Safety and patient experience of multi-drug intravenous conscious sedation in primary care dentistry: a multicentre service evaluation

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Abstract

Aims

To evaluate intravenous (IV) conscious sedation in primary care dentistry, including predominantly propofol-based multi-drug regimens, delivered by consultant anaesthetists (CA) and trained non-consultant medical sedationists (NC).

Materials and methods

A retrospective audit of 3,678 sedation records (January 2022-June 2024) captured demographics, ASA grade, sedation regimens, adverse events, and satisfaction. Outcomes were compared between CA and NC. A supplementary patient and clinician survey, under unchanged protocols, assessed perceived necessity and acceptability.

Results

Patients aged 16-93 years; most were ASA 1-2. Midazolam-propofol predominated (85%). Satisfaction was high, with 98% rating eight-ten out of ten. Desaturation events (SpO_2 <90%) occurred in 0.79%, were brief and self-limiting, mainly with longer procedures and higher ASA grades. No serious adverse events or escalation occurred. No significant CA-NC differences were identified. Supplementary survey responses from 627 patients and 67 dentists indicated high reliance on intravenous sedation services: 98.9% of patients reported that sedation had been essential to completing treatment, and 95.5% of clinicians reported that propofol-based intravenous sedation improved care.

Conclusions

IV conscious sedation, predominantly using propofol-based multi-drug regimens, was delivered safely within a structured governance framework, with high patient satisfaction and no significant differences between CA- and NC-led care.

Key learning points

- Intravenous conscious sedation in primary dental care, including propofol-based regimens, was delivered safely to 3,678 patients over a 30-month period, with no major adverse events or hospital transfers
- Patient satisfaction was exceptionally high, with the vast majority (98%) rating eight to ten out of ten and preferring sedation for future dental treatment
- Clinical outcomes and safety indicators were comparable between consultant anaesthetists (CA) and trained non-consultant medical sedationists (NC) within a structured governance framework.

Introduction

Demand for sedation in dentistry remains high across the UK, driven by dental anxiety, increasingly complex treatment needs, and limited access to general anaesthesia services.[1,2] In England alone, more than 148,000 episodes of adult dental sedation were delivered in a single year, underscoring the importance of this service.[3]

Intravenous conscious sedation with propofol is valued for its rapid onset, titratability and favourable recovery profile, but caution persists because of its narrow therapeutic index and potential for cardiorespiratory depression.[4] Debate continues over who should provide propofol sedation, with NAAP (Non-Anaesthesiologist Administration of Propofol for GI endoscopy) guidance supporting trained NC in GI endoscopy, while European anaesthetic societies argue it should be limited to doctors trained in general anaesthesia.[5,6] Similar concerns about competence, safety and governance remain relevant in primary-care dentistry.[4,7,8]

While intended to maximise patient safety, such restrictions may limit capacity and exclude skilled NC providers, reducing access to timely treatment.

Emerging evidence suggests that trained NC can safely deliver propofol conscious sedation within structured governance frameworks.[9,10] Although dental data remain limited, recent paediatric audits and parental feedback support the safety, acceptability and service value of propofol-based sedation delivered by experienced teams.[11–13]

Despite these findings, evidence for adult primary care intravenous conscious sedation using propofol-based and other multi-drug regimens remains sparse, particularly regarding complication rates, recovery, and satisfaction. Questions persist about who should deliver propofol sedation, whether CA should have exclusive responsibility or if appropriately trained NC can achieve comparable outcomes.[4,7,8]

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This service evaluation reports outcomes from a large multi-centre primary-care cohort receiving intravenous conscious sedation, most commonly using midazolam-propofol regimens. Its primary aim was to evaluate safety, patient experience, and operator-related outcomes in routine practice. A supplementary survey of patients and referring dentists was included to provide contextual information on the perceived value of intravenous sedation services, but not to determine which specific regimen was required in individual cases.

Materials and methods

This retrospective clinical audit of 3,678 patients reviewed intravenous conscious sedation activity within a primary care dental service between January 2022 and June 2024. It evaluated sedation practice, safety outcomes, and satisfaction, also comparing CA (nine) and trained NC (eight).

Intravenous conscious sedation was provided by Sedation Solutions (SSL), a Care Quality Commission-registered mobile sedation service operating across London and the South East. Since 2011, SSL has delivered approximately 30,000 sedations in primary care. All NC were medically qualified, GMC-registered, and experienced in sedation practice. All providers underwent shadowing and mentoring within a structured governance framework aligned with IACSD 2020 standards.

Of more than 5,000 sedation cases during the audit period, those documented using a standardised electronic sedation record (3,678) were included in the audit. The cases were drawn from routine clinical practice and represent an unselected sample. Missing data were <5% and were handled by complete-case analysis.

Recorded variables included demographics, ASA grade, sedation regimens, drugs administered, treatment duration, adverse events including oxygen desaturation (<90%), and patient-reported outcomes such as satisfaction, side effects, and future treatment preference. Feedback questionnaires were sent by text 24 hours post-procedure.

Primary outcomes were patient safety and satisfaction. Secondary analysis compared CA- and NC-led cases to explore any differences in safety or experience.

Secondary patient and clinician survey component

A supplementary anonymised electronic survey was conducted in early 2025 among patients treated by the service and their referring dentists (Appendices 1 and 2). Although undertaken after the audit period, the service model, staffing, protocols and governance framework were unchanged. The survey explored perceived dependence on intravenous sedation services and their clinical value; it was not designed to determine whether advanced or propofol-based techniques were specifically required in individual cases. Responses were voluntary and non-identifiable, and formal research ethics approval was not required as this constituted service evaluation.

Sedation method

Patients underwent pre-sedation assessment including medical history, consent, and screening for comorbidity. Written and verbal peri-procedural instructions were provided, including escort requirements. Standard monitoring included pulse oximetry and non-invasive blood pressure; supplemental oxygen and capnography were not routinely used, although oxygen was immediately available. Sedation was titrated incrementally, most commonly with midazolam–propofol, to maintain conscious sedation with verbal responsiveness and preserved airway reflexes. Patients were observed until discharge criteria were met (modified Aldrete),[14] and follow-up questionnaires were sent digitally 24 hours later.

Statistical analysis

Continuous variables were summarised as mean ± SD or median [IQR], and categorical variables as n (%) with exact 95% CIs. Group comparisons used Fisher's exact test, chi-squared test, Student's t-test, or Mann–Whitney U test as appropriate. Binary logistic regression examined predictors of desaturation, including duration, ASA grade, age, BMI and provider grade. Odds ratios (ORs) with 95% CIs are reported; $p < 0.05$ was considered significant. Analyses were performed in IBM SPSS Statistics v29.0.

Results

The audit analysed 3,678 electronic sedation records. The cohort included both male and female patients in roughly equal proportions, aged 16-93 years (median 38 years), with peaks in the third and sixth decades (Fig. 1a). More than 90% of patients were classified ASA 1-2, with a small minority ASA 3 (Fig. 1b). BMI values were used when analysing risk for specific adverse events. CA-led cases numbered 856 and NC-led 2,822. Treatment duration ranged from 7 to 573 minutes (mean 90, median 72). Two cases exceeding 500 minutes represented exceptional outliers: one involved extensive oral surgery with sinus grafting and multiple implant placements, and the other a full-mouth cosmetic rehabilitation involving veneers and crowns. No sedation failures (failure to complete planned treatment) occurred.

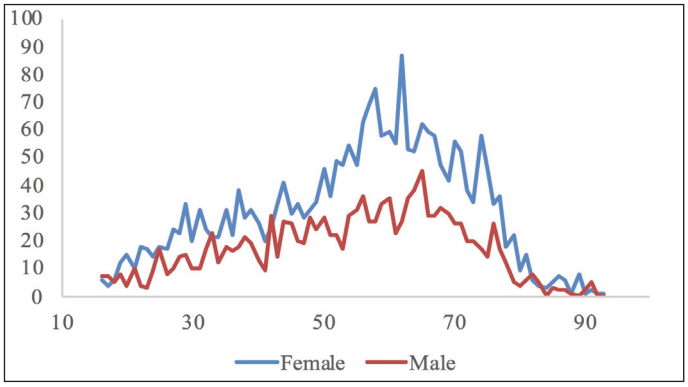

Fig. 1a Case numbers by age and sex

Age distribution of patients undergoing dental sedation, stratified by sex. The number of cases across age groups is shown for female (blue line) and male (red line) patients. A higher number of sedation cases was observed among females, with peak activity occurring in middle-aged adults.

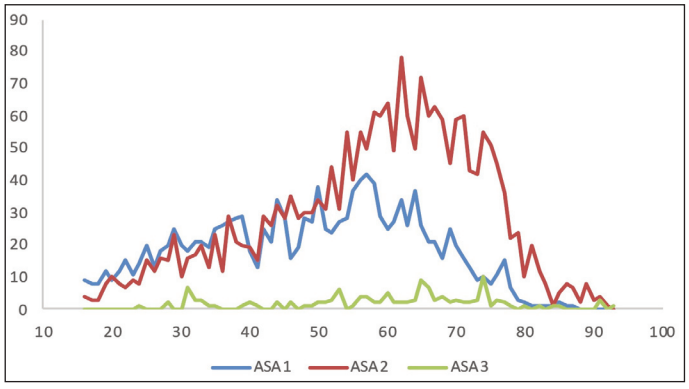

Fig. 1b Case numbers by age and ASA grade

Age distribution of patients undergoing dental sedation according to ASA (American Society of Anaesthesiologists) physical status classification. The number of cases for ASA I (blue line), ASA II (red line), and ASA III (green line) patients is shown across age groups. Most patients were classified as ASA II, with peak sedation activity observed in middle-aged to older adults.

Sedation techniques

The most frequent regimen was midazolam–propofol, accounting for approximately 85% of all cases. When propofol was used, TCI was employed in 76% and bolus in 24%. Other regimens, including propofol alone, midazolam alone, and midazolam-ketamine, were rare. A minority of cases used opioid or ketamine adjuncts, primarily for longer or more complex procedures (Fig. 2). CA and NC followed similar prescribing patterns (Table 1).

Safety outcomes

Serious adverse events

No major adverse events, cardiac arrests, paramedic callouts or hospital transfers occurred.

Desaturation events

Oxygen desaturation (<90%) was recorded in 29 cases (0.79%, 95% CI 0.53-1.13%). The 29 cases contained 72 desaturation readings. Based on estimated monitoring frequencies, this equates to 0.30% per recorded measurement at 15-minute intervals (≈ 1 in 338 readings) or 0.10% at 5-minute intervals (≈ 1 in 963 readings). All episodes were brief/self-limiting and did not require any advanced or invasive airway interventions.

Drug Combination	CA (n / %)	NC (n / %)
Midazolam + Propofol	583 (68.1%)	2530 (89.7%)
Fentanyl + Midazolam + Propofol	97 (11.3%)	153 (5.4%)
Propofol-only	96 (11.2%)	25 (0.9%)
Ketamine + Midazolam + Propofol	12 (1.4%)	49 (1.7%)
Alfentanil + Midazolam + Propofol	34 (4.0%)	25 (0.9%)
Midazolam-only	2 (0.2%)	17 (0.6%)
Remimazolam	17 (2.0%)	0 (0.0%)
Fentanyl + Ketamine + Midazolam + Propofol	6 (0.7%)	4 (0.1%)
Alfentanil + Propofol	2 (0.2%)	7 (0.2%)
Ketamine + Midazolam	0 (0.0%)	6 (0.2%)
Fentanyl + Propofol	3 (0.4%)	1 (0.0%)
Ketamine + Propofol	0 (0.0%)	3 (0.1%)
Fentanyl + Remimazolam	2 (0.2%)	0 (0.0%)
Alfentanil + Ketamine + Midazolam + Propofol	2 (0.2%)	0 (0.0%)
Fentanyl + Ketamine + Midazolam	0 (0.0%)	1 (0.0%)
Alfentanil + Ketamine + Midazolam	0 (0.0%)	1 (0.0%)

Table 1 Drug combinations

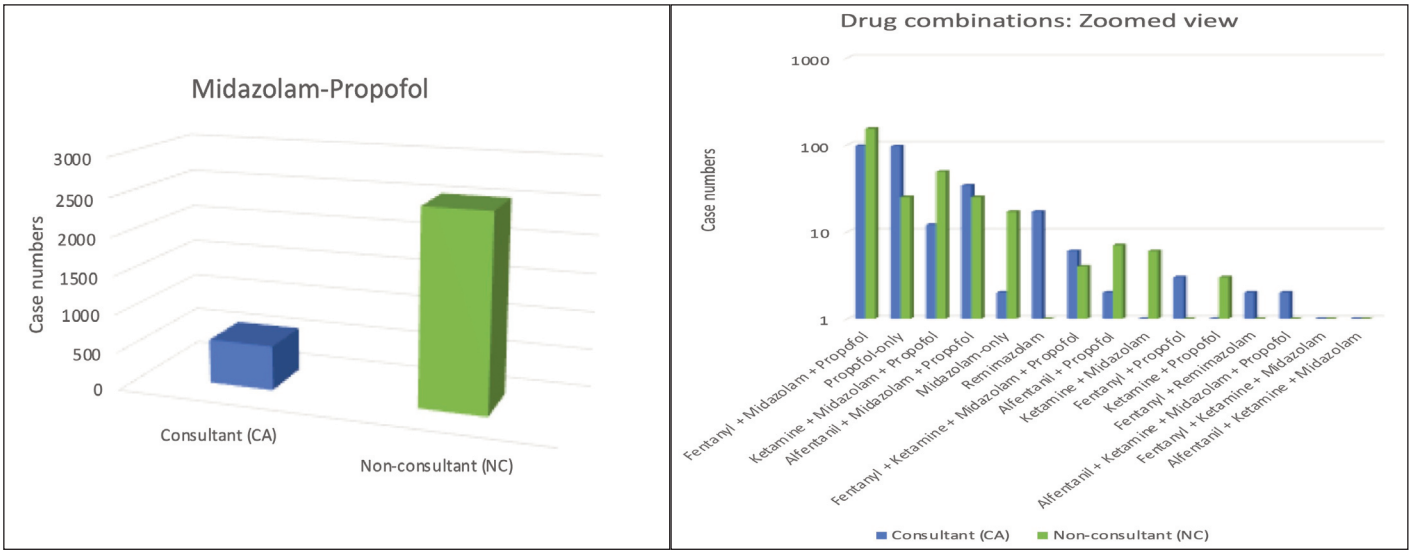

Fig. 2 (Panel A & B) Drug combinations by operator

Drug combinations used for dental sedation by consultant anaesthetists (CA) and trained non-consultant medical sedationists (NC). Panel A shows the dominant midazolam-propofol regimen. Panel B shows the remaining less frequent drug combinations on an expanded scale to improve readability.

The median age of affected patients was 62 years compared with 57 in those without desaturation. Median ASA classification was 2 in both groups, although higher ASA patients were more likely to desaturate. Median BMI was 26.9 kg/m² versus 25.6 kg/m², and median sedation duration was 159 versus 72 minutes. Incidence for specific drug regimens ranged from 0.71% to 10.0%, highest in multi-agent combinations containing opioids and lowest in midazolam–propofol, but these findings are not statistically significant (p >0.99) (Table 2).

Regimen	Total (n)	Events	Rate %	95% CI
Midazolam + Propofol	3,113	22	0.71	0.43–1.03
Fentanyl + Midazolam + Propofol	250	5	2.00	0.63–4.43
Propofol only	121	1	0.83	0.02–4.12
Fentanyl + Ketamine + Midazolam + Propofol	10	1	10.00	0.21–38.48

Table 2 Desaturation events by drug combinations

Predictors of desaturation events

Binary logistic regression identified sedation duration and ASA physical status as significant predictors. Duration was positively associated with desaturation (OR = 1.004, 95% CI 1.002–1.006, p <0.001), as was ASA status (OR = 2.74, 95% CI 1.35–5.54, *p* = 0.005). Age, BMI, number of drugs, and combination were not significant (*p* >0.05). Desaturation rates between NC and CA were 0.81% and 0.73% respectively, with Fisher's exact test showing no statistically significant difference (*p* = 0.635). (Table 3).

Predictor	OR	95% CI	p
Procedure duration (per min)	1.004	1.002-1.006	<0.001
ASA status (per grade)	2.74	1.35-5.54	0.005
Age (per year)	1.003	0.996-1.010	0.396
BMI (per kg/m²)	1.000	0.9995-1.0004	0.954
Provider (Non-Consultant vs Consultant)	0.88	0.51-1.51	0.635

Table 3 Predictors of oxygen desaturation (logistic regression)

The corresponding forest plot in Figure 3 displays odds ratios with 95% CIs on a log scale (Panel A), with a zoomed inset highlighting near-unity predictor (Panel B).

Patient-reported outcomes

Of the 3,678 patients, 2,636 patients (71.7%) completed 24-hour post-sedation questionnaires, with 98% rating satisfaction between eight-ten out of ten (Fig. 4). Both CA and NC cases demonstrated very high satisfaction scores, with median 10/10 across both groups (mean 9.56 ± 1.21 and 9.73 ± 0.77). For future treatment, 98% preferred sedation, 0.5% local anaesthesia, and 1.5% general anaesthesia.

Nausea was reported in 7.4% overall and was not associated with drug combination ($\chi^2 = 2.93$, p = 0.57). Internal-consistency analysis suggested that many positive nausea responses were likely to reflect misinterpretation rather than clinically meaningful symptoms, with adjusted estimates ranging from 1.3% to 3.3% depending on the model applied.

Free-text feedback was overwhelmingly positive, commonly highlighting professionalism, reassurance, communication and the value of sedation for dentally anxious patients.

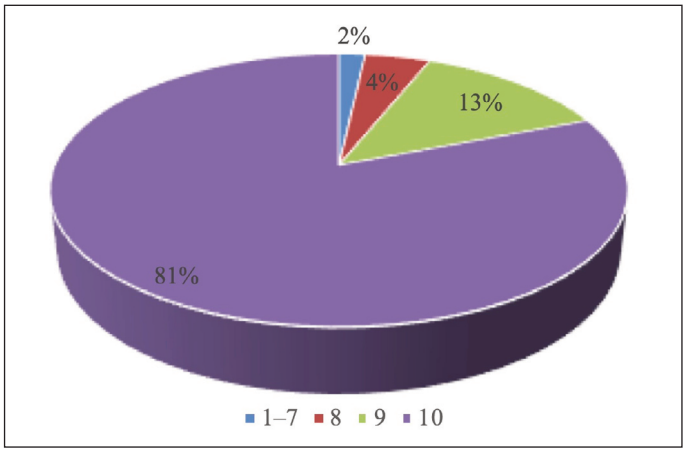

Fig. 4 Patient reported sedation rating

Patient satisfaction scores following dental sedation, rated on a 10-point scale where 1 indicates a very poor experience and 10 indicates an excellent experience. The vast majority of patients rated their experience as 8 or higher.

Fig. 3 Logistic regression analysis of predictors of oxygen desaturation (SpO_2<90%)

Panel A: Forest plot showing odds ratios (ORs) with 95% confidence intervals for all modelled predictors: procedure duration (per minute), American Society of Anesthesiologists (ASA) physical status (per grade), age (per year), body mass index (per kg·m^{-2}), and operator grade (non-consultant vs consultant).

Panel B: Expanded view of predictors with ORs close to 1 (age, BMI, operator grade, and procedure duration) to illustrate confidence intervals relative to the line of no effect (OR = 1.0).

Supplementary patient and clinician survey findings

In the supplementary 2025 survey, 627 patients and 67 referring dentists responded. Findings indicated high perceived clinical value of intravenous sedation services: 98.9% of patients reported that sedation had been essential to completing treatment, 91.4% said loss of access would significantly impair their ability to receive care, and 95.5% of clinicians reported that propofol-based intravenous sedation improved patient care and procedural completion. Many clinicians also noted reduced need for referral to secondary care and improved efficiency.

Discussion

This audit shows that intravenous conscious sedation, most commonly using propofol-based multi-drug regimens, can be delivered safely and effectively in a high-volume primary-care dental service, including by both CA and trained NC.

A key audit strength is the large dataset, offering a robust overview of real-world primary-care sedation. High patient satisfaction highlights sedation's importance in maintaining access to dental care at a time when hospital-based anaesthesia is limited.[15] Notably, no failed sedations were recorded, supporting the reliability of the sedation approaches used.

Oxygen desaturation was uncommon (0.79%) and brief, typically corrected with verbal prompts. Longer procedures and higher ASA grades were the main predictors, emphasising careful titration and monitoring in these patients. No independent association was observed between drug combinations or number of sedative agents and the occurrence of desaturation events. Age and BMI likewise did not significantly predict desaturation. These findings highlight the importance of individual risk assessment, careful titration of sedatives, and close intra-operative monitoring, particularly in higher-ASA patients and during long procedures.

Compared with NAAP endoscopy studies reporting hypoxia rates around 4%,[16] sedation in this audit was limited to conscious sedation with preserved verbal responsiveness and airway reflexes. Routine supplemental oxygen was also not used here, unlike many NAAP studies, and this should be considered when comparing desaturation rates.[17,18]

Importantly, no significant differences were observed between CA and trained NC across desaturation events, treatment success, or patient satisfaction. These findings support the view that, within a structured governance framework and defined scope of practice, appropriately trained NC can deliver intravenous conscious sedation with comparable observed outcomes. This has potential implications for workforce planning, particularly in the context of increasing demand for primary-care dental sedation and ongoing debate regarding who should be permitted to provide more advanced intravenous techniques.

Furthermore, the survey findings suggest a high perceived reliance on intravenous sedation services among both patients and referring clinicians. These findings support the importance of maintaining accessible primary-care sedation pathways. Although the present audit was not designed to determine whether advanced intravenous sedation was necessary in preference to simpler techniques such as midazolam alone, the overwhelming predominance of midazolam–propofol regimens in a large, experienced service suggests that their use was not merely a matter of clinician preference, but may reflect genuine clinical advantages in predictability, titratability and suitability for the procedural and patient characteristics encountered. Although cases exceeding 500 minutes were exceptional, prolonged sedation sessions of 4-6 hours were not uncommon in this service, reflecting the complexity of treatment undertaken and potentially helping to explain the predominance of more advanced regimens.

The case numbers in the present audit further indicate that full-time NC often accumulate substantially more primary-care dental sedation experience than CA, who tend to work in these settings only part-time, and this may help explain the comparable safety outcomes observed between groups. Restricting delivery of advanced intravenous conscious sedation solely to CA may therefore reduce service capacity and access, without clear evidence from the present dataset that such a restriction would improve patient safety.

Several limitations should be acknowledged. This was a retrospective audit, and safety was assessed indirectly through recorded desaturation and adverse events rather than full continuous physiological data review. Patient outcomes were measured using satisfaction surveys, which, while valuable, may be subject to response bias. The audit also lacked long-term follow-up. Future studies should address these limitations by incorporating prospective designs, standardised safety endpoints, and extended patient-reported outcomes.

Conclusion

These findings highlight ongoing demand for conscious sedation in primary care dentistry and demonstrate that intravenous conscious sedation, most commonly using a midazolam–propofol regimen, can be delivered safely within a high-volume UK primary-care service. Safety appears to depend not only on sedative choice, but on the wider clinical framework, including careful patient selection, structured assessment, titration to maintain conscious sedation, defined escalation pathways, and robust governance with competency-based training and supervision.

In the context of ongoing debate about dental sedation provision, restricting advanced techniques, including propofol-based regimens, to CA could reduce patient access without clear evidence from the present dataset of improved safety. These findings support retaining trained NC within structured teams and support development of a formal UK training pathway for multi-drug conscious sedation. Future prospective studies should incorporate standardised safety measures, longer follow-up and economic evaluation of service models.

Declarations

Funding: No external funding was received.

Conflict of interest: The authors declare no conflicts of interest.

Ethics: This audit was conducted as a service evaluation and did not require formal research ethics approval.

Data availability statement

The datasets generated and analysed during the current audit are not publicly available due to patient confidentiality and data protection requirements but are available from the corresponding author on reasonable request in anonymised form.

Author contributions:

WJ Botha: Methodology, Formal analysis, Investigation, Writing - Original Draft, Writing - Review & Editing, Supervision. **A du Plessis**: Methodology, Software, Investigation. **A von Backström**: Methodology, Investigation. **A Ashraf**: Methodology, Investigation, Writing - Review & Editing, Supervision.

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Appendix 1: Supplementary patient survey

Question 1: How many times have you had intravenous sedation with Sedation Solutions? (Once; 2 - 5 times; More than 5 times)

Question 2: Indicate your view on the following statements (Completely agree; somewhat agree; neither agree/disagree; disagree):

- The sedation helped me to successfully undertake dental treatment
- I felt comfortable having my dental treatment under sedation, outside of the hospital environment

Question 3: If you could not have your choice of sedation, how much would this affect your ability to have treatment? (Scale of 1-5, where 1 is "No effect" and 5 is "Completely unable to have treatment")

Question 4: Please provide a personal testimony of your sedation experience and why you would like this option to remain open to you

Appendix 2: Supplementary dentist survey

Question 1: How often do you use sedation for your patients (Patients per month)?

Question 2: Do you make use of Midazolam-only sedation (Yes/No)?

Question 3: Indicate your view on the following statements (Completely agree; somewhat agree; neither agree/disagree; disagree):

- In General, Propofol sedation provides better sedation than Midazolam-only.
- I've experienced Propofol-based sedation to be perfectly safe in the hands of experienced sedationists, like those from Sedation Solutions.
- Removing Propofol sedation will have a detrimental impact on my patients and my practice.

Question 4: Sedation without Propofol will impact my patients and my practice in the following ways (Indicate all that applies):

- Failed sedation (Patients do not cope with other forms of sedation)
- Inappropriate for the type of treatment (invasive/extensive surgery)
- Unsuitable for duration of treatment
- Time management issues due to slower onset of sedation and prolonged recovery
- None of the above/ I would be unaffected

Question 5: Please provide a personal testimony of your sedation experience and why you would like Propofol sedation as an option to remain open to you: