Conscious sedation experiences in graduate pediatric dentistry programs

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Abstract

***Purpose**: Conscious sedation is a behavior modification adjunct taught in all postgraduate pediatric dental residency programs. It has been a decade since the last survey was done specifically related to didactic and clinical aspects of conscious sedation in postgraduate pediatric dental programs. The aim of the study was to determine the clinical and didactic experiences associated with conscious sedation in these programs and to compare some of the findings to those collected a decade ago.*

***Methods**: A 31-item survey similar to that of a decade ago was constructed and sent to all pediatric dentistry program directors of accredited postgraduate and residency programs in the United States. The items covered several didactics including didactic topics, sedative agents, monitoring, and emergency policy among others. A follow-up mailing was done involving those who had not responded 6 weeks following the initial mailing.*

***Results**: Fifty-four of 58 (93%) program directors returned the 31-item survey. The following are highlighted findings. Conscious sedation among residency programs was achieved most commonly with a combination of sedative agents used with N_2O. Midazolam was more popular than chloral hydrate. The oral route was the predominant route of administration. More lecture hours were spent on conscious sedation than 10 years ago. The pre-cordial stethoscope, pulse oximeter, and blood pressure cuff were the most commonly used monitors. Sedative agent and anticipated depth of sedation were the factors most often considered in choosing monitors used during the sedation of a patient. The capnograph was being used more frequently than it was 10 years ago. Programs did not report an increase in sedation emergencies but practiced emergency drills more often and had increased numbers of individuals certified in Advanced Cardiac Life Support (ACLS) or Pediatric Advanced Life Support (PALS). The percent of the total patient population which required sedation is about 1-20%, with most directors reporting an increase in the numbers of sedations done in the past few years.*

***Conclusions**: While many factors remained unchanged or slightly modified when compared to the survey done a decade ago, the results of this study suggest that there has been significant changes in several key factors including the most frequently used sedative (i.e., midazolam) and increased preparation in the area of emergency preparedness. (Pediatr Dent 23:307-314, 2001)*

Conscious sedation is a part of a larger set of behavior management techniques that are often used in the practice of pediatric dentistry with the intent of providing quality care under favorable psychological conditions in children. Typically, sedation is indicated for treating pre-cooperative children (children less than three years of age), children who are fearful or anxious to the degree that normal coping skills are inoperative, and some children who have physical or mental disabilities. It is estimated that these patients make up about 10-20% of the total pediatric patient population[1-4] and present significant challenges and dilemmas for the dentist.

Although sedative agents are not used by all pediatric dentists,[1,5-8] conscious sedation is taught in every accredited pediatric dentistry postgraduate training program and some predoctoral programs. Evidence suggests the methods and standards employed by practitioners are consistent with those taught among residency programs.[4]

The past 30 years have brought many changes to the practice and procedures of sedating children. In 1985, the first set of guidelines was published by the American Academy of Pediatric Dentistry.[9] It was uncertain at that time what impact the guidelines would have on training programs and private practice. According to some studies,[8,10,11] guidelines have had little influence on the practice of sedation in pediatric dentistry. One may only speculate as to why there has been little influence, although economic pressures and an increase in the number of uncooperative patients have been cited as having more of an impact than the guidelines.[3,8] Other factors that may contribute to changes are revisions of state regulations and rising malpractice insurance costs. Negative media coverage may also increase the fear of litigation. The guidelines have been modified twice since 1985 and it remains to be seen what impact those changes have had on training programs and private practitioners alike.

There have been many studies and surveys over the past three decades on sedation involving children. As a result, we have some information, albeit incomparable in subject, consistency, and methodology, that provides a rough representation of what is believed to be the state of affairs of sedating children for dental treatment. The scope of these studies has been fairly broad and, among others, has included topics

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Table 1. Summary of Survey Articles Related to Conscious Sedation in Pediatric Dentistry.

Year	Author*	Constituency Surveyed	% Sedating	Comment
1971	[5]	Pedodontic Diplomates	84%	Most frequent age of child was 2-4 years
1980	[6]	Pedodontic Diplomates	80%	Significant increase in hand-over-mouth (54% compared to 36% in 1971)
1981	Duncan et al[7]	Pedodontic Diplomates	75%	Chloral hydrate most popular sedative agent
1984	Hills-Smith et al[2].	New York State Association of Pediatric Dentists		
1984	Waggoner[10]	Predoctoral Program Directors	56%	Majority used oral route
1988	Davis[8]	Pedodontic Diplomates	69%	87% used N2O which is increase from two previous surveys
1988	Wilson & McTigue[4]	Postgraduate Program Directors	100%	Although all reported the use of sedation, the type of drugs varied greatly
1988	Nathan[11]	Diplomates and non-Diplomates of AAPD		64% indicated "no difficulty in complying with new AAPD guidelines"
1990	Allen et al[1]	Diplomates of AAPD	74%	Nearly 25% of all children had management problems
1991	Houpt[3]	AAPD Membership	86%	Geographic pockets of high frequency of sedation were found (e.g., southeastern US)
1991	McKnight-Hanes et al[16]	Pediatric and General Dentists		52% of pediatric dentists saw increase in numbers of children less than 3 yrs old
1993	Belanger & Tilliss[12]	Pre- and Postgraduate Pediatric Program Directors		
1996	Wilson[13]	AAPD Membership		Most respondents indicated 20% or less of patients required nitrous or other sedative agents

*References

such as parental acceptance of pharmacological techniques, sedation in academic settings, and the opinions of practitioners.

There have been several studies involving questionnaires related to sedation.[1-8,10-17] Table 1 summarizes some of the survey studies. Interested readers are encouraged to review the studies in detail. Because it has been almost 10 years since the last survey specifically focused on didactic and clinical experiences in pediatric dentistry postgraduate and residency programs, it seemed appropriate to conduct a more contemporary survey to reflect any change or lack of change the last decade has imparted on conscious sedation training. The timeliness is also appropriate because of the changes in the Academy's sedation guidelines twice since the last survey.

Therefore, the purpose of this survey was to identify any changes or trends that have developed regarding conscious sedation in pediatric dentistry postgraduate and residency programs over the past decade. These included the methods in which conscious sedation was taught, the routes and agents used, and the professionals involved. Other factors included emergency management, monitors, and anesthesia training. Lastly, program directors were asked their opinions regarding the future of sedation training in residency programs.

Methods

A 31-item questionnaire was developed to obtain information on the didactic and clinical experiences of residents in advanced pediatric dentistry programs in the United States. Questions also pertained to if and how program directors would like to see standardization among programs related to sedation.

The questionnaire was reviewed by several members in the Ohio State University Section of Pediatric Dentistry for clarity of the items and for additional comments. Following this preliminary testing, the questionnaire was sent to all pediatric dentistry postgraduate program directors. A cover letter was included with the questionnaire stating its purpose and directions to return the questionnaire as soon as possible. A second questionnaire was sent to non-respondents after six weeks.

The items were closed-ended and some had the potential of creating multiple responses. If a particular answer was not available or inappropriate for the respondent's situation for an item, the respondent could mark "other" and was then directed to provide comment. An effort was made to clarify that conscious sedation did not mean using N_2O/oxygen sedation alone.

Each completed questionnaire was entered into a spreadsheet. The data was then analyzed using the SPSS/PC+ statistics package.

Results

Of the 58 surveys sent out, 54 (93%) were returned. Some respondents did not answer each of the questions resulting in slight variations in the total number of valid cases. The percentages reported are based on only those responding to the particular item. For reading consistency, topic areas will be addressed in describing the results.

Table 2. Programs Using a Specific Route.

Route	Number of programs	Percentage
Oral	53	98
IV	22	40
Nasal	20	37
IM	15	28
Submucosal	12	22
Other	3	5

Pharmacologic agents and sedations

Combinations of pharmacologic agents used in conjunction with N_2O was the procedure most often used in sedating uncooperative patients; 22 programs (42%) exclusively used a combination of agents with N_2O, while another 12 programs (22%) used a combination of agents with N_20 and other protocols as well (e.g., single drug with N_2O); 48 programs (89%) used N_2O during sedations whether using a single drug or a combination of drugs; 11 programs (21%) preferred using a single drug with N_2O.

The variety and availability of pharmacologic agents were not restricted to one or two agents. Fifty program directors (93%) reported having at least three agents available to choose from in addition to N_2O and 39 directors (72%) reported having at least four. Diazepam was available in 47 programs (88%) of programs. Midazolam and hydroxyzine, independently or together, were available in 43 programs (80%). Forty programs (74%) reported using chloral hydrate. Meperidine and promethazine were available in 29 programs (54%) and 18 programs (34%), respectively. Other drugs such as fentanyl and ketamine were available in 17 programs (31%).

Oral sedation, the most popular route, was used in 53 of the 54 (98%) of responding programs. The intravenous route was used in 22 programs (40%). Other routes were nasal (20 programs), intramuscular (15 programs), and submucosal (12 programs; see Table 2). Eleven programs (20%) reported exclusively using the oral route.

Twenty-two of the 54 (42%) programs that used the oral route do so 91-100% of the time; 7 of the 12 programs administering drugs sub-mucosally do so less than 20% of the time; 15 of the 20 programs that used the nasal route did so 10% or less of the time. In 13 of the 22 programs that did IV sedations, they were done in 10% or less of sedation cases. The majority (11 of 12) of the programs that used intramuscular administration did so less than 15% of the time. Sedations by other routes, such as rectal administration, were primarily done in only 1% of cases.

Table 3. Success Rates of Sedations.

Percentage of time successful	Number of programs	Percentage
21-40%	1	2%
41-60%	26	48%
61-80%	20	37%
81-100%	7	13%

Table 4. Sedations Done Per Year Per Resident

Number of sedations done per year	Frequency	Percentage
1-20	16	31%
21-40	10	20%
41-60	9	18%
61-80	3	6%
81-100	6	12%
101-150	5	10%
151-200	2	4%

Twenty-six programs (48%) regarded sedations in their programs as being successful 41-60% of the time. Another 20 programs (37%) reported a 61-80% success rate. Seven programs (13%) estimated a success rate of 81-100% (see Table 3).

Numbers of conscious sedations done yearly by residents varied widely. In 16 programs (31%), each resident did about 1-20 sedations per year. Ten programs (20%) did 21-40 sedations per resident per year, and 9 programs (18%) did 41-60 sedations per resident per year. The remaining 16 programs (30%) reported doing over 61 sedations per resident per year, see Table 4.

Factors taken into consideration for the selection of a sedative agent were variable but the highest frequency of programs (23) reported evaluating child temperament, behavior, age, medical history, physical exam, and dental needs prior to sedating a child.

Educational experience in sedation

In preparation for doing conscious sedations, residents in 22 programs (43%) experienced greater than 15 lecture hours dedicated solely to conscious sedation. Overall, residents in 46 responding programs (92%) received at least six lecture hours on conscious sedation (see Table 5).

In the teaching of sedation to residents, 47 programs (87%) reported relying on multiple specialties. Pediatric dentists were available in 52 (96%) and anesthesiologists in 40 (74%) of the programs. Oral surgeons, pharmacists, and other specialties were available in 21 programs (39%), 14 programs (26%), and seven programs (13%), respectively.

Seminars were used in all programs as a method of instruction for teaching conscious sedation. Most programs used other methods as well. The most popular combination of teaching methods was seminar, clinical demonstration, textbooks, and

Table 5. Number of Lecture Hours Dedicated Solely to Conscious Sedation.

Number of hours	Number of programs	Percentage
1-2	1	2%
3-5	3	6%
6-10	16	31%
10-15	7	14%
>15	22	43%
None	1	2%

Table 6. Number of Hours of Instruction Dedicated to Monitors

Number of hours	Number of programs	Percentage
1-2	26	51%
3-5	18	35%
6-10	4	7%
10-15	1	2%
>15	1	2%
None	1	2%

periodicals, which was reported as being used in 15 programs (28%).

Monitors or monitoring and sedation guidelines were topics covered in the didactic portion of all programs. Thirty-six programs (69%) taught a combination of the following topics: pharmacology of agents, physical assessment, monitors/monitoring, sedation guidelines, parental instructions, and emergencies related to sedation.

Monitors

Nine programs (17%) reported having all of the following monitors: pre-cordial stethoscope, pulse oximeter, blood pressure cuff, capnograph, temperature probe, and defibrillator with EKG. Forty-nine programs (90%) had at least a pre-cordial stethoscope, pulse oximeter, and blood pressure cuff. The pulse oximeter was available in all 54 responding programs. Overall, the pre-cordial stethoscope was available in 52 programs (96%), the blood pressure cuff in 51 programs (94%), an EKG monitor in 28 programs (52%), capnographs in 20 programs (37%), and temperature probes in 19 programs (35%).

Monitors typically used in 27 programs (50%) were the pulse oximeter, pre-cordial stethoscope, and blood pressure cuff alone. Another seven programs (13%) used these three in combination with some other monitor (e.g., capnographs). Fifteen programs (27%) reported using a pulse oximeter and stethoscope or pulse oximeter alone in typical sedations. Only seven programs (13%) reported using a capnograph.

When asked what combination of monitors they personally feel are adequate during sedation, 24 program directors (44%) responded that the combination of a pulse oximeter, pre-cordial stethoscope, and blood pressure cuff were adequate. Another 13 respondents (24%) responded that a pulse oximeter and pre-cordial stethoscope alone were adequate. Six program directors (11%) added a capnograph to the combination of a pulse oximeter, pre-cordial stethoscope and blood pressure cuff.

Table 7. Hours of Principles of Emergency Management Taught

Number of hours	Number of programs	Percentage
1-2	16	31%
3-5	27	52%
6-10	4	8%
>10	4	8%
None	1	2%

Table 8. Number of Sedation Emergencies in the Past Five Years

Number of emergencies	Number of programs	Percentage
0	34	68%
1	5	10%
2	4	8%
3	2	4%
5	3	6%
9	1	2%
10	1	2%

All residents received specific training in the use of the pulse oximeter. 42 programs (77%) taught the use of the pre-cordial stethoscope, pulse oximeter, and blood pressure cuff together. Only 23 programs (42%) taught the use of the capnograph. Eighteen programs (33%) and 16 programs (29%) provided specific training in the use of the defibrillator with EKG and temperature probe, respectively. One to two hours of lecture are dedicated solely to the use of monitors in 26 programs (51%); 18 programs (35%) reported dedicating three to five hours (see Table 6).

Sedative agent (42 programs) and anticipated depth of sedation (42 programs) were the factors most often considered in determining the constellation of monitors used during sedations. Route and final depth of sedation were considered in 19 programs (35%) and 18 programs (33%), respectively. Patient behavior was considered in 14 programs (26%). A combination of at least three factors was used in 33 programs (61%).

Sedation emergencies

All 54 responding programs reported having a specific clinic emergency policy and 39 programs (72%) practiced emergency drills. The number of hours of teaching principles of emergency management of the sedated patient was estimated to be 3-5 hours for 27 programs (52%); 16 programs (31%) had 1-2 hours of lecture (see Table 7).

Airway management was the only topic covered by all programs in lectures on emergency management. Fifty programs (93%) taught the pharmacology of the agents used, 39 programs (73%) covered emergency drills, and 49 programs (90%) covered personnel responsibilities; 35 programs (66%) reported covering all four.

Pediatric dentists were responsible most commonly for teaching emergency management of the sedated patient. Forty-six programs (87%) reported the involvement of pediatric dentists. Anesthesiologists were involved in 35 programs (64%). Oral surgeons and other physicians accounted for 16 programs (30%) and 15 programs (28%), respectively.

Of 54 responding programs, 34 programs (68%) reported having no sedation emergencies in the past 10 years. Of the remaining 16 programs, five (10%) have had at least one emergency, four programs (8%) reported having two, two programs (4%) reported having three, three programs (6%) have had five, and nine and 10 emergencies have occurred in one program each (see Table 8).

Table 9. Length of Anesthesiology Rotation

Length of Rotation	Number of Programs	Percentage
4 weeks or less	31	57%
5-8 weeks	18	33%
9-12 weeks	2	4%
13-16 weeks	2	4%
Other	1	2%

Table 10. Percentage of Total Patient Population Which Requires Sedation

Percent of population	Number of programs	Percentage
1-20%	43	84%
21-40%	6	12%
41-60%	2	4%

Residents were required to have BLS and PALS or ACLS training in 36 programs (66%). Faculty were required to have BLS and PALS or ACLS training in 28 programs (53%). Staff was BLS certified in 52 programs (98%).

Anesthesia training

Anesthesia rotations of four weeks were scheduled in 31 programs (57%). Eighteen programs (33%) reported rotations of 5-8 weeks. All but one program scheduled anesthesia training as a block rotation (see Table 9).

Sedation and patient population

With regard to percent of patient population requiring sedation with more than N_2O alone, 43 program directors (84%) reported that 1-20% of their patient population require pharmacologic intervention (see Table 10). The range of patient visits that occur each year per program was from 2000 to 30,000, with a mean of 9604 (± 745) visits.

When asked if frequency of sedative use has increased, decreased or remained the same in the past five years, 31 programs (57%) reported an increase. Eight programs (15%) reported a decrease, and 15 programs (28%) reported no change.

The number of uncooperative patients was the only factor 13 programs (28%) noted as being the cause of the change or lack of change in the number of sedations done in the past five years. Overall, 29 programs (53%) noted a change due to the number of uncooperative patients, 16 programs (30%) attributed the change to faculty coverage, and 12 programs (21%) to state sedation guidelines. Fear of litigation and cost of insurance contributed to the change in 7 programs (13%) and 2 programs (4%), respectively; 38% of program directors cite other factors such as increased access to the operating room as contributing factors.

Future of sedation training

When asked if didactic material related to sedation among programs should be standardized or remain non-standardized, 34 program directors (64%) responded it should remain non-standardized; 38 program directors (73%) believed clinical training should remain non-standardized. Faculty training should remain non-standardized according to 34 program directors (67%).

Thirty-three program directors (66%) believed the numbers of sedations done should remain the same and 15 program directors (30%) would like to increase the experience. When asked if state board preparation should be standardized for all programs, 36 program directors (72%) responded that it should not; 31 program directors (61%) did not believe regional training centers should be established for faculty and student rotations; 41 program directors (79%) would keep the length of anesthesia experience for accreditation as is, and 8 directors (15%) would like to see it increased; 38 program directors (73%) did not advocate having a standard for experience with all routes of drug administration. However, emergency management related to sedation should be standardized according to 34 program directors (65%).

Discussion

The results of this study suggest several similarities and variances to studies conducted by others.[3,4,8,10] Highlights of the similarities and variances will be discussed by section to reflect changes and plausible explanations in findings.

Pharmacologic agents and sedations

A combination of agents used in conjunction with N_2O was found to be the predominant method of sedating children in the postgraduate pediatric dental programs. However, all programs use N_2O as a behavior management adjunct, whether administered alone or in combination with other agents. This is consistent with past findings among private practitioners and residency programs.[2,3,11,13]

This survey revealed that most programs had a variety of agents available. Wilson and McTigue[4] found that in 1989 79% of programs had available four or more agents either alone or in combination and 83% had available three or fewer. In this survey, 72% and 92% had available four and three drugs, respectively. Several explanations may account for these minor changes. The most obvious reason is that the leadership in the programs (i.e., respondents) has changed since 1989. Also, the increase in programs utilizing three agents may be due to the increasing popularity of midazolam which is generally administered as a single agent. Furthermore, the decreasing popularity of chloral hydrate, hydroxyzine, and meperidine may account for less utilization of one or more of these agents.

The use of a variety of sedative agents in postgraduate pediatric dentistry programs possibly allows the student to become more a) comfortable in using different agents and experiencing the effects of the agents on children who have varying personality and behavioral characteristics and dental needs; and b) proficient in honing the student's skills in the selection and matching of different drugs to a host of children. Supportive of this notion was the finding that apparently most programs discriminate among drug regimens based on child personality and behavioral characteristics such as child temperament, manifestations of behavior, patient age, medical history, and dental needs.

Previous studies have noted that chloral hydrate was the most commonly given agent either alone or in combination with other agents.[2,3,7,11] The order of agents from most popular to least popular in 1989 was chloral hydrate (98%),

hydroxyzine (94%), benzodiazepines (85%), and meperidine (69%).[4] Compared to that survey, this study found a decrease of 24%, 14%, and 16% of chloral hydrate, hydroxyzine, and meperidine, respectively. Diazepam and/or midazolam was available in 88% of the programs according to this survey, compared to 85% in 1989. The most recently revised American Academy of Pediatric Dentistry sedation guidelines have specifically identified drugs and their use under limited circumstances. For instance, midazolam's and diazepam's popularity may be due to its being considered a "minor tranquilizer" which is a term identified in the guideline's section on preoperative prescriptions. Furthermore, minor tranquilizers such as diazepam and midazolam when administered orally and in therapeutic dosages most often cause a level of sedation consistent with levels I and II of the guidelines where adverse effects are highly unlikely to occur.

Also, levels I and II require less monitoring equipment and fewer time periods in which physiological variables need to be recorded in a time-based record. Midazolam is a newer agent which is quick acting and desirable for shorter procedures. Midazolam is also responsible for the increase in nasal administration reported among programs. Another fact to be considered is that both diazepam and midazolam can be reversed with flumazenil and therefore may give the perception of being safer agents.

All programs indicated that they used the oral route. This is consistent with previous findings in which a long history is noted of pediatric dentistry using primarily the oral route of sedative administration.[4,10,11] The oral route has distinct advantages including, but not limited to: easy administration; no needles, which have the potential of frightening young children; the likelihood of rapid onset of adverse reactions is less than that of parenteral routes (especially intravenous); if covered by third party agencies the cost is usually lower because the oral route is not regarded as high a risk as other parenteral techniques; and the perceived training required for the actual technique of oral administration is less. Furthermore, many children have had experience in taking other medications by mouth (e.g., amoxicillin for otitis media) and thus much more likely to consume the sedative by this route.

The IV route was not a route that was used by a majority of programs. This method of administration has practical issues that relegate it to a less frequently used technique for operative dentistry. For instance, young children are typically fearful of and react negatively to needles. Consequently, other methods of sedation (e.g., oral), amelioration of associated pain with needles (e.g., EMLA cream), or physical management of a patient (e.g., immobilization) are initially required. Also, very young children who are considered pre-cooperative typically require deeper levels of sedation and more monitoring, increasing the likelihood of adverse events. The advantages of the IV route are the rapid onset, ability to titrate the drugs to the patient's behavior, and having access for emergency drugs readily available.

Becoming more popular is the nasal route of administration that has a rapid onset but was not even mentioned in the 1989 survey. Midazolam given via the nasal route is associated with burning of the mucosal lining. The numbers in this survey may also be slightly misleading due to some respondents regarding N_2O inhalation as the only nasal route.

The sub-mucosal and intramuscular routes used by some programs allow reliable absorption and a rapid onset of action. Although it relies on little patient cooperation compared to the oral route, it does rely on the use of needles that, as previously mentioned, are fear provoking in children. Other factors are also notable including increased cost due to liability insurance and a perceived need for proficiency in emergency management. Meperidine is commonly given by these two routes and the disadvantages just mentioned may have contributed to its decreasing popularity.

The rectal route is regarded as inconvenient and has the disadvantage of a relatively slow onset and unpredictable effects due to variable absorption in the large intestine. Thus, very few programs utilize it.

Most programs reported a success rate of 41-60%. This is lower than the 76% success rate Wilson reported for private practitioners in 1993.[13] Nathan[11] found that pediatric dentists reported needing or using sedation less the longer they practiced. Perhaps experience allows for more successful non-pharmacological management of children but this hypothesis has not been tested. No criteria was offered to directors as to what defines success and some directors may have interpreted it to mean treatment completed despite struggling or crying. Others may have felt success meant a quiet, sleeping, or cooperative child. It was impossible to tell if higher success rates were due to different routes or agents. Two program directors responded that their success rates were higher due to the IV route. This may be due to the ability to titrate and induce deeper levels of sedation or to different patient selection criteria.

No direct calculation of the actual reported increase in sedations among programs was possible in this study. This survey asked for sedations per resident per year but did not inquire as to how many residents are in each program. The 1989 survey asked for sedations per program per year.

Educational experience in sedation

Residents are receiving more hours of lecture on the topic of conscious sedation. In 1989, 34% of programs held 2-5 hours of instruction. In this survey, 45 programs (92%) reported having at least six hours of instruction.

At the time of the 1989 survey, Wilson and McTigue[4] commented on the hours being few in comparison to the number of sedations being done. This may have been a catalyst for the increase. Furthermore, the guidelines have perhaps provided a more structured format that has guided the hours and topics of instruction on conscious sedation. Instruction previous to the guidelines may have relied upon a more empirical approach which had been passed down from previous generations of pediatric dentists with periodical publications and research altering the material in a subtle way. The guidelines may act as a template for instruction in training residents. In fact, the guidelines and monitors were the two topics covered by all 54 programs when teaching conscious sedation. This suggests that the guidelines may have influenced at least didactic components of the teaching of sedation.

More difficult to explain is the increase in anesthesiologists' involvement in the teaching of conscious sedation. In 1989, anesthesiologists participated in the teaching of conscious sedation in 79% of programs. This survey revealed involvement in 91% of programs. This may be due to a lack of confidence

on the part of program directors in the topic matter or pediatric dentists or to decreased numbers of the latter who are qualified to teach such topics. Conversely, there may be more anesthesiologists available in programs today compared to 10 years ago.

Monitors

In general, there was an increase in monitor use except for the use of the pre-cordial stethoscope that has essentially remained the same (i.e., 95% utilization). The use of the pulse oximeter has increased from 90% to 100% over the last 10 years. The combination of the pre-cordial stethoscope, blood pressure cuff, and pulse oximeter was used in 38% of programs in typical sedation cases in 1989, but is now used by at least 63% of programs. This combination is also reported to be the most commonly used among private practitioners.[13]

The fact that 17 programs reported using less than those three monitors suggests one of two things: a) either these programs do not sedate children to level III or deeper as required by the guidelines; or b) they are not adhering to the guidelines when level III or deeper sedation is attained. Related findings were that only 33% of program directors indicated the final depth of sedation was a factor in determining which monitors were used and only 63% of directors felt the pre-cordial stethoscope, pulse oximeter, and blood pressure cuff at the very least were adequate monitors which means 37% felt comfortable with fewer monitors. Again, the depth of sedation may be a mediating factor.

The use of the capnograph is up from 0% in 1989 to 13% in 1998. There are several good reasons for this increase and it is foreseeable that capnograph utilization will increase in the future. The capnograph has one main advantage over the pulse oximeter: ventilatory problems are usually detected prior to desaturations.[18] At least eight program directors expressed that the capnograph was part of the constellation of monitors they felt were adequate. Two directors picked the capnograph as preferred to the blood pressure cuff. Presently, the capnograph is not a required monitor for levels I through III of the guidelines but is desirable for level III and required for levels IV and V.

Training in the use of monitors, particularly the pulse oximeter and capnograph, have increased since 1989. Training in the use of the pulse oximeter increased from 85% of programs in 1989 to 100% in 1998. Likewise, increases were noted for training on the use of capnographs from 10% to 42%. There were only slight increases (2-3%) in the amount of programs providing training in the use of the pre-cordial stethoscope and blood pressure cuff. Training in the use of the temperature probe and EKG decreased by 2% and 9%, respectively. The EKG is required by the guidelines only for levels IV and V and temperature is required only at level V (i.e., general anesthesia).

Sedation emergencies

What is very striking from the data collected in this survey is an increase in safety precautions and emergency management compared to the data in the 1989 survey. Whether this is a result specifically of the Academy's sedation guidelines or of a generalized sensitivity for the need of such training emanating from either within the profession or from outside professions is not known. It is most likely a combination of both.

The number of programs reporting no emergencies in 1989 was 69%, which is very close to the 68% reported in this survey. Twenty-seven percent of programs in 1989 reported having one to five emergencies and two programs had six to 10. This survey revealed that 30% of programs had one to five emergencies and two programs having almost 10. Although the number of emergencies during sedations was similar to that reported in 1989, there was an increase in programs practicing emergency drills from 3%-72%. This increased attention to safety was noted in private practices where 79% practice emergency drills.[13]

No attempt was made to define what an emergency is in this study and variations in the perception and interpretation of emergencies probably occurred. For example, pulse oximeters can display degrees of desaturations associated with movement artifact and also after prolonged periods of crying.[17] Such false alarms may have been interpreted by some as "emergencies". In addition, there appeared to be no relationship between having had an emergency and the particular agents or routes a program was using.

There was a dramatic increase in the number of programs requiring their residents to be ACLS or PALS certified (25% in 1989 versus 66% in 1998). An increase of 43% in faculty being certified was also seen and 98% of staff are now BLS certified. An interesting finding that Nathan reported in 1989 was that 41% of pediatric dentists felt that ACLS training should be mandatory in pediatric dental training programs.[11] At that time an estimated 10-17% of private practitioners were ACLS certified. Wilson in 1993[13] found that slightly higher percentages (26%) of pediatric dentists were ACLS or PALS certified.

An increase was noted in hours spent teaching emergency management. 38% of programs taught three to five hours in 1989, whereas 51% of programs are now spending at least that many hours. There was an increase in the number of programs teaching specific topics as compared to 1989. In 1989, 94%, 83%, and 81% of programs taught airway management, pharmacology of agents, and personnel responsibilities, respectively. In 1998, the figures increased to 100% for airway management, 94% for pharmacology of agents, and 92% for personnel responsibilities. There was an increase of 5% in pediatric dentists teaching emergency management to residents in comparison to the 1989 survey. On the other hand, anesthesiologists decreased their role by 7%.

Anesthesia training

It is difficult to ascertain whether anesthesiology rotations have changed in length. The 1989 survey divided the answers into different time segments compared to this survey. There was only one program in this survey which did not hold a block rotation compared to the 12% of programs that did not in 1989.

Sedation and patient population

Consistent with private practitioners, patients requiring pharmacologic management fell within the 1-20% range of the total patient population.[2,13] Although more than half of program directors (57%) reported an increase in the number of sedations, no information is available to support the same trend among private practitioners. Surveys from the early '90s indicated that most private practices were not noticing a change

or even noting a decrease.[8,13,15] It is unknown whether that has changed in recent years. What is comforting about the information from this survey is that sedation numbers were increasing mostly in response to patient need (53% of responding programs noted their increase due to an increase in uncooperative patients), not guidelines (21%), fear of litigation (12%), or cost of insurance (4%).

Future of sedation training

The only portion of postgraduate training that program directors felt should be standardized was emergency management related to sedation; 65% of program directors would like to see this standardized. This may be a reflection of the fact that more pediatric dental faculty are responsible for teaching it and may in comparison to their anesthesia colleagues feel less prepared to do so.

Conclusions

The results of this study indicate that significant change has occurred in the teaching of sedation in graduate pediatric dentistry programs over the past decade. Some areas of change include commonly used sedative agents (i.e., midazolam has replaced chloral hydrate as the most popular sedative agent), increases in the amount of time and topic diversity presented in didactic formats, increased ACLS or PALS certification of residents and faculty, and increases in the number of emergency drills being practiced. In general, however, program directors do not feel that sedation training should be standardized, except in the area of emergency management.

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