

**ADAVB clinical update**  
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***Kumar H, Nanayakkara S, Tsai C, Rauniyar A, Kucera A. Investigating the impact of a chronic disease management protocol on reducing the need for dental general anaesthesia for treating early childhood caries in Australia. Australian Dental Journal, 2026;0:1–17.***

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*Prepared by: Dr Francis Chan*

**Introduction**

Early Childhood Caries (ECC) is defined as the presence of one or more carious teeth in children under the age of 6 years. It is reported to affect 48% of pre-school children globally. Children with ECC often present with pain and require extensive dental procedures, frequently warranting dental treatment under general anaesthesia (GA). In Australia, public GA waiting times to treat ECC can be over one year. Protective stabilisation is not utilised in Australia, and instead the focus is on non-maleficence and positive behaviour guidance. Oral/intravenous sedation for dental treatment in children is less common, as additional postgraduate training and compliance with strict regulatory standards is required. This leads to further reliance on treatment under GA when modalities such as nitrous oxide sedation and behaviour management techniques are insufficient, resulting in increased GA waiting times.

Continuation or recurrence of disease with attendant negative impacts on the quality of life is likely until the caries balance is altered. A collaborative effort by clinicians, patients and their families to treat ECC as a chronic condition is required. Chronic Disease Management (CDM) focuses on empowering patients and their families to play a central role in addressing their chronic condition at home and selecting their own disease management goals. Instead of telling the patient what to do, this approach utilises motivational interviewing delivered via a trained multidisciplinary team of health professionals. This can involve modifying diet and oral hygiene practices, using fluoridated products, and increasing disease management visits (DMV) according to individual need and disease severity.

A 2008 US-based CDM protocol developed by Ng et al. investigated a three-year quality improvement project across seven sites in the United States. Compared with historical controls, the group that received the CDM protocol experienced fewer new cavitated lesions (28% improvement), reduced instances of new pain (27% improvement), and fewer referrals for treatment under GA (36% improvement). However, investigating the effect of this CDM protocol and its impact on the need for dental GAs in Australia has not yet been documented.

A CDM protocol (the Steps to Smiles Program) based on the work of Ng and colleagues was introduced and tailored to the Australian population. This study aimed to investigate its effect on preventing the need for dental treatment under GA for patients with ECC. The effect of silver fluoride treatment as an added intervention on the prospective group was also analysed.

**Materials and methods**

This was a multi-site, historically controlled, non-blinded quasi-experimental trial with retrospective and prospective arms. Patient recruitment sites in New South Wales (NSW) were divided into three categories: tertiary (Sydney Dental Hospital, a specialist referral centre), metropolitan (South Western Sydney Local Health District general dental clinics), and regional (Northern NSW and Western NSW Local Health District general dental clinics). The study was conducted over 24 months.

Retrospective and prospective patients who could not complete treatment in the dental chair and were treatment planned for GA were allocated to a 'referred to GA' sub-cohort, allowing evaluation of whether treatment initially planned under GA was diverted and completed in the dental chair instead, thereby avoiding a preventable dental hospitalisation.

For the prospective arm, inclusion criteria consisted of children aged <72 months presenting with at least one cavitated carious lesion (not including white spot or incipient lesions) who attended appointments between January and November 2020. Patients who presented with an immediate need for GA (e.g., facial swelling) after the first visit were excluded, as were prospective patients who attended fewer than two follow-up visits after the initial visit (marked as dropouts). The retrospective arm had similar inclusion and exclusion criteria. Data from 2013 to 2015 were used as a historical control for the tertiary site (from a previous study), while digital records from 2018 to 2020 were analysed retrospectively for the other three sites, to avoid overlap with implementation of the CDM protocol. Sample size calculation indicated 157 participants were required for the retrospective group and 197 for the prospective group to achieve adequate power.

The first component of the CDM protocol (the Steps to Smiles Program) was a Caries Risk Assessment (CRA) adapted to the Australian population. Half were completed by parents/guardians (dietary and oral hygiene habits) and the other by clinicians during appointments. Based on the CRA and clinical examination, patients were categorised into high, medium, or low caries risk. High-risk patients were recalled every 1–3 months, medium-risk every 3–6 months, and low-risk patients every 6–12 months for disease management visits (DMV).

DMVs involved prevention and remineralisation of dental caries via motivational interviewing, setting self-management goals, dietary discussion, oral hygiene instructions, and use of various fluoride modalities, aided by a purpose-designed patient booklet. Fluoride-based products used in the protocol included stannous-stabilised silver fluoride, fluoride varnish (22 600 ppm), and stannous fluoride toothpaste (0.454%, 1450 ppm fluoride) provided to all participants. Prospective patients initially referred for GA were offered silver fluoride treatment to arrest active carious lesions, with the aim of enabling treatment to be completed in the dental chair. Remineralisation of caries allowed modified treatment approaches such as the Hall technique and interim therapeutic restorations, often without local anaesthesia or drilling.

Seventy-four staff across all four Local Health Districts, including specialist paediatric dentists, dentists, oral health therapists, dental therapists, a dietician, dental assistants and administrative staff, were trained in the Steps to Smiles program. Training comprised online modules, lectures on the management of ECC and the American Dental Association Caries Classification System (ADA CCS), motivational interviewing training and role play, and a hands-on silver fluoride workshop, followed by a supervised 'go-live' session.

For each participant, the number of cavitations, DMFT (decayed, missing and filled teeth) score, presence of dental pain and oral hygiene status at the initial visit were recorded, along with special healthcare needs and previous dental GAs. The number of fluoride varnish applications, disease management visits, restorative visits, total visits, and follow-up duration were also recorded. Demographic characteristics including age, sex, postcode, and presence of a government-issued, means-tested concession card were recorded, with socio-economic status derived from postcode using the Socio-Economic Indexes for Areas (SEIFA).

Statistical analyses were performed in two stages: Stage 1 compared the total recruited cohort between prospective and retrospective arms; Stage 2 analysed the sub-cohort referred to GA, with the primary outcome being avoidance of GA and completion of treatment in the chair.

## **Results**

In total, 445 children (186 retrospective, 259 prospective) were recruited, of whom 256 children (99 retrospective, 157 prospective) were referred to GA for dental treatment. A dropout rate of 17% (44 patients) was recorded in the prospective cohort.

The prospective cohort was significantly younger than the retrospective cohort (mean  $51.47 \pm 12.82$  months vs.  $54.38 \pm 10.62$  months,  $p=0.003$ ), with significantly fewer cavitations at baseline (mean  $5.83 \pm 4.56$  vs.  $7.22 \pm 6.33$ ,  $p<0.001$ ) and consequently lower DMFT scores.

The prospective cohort had a significantly higher number of fluoride varnish applications ( $2.53 \pm 1.90$  vs.  $1.77 \pm 1.76$ ,  $p=0.033$ ) and disease management visits ( $5.65 \pm 2.48$  vs.  $3.89 \pm 2.00$ ,  $p<0.001$ ), and a significantly lower number of restorative visits ( $2.09 \pm 1.71$  vs.  $2.67 \pm 2.10$ ,  $p=0.003$ ) than the retrospective cohort. There was no significant difference in the total number of visits (mean six in both groups) or total treatment duration ( $p=0.05$ ).

Among the sub-cohort initially referred for GA ( $n=231$ ), treatment under GA was avoided in 47% of the prospective group compared with 15% of the retrospective group. On multivariate logistic regression, the adjusted odds ratio for patients in the prospective group avoiding treatment under GA was 9.60 ( $p<0.01$ ) compared with the retrospective group. A greater total number of restorative appointments was associated with an increased likelihood of avoiding GA (adjusted OR 1.94, 95% CI: 1.56–2.42,  $p<0.001$ ), whereas a greater number of fluoride varnish applications over 24 months was associated with an increased likelihood of requiring treatment under GA (adjusted OR 0.67, 95% CI: 0.55–0.82,  $p<0.001$ ).

There was no significant difference in the number of silver fluoride applications between prospective patients who were referred to GA and those who were not ( $p>0.05$ ). However, participants who received silver fluoride applications were significantly more likely to present with arrested lesions than those who did not (OR 5.62, 95% CI: 2.91–10.86,  $p<0.001$ ).

Among prospective patients initially referred for GA ( $n=132$ ), silver fluoride application was associated with significantly increased odds of avoiding GA and completing dental treatment in the dental chair compared with those who did not receive silver fluoride (OR 5.51, 95% CI: 2.09–14.57,  $p<0.001$ ). Participants who received treatment in the dental chair had a significantly higher mean number of silver fluoride applications than those who underwent treatment under GA ( $1.84 \pm 1.28$  vs.  $1.27 \pm 1.33$ ,  $p=0.014$ ).

## **Discussion**

Prior to implementation of the Steps to Smiles program at the tertiary dental hospital, rates of paediatric patients requiring repeat GAs for caries were as high as 13.3% within a 2-year period, and 41% of patients who had a GA experienced repeat caries within 2 years. This study demonstrated that in NSW, Australia, application of the CDM protocol had a significant impact on preventing treatment under GA in a public sector setting. The finding that treatment under GA was avoided in 47% of children in the prospective group compared with 15% in the retrospective group was similar to the Ng et al. study.

Shifting the focus away from the surgical treatment of ECC under GA has been emphasised by other Australian studies. A dental caries management protocol utilising silver diamine fluoride at the Royal Dental Hospital of Melbourne successfully diverted 88% of at-risk children from a dental GA during a six-month study period, and an atraumatic restorative treatment approach has also been shown to reduce the need for GA.

Avoiding the need for dental treatment under GA was achieved without the need for additional appointments over a course of care – there was no significant difference in the total number of appointments between the retrospective and prospective cohorts. There were, however, greater overall disease management visits but fewer restorative appointments in the CDM protocol group, which the authors attribute to the higher rates of arrested lesions in this group making treatment of multiple teeth in a single visit less time-consuming and invasive.

The authors propose several explanations for their findings: as more teeth were remineralised through silver fluoride treatment, the need for GA decreased and more children could eventually be managed in the chair, since remineralised teeth often do not need local anaesthetic or drilling to restore; there may also have been a shift in the treatment-planning mindset as clinicians gained confidence and experience with the principles of CDM. Motivational interviewing, empowering families to select their own self-management goals, was also considered to have contributed to the more favourable result in the prospective group.

Avoiding the need for treatment under GA has significant implications for cost-savings in the public health sector. A single dental GA in Australia for under-15-year-olds has been estimated to cost more than \$5000 (AUD) when indirect costs are included. The authors intend to conduct a cost-effectiveness analysis of the Steps to Smiles program.

The authors identified several limitations in the present study. Since randomisation was not possible in this historically controlled quasi-experimental design, the retrospective and prospective cohorts differed significantly in age and mean cavitations (and consequently DMFT scores) at Visit 1. Multivariate logistic regression was used to address these confounders. There was also up to a 7-year time gap between the tertiary retrospective cohort and their prospective counterparts, necessary to avoid contamination between protocol implementation timelines. It is possible that caries rate and treatment decisions could vary due to health policy changes and clinician efforts over time. The COVID-19 pandemic disrupted delivery of care for prospective cohorts for several months and may have influenced clinician motivation to avoid GA referral. Other limitations included the small sample size and the relatively short follow-up period of 24 months and 6 weeks.

## **Conclusion**

This study concluded that the CDM protocol (Steps to Smiles Program) was effective in reducing the number of dental treatments under GA for ECC in select public dental clinics. Prospective patients referred for treatment under GA were 9.6 times more likely to have their treatment completed in the dental chair and avoid a GA compared with historical controls. Use of silver fluoride was associated with a significantly increased odds of avoiding GA. The CDM protocol was highly effective in incorporating disease management visits within the existing appointment framework, avoiding the need for additional appointments overall. The authors call for a paradigm shift in the management of caries in young children and further uptake of CDM protocols across the public dental health sector in Australia.

## **Questions**

1. Early Childhood Caries (ECC) is defined as the presence of one or more carious teeth in children under the age of:
  - a. 4 years.
  - b. 6 years.
  - c. 8 years.
  - d. 12 years.
2. Chronic Disease Management (CDM), as described in this study, focuses on:
  - a. telling the patient what to do to manage their disease.
  - b. empowering patients and families to play a central role in addressing their chronic condition and selecting their own disease management goals.
  - c. a purely surgical approach to dental caries.
  - d. referring all high-risk patients directly for GA.
3. Patients were excluded from the prospective arm if they:
  - a. had only one cavitated lesion.
  - b. presented with an immediate need for GA (e.g., facial swelling) after the first visit.
  - c. had previously undergone a dental GA.
  - d. were recruited from a regional site.
4. According to the Caries Risk Assessment used in this study, high-risk patients were recalled every:
  - a. 1–3 months.
  - b. 3–6 months.
  - c. 6–12 months.
  - d. 12–24 months.
5. Fluoride-based products used in the CDM protocol included:
  - a. sodium fluoride varnish only.
  - b. stannous-stabilised silver fluoride, fluoride varnish, and stannous fluoride toothpaste.
  - c. acidulated phosphate fluoride gel only.
  - d. silver diamine fluoride only.
6. At baseline, compared with the retrospective cohort, the prospective cohort had:
  - a. more cavitations and higher DMFT scores.
  - b. fewer cavitations and lower DMFT scores.
  - c. the same number of cavitations and DMFT scores.
  - d. a higher proportion of special healthcare needs.
7. A greater number of fluoride varnish applications over 24 months was associated with:
  - a. an increased likelihood of requiring treatment under GA.
  - b. a decreased likelihood of requiring treatment under GA.
  - c. no change in the likelihood of requiring GA.
  - d. increased odds of caries arrest.
8. Silver fluoride application in the prospective cohort initially referred for GA was associated with:

- a. no significant difference in the odds of avoiding GA.
  - b. significantly increased odds of avoiding GA and completing treatment in the dental chair.
  - c. significantly decreased odds of avoiding GA.
  - d. an increased need for restorative visits.
9. Compared with the Ng et al. study, which reported a 36% improvement in referral to GA with a CDM protocol, the present study found an improvement (GA avoidance) of approximately:
- a. 15%.
  - b. 32% (47% vs. 15%).
  - c. 47%.
  - d. 88%.
1. The estimated cost of a single dental GA in Australia for a child under 15 years, including indirect costs, was reported to exceed:
- a. \$500 (AUD).
  - b. \$1500 (AUD).
  - c. \$5000 (AUD).
  - d. \$10 000 (AUD).