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Dental general anaesthetic procedures for early childhood caries: a review for New Zealand dental practitioners

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Abstract

Many New Zealand (NZ) children undergo dental treatment under general anaesthetic (GA), most commonly for treating early childhood caries. This narrative review describes the literature on dental GA rates and characteristics of treated children in NZ and internationally, including a discussion of GA costs and frequency of repeat admissions. It also highlights considerations for treating children with special health care needs, implications for quality of life, along with dental GAs among overseas-born children and GA safety and morbidity. The rate of dental GAs rose by 67% from 2004 to 2014, with persisting ethnic and socioeconomic disparities. Additionally, some children continued to need repeated GA procedures. Rates of treatment for overseas-born children were higher than for their non-overseas-born counterparts. Although dental GAs are costly, there is a considerable improvement in quality of life for both the child and family after treatment. Clinical decision-making when providing dental care under GA should consider current best practice in oral condition management and balance this against the need to avoid repeat procedures. Health policy at the broadest level should have preventive strategies as a foundation in order to reduce the dental GA rate while ensuring that GA care is available for those who need it, when they need it. Research is needed to update knowledge on the scope of dental care provided under GA for NZ children and whether treatment provided aligns with best practice.

Introduction

A general anaesthetic (GA) may be required if conventional dental care for dental caries is not feasible due to the severity of dental disease (Macpherson *et al.,* 2005), dental anxiety (Eidelman *et al.,* 2000), difficulty in achieving local anaesthesia (Tyrer, 1999), or the presence of pre-existing medical conditions. Furthermore, GA may be required in cases of orofacial or dental trauma, oral surgery or treatment of orofacial pathology (Knapp *et al.,* 2017). GA enables completion of all treatment in a single session, minimises stress to the child, their parents, and the treating clinician (Knapp *et al.,* 2017), and results in high levels of parental satisfaction (Anderson *et al.,* 2004; Savanheimo *et al.,* 2005). However, provision of dental care under GA is more resource-intensive and costly than conventional dental care, and waiting lists can be long. Specialised equipment, hospital facilities and additional staffing (anaesthetist, anaesthetic technician, nurses, healthcare assistants) are required. One important consideration is the complex, likely bidirectional association between receiving a GA in childhood and the subsequent development of dental anxiety (Haworth *et al.,* 2017). Despite efforts to improve child oral health, many children still undergo dental treatment under GA, and rates have been increasing worldwide. This narrative review examines the existing literature on dental GA rates and the characteristics of children receiving treatment under GA. It explores the associated costs and the frequency of repeat GA admissions and discusses key considerations in managing children with special health care needs. It also addresses the implications of dental GA for quality of life, the experiences of overseas-born children, and the safety and morbidity associated with GA procedures.

Context on the care pathway for treatment for children under GA in NZ

Most child dental GAs in NZ are conducted in the public health care system (Thomson, 2016) due to cost and lack of GA capacity in the private sector (Whyman, 2000). A report commissioned in 2003 by the NZ Society of Hospital and Community Dentistry made recommendations to standardise the provision of dental GA services. The guideline suggested that a dental GA would be appropriate in certain scenarios (as listed in Figure 1; Lingard *et al.,* 2008). These recommendations were not adopted as a national guideline or standard; however, many hospital

Figure 1. Indications for dental treatment under general anaesthesia

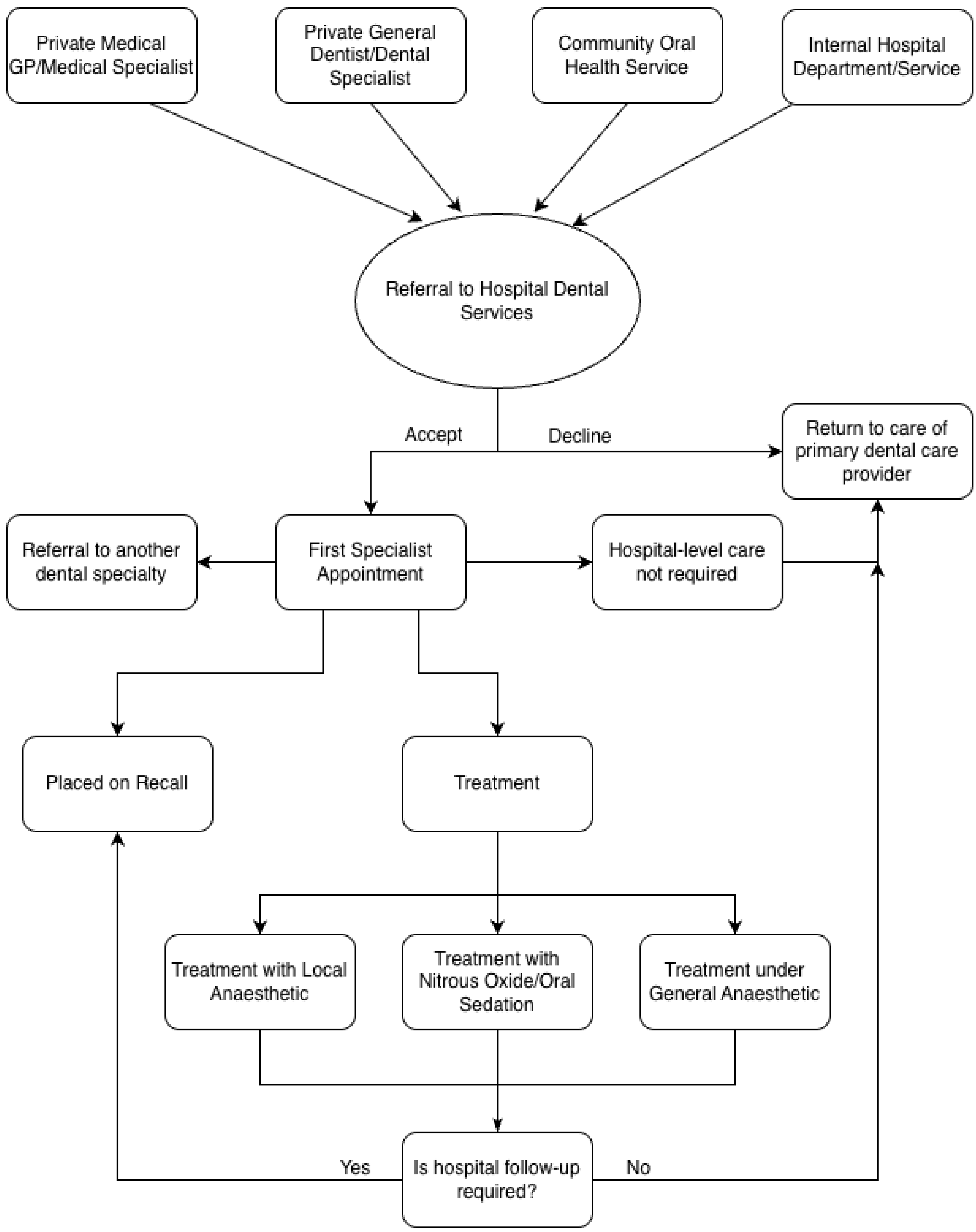
- Acute pain and/or orofacial infection that cannot be managed palliatively or treated under local/regional anaesthesia (with or without sedation)
- Need for multiple extractions and/or comprehensive treatment
- Too young or anxious to co-operate with treatment under local/regional anaesthetic (with or without sedation)
- Presence of certain disabilities or medical problems that preclude treatment under local/regional anaesthesia (with or without sedation)
- Need for oral surgery
- Need for treatment of extensive orofacial or dental trauma; or
- Need for extensive dental treatment but have restricted access to care because of living in a remote location (not applicable in cases where the child is able to cope with extensive dental treatment with local anaesthetic alone)

dental departments had, as of 2018, made some attempt to implement them locally (Hunt *et al.,* 2018).

Referrals to hospital dental departments for GA may be received from dental/oral health therapists, private dentists or medical practitioners. The process from referral to treatment is illustrated in Figure 2. However, this is not a standardised process; for example, some localities do not utilise a 'First Specialist Appointment' (FSA), an appointment at which a dental assessment is conducted before scheduling or placing the child on the waiting list for dental GA. Treatment for dental caries under GA generally falls into one of the two categories: comprehensive dental treatment (combination of restorative treatment and extractions) or extractions only. Where only extractions are needed, a GA of short duration is administered to enable the removal of the appropriate teeth. Most localities have regular operating lists for comprehensive treatment. While treatment is usually undertaken in hospital operating theatres, some localities outsource to the private sector. For example, the private company *Mobile Health* provides mobile surgical services, including dental treatment under GA, in remote regions of NZ (Blick *et al.,* 2014; Hunt *et al.,* 2018).

Despite the availability of public dental GA services, the system lacks capacity to meet the needs of all children referred, resulting in substantial delays for the FSA and subsequent treatment. Waiting times differ among localities,

Figure 2. Referral pathway to New Zealand hospital dental services for children.



and treatment delays can result in children experiencing ongoing or recurring pain and discomfort (Lingard *et al.,* 2008). The impacts of untreated dental caries while waiting for a dental GA include sleepless nights and stress within the family unit, absenteeism from school, and pain; these are exacerbated by long waiting times for treatment (Goodwin *et al.,* 2015; Thomson, 2016). Symptoms are commonly managed with pain relief and antibiotic therapy (if indicated) until treatment is carried out.

Alternative methods—such as relative analgesia or sedation—are available, but only half of the hospital dental units in NZ offer these options (Hunt *et al.,* 2018). Many children have had attempts at treatment using one or more of these methods prior to being referred for treatment under GA. Emerging evidence suggests that the use of Silver Diamine Fluoride (SDF) may reduce referrals for dental GA, as demonstrated in Victoria, Australia (Yawary and Hegde, 2022), and can help minimise emergency dental visits for pain or infection while children remain on GA waiting lists (Thomas *et al.,* 2020). With SDF now registered as a medicine and recently made available in NZ, its future impact on GA utilisation warrants close observation.

GA rates among children

The number of NZ children undergoing dental treatment under GA has risen since the 1990s (Thomson, 1994; Davidson *et al.,* 2002) and by as much as 67% from 2004-2005 to 2014 (Hunt *et al.,* 2018). From 2010 to 2019, admission rates for children aged 0-4 years were 10.3/1,000 and 13.7/1,000 among 5–9-year-olds (Graham, 2025). There was an increase in the annual number of Taranaki children who underwent a dental GA during the 2001-2005 period, along with a rise in the number of cases treated under GA for dental caries in 2003-2004. This increase was attributed to more cases being referred by dental therapists because of severe dental caries (Foster Page, 2009). The number of Dunedin children aged 0-5 years dentally treated under GA at the University of Otago Faculty of Dentistry rose from 81 in 1997 to 139 in 1999. This was attributed by the authors to the greater availability of public sector funding to reduce community dental service waiting lists for routine dental care, but that initiative had little impact because of an increase in the number of referrals received (Davidson *et al.,* 2002). A subsequent study from the same facility found that the number of 1-6-year-old children treated increased until 2002 and then decreased until 2009 (Kamel *et al.,* 2013), possibly due to greater efforts to provide care via relative analgesia instead of a GA. The rate of dental GAs differs among regions, ranging in 2014 from 4.9/1,000 in the Waikato to 25.3/1,000 in Whanganui. This difference is due not only to differing disease levels among regions, but also differences in need, resourcing and decision-making (Hunt *et al.,* 2018).

NZ's increases are broadly similar to those seen in Australia. In New South Wales, the number of child dental GAs was reported as 189 in 1984 rising to 777 in 1996. More than two-thirds of treated children were 0-5 years old, and the increase was attributed to a rising need for caries-related treatment (Alcaino *et al.,* 2000). Similar trends were observed nationally in Australia from 1993 to 2004, with the rate trebling from 215.8/100,000 children (age 0-9 years) in 1993-1994 to 731.4/100,000 in 2003-2004. Several reasons have been suggested for the higher rate of dental GAs, including rising numbers of specialist paediatric dentists (who may prefer to carry out treatment under GA), better resourcing for GA treatment, greater reluctance of general dentists to treat children in conventional settings, an increase in parental demand for GA treatment, an increase in the severity of dental caries in some groups of children, less focus on preventing dental caries, or better-quality data (Jamieson and Roberts-Thomson, 2006a).

Other countries have also seen increases. In England, rates rose by 28% from 1997 to 2006. This was attributed to an increase in caries severity and a decrease in the provision of restorative treatment in primary care (Moles and Ashley, 2009). Preschool child dental GA rates in Manitoba (Canada) increased from 19.4/1,000 in 1997-1998 to 32.6/1,000 in 2006-2007, possibly due to rising caries rates, increased service capacity, and/or greater awareness by parents for their children's need for dental treatment under GA (Schroth *et al.,* 2014).

Sociodemographic differences

The uptake of dental GA services is unevenly distributed across the child population. There are distinct and consistent differences by ethnicity, deprivation level and socio-economic status (SES), and age group (but there is no clear consensus on the nature and extent of sex differences). The demographic characteristics from published NZ studies are summarised in Table 1. Where ethnicity is concerned,

Table 1. Demographic summary of published New Zealand studies

Year	Author	Location	Ethnicity (%)[a]			Age (mean)	Sex (%)		Socioeconomic status (%)[b]		
			European	Māori	Pasifika		Male	Female	High	Med	Low
1994	Thomson	Manawatu-Wanganui	NR	NR	NR	5.1	53.7	46.3	NR	NR	NR
2002	Davidson et al.	Dunedin	75.7	15.0	3.8	4.3	58.6	41.4	29.8	56.2	14.0
2004	Anderson et al.	Dunedin & Christchurch	84.2	11.6	NR	5.1	55.8	44.2	26.3	55.8	17.9
2008	Malden et al.	Wellington	38.6	27.2	25.7	5.9	53.0	47.0	25.9	33.8	40.3
2009	Foster Page	Taranaki	51.6	43.7	1.8	5.0	55.3	44.7	8.3	58.2	33.5
2012	Gaynor & Thomson	Auckland	17.2	20.4	36.9	4.8	56.7	43.3	NR	NR	NR
2013	Kamel et al.	Dunedin	NR	13.5	NR	4.6 NF 4.8 F	52.5	47.5	34.7	37.9	27.4
2025	Natarajan et al.	Christchurch	49.0	28.3	6.2	6.0	55.8	44.2	16.4	30.9	35.1

NR–not reported F–fluoridated NF–non-fluoridated

[a] Other ethnic groups not included except for Natarajan et al, where European and Other ethnic groups were grouped together

[b] School decile rating used except for Malden et al, where New Zealand Index of Deprivation 2001 was used and Natarajan et al, where the New Zealand Socio-Economic Index 2006 was used (high deprivation being equivalent to low SES and *vice versa*)

higher rates of dental care under GA in Māori than in non-Māori children have been well documented over recent decades (Thomson, 1993; Ministry of Health, 2010; Parker *et al.,* 2010), in Manawatu-Wanganui (Thomson, 1993), Taranaki (Foster Page, 2009) and nationally (Whyman *et al.,* 2012). Pasifika children's uptake of dental GA is also higher (Lingard *et al.,* 2008; Gaynor and Thomson, 2012; Ruhe *et al.,* 2023). Data on other ethnic groups are scarce. Such patterns mirror those reported internationally whereby dental GA rates are higher for particular ethnic groups (Jamieson and Roberts-Thomson, 2006a; 2006b; Centers for Disease Control and Prevention, 2011; Schroth *et al.,* 2016).

Socioeconomic disparities in dental GA rates have also persisted over recent decades, with higher dental GA rates among lower-SES children (or those in more deprived neighbourhoods) than among those of higher SES (Thomson, 1994; Davidson *et al.,* 2002; Foster Page, 2009; Whyman *et al.,* 2012; Kamel *et al.,* 2013). Again, such disparities are also seen internationally (Madan *et al.,* 2010; Schroth *et al.,* 2016; Rogers *et al.,* 2018b; Kaddour *et al.,* 2023).

Admission rates in NZ have been reported to be higher for younger than older children (Whyman *et al.,* 2012), and increases in admission rates rose most steeply for the 3-4-year and 5-8-year age groups in the 1990s and early 2000s (Whyman *et al.,* 2014). Although there is anecdotal evidence that this trend is continuing, there have been no recent NZ reports to substantiate this.

Treatment provision

There are essentially two opposing treatment philosophies for care provision under GA: one involves extracting any unsavable teeth and restoring less-severely-affected ones; the other involves the pragmatic extraction of not only severely affected teeth but also others which show signs of established disease, and which may cause the need for a repeat GA at some stage. It is ethically problematic to extract potentially restorable teeth due to resource constraints, and the extent to which this may occur in NZ is unknown. Various studies have reported limitations in resourcing or rising severity of caries experience in the child population can lead to a greater rates of tooth extraction (Harrison and Nutting, 2000; Jamieson and Roberts-Thomson, 2006a; Kwok-Tung and King, 2006; Foster Page, 2009; Moles and Ashley, 2009; Raja *et al.,* 2016; Mortimore *et al.,* 2017). It is possible that both factors could be contributing, and further research is needed to fully understand the underlying dynamics.

There has been considerable variation across NZ in restorative material selection for dental treatment provided under GA. For example, in 2005, most hospital dental units routinely used glass ionomer cement restorations, half routinely used amalgam, and about one-third used composite or stainless steel crowns (Lingard *et al.,* 2008). This has changed over time, with lower use of amalgam and glass ionomer cement restorations (12.7% and 47.6%, respectively), and composite and stainless steel crowns being used more (75.0% and 90.0%, respectively; Hunt, 2016). These changes in restorative practices are consistent with updated international guidelines for managing extensive caries and children at high risk of caries (American Academy of Pediatric Dentistry, 2016a), and they are broadly consistent with changes observed internationally.

Cost

NZ spent approximately $250 million on oral health care services in 2024[1], up from $185 million in 2008[2]. Child dental GAs were estimated to cost nearly $17 million in 2018 (Thomson, 2018), but there is a lack of other data on this. These direct costs have increased over time, doubling from nearly $23,000 in 2001 to nearly $47,000 in 2005 in Taranaki (Foster Page, 2009). Similarly in Western Australia, direct costs doubled from $6 million in 2000 to close to $13 million in 2009 (Alsharif *et al.,* 2015). Reasons for such increases could include rising population, rising costs of supplying dental equipment and employing personnel, or increases in the severity of disease experience and the number of children needing an dental GA (Alsharif *et al.,* 2015). Economic costs from different countries are not easily comparable due to differences in context and culture.

Dental GA procedures also result in indirect economic costs due to parent/caregiver work absences, school absenteeism, and transport costs incurred during hospital visits (Casamassimo *et al.,* 2009). Indirect costs were estimated at $138 million in Western Australia in 2015 (Alsharif *et al.,* 2015). One dental GA could result in around five days of school absences, where appointments may be required for an initial dental consultation, an anaesthetic pre-assessment, the surgery itself, one or more days of recovery, and a postoperative review. This can contribute to socioeconomic inequalities in school absences: for example, one study reported children from the most deprived areas to have over three times the rate of missed school days than those living in the least deprived areas of Southampton, England (Mortimore *et al.,* 2017).

The rising cost highlights the importance of reducing the need for a dental GA. Strategies should not only target caries prevention in high-risk families and communities, but also need to address the upstream social determinants of oral health by including policy and legislative changes (Otero *et al.,* 2015; Rogers *et al.,* 2018a).

Repeat admissions

A dental GA incurs substantial cost, expends resources and exposes children to risk. It is important to avoid a GA wherever possible and repeat GAs should be exceedingly rare. Unfortunately, many children (particularly those with special needs) may require more than one dental GA, but few studies have investigated this.

In NZ over the period 1989-1994, the repeat GA rate among the 406 Manawatu-Wanganui children treated during that time was 4.2% (Thomson, 1994). This was similar to the rate of repeat GAs of 5.1% among 277 Dunedin children first treated in 1997-1999 and followed for up to four years (Drummond *et al.,* 2004). For NZ overall, from 1990-2009, rates of repeat within four years were approximately 7%, 5%, and 4% for children aged up to two, 3-4 years, and 5-8 years, respectively (Whyman *et al.,* 2012).

1 Hon. Minister of Health Reti, parliamentary Hansard, 6 Nov 2024
2 Memorandum "Dental expenditure in NZ", GL Chua (Senior Advisor Oral Health, Ministry of Health) 15 April 2011

Internationally, reported retreatment rates differ greatly by treatment centre and region, and over time. An English study reported a repeat GA rate of 10.8% over six years among children and young people aged 0-16 years in Leeds (Kakaounaki *et al.,* 2011), while another reported 12.9% (Tahmassebi *et al.,* 2014). These studies used different criteria (extraction-only vs. comprehensive care), but both found repeat rates to be higher among disabled children. In the first quarter of 2003 in Liverpool (England), 11.9% GAs were repeats with a mean interval of 2.3 years (Albadri *et al.,* 2006). On the other hand, repeat rates among six hospitals in North West England ranged from 12% to 37% (Goodwin *et al.,* 2015). In North Carolina (USA), from 2002 to 2014, of 3,973 children aged under 18 years who had had a dental GA, 8.9% received repeat GAs (7.2% twice and 1.7% three or more times) (Rudie *et al.,* 2018). Of the 581 children aged 1-12 years treated under GA at the University School of Dental Medicine in Boston (USA) from 2004 to 2009, 5.0% underwent a second dental GA within four years of the first one, and medically compromised children had a 4.3 times greater risk of being treated a second time than healthy children (Guidry *et al.,* 2017). A study of 339 First Nations and Inuit children in Alberta (Canada) from 1996 to 2005 who had had more than one GA procedure during that time found that 24.2% underwent three or more procedures, while the remainder had two, each with an average of 3.5 years between procedures (Schroth and Smith, 2007).

Not only are children who receive dental treatment under GA known to be at high risk for future caries experience, but their siblings are too. At Virginia Commonwealth University (USA), from July 2017 to March 2018, nearly half (45%) of those with one or more siblings (n=40) had a sibling who had previously had a dental GA. Children who were raised in a single-parent household were more likely to have siblings who had received a dental GA (Edmonds *et al.,* 2019).

It is important to reduce the frequency at which children receive repeat GAs. Certain largely preventive characteristics of children and their parents are associated with a greater likelihood that a child will require a repeat dental GA. These include anterior dentition caries, bedtime use of a bottle with fluids other than water, poor cooperation during dental procedures, poor oral hygiene habits, dysfunctional family situations, missed post-operative checks, and the irregular use of dental services (Sheller *et al.,* 2003; Kakaounaki *et al.,* 2011). The medical history of the child appears to further render the child at higher risk of a repeat procedure. There need to be changes to address more upstream underlying social determinants of oral health as well as changing behaviours of high-risk children and families (Watt 2007). Siblings of children treated under GA should receive close dental monitoring.

Special health care needs and dental GA

Statistics NZ estimated in 2023 that a tenth of the NZ population aged 0-14 years had a disability, defined as "long-term physical, mental, intellectual or sensory impairments which, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with others"[3]. Among those aged 0-17 years who were admitted for dental treatment in NZ hospitals from 2005 to 2009, intellectual disability was noted as a comorbidity for 1.6% (n=503/31,820); data were not reported on the proportion with any disability (Whyman *et al.,* 2012).

Children with a disability or medical co-morbidity tend to be referred for dental assessment at a younger age, on average, than other children (Harrison and Nutting, 2000; Haubek *et al.,* 2006; Tsai *et al.,* 2006; Lee *et al.,* 2009). They may also receive less restorative care but more extractions when receiving care under GA (Tsai *et al.,* 2006; Lee *et al.,* 2009). With certain medical conditions (such as some cardiac conditions or cancers), failure of a dental treatment may require additional medical interventions such as blood products, antibiotic cover, and steroid cover, all of which could have been avoided if the tooth had been extracted in the first instance, particularly where its prognosis was poor. This may explain the greater rate of extractions and lower rate of restorative treatment for children with special health care needs. Further, children with special health care needs may be more likely to require tooth extraction due to severity of caries. However, some studies have reported contrasting findings, such as a lower rate of extractions but a greater rate of restorations for English children (Camilleri *et al.,* 2004) and for Danish children (Haubek *et al.,* 2006) with severe medical comorbidities than other children.

Preventive management strategies, including prophylactic dental care and regular recall, are important to minimise impacts of dental problems on the wellbeing of children with special care needs (American Academy of Pediatric Dentistry, 2016b). Preventive management could also help decrease the likelihood of needing a repeat GA, since medically compromised children are at a higher risk of requiring one or more of those (Tahmassebi *et al.,* 2014; Rudie *et al.,* 2018).

Overseas-born children and dental GA

Many overseas-born families originate from countries without adequate access to dental care for children, prevention programs or fluoride exposure. Caries experience among immigrants tends to be higher than national averages (Locker *et al.,* 1998; Hallett and O'Rourke 2002; Sundby and Petersen 2003; Valencia-Rojas *et al.,* 2008; Werneck *et al.,* 2008). A report from NZ's Pacific Island Families Study found that unmet treatment need was greater among children from families who were strongly aligned to the Pasifika culture than in other NZ population groups (Schluter *et al.,* 2017).

A Danish study found longer GA waiting times for immigrant children than for Danish-born children, possibly due to language barriers and a greater rate of missed appointments. Immigrant children were, on average, younger and had more primary teeth treated than Danish-born children. The proportion of children requiring treatment under GA who were from immigrant families rose from 15.3% in 1990 to 41.7% in 2001 (Haubek *et al.,* 2006).

3 Statistics New Zealand website accessed 17th March 2025 https://www.stats.govt.nz/information-releases/disability-statistics-2023/#:~:text=One%20in%2010%20children%20were,to%2064%20years%20were%20disabled

Similarly, an Australian study reported that the proportion of children treated under GA who were from immigrant families rose from 13% in 1984 to 24% in 1996 (Alcaino *et al.,* 2000). A Finnish study found that for the year 2004, a quarter of those treated under GA were immigrants, and that immigrant children had more treatment carried out under GA more often than non-immigrant children (Savanheimo and Vehkalahti 2014). On the other hand, a Canadian study found lower GA rates in neighbourhoods with high immigrant populations for the years 2010-2014, but the reason for this was unclear (Schroth *et al.,* 2016).

Oral health-related quality of life (OHRQoL)

Just as oral disease can impact on multiple domains of quality of life for children, treating children under GA improves both their lives and those of their families. Several instruments have been developed and validated for assessing OHRQoL among children, and NZ research has been important in developing these (Foster Page *et al.,* 2013; Thomson 2020). A 2004 study undertaken in Christchurch and Dunedin assessed OHRQoL among 95 children aged 1-8 years receiving a dental GA. Following dental GA, there was an immediate improvement in the OHRQoL of the child and the family (Anderson *et al.,* 2004). Among 130 children who underwent a dental GA in Wellington over a five-month period in 2005, their mean overall OHRQoL score reduced significantly, indicating that dental treatment for children under GA is associated with considerable improvement in the quality of life of both the child and family as perceived by the parents (Malden *et al.,* 2008). This finding was also confirmed in a consecutive sample of 157 Auckland children who received a dental GA from September 2010 to February 2011 (Gaynor and Thomson, 2012), and more recently, among 353 children who underwent dental treatment under GA in Christchurch from October 2019 to December 2023, where the improvement in OHRQoL persisted for at least 12 months (Natarajan *et al.,* 2025). A recent meta-analysis included 36 studies that had used either the Early Childhood Oral Health Impact Scale (ECOHIS) or the Child Oral Health Quality of Life (COHQoL), (which includes the Parental-Caregiver Perceptions Questionnaire (P-CPQ) and the Family Impact Scale (FIS)) measures to assess the change in the OHRQoL among children aged up to 16 years following a dental GA, based on parental perception. The meta-analysis reported that a dental GA improved OHRQoL among children receiving care up to 52 weeks following a dental GA, as well as fewer impacts on the family unit as measured by the FIS (Yilmaz *et al.,* 2025). These studies illustrate the impact of dental caries on a child and family and the improvement in the quality of life of both following dental GA treatment (Thomson, 2020).

GA safety and morbidity

The risks of GA (e.g., laryngospasm, anaphylaxis, cardiac complications, and death) occur most frequently among older patients, those with health comorbidities, and those undergoing non-elective surgery (Australian and New Zealand College of Anaesthetists). Since the 1960s, ongoing improvements in monitoring, anaesthetic drug safety, and specialised paediatric protocols have made GA considerably safer for children (Gonzalez *et al.,* 2012). The landmark ‘Poswillo Report’ on prevention of adverse effects due to GA and relative analgesia for dental care (Poswillo, 1990) resulted in the UK’s Department of Health mandating dental GAs only in hospital settings with available critical care facilities (Department of Health, 2000). In NZ, children have by far the lowest risk of mortality, and there are no specific findings on dental treatment under GA (Gurney *et al.,* 2020) .

Studies of morbidity associated with dental GAs are difficult to compare (Needleman *et al.,* 2008). It can occur either pre-operatively or post-operatively. Pain and dental anxiety are often reported immediately before a dental GA (Atan *et al.,* 2004; Hosey *et al.,* 2006). Frequently reported post-operative morbidity includes pain, sleepiness, nausea, vomiting, weakness, agitation, sore throat, bleeding, fever, cough, insomnia, and lack of appetite (Hosey *et al.,* 2006; Escanilla-Casal *et al.,* 2016). Pain is reported most frequently and can differ according to the type of dental treatment received (Atan *et al.,* 2004; Needleman *et al.,* 2008). Among 90 Boston children who received a dental GA, those who had extractions were seven times more likely to experience pain at home during the first post-operative week than those who had other dental care (Needleman *et al.,* 2008). Among children dentally treated under GA at the Eastman Dental Hospital (England), the odds of experiencing pain were greater among children who underwent a higher number of surgical procedures, but lower among those who had local anaesthetic administered at the surgical site (Atan *et al.,* 2004). By contrast, among 130 Barcelona (Spain) children dentally treated under GA in 2010-2011, there was no association found between post-operative pain and the number and type of dental procedures (Escanilla-Casal *et al.,* 2016). The duration of GA procedures has been associated with sleepiness and nausea. Longer GA times have been associated with greater post-operative sleepiness (Atan *et al.,* 2004; Needleman *et al.,* 2008), with one study reporting each ten-minute increment in GA time to be associated with 1.2 times greater odds of post-operative nausea (Atan *et al.,* 2004). Another study used video diaries to record children’s own descriptions of their dental GA journeys, and found hunger, disturbed eating, and presence of the IV cannula to be the most notable adverse impacts described, not pain as reported by proxies in other studies (Rodd *et al.,* 2014).

Dental treatment for a child under GA requires careful consideration due to the GA and surgery-related morbidity and mortality, and this should be communicated to the parent (Guidry *et al.,* 2017). It is vital to consider the safety of the child, dental practitioner and staff when making the decision to undertake dental treatment under GA and the benefits of the procedure should be weighed against the potential risks of a GA (Cantlay *et al.,* 2005).

Conclusions

Dental GAs improve the quality of life for children who need them. Dental GAs are costly and carry risk but adverse events are rare. The rate of dental GAs in NZ rose from 2004-2014, ethnic and socioeconomic inequalities in these rates have persisted, and some children continue to require repeated GA interventions. Numerous studies have recommended early intervention strategies to control these rates. The balance of clinical treatments provided under GA has changed, with placement of stainless steel crowns having become more common. On-going health service and quality improvement research on dental GAs is needed, along with maintaining emphasis on the introduction of early preventive interventions to reduce the rate of avoidable dental GAs.

Author contributions

Conception and design of study – MN, LFP, MT
Literature search – MN
Drafting manuscript – MN, JMB
Critical revision of manuscript – MN, JMB, LFP, MT
Final approval of version to be published – MN, JMB, LFP, MT

Conflict of interest statement

The authors declare no conflict of interest.

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References

Albadri SS, Jarad FD, Lee GT, Mackie IC (2006). The frequency of repeat general anaesthesia for teeth extractions in children. *International Journal of Paediatric Dentistry*. 16(1):45-48.

Alcaino E, Kilpatrick NM, Smith ED (2000). Utilization of day stay general anaesthesia for the provision of dental treatment to children in New South Wales, Australia. *International Journal of Paediatric Dentistry*. 10(3):206-212.

Alsharif AT, Kruger E, Tennant M (2015). A population-based cost description study of oral treatment of hospitalized Western Australian children aged younger than 15 years. *Journal of Public Health Dentistry*. 75(3):202-209.

American Academy of Pediatric Dentistry (2016a). Guideline on Restorative Dentistry. *Pediatric Dentistry*. 38(6):250-262.

American Academy of Pediatric Dentistry (2016b). Management of Dental Patients with Special Health Care Needs. *The Reference Manual of Pediatric Dentistry*. 40(No 6):237-242.

Anderson HK, Drummond BK, Thomson WM (2004). Changes in aspects of children's oral-health-related quality of life following dental treatment under general anaesthesia. *International Journal of Paediatric Dentistry*. 14(5):317-325.

Atan S, Ashley P, Gilthorpe MS, Scheer B, Mason C, Roberts G (2004). Morbidity following dental treatment of children under intubation general anaesthesia in a day-stay unit. *International Journal of Paediatric Dentistry*. 14(1):9-16.

Australian and New Zealand College of Anaesthetists (2017). *Safety of Anaesthesia: A review of anaesthesia-related mortality reporting in Australia and New Zealand 2012-2014*. Melbourne: Australian and New Zealand College of Anaesthetists.

Blick G, Davis P, Esplin J (2014). *Review of Mobile Surgical Services and related services*. Ministry of Health.

Camilleri A, Roberts G, Ashley P, Scheer B (2004). Analysis of paediatric dental care provided under general anaesthesia and levels of dental disease in two hospitals. *British Dental Journal*. 196(4):219-223; discussion 213.

Cantlay K, Williamson S, Hawkings J (2005). Anaesthesia for dentistry. *Continuing Education in Anaesthesia Critical Care & Pain*. 5(3):71-75.

Casamassimo PS, Thikkurissy S, Edelstein BL, Maiorini E (2009). Beyond the dmft: the human and economic cost of early childhood caries. *Journal of the American Dental Association*. 140(6):650-657.

Centers for Disease Control and Prevention (2011). Dental caries in rural Alaska Native children—Alaska, 2008. *Morbidity and Mortality Weekly Report*. 60(37):1275-1278.

Davidson LE, Drummond BK, Williams SM, Boyd DH, Meldrum AM (2002). Comprehensive dental care under general anaesthesia from 1997-1999 for children under age 6 years. *New Zealand Dental Journal*. 98:75-78.

Department of Health (2000). *A conscious decision: a review of the use of general anaesthesia and conscious sedation in primary dental care*. London: Department of Health.

Drummond BK, Davidson LE, Williams SM, Moffat SM, Ayers KM (2004). Outcomes two, three and four years after comprehensive care under general anaesthesia. *New Zealand Dental Journal*. 100(2):32-37.

Edmonds B, Williams T, Carrico C (2019). The Prevalence and Factors Associated with Sibling-Recurrent Dental Treatment Under General Anesthesia at an Academic Institution. *Pediatric Dentistry*. 41(1):40-46.

Eidelman E, Faibis S, Peretz B (2000). A comparison of restorations for children with early childhood caries treated under general anesthesia or conscious sedation. *Pediatric Dentistry*. 22(1):33-37.

Escanilla-Casal A, Ausucua-Ibanez M, Aznar-Gomez M, Viano-Garcia JM, Sentis-Vilalta J, Rivera-Baro A (2016). Comparative study of postoperative morbidity in dental treatment under general anesthesia in pediatric patients with and without an underlying disease. *International Journal of Paediatric Dentistry*. 26(2):141-148.

Foster Page LA (2009). Retrospective audit of Taranaki children undergoing dental care under general anaesthetic from 2001 to 2005. *New Zealand Dental Journal*. 105(1):8-12.

Foster Page LA, Boyd D, Thomson WM (2013). Do we need more than one Child Perceptions Questionnaire for children and adolescents? *BMC Oral Health*. 13:26.

Gaynor WN, Thomson WM (2012). Changes in young children's OHRQoL after dental treatment under general anaesthesia. *International Journal of Paediatric Dentistry*. 22(4):258-264.

Gonzalez LP, Pignaton W, Kusano PS, Modolo NS, Braz JR, Braz LG (2012). Anesthesia-related mortality in pediatric patients: a systematic review. *Clinics (Sao Paulo)*. 67(4):381-387.

Goodwin M, Sanders C, Davies G, Walsh T, Pretty IA (2015). Issues arising following a referral and subsequent wait for extraction under general anaesthetic: impact on children. *BMC Oral Health*. 15:3.

Graham D (2025). *Potentially preventable admissions to New Zealand public hospitals for treatment of dental disease*. [Dunedin]: University of Otago.

Guidry J, Bagher S, Felemban O, Rich A, Loo C (2017). Reasons of repeat dental treatment under general anaesthesia: A retrospective study. *European Journal of Paediatric Dentistry*. 18(4):313-318.

Gurney JK, McLeod M, Stanley J, Campbell D, Boyle L, Dennett E, Jackson S, Koea J, Ongley D, Sarfati D (2020). Postoperative mortality in New Zealand following general anaesthetic: demographic patterns and temporal trends. *BMJ Open*. 10(9):e036451.

Hallett KB, O'Rourke PK (2002). Dental caries experience of preschool children from the North Brisbane region. *Australian Dental Journal*. 47(4):331-338.

Harrison M, Nutting L (2000). Repeat general anaesthesia for paediatric dentistry. *British Dental Journal*. 189(1):37-39.

Haubek D, Fuglsang M, Poulsen S, Rolling I (2006). Dental treatment of children referred to general anaesthesia—association with country of origin and medical status. *International Journal of Paediatric Dentistry*. 16(4):239-246.

Haworth S, Dudding T, Waylen A, Thomas SJ, Timpson NJ (2017). Ten years on: Is dental general anaesthesia in childhood a risk factor for caries and anxiety? *British Dental Journal*. 222(4):299-304.

Hosey MT, Macpherson LM, Adair P, Tochel C, Burnside G, Pine C (2006). Dental anxiety, distress at induction and postoperative morbidity in children undergoing tooth extraction using general anaesthesia. *British Dental Journal*. 200(1):39-43.

Hunt G (2016). *Dental Treatment of Children under GA: a situational analysis*. [Dunedin, New Zealand]: University of Otago.

Hunt GR, Foster Page LA, Thomson WM (2018). Dental treatment of children under general anaesthesia in District Health Boards in New Zealand. *New Zealand Dental Journal*. 114:156-163.

Jamieson LM, Roberts-Thomson KF (2006a). Dental general anaesthetic trends among Australian children. *BMC Oral Health*. 6:16.

Jamieson LM, Roberts-Thomson KF (2006b). Indigenous children and receipt of hospital dental care in Australia. *International Journal of Paediatric Dentistry*. 16(5):327-334.

Kaddour S, Slater S, Feleke R, Doran G, Halpin L, Srinivasan A, Yusuf H (2023). Secondary analysis of child hospital admission data for dental caries in London, UK: what the data tells us about oral health inequalities. *BMJ Open*. 13(10):e072171.

Kakaounaki E, Tahmassebi JF, Fayle SA (2011). Repeat general anaesthesia, a 6-year follow up. *International Journal of Paediatric Dentistry*. 21(2):126-131.

Kamel MS, Thomson WM, Drummond BK (2013). Fluoridation and dental caries severity in young children treated under general anaesthesia: an analysis of treatment records in a 10-year case series. *Community Dental Health Journal*. 30(1):15-18.

Knapp R, Marshman Z, Rodd H (2017). Treatment of dental caries under general anaesthetic in children. *BDJ Team*. 4(17116):7-10.

Kwok-Tung L, King NM (2006). Retrospective audit of caries management techniques for children under general anesthesia over an 18-year period. *The Journal of Clinical Pediatric Dentistry*. 31(1):58-62.

Lee PY, Chou MY, Chen YL, Chen LP, Wang CJ, Huang WH (2009). Comprehensive dental treatment under general anesthesia in healthy and disabled children. *Chang Gung Medical Journal*. 32(6):636-642.

Lingard GL, Drummond BK, Esson IA, Marshall DW, Durward CS, Wright FA (2008). The provision of dental treatment for children under general anaesthesia. *New Zealand Dental Journal*. 104(1):10-18.

Locker D, Clarke M, Murray H (1998). Oral health status of Canadian-born and immigrant adolescents in North York, Ontario. *Community Dentistry and Oral Epidemiology*. 26(3):177-181.
Macpherson LM, Pine CM, Tochel C, Burnside G, Hosey MT, Adair P (2005). Factors influencing referral of children for dental extractions under general and local anaesthesia. *Community Dental Health Journal*. 22(4):282-288.
Madan C, Kruger E, Perera I, Tennant M (2010). Trends in demand for general anaesthetic care for paediatric caries in Western Australia: geographic and socio-economic modelling of service utilisation. *International Dental Journal*. 60(3):190-196.
Malden PE, Thomson WM, Jokovic A, Locker D (2008). Changes in parent-assessed oral health-related quality of life among young children following dental treatment under general anaesthetic. *Community Dentistry and Oral Epidemiology*. 36(2):108-117.
Ministry of Health (2010). *Our Oral Health: Key findings of the 2009 New Zealand Oral Health Survey*. Wellington: Ministry of Health.
Moles DR, Ashley P (2009). Hospital admissions for dental care in children: England 1997-2006. *British Dental Journal*. 206(7):E14.
Mortimore A, Wilkinson R, John JH (2017). Exploring the potential value of using data on dental extractions under general anaesthesia (DGA) to monitor the impact of dental decay in children. *British Dental Journal*. 222(10):778-781.
Natarajan AK, Ekambaram M, Cooper EJ, Bruce-Jones JE, Collett LA, Thoroughgood RE, Schurr ARZ, Thomson WM (2025). Sustainability of Improvement in Oral-Health-Related Quality of Life Following Dental Treatment Under General Anaesthetic: The Role of Family Functioning. *Int J Paediatr Dent.* 35: 1046-1054.
Needleman HL, Harpavat S, Wu S, Allred EN, Berde C (2008). Postoperative pain and other sequelae of dental rehabilitations performed on children under general anesthesia. *Pediatric Dentistry*. 30(2):111-121.
Otero G, Pechlaner G, Liberman G, Gürcan E (2015). The neoliberal diet and inequality in the United States. *Social Science & Medicine*. 142:47-55.
Parker EJ, Jamieson LM, Broughton J, Albino J, Lawrence HP, Roberts-Thomson K (2010). The oral health of Indigenous children: a review of four nations. *Journal of Paediatrics and Child Health*. 46(9):483-486.
Poswillo DE (1990). *General anaesthesia, sedation and resuscitation in dentistry: Report of an expert working party*. London: Department of Health (UK).
Raja A, Daly A, Harper R, Senghore N, White D, Ravaghi V (2016). Characteristics of children undergoing dental extractions under general anaesthesia in Wolverhampton: 2007-2012. *British Dental Journal*. 220(8):407-411.
Rodd H, Hall M, Deery C, Gilchrist F, Gibson BJ, Marshman Z (2014). 'I felt weird and wobbly.' Child-reported impacts associated with a dental general anaesthetic. *British Dental Journal*. 216(8):E17.
Rogers J, Delany C, Wright C, Roberts-Thomson K, Morgan M (2018a). What factors are associated with dental general anaesthetics for Australian children and what are the policy implications? A qualitative study. *BMC Oral Health*. 18(1):174.
Rogers JG, Adams GG, Wright FAC, Roberts-Thomson K, Morgan MV (2018b). Reducing Potentially Preventable Dental Hospitalizations of Young Children: A Community-Level Analysis. *JDR Clinical & Translational Research*. 3(3):272-278.
Rudie MN, Milano MM, Roberts MW, Divaris K (2018). Trends and Characteristics of Pediatric Dentistry Patients Treated under General Anesthesia. *The Journal of Clinical Pediatric Dentistry*. 42(4):303-306.
Ruhe T, Broadbent JM, Schluter PJ, Bowden N, Theodore R, Richards R, Kokaua J (2023). Parents' education and Pasifika children's oral health in Aotearoa/New Zealand: A national linked data study using Aotearoa/New Zealand's integrated data infrastructure. *Community Dentistry and Oral Epidemiology*. 51(5):936-944.
Savanheimo N, Vehkalahti MM, Pihakari A, Numminen M (2005). Reasons for and parental satisfaction with children's dental care under general anaesthesia. *International Journal of Paediatric Dentistry*. 15(6):448-454.
Savanheimo N, Vehkalahti MM (2014). Five-year follow-up of children receiving comprehensive dental care under general anesthesia. *BMC Oral Health*. 14:154.
Schluter PJ, Kanagaratnam S, Taylor S, Tautolo ES (2017). Acculturation and its impact on the oral health status of Pacific children in New Zealand: findings from the Pacific Islands Families study. *Journal of Public Health Dentistry*. 77(3):225-233.
Schroth RJ, Smith WF (2007). A review of repeat general anesthesia for pediatric dental surgery in Alberta, Canada. *Pediatric Dentistry*. 29(6):480-487.
Schroth RJ, Pang JL, Levi JA, Martens PJ, Brownell MD (2014). Trends in pediatric dental surgery for severe early childhood caries in Manitoba, Canada. *Journal of the Canadian Dental Association*. 80:e65.
Schroth RJ, Quinonez C, Shwart L, Wagar B (2016). Treating Early Childhood Caries under General Anesthesia: A National Review of Canadian Data. *Journal of the Canadian Dental Association*. 82:g20.
Sheller B, Williams BJ, Hays K, Mancl L (2003). Reasons for repeat dental treatment under general anesthesia for the healthy child. *Pediatric Dentistry*. 25(6):546-552.
Sundby A, Petersen PE (2003). Oral health status in relation to ethnicity of children in the Municipality of Copenhagen, Denmark. *International Journal of Paediatric Dentistry*. 13(3):150-157.
Tahmassebi JF, Achol LT, Fayle SA (2014). Analysis of dental care of children receiving comprehensive care under general anaesthesia at a teaching hospital in England. *European Archives of Paediatric Dentistry*. 15(5):353-360.
Thomas ML, Magher K, Mugayar L, Davila M, Tomar SL (2020). Silver Diamine Fluoride Helps Prevent Emergency Visits in Children with Early Childhood Caries. *Pediatr Dent*. 42(3):217-220.
Thomson WM (1993). Ethnicity and child dental health status in the Manawatu-Wanganui Area Health Board. *New Zealand Dental Journal*. 89(395):12-14.
Thomson WM (1994). Day-stay treatment for dental caries at a New Zealand hospital dental unit: a 5-year retrospective audit. *New Zealand Dental Journal*. 90(402):139-142.
Thomson WM (2016). Public Health Aspects of Paediatric Dental Treatment under General Anaesthetic. *Dentistry Journal (Basel)*. 4(2).
Thomson WM (2020). Subjective oral health measures for use with children: New Zealand's contribution to a burgeoning field. *Journal of the Royal Society of New Zealand*. 50(1):4-14.
Tsai CL, Tsai YL, Lin YT, Lin YT (2006). A retrospective study of dental treatment under general anesthesia of children with or without a chronic illness and/or a disability. *Chang Gung Medical Journal*. 29(4):412-418.
Tyrer GL (1999). Referrals for dental general anaesthetics—how many really need GA? *British Dental Journal*. 187(8):440-443.
Valencia-Rojas N, Lawrence HP, Goodman D (2008). Prevalence of early childhood caries in a population of children with history of maltreatment. *Journal of Public Health Dentistry*. 68(2):94-101.
Watt RG (2007). From victim blaming to upstream action: tackling the social determinants of oral health inequalities. *Community Dentistry and Oral Epidemiology*. 35(1):1-11.
Werneck RI, Lawrence HP, Kulkarni GV, Locker D (2008). Early childhood caries and access to dental care among children of Portuguese-speaking immigrants in the city of Toronto. *Journal of the Canadian Dental Association*. 74(9):805.
Whyman RA (2000). Dental care for children under general anaesthesia by private dental practitioners in New Zealand. *New Zealand Dental Journal*. 96(423):14-17.
Whyman RA, Mahoney EK, Stanley J (2012). *Admissions to New Zealand Public Hospitals for Dental Care*. Wellington: Ministry of Health.
Whyman RA, Mahoney EK, Morrison D, Stanley J (2014). Potentially preventable admissions to New Zealand public hospitals for dental care: a 20-year review. *Community Dentistry and Oral Epidemiology*. 42(3):234-244.
Yawary R, Hegde S (2022). Silver Diamine Fluoride Protocol for Reducing Preventable Dental Hospitalisations in Victorian Children. *Int Dent J*. 72(3):322-330.
Yilmaz NA, Arayici ME, Efeoglu C (2025). Impact of dental treatments under general anesthesia on oral health-related quality of life in children: a comprehensive meta-analysis. *BMC Oral Health*. 25(1).

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