA = Association of Paediatric Anaesthetists of Great Britain *Guidelines for the management of children referred for dental extraction under General Anaesthesia)***

**Figure 4. Factors influencing the decision to use general anaesthesia**

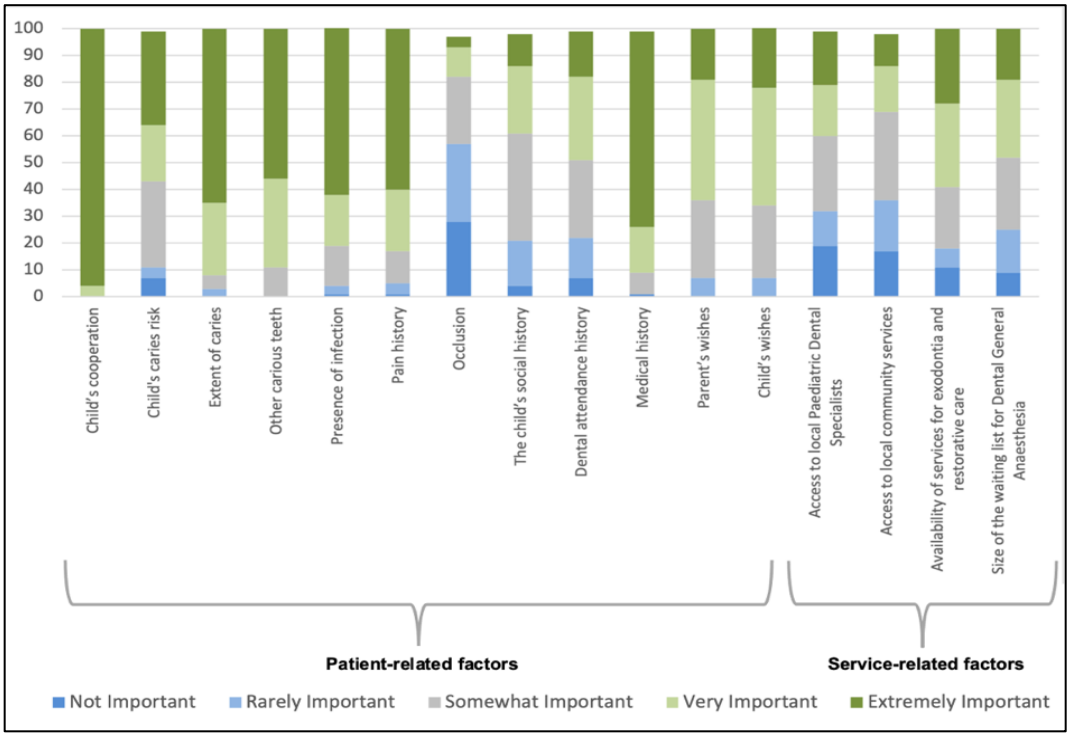
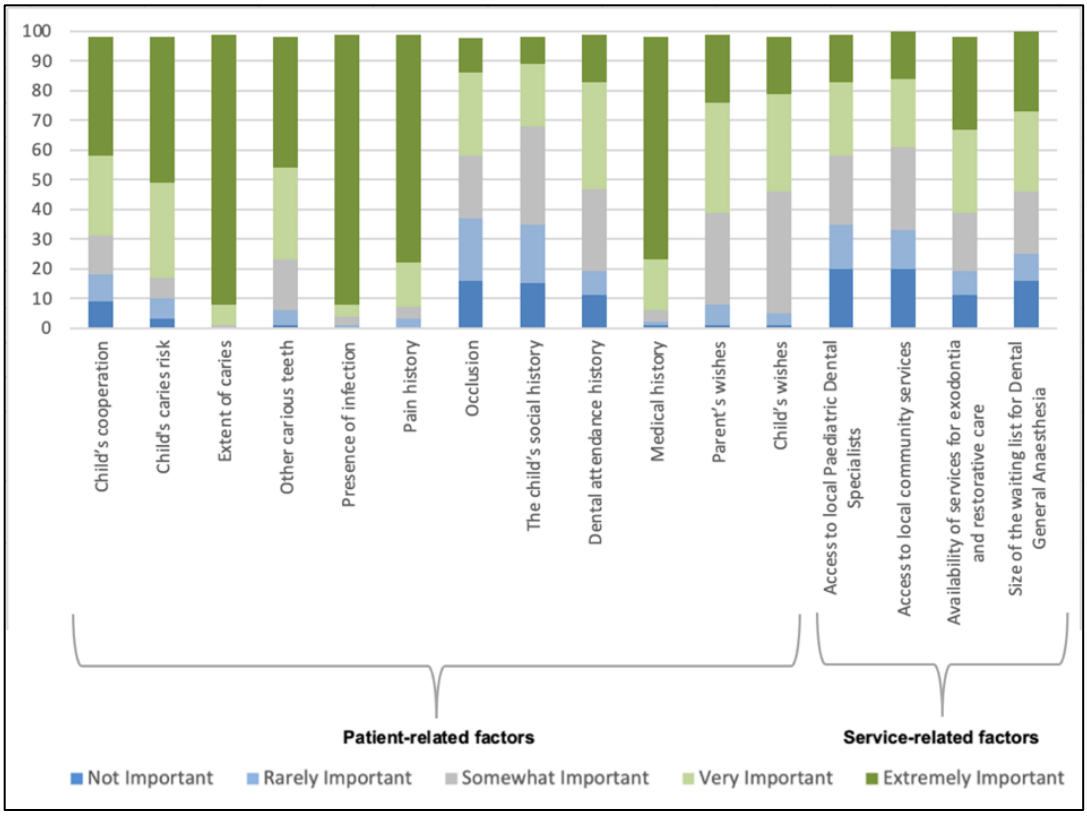



**Figure 5. Factors influencing the decision about the type of treatment for carious primary second molars**



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