



Project USAP 2010: Use of Sedative Agents in Pediatric Dentistry—a 25-year Follow-up Survey

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Abstract: Purpose: A 25-year follow-up survey was conducted among members of the American Academy of Pediatric Dentistry (AAPD) to explore changes in the use of sedative agents. **Methods:** The survey was conducted in the winter of 2010 via an email LISTSERV of active members of the AAPD in the United States. The survey targeted demographics of participants and issues related to their use of sedation. **Results:** A total of 1,642 responded, representing a response rate of 44 percent. The majority was board certified (58 percent) and indicated that nitrous oxide was used for over 50 percent of patients. Restraint (protective stabilization) was used by 72 percent of respondents but had declined compared to previous surveys. The dominant route of sedative administration was oral (93 percent). Benzodiazepines and nitrous oxide represented the most frequently used sedatives. **Conclusions:** Respondents and their patient pool characteristics are changing (e.g., there are proportionately more diplomates), benzodiazepines are the most frequently used sedative besides nitrous oxide (the use of which appears to be increasing), and protective stabilization among users is declining. (*Pediatr Dent* 2016;38(2):127-33) Received January 20, 2015 | Last Revision September 1, 2015 | Accepted September 25, 2015

KEYWORDS: CONSCIOUS SEDATION, SEDATIVE AGENTS, PEDIATRIC DENTISTRY

Children in a dental setting are initially and usually managed using nonpharmacological approaches. When such approaches fail to address a child's emotional, psychological, or cognitive coping in a mutually acceptable interaction with a dental professional, considerations of pharmacological interventions are suggested for diagnostic and therapeutic procedures. Sedation techniques vary widely around the country, and many factors, including the needs of the patient, affect the use of sedative regimens. Training of future practitioners is quite variable and influenced by factors, such as location of training program, resources available for training, types of patient experiences, availability of experienced teachers, and guidelines for training (as determined by geographic location). When sedation was expanded as a behavior management technique, the American Academy of Pediatric Dentistry (AAPD) developed guidelines to improve the safety of its use. In 1985, a mail survey of AAPD members was conducted to record the use of sedative agents by pediatric dentists. Titled Project USAP, it was repeated in 1991, 1995, 2000, and 2010 to monitor changes in the use of sedation in the United States.

The purpose of this paper was to report the results of a survey of active members of the AAPD conducted in 2010. It follows similar surveys conducted in 1985, 1991, 1995, and 2000 as a part of the USAP project initiated by one of the authors.¹⁻⁴ This report consequently represents a 25-year follow-up on the use of sedative agents in the United States showing some comparisons to the results of the previous USAP surveys.

Methods

This survey study was approved by the Institutional Review Board Committee of Cincinnati Children's Hospital Medical

Center, Cincinnati, Ohio, USA, prior to its implementation. During the winter of 2010 a survey was sent via an email LISTSERV, obtained from the AAPD, listing active AAPD members in the United States.

The survey was a 31-item questionnaire fashioned after the surveys sent in 1985, 1991, 1995, and 2000¹⁻⁴; however, a few of the questions were modified slightly by the authors to improve the intent of the item compared to previous iterations. In summary, the questionnaire inquired about: geographic location of the practitioner in the United States; types of training program attended and lengths of time in practice; use of nitrous oxide and other sedative agents; percent and ages of patients, including those with special needs, receiving sedation; reasons for changes in the use of sedation over the past five years; use of restraints during sedation; methods for monitoring patients during treatment; typical doses and effects of drugs used; and the prevalence of any undesirable side effects.

The questionnaire was housed on SurveyMonkey (Palo Alto, Calif., USA) which generated a hyperlink that could be incorporated into the body of an email. The email indicated the purpose of the study and the fact that this survey was a follow-up to previous surveys associated with Project USAP, initiated by one of the authors in 1985. It contained an invitation to voluntarily participate in an untraceable, anonymous survey without any consequences for either responding or not responding, a deadline date for responding, an estimated survey completion time, and contact information for the authors. The invitees were directed to a hyperlink embedded in the email, which the participants could click, taking them electronically to the survey. Once the participant was finished, an exit link was available to exit the survey, taking the participant back to the home browser. The computer IP address of the participant was blocked by the software, assuring anonymity, and responses were collated within the SurveyMonkey software.

The captured data were collated and directly downloaded into IBM SPSS 20.0 software (IBM Corporation, Armonk, N.Y., USA). Analysis of the data was done using descriptive

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| Year | 1985 | 1991 | 1995 | 2000 | 2010 |
|------------------------------------|--------------|--------------|--------------|--------------|--------------|
| Total number of respondents | 1,105 | 1,497 | 1,676 | 1,778 | 1,642 |
| Response rate (%) | 54 | 59 | 62 | 54 | 44 |
| Type of training* | | | | | |
| Grandfathered | 9 | 3 | 2 | 2 | 0 |
| University-based | 47 | 47 | 58 | 23 | 17 |
| Hospital-based | 31 | 40 | 40 | 27 | 30 |
| Combined | 13 | 10 | - | 48 | 53 |
| Area of practice* | | | | | |
| Northeast | 25 | 27 | 27 | 26 | 25 |
| South/Southeast | 27 | 30 | 29 | 30 | 30 |
| Midwest | 25 | 24 | 24 | 20 | 19 |
| West | 21 | 19 | 20 | 23 | 26 |
| Years of practice* | | | | | |
| 1-5 | 18 | 19 | 20 | 19 | 23 |
| 6-10 | 30 | 19 | 15 | 15 | 17 |
| 11-15 | 23 | 24 | 18 | 13 | 14 |
| 16-20 | 10 | 19 | 19 | 15 | 10 |
| 20+ | 19 | 19 | 28 | 39 | 36 |
| Diplomate status* | | | | | |
| Diplomate | 19 | 34 | 35 | 35 | 58 |
| Non-diplomate | 81 | 66 | 65 | 65 | 42 |

* Numbers in these sections are percentages.

statistics, frequency distributions, non-parametric statistics, and tables function. Any statistical analysis set the a priori significance level at 0.05.

Results

Although the LISTSERV provided email addresses for 3,982 individuals, 285 addresses were returned immediately, indicating a subset of email addresses that apparently were incorrect or unreachable. Thus, the email apparently reached 3,697 individuals, among whom 1,642 responded for a response rate of 44 percent. Survey results are presented in Tables 1 through 11 and, in most instances, were compared to the findings of the earlier surveys.

Table 1 describes the characteristics of the respondents. The majority of respondents were graduates of a combined university/hospital-based program, which was consistent with the most recent survey conducted in 2000. All sections of the United States were evenly represented, which was consistent with previous surveys. Regarding the number of years in practice, a bimodal distribution was seen, with the frequency of those having practiced 20 years or more being greatest followed by those who practiced one to five years. This trend had been slowly emerging in the two previous surveys. The majority of respondents were board certified, which represented a major change in diplomate status compared to all previous surveys.

| | 1985 | 1991 | 1995 | 2000 | 2010 | |
|---|------------|------------|------------|------------|----------------------------|-------------------------------|
| % of patients sedated only with N₂O* | | | | | | |
| 0 | 19 | 18 | 18 | 15 | 6 | |
| 1-5 | 24 | 26 | 23 | 19 | 11 | |
| 6-10 | 12 | 13 | 12 | 13 | 11 | |
| 11-25 | 12 | 14 | 15 | 16 | 18 | |
| 26-50 | 11 | 12 | 12 | 15 | 20 | |
| >50 | 22 | 17 | 20 | 22 | 34 | |
| Total | 100 | 100 | 100 | 100 | 100 | |
| % of patients sedated with other sedative agents † | | | | | | |
| | | | | | With N₂O | Without N₂O |
| 0 | 23 | 26 | 28 | 29 | 32 | 67 |
| 1-5 | 52 | 50 | 43 | 39 | 27 | 24 |
| 6-10 | 14 | 13 | 15 | 14 | 16 | 5 |
| 11-25 | 7 | 7 | 10 | 10 | 12 | 2 |
| 26-50 | 3 | 3 | 3 | 5 | 8 | 1 |
| >75 | 1 | 1 | 1 | 2 | 3 | 1 |
| Total | 100 | 100 | 100 | 100 | 98 | 100 |

* Figures shown as percentage of practitioners.

† Figures shown as percentage of practitioners rounded to whole numbers.

| | 1985 | 1991 | 1995 | 2000 | 2010 | |
|--|------------------------|------------------------|------------------------|------------------------|---------------------------------------|-------------------|
| % of patients sedated with agents other than N₂O who were ages (years old) | | | | | | |
| 0-2 | 41 | 34 | 27 | 17 | 13 | |
| 3 | 34 | 38 | 39 | 33 | 25 | |
| 4-5 | 16 | 19 | 22 | 28 | 25 | |
| 6-10 | 6 | 6 | 7 | 12 | 22 | |
| >10 | 3 | 3 | 4 | 5 | 14 | |
| | 1985 % of total | 1991 % of total | 1995 % of total | 2000 % of total | 2010 % of patients in practice | % of total |
| % of sedated patients (other than N₂O) who were special needs | | | | | | |
| | 13 | 11 | 13 | 7 | 1-10 | 55 |
| | | | | | 11-20 | 6 |
| | | | | | 21-30 | 3 |
| | | | | | 31-40 | 1 |
| | | | | | >40 | 3 |

Table 2a, 2b, and 2c presents summaries frequency of use of sedative agents. The respondents were asked what percentage of their patients was sedated only with nitrous oxide. Greater

Table 2c. FREQUENCY OF USE OF SEDATIVE AGENTS

| Number of patients sedated with agents other than N ₂ O in a three-month period | | | | | |
|--|---------------|---------------|---------------|---------------|---------------|
| Number of practitioners | 802 | 1,043 | 1,138 | 1,224 | 1,023 |
| Average per practitioner | 42 | 32 | 52 | 63 | -59 |
| Total for all practitioners using sedation | 33,683 | 33,208 | 59,216 | 77,112 | 60,085 |

than 50 percent of respondents indicated that 26 percent or more patients in their practice needed nitrous oxide; the response category most frequently selected by respondents was “greater than 50 percent” of their patients. New graduates and older groups of respondents were the largest proportion of sedation users. At least 75 percent of the respondents indicated that they sedated special needs patients with agents other than nitrous oxide alone. However, the overwhelming majority of respondents indicated that special needs patients who are sedated represented 10 percent or less of their patients. This percentage was significantly higher than previous surveys, but the format of the question was different and, thus, not comparable.

Changes in the frequency of use of sedation are reported in Table 3. Of the 1,312 who responded, 22 percent indicated they had increased their use of sedation, 30 percent decreased their use, and 49 percent had not made any changes to their use of sedation. The most consistent trend since 1991 was an increase in the frequency of sedation use. Again, the major reasons for respondents reporting increased use of sedation were: the perception that more patients required sedation (70 percent); they were prepared to use sedation (48 percent); and they felt the logistics for the use of general anesthesia were more difficult (see Table 4). Among those who decreased their use of sedation, the principle reasons reported were: less patients required sedation (25 percent); respondents felt they were better able to manage patients without sedation (48 percent); and the logistics of using general anesthesia were perceived as less difficult (indicated as the most frequent reason). Almost one fifth (21 percent) indicated that state legislation negatively confounded the use of sedation in the office. This distribution was not unlike that reported in 2000. A significant relationship was demonstrated by performing a separate chi-square analysis investigating the frequency distributions among practice location, type of training, years in practice, and board certification as a function of the multiple responses for increasing and decreasing uses of sedation. A distribution difference was found comparing increased use of sedatives with years in practice when excluding the grandfathering (because of the few respondents in that category [chi-square equals 55.2, *P*<0.001]). Those with the least experience and who had practiced longest were more likely to say that more patients required sedation and were prepared to use sedation.

Table 5 indicates the use of physical restraints by respondents. Of the 1,181 who responded to this question, 28 percent indicated they did not use restraints. Of the 72 percent who did use restraints, the most frequent type was the Papoose Board (27 percent), followed by Papoose Board with head

Table 3. CHANGES IN FREQUENCY OF USE OF SEDATIONS OVER THE PAST FIVE YEARS

| | 1991 (N=1,043) | 1995 (N=1,138) | 2000 (N=1,328) | 2010 (N=1,312) |
|--|-------------------|-------------------|-------------------|-------------------|
| % of practitioners using sedation | | | | |
| Increased | 12 | 17 | 19 | 22 |
| Decreased | 31 | 21 | 28 | 30 |
| No change | 57 | 62 | 53 | 48 |
| Total | 100 | 100 | 100 | 100 |

Table 4. REASONS FOR CHANGE IN FREQUENCY OF USE OF SEDATIONS OVER THE PAST FIVE YEARS

| Percentage of practitioners who increased use of sedation | 2000 (N=255) | 2010 (N=260) |
|---|-----------------|-----------------|
| More patients require sedation | 82 | 70 |
| More prepared to use sedation | 40 | 48 |
| More difficult to use general anesthesia | 35 | 33 |
| Decreased malpractice cost compared to general anesthesia | | 1 |
| State legislation makes sedation easier | 29 | 3 |
| Percentage of practitioners who decreased use of sedation | 2000 (N=376) | 2010 (N=348) |
| Less patients require sedation | 27 | 28 |
| Better able to manage patients without sedation | 60 | 48 |
| Less difficult to use general anesthesia | 55 | 58 |
| Increased malpractice cost | | 9 |
| Difficult to comply with AAPD guidelines | 15 | 9 |
| State legislation made sedation difficult | 18 | 21 |

Table 5. USE OF PHYSICAL RESTRAINTS

| Physical restraint | % of practitioners who use sedation | | |
|-----------------------------------|-------------------------------------|-------------------|-------------------|
| | 1995 (N=1,138) | 2000 (N=1,328) | 2010 (N=1,180) |
| None | 18* | 26 | 28 |
| Parent holding child | 15 | 28 | 10 |
| Assistant holding child | 16 | 29 | 11 |
| Wrist restraints | 6 | 9 | 2 |
| Pedi-wrap | 17 | 14 | 7 |
| Papoose Board with head holder | 20 | 22 | 15 |
| Papoose Board without head holder | 27 | 37 | 27 |

* The total exceeds 100, as some practitioners used more than one method.

holder (15 percent), assistant holding child (11 percent), parent holding child (10 percent), Pedi-wrap (seven percent), and wrist restraints (two percent). In general, over the years the use of physical restraint appears to be slowly declining.

The methods used to monitor patients during sedation are outlined in Table 6. In this survey, the question of monitoring was broken into two parts: mild and moderate levels of sedation. Pulse oximetry was the most frequently reported monitor used (90 percent and 97 percent, respectively), followed closely by evaluating patient color (89 percent and 88 percent, respectively), heart rate (73 percent and 82 percent, respectively), respiratory rate (54 percent and 67 percent, respectively), and blood pressure (48 percent and 63 percent, respectively). The use of a precordial stethoscope (36 percent and 52 percent, respectively) and capnography (five percent and 12 percent, respectively) was also noted.

We queried the respondents concerning the typical effect observed when the target level of sedation was minimal and moderate. We did not include deep level of sedation, assuming most pediatric dentists do not target this level unless collaborating with other providers (e.g., anesthesiologists). As seen in Table 7, the response category most frequently chosen

was good for both levels of sedation (44 percent and 47 percent, respectively), followed by excellent (20 percent and 33 percent, respectively) and fair (33 percent and 17 percent, respectively).

The overwhelming response category chosen by the respondents for the route of administration of a sedative other than nitrous oxide was oral (93 percent, see Table 8). Compared to the 2000 survey, a slight increase was seen in the use of the submucosal and intranasal routes (three percent and one percent, respectively).

Table 9 indicates that the distribution of undesirable side effects was similar to those in the 2000 survey. Several undesirable side effects were identified. Most respondents (63 percent) indicated that the side effects occurred rarely. However, it should be noted that nine laryngospasms were reported but occurred rarely. In four of those nine cases, the respondents indicated the laryngospasms occurred with intravenous sedation or general anesthesia performed by an anesthesiologist. No comments were made by the remaining five respondents.

Table 10 shows the percent of the respondents' sedated patients who received each of the agent combinations. Diazepam and nitrous oxide was the most frequently reported combination

Table 6. HOW PATIENTS ARE MONITORED

| Monitoring method | % of practitioners who use sedation | | | | | |
|-------------------------------|-------------------------------------|-----------|-----------|-----------|----------------|------------------|
| | 1985 | 1991 | 1995 | 2000 | 2010 | 2010 |
| | (N=1,003) | (N=1,043) | (N=1,138) | (N=1,328) | mild (N=1,066) | moderate (N=903) |
| Evaluate color | 98 | 98 | 99 | 82 | 89 | 88 |
| Use of precordial stethoscope | 35 | 54 | 60 | 41 | 36 | 52 |
| Monitor pulse | 58 | 93 | 60 | 54 | 73 | 82 |
| Monitor respiration | 76 | 80 | 87 | 47 | 54 | 67 |
| Monitor blood pressure | 18 | 34 | 82 | 28 | 48 | 63 |
| Use a pulse/oximeter | 0 | 69 | 87 | 80 | 90 | 97 |
| Use a capnography | 0 | 0 | 2 | 4 | 5 | 12 |

Table 7. TYPICAL EFFECT ACHIEVED WITH SEDATION OTHER THAN NITROUS OXIDE

| % of practitioners responding to question | 2000 (N=1,135) | 2010 mild (N=1,063) | 2010 moderate (N=943) |
|--|----------------|---------------------|-----------------------|
| Excellent (no or slight crying) | 23 | 20 | 33 |
| Good (crying or movement but no treatment interruption) | 50 | 44 | 47 |
| Fair (treatment interrupted but all treatment complete) | 25 | 33 | 17 |
| Poor (treatment interrupted; only partial treatment completed) | 2 | 3 | 2 |

Table 8. HOW DRUGS OTHER THAN NITROUS OXIDE WERE ADMINISTERED

| % of practitioners responding to questions | 2000 (N=1,137) | 2010 (N=1,050) |
|--|----------------|----------------|
| Orally | 95 | 93 |
| Intravenously | 2 | 2 |
| Intramuscularly | 1 | 1 |
| Intranasally | 0 | 1 |
| Submucosally | 1 | 3 |

Table 9. UNDESIRABLE SIDE EFFECTS EXPERIENCED

| Occurrence | % of practitioners responding to question | |
|------------------------|---|----------------|
| | 2000 (N=1,778) | 2010 (N=1,061) |
| None | 16 | 18 |
| Nausea | 31 | 26 |
| Vomiting | 37 | 39 |
| Excessive sleep | 15 | 11 |
| Respiratory depression | 8 | 6 |
| Other | 5 | 1 |

| Frequency | % of practitioners responding to question | |
|---------------|---|----------------|
| | 2000 (N=1,055) | 2010 (N=1,123) |
| Never | 10 | 9 |
| Rarely | 61 | 63 |
| Occasionally | 27 | 25 |
| Frequently | 2 | 2 |
| Almost always | 1 | 0 |

of agents followed, in rank order, by: oral midazolam and nitrous oxide; hydroxyzine and nitrous oxide; and chloral hydrate, hydroxyzine, and nitrous oxide. Diazepam alone, meperidine, promethazine and nitrous oxide, and the triple combination of chloral hydrate, meperidine, and hydroxyzine were also frequently reported combinations. Although these combinations of drugs were used primarily for 20 percent or less of the respondent's patients seen, some exceptions were noted wherein higher percentages of patients were sedated with the combination (e.g., triple combination of chloral hydrate, meperidine, and hydroxyzine).

Table 11 indicates the typical dose of drugs by patient weight used by practitioners. The upper portion of each cell in the table indicates the number of respondents who used the dose of that particular drug, whereas the lower portion of the cell is the percent of total respondents who used that dose of that drug in their practice. The dose of the particular drug was within therapeutic levels for most of the respondents; however, some reported doses that seemed inappropriate, suggesting either that the respondent did not understand the format of the question (creating an input response error) or was confusing drug doses. Table 12 shows the responses of practitioners who used fixed drug doses in their practices. The left portion of each cell in the table indicates the number of respondents who used the indicated dose for the particular drug, whereas the right portion of the cell is the percent of total respondents who used that dose for that drug. Again, some responses were outside of the normal and expected therapeutic range of drug dose.

Discussion

Several findings in this study demonstrated changes in the landscape of sedation of pediatric patients for dental care. For instance, since this project series of surveys began in 1985,¹ fewer percentages of respondents from university-based programs and more respondents from combined hospital/university-based programs performed less and more sedations, respectively, whereas those from hospital programs have remained relatively stable. It is possible that we have witnessed changes in

Table 10. NUMBER AND PERCENTAGE OF RESPONDENTS INDICATING USE OF REGIMENS ACROSS PERCENTAGE DISTRIBUTION OF THEIR PATIENT POOL

| Regimen | N* | 5-20† | 21-40 | 41-60 | 61-80 | >80 |
|--|-----|-------|-------|-------|-------|-----|
| Diazepam and nitrous | 361 | 67‡ | 11 | 5 | 5 | 11 |
| Midazolam oral and nitrous | 284 | 57 | 13 | 9 | 5 | 16 |
| Hydroxyzine and nitrous | 256 | 42 | 13 | 10 | 12 | 23 |
| Chloral hydrate hydroxyzine and nitrous | 238 | 34 | 7 | 13 | 11 | 35 |
| Diazepam | 195 | 70 | 9 | 6 | 2 | 14 |
| Meperidine promethazine and nitrous | 190 | 18 | 11 | 12 | 16 | 44 |
| Hydroxyzine alone | 184 | 48 | 10 | 4 | 8 | 30 |
| Chloral hydrate meperidine and hydroxyzine | 146 | 23 | 10 | 14 | 19 | 34 |
| Chloral hydrate and nitrous | 131 | 44 | 8 | 10 | 10 | 28 |
| Chloral hydrate and hydroxyzine | 104 | 39 | 10 | 13 | 12 | 27 |
| Chloral hydrate alone | 102 | 45 | 13 | 6 | 10 | 26 |
| Midazolam nasal and nitrous | 87 | 69 | 8 | 3 | 3 | 16 |
| Midazolam meperidine and hydroxyzine | 78 | 62 | 18 | 4 | 8 | 9 |
| Meperidine and promethazine | 62 | 37 | 11 | 10 | 6 | 35 |
| Chloral hydrate promethazine and nitrous | 54 | 43 | 24 | 13 | 9 | 11 |
| Meperidine with nitrous | 52 | 48 | 13 | 6 | 15 | 17 |
| Chloral hydrate and promethazine | 24 | 63 | 17 | 8 | 8 | 4 |
| Meperidine | 16 | 69 | 6 | 6 | 0 | 19 |

* Number of respondents reporting use of listed drug regimen.

† List of response categories in the survey of % of patients in respondent's practice.

‡ % of sedated patients who receive listed drug regimen in their practice by response categories (e.g., in the first cell labeled 67, the interpretation is that 67 of 361 respondents indicated they use diazepam and nitrous for 1-20 of their patient pool).

Table 11. TYPICAL DOSE USED FOR VARIOUS DRUGS

| Drug | 0.3-0.5 mg/kg N (%) | 0.6-0.75 mg/kg N (%) | > 0.75 but <1 mg/kg N (%) | 1 mg/kg N (%) | 2 mg/kg N (%) | 3 mg/kg N (%) | 10-20 mg/kg N (%) | 21-30 mg/kg N (%) | 31-40 mg/kg N (%) | 41-50 mg/kg N (%) | > 50 mg/kg N (%) | Total (N) |
|-----------------|------------------------|-------------------------|------------------------------|------------------|------------------|------------------|----------------------|----------------------|----------------------|----------------------|---------------------|-----------|
| Hydroxyzine | 44 (9) | 35 (7) | 13 (3) | 167 (36) | 176 (37) | 20 (4) | 5 (1) | 8 (2) | 1 (<1) | | 1 (<1) | 470 |
| Meperidine | 42 (9) | 13 (3) | 11 (2) | 125 (28) | 251 (56) | 4 (1) | 1 (<1) | | | | 2 (<1) | 449 |
| Promethazine | 25 (32) | 4 (5) | 4 (5) | 34 (44) | 8 (10) | 2 (3) | | 1 (1) | | | | 78 |
| Chloral Hydrate | 4 (1) | 1 (1) | | 2 (1) | 3 (1) | 1 (<1) | 20 (7) | 76 (26) | 54 (19) | 101 (35) | 29 (10) | 291 |
| Diazepam | 270 (75) | 34 (10) | 13 (4) | 26 (7) | 8 (2) | 3 (1) | 4 (1) | | | | | 358 |
| Midazolam | 276 (45) | 197 (32) | 86 (14) | 48 (8) | 3 (1) | 2 (<1) | 1 (<1) | | | | 2 (<1) | 615 |
| Other | 9 (33) | 1 (4) | 2 (7) | 10 (37) | 1 (4) | 3 (11) | | | | | 1 (4) | 27 |

Table 12. FIXED DOSE USED FOR VARIOUS DRUGS

| Mg | Hydroxyzine | | Promethazine | | Chloral hydrate | | Meperidine | | Midazolam | | Diazepam | | Other | |
|------------------|-------------|------|--------------|------|-----------------|------|------------|------|-----------|------|------------|------|-----------|-------|
| 0.5 | 2* | 0.7† | 1* | 3.4† | 1* | 1.9† | 3* | 4.8† | 7* | 9.0† | 4* | 2.0† | 6* | 35.3† |
| 1 | 4 | 1.5 | 0 | | 0 | | 1 | 1.6 | 2 | 2.6 | 3 | 1.5 | 0 | |
| 2 | 0 | | 0 | | 1 | 1.9 | 2 | 3.2 | 4 | 5.1 | 13 | 6.5 | 0 | |
| 3 | 1 | 0.4 | 0 | | 0 | | 1 | 1.6 | 1 | 1.3 | 3 | 1.5 | 1 | 5.9 |
| 4 | 2 | 0.7 | 0 | | 0 | | 0 | | 3 | 3.8 | 4 | 2.0 | 0 | |
| 5 | 1 | 0.4 | 2 | 6.9 | 0 | | 1 | 1.6 | 9 | 11.5 | 73 | 36.5 | 1 | 5.9 |
| 10 | 23 | 8.6 | 3 | 10.3 | 2 | 3.8 | 5 | 7.9 | 34 | 43.6 | 76 | 38.0 | 3 | 17.6 |
| 11-24 | 41 | 15.2 | 9 | 31.0 | 0 | | 8 | 12.7 | 15 | 19.2 | 6 | 3.0 | 2 | 11.8 |
| 25-50 | 194 | 72.1 | 14 | 48.3 | 5 | 9.4 | 42 | 66.7 | 0 | | 0 | | 4 | 23.5 |
| 250 | 1 | 0.4 | 0 | | 5 | 9.4 | 0 | | 0 | | 1 | 0.5 | 0 | |
| 500 | 0 | | 0 | | 20 | 37.7 | 0 | | 0 | | 0 | | 0 | |
| 750 | 0 | | 0 | | 10 | 18.9 | 0 | | 0 | | 0 | | 0 | |
| 1,000 | 0 | | 0 | | 7 | 13.2 | 0 | | 1 | 1.3 | 0 | | 0 | |
| >1,000 | 0 | | 0 | | 2 | 3.8 | 0 | | 0 | | 1 | 0.5 | 0 | |
| 1 mg/y of age | 0 | | 0 | | 0 | | 0 | | 2 | 2.6 | 16 | 8.0 | 0 | |
| Total (n) | 269 | | 29 | | 53 | | 63 | | 78 | | 200 | | 17 | |

* Number of respondents. † Percentage of respondents.

the teaching of pharmacological behavior management tools in a portion of our training programs. Many reasons may account for this effect, including a disproportionate distribution among programs of qualified and competent faculty who teach sedation, economic factors (e.g., salary differentials); greater opportunities for inter-professional collaboration in hospital-related programs; concerns for safety in a dental school environment; and lack of resources for training of emergency management of adverse events.⁵ Accreditation standards for advanced pediatric dentistry training programs have recently changed; now, each program is necessarily required to afford a fixed number of sedation experiences for each trainee. It will be interesting to determine in the future if this accreditation change will impact programs. A slow-growing trend of higher percentages of respondents in the western regions performing sedation, along with a slight decrease over time of those in the Midwest, can be appreciated. However, southeastern respondents who sedate continue to dominate as the leaders of sedation practices over the other regions; the Northeast remains quite stable, but fewer sedations are apparently conducted there. These results are not unlike those of others.⁶ Furthermore, a dichotomy of respondents was noted, with higher percentages of practitioners who practiced five years or less or who practiced for 20 or more years performing larger percentages of sedation. Similar trends have been reported by others.⁶

A significant change in the board certification process has transpired over the past 15 years, and its influence on respondent distributions has significantly shifted, as is noted in this study. For the first time since the USAP program began, more respondents in this survey indicated they were board certified than in past surveys. Others have reported similar findings.⁶

A trend for higher percentages of patients in practices receiving nitrous oxide was first seen in the 2000 survey, but more dramatically emphasized in this survey. Interestingly, the percentage of respondents indicating that they did not use other sedative agents, with or without nitrous oxide, continued to increase compared to previous surveys; concurrently, those sedating larger percentages of patients with sedatives and nitrous oxide also continued to increase.

Another interesting trend over the last two decades has been the change in percentage of age groups that respondents sedate. It appears that the percentage of preschool-aged children being sedated has decreased while the percentage of those who are in school and older (i.e., older than 10 years old) has proportionately increased compared to previous surveys. Nonetheless, children who are three to five years old continue to represent the highest percentages of children sedated. This may reflect several factors, including changes in parental demands for preferred types of behavioral guidance (i.e., less protective stabilization), changes in state practice acts, easier access to general anesthesia, and a greater sense of safety by sedating older children who are likely to have better coping skills.

For those who use protective immobilization or restraint of the child, regardless of whether it is performed by the dental team, parents, or with the use of a passive restraint (e.g., Papoose Board), its use appears to be declining. This may reflect the continuing change in parents' desire for how their children are managed by medical/dental personnel, with less use of more dramatic management techniques and increased desire for painless or non-challenging clinical situations (i.e., pharmacological management).⁷

Compared to the last survey conducted in 2000, there was a slight increase in the proportion of respondents who indicated their frequency of sedation used in the past five years

increased. Likewise, a similar increase was observed in the proportion of respondents who indicated their frequency decreased. However, a slight decrease was noted in the proportion of respondents who indicated “no change” in their use of sedation. It is not clear if there is a definitive, lasting trend in the direction of the number of sedations being performed. A significant finding was that a greater proportion of those who have been in practice the least and most number of years were more likely to sedate; this is because more children needed to be sedated and practitioners felt prepared to provide sedation. These results were essentially similar to the same reasons accounting for change in the 2000 survey. It is unclear why those with the most and least experience in practice feel that more children require sedation and are prepared to provide it. In terms of generalities of findings, pulse oximetry remains the dominant means of monitoring patients, with capnography increasing in use during moderate sedation; the oral route (other than nitrous oxide) is most frequently used among pediatric dentists, and little change has occurred in terms of drugs and their dosages used in oral sedation among pediatric dentists.

Benzodiazepines remain most popular but are closely followed with combinations involving chloral hydrate and Demerol. This was not unexpected, as few new drugs have been introduced recently that have been incorporated into the drug armamentarium of the pediatric dentist. As manufacturers assess the marketplace, the production or even withdrawal of current agents may spark more experimentation in private offices and training programs in order to maintain an effective, safe arsenal of agents for children receiving dental care.

Surprisingly, but consistent with a recent survey of the training of pediatric dentists, the greatest number of respondents use diazepam with nitrous oxide.⁵ However, midazolam, hydroxyzine, chloral hydrate, and meperidine—which have been dominant drugs used in pediatric dentistry—remain popular. While the respondents’ selection of dosages of drugs was predominantly consistent with published values, there were several individuals who selected doses or dosages that were disconcerting (e.g., eight individuals indicated their dosage range of hydroxyzine was between 21 to 30 mg/kg). It is likely that these responses were miss-clicks entered when responding to the survey question or misunderstanding of the question.

Although more respondents were sent surveys in this study than any previous USAP study, the proportion who responded was the least of any previous study. Frequent and more complex survey studies on sedation involving adverse events, in the midst of greater Internet traffic and broader public scrutiny of sedation of children, may have curtailed the desire of respondents to participate in this study. It is unknown whether this study’s results would have been different if a larger number of respondents had participated.

Like most survey studies, this survey has limitations. One particular limitation concerns the content of items in this survey compared to previous renditions of the USAP project. We attempted to keep the questions consistent with older versions of USAP surveys. Nonetheless, a few items changed in format, making interpretation of changes across time impossible. We also focused our attention on USAP project findings over the past two decades rather than USAP project findings of other studies. Other surveys of behavior management techniques, including sedation, are available; however, because of differences in designs (e.g., response categories), target popula-

tion, and content, it is difficult if not impossible to make valid comparisons and conclusions.⁸⁻¹⁶

Conclusions

Based on this study’s results, the following conclusions can be made:

1. Respondents and their patient pool characteristics appeared to be changing (e.g., proportionately more diplomates were noted).
2. Benzodiazepines were the most frequently used sedatives besides nitrous oxide, the use of which appears to be increasing.
3. Protective stabilization among users is declining.

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