Management of Pediatric Medical Emergencies in the Dental Office

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Continuing Education Units: 2 hours


Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

The dentist’s successful management of medical emergencies requires preparation, prevention and knowledge of definitive management not just by the dentist but by all dental staff. Although the primary focus of this course is the pediatric dental patient, adult medical emergencies will also be addressed.

Conflict of Interest Disclosure Statement
• Dr. Schwartz is a member of the dentalcare.com Advisory Board.

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Overview
Although uncommon, pediatric medical emergencies can occur in the dental office. When they do happen, they happen quickly without warning and with possible dire consequences. A child’s under-developed physiology coupled with small oxygen reserves requires early recognition of the problem and swift definitive treatment.

Since adults accompany the pediatric patient to the dental office there is a strong possibility, although the child is the one receiving dental treatment, it’s the accompanying adult that presents with the emergency. Although the primary focus of this course is the pediatric dental patient, adult medical emergencies will also be addressed.

The dentist’s successful management of medical emergencies requires preparation, prevention and knowledge of definitive management not just by the dentist but by all dental staff.

Learning Objectives
Upon completion of this course, the dental professional should be able to:
• Identify predisposing factors for medical emergencies.
• Structure an effective office medical emergency team.
• Choose the appropriate emergency drug kit and equipment.
• Recognize and provide definitive treatment for the following medical emergencies:
  ◦ Syncope
  ◦ Mild and anaphylactic allergic reactions
  ◦ Acute asthmatic attack
  ◦ Local anesthetic and vasoconstrictor toxicity
  ◦ Hypoglycemia and hyperglycemia
  ◦ Seizures
  ◦ Respiratory distress
  ◦ Cardiac arrest

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Introduction
Although rare, medical emergencies do occur in the dental office. While the majority of medical emergencies occur in adult patients, pediatric medical emergencies can occur too. Pediatric medical emergencies occur quickly, without warning, and with possible severe consequences due to the child’s under-developed physiology coupled with small oxygen reserves. Successful resolution of the emergency requires early recognition of the problem and swift definitive treatment.
The primary focus of this course is the pediatric dental patient. However, adult medical emergencies will also be addressed as adults accompany pediatric patients to their appointments. Although the child is the one receiving dental treatment, there is a strong possibility it will be the accompanying adult that will experience the emergency. The most common medical emergency seen by dentists is syncope, and the vast majority of these events occur in adults.

In a survey conducted at the 2004 American Academy of Pediatric Dentistry "Pediatric Emergencies in the Dental Office" course, the incidence of specific emergency situations reported by 66 pediatric dentists over a 10-year period were:

<table>
<thead>
<tr>
<th>Situation</th>
<th># Incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syncope (fainting)</td>
<td>75 (mostly parents)</td>
</tr>
<tr>
<td>Hysteria</td>
<td>23 (mostly children)</td>
</tr>
<tr>
<td>Allergy, mild</td>
<td>22</td>
</tr>
<tr>
<td>Seizures</td>
<td>13</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>9</td>
</tr>
<tr>
<td>Hyperventilation</td>
<td>7</td>
</tr>
<tr>
<td>Aspiration</td>
<td>5</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>4</td>
</tr>
<tr>
<td>Bronchospasm</td>
<td>3</td>
</tr>
<tr>
<td>Airway obstruction</td>
<td>3</td>
</tr>
<tr>
<td>Allergy, anaphylaxis</td>
<td>1</td>
</tr>
<tr>
<td>Drug overdose</td>
<td>1</td>
</tr>
<tr>
<td>Local anesthesia overdose</td>
<td>1</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>1</td>
</tr>
</tbody>
</table>

The dental office's successful management of medical emergencies requires preparation, prevention and response not just by the dentist but by all dental staff.

**Preparation**

Adequate preparation for emergencies reduces the possibility of an emergency occurring and further complications if it does occur. Preparation steps include:

- Taking and reviewing a comprehensive medical and dental history.
- Providing minimum basic life support (BLS) training for providers and staff.
- Advanced Cardiac Life Support (ACLS) or Pediatric Advanced Life Support (PALS) training, especially for those administering sedation and general anesthesia.
- Initiation and coordination of an office emergency team.
- Organizing an emergency drug kit and equipment.
- Retraining on a regular basis.

**Medical and Dental History**

Taking a comprehensive medical and dental history, and noting not only contraindications to dental treatment but also previous medical and psychological experiences that can precipitate a medical emergency, alerts the clinician and staff to any precautions or preparations that need to be taken to avert and manage an emergency. A diabetic patient may not only have compromised healing but may undergo a hypoglycemic incident because of low blood glucose level due to not eating or excessive stress before and during treatment. Patients and parents of pediatric patients with previous negative dental experiences may develop syncope prior, during, and post-treatment due to anticipated or unanticipated discomfort, the sight of dental instruments, or upon seeing blood drenched gauze. The patient’s medical problems and related potential emergency situations should be noted in a prominent location in the patient’s chart so staff can prepare the necessary emergency drugs and equipment prior to seating the patient.

**Staff Training and Duties**

All staff should receive training in recognition of emergency situations and BLS. A receptionist at the front desk will be the one most likely to be alerted to an emergency in the waiting area. All staff should be familiar with the location of the emergency drug kit, monitoring and resuscitation equipment as well as Emergency Medical Services (EMS). For greater efficiency, each staff member should be assigned a predefined role during an emergency. Periodically these roles should be reassigned to other personnel so staff is familiar with all aspects of emergency management. An efficient emergency team can be organized with as few as two or three staff. In offices where sedation and general anesthesia is administered, training in PALS or ACLS is recommended (and in some states required) for the clinical staff. A suggested assignment of duties follows:
Team member #1 is the first person on the scene when the emergency occurs. Thus, every staff member should be familiar with the Team Member #1 duties since an emergency can occur in any location within the office. After the initial activation of the emergency team, a team with advanced training can assume the role of Team Member #1. Upon discovery of an emergency patient, this member’s responsibilities include:

- Alerting other office staff members.
- Activating BLS (Positioning, Airway maintenance, Breathing, Circulation, Definitive treatment) after assessing the victim’s responsiveness.
- Staying with the victim.

Team member #2 duties include:

- Retrieval of the emergency drug kit, O2, monitoring equipment and automated electronic defibrillator (AED) to the emergency site.
- Assist with BLS.
- Contact EMS, if deemed necessary and there is no other team member available.
- Check the O2 daily.
- Check the emergency kit weekly.
- Check the AED and monitoring equipment weekly.

Team member #3 duties include:

- Assist with BLS.
- Consult with family accompanying patient as to previous history and management of emergency.
- Contact EMS, if deemed necessary.
- Monitor vital signs.
- Prepare emergency drugs for administration.
- Meet the rescue team at the building entrance and escort them to the office.

Emergency Medical Service Contact

Once the determination is made that involvement of EMS is necessary, their prompt arrival is crucial. To facilitate this, the following information should be given to the EMS operator:

- The location of the emergency with the names of cross streets and the office and room number.
- The telephone number from where the call is being made.
- What happened - an accident, a medical condition, a reaction during treatment.
- How many people need help?

- The condition(s) of the victim(s).
- What aid is being given to the victim(s) (CPR, drugs, AED)?
- Any other information requested.

To ensure the EMS personnel have no more questions, do not hang up until after the operator terminates the phone call.

Refresher Training

Since medical emergencies in the dental office are a rare occurrence, it is easy for staff members to become “rusty” because of the lack of practice. Although recertification is required usually at two-year intervals, periodic in-office drills are recommended. Some suggestions are:

- **Mock Codes** – Medical emergency scenarios are presented to staff members. Mannequins or large life-like dolls can make the exercise more realistic. Staff members can identify and practice the different member duties and responsibilities for various emergency situations.
- **Scavenger Hunt** – A staff member is given a list of items needed for a particular emergency and is required to obtain and prepare them for administration and use within a given amount of time.

Emergency Equipment and Drugs

Trained office personal must have the appropriate emergency equipment and drugs available to render definitive treatment when indicated. All staff members should know where emergency equipment and drugs are located. A specific area or box can be prepared with the equipment and drugs readily available to be transported to the site of the emergency.

There are emergency kits produced commercially for sale to dental and medical professionals. While well designed, they may contain equipment and drugs of questionable value in a dental office setting because of limited medical training of the dentist and staff. For example, an emergency drug kit containing IV resuscitative drugs would be of negligible value to an emergency treatment provider with unfamiliarity in IV placement whether due to lack of training or not having the opportunity to practice the technique due to rare exposure to dental office emergencies. A laryngoscope is not an essential piece of
emergency equipment for those not trained in intubation technique. Office personnel should be able to provide basic management of airway, breathing and circulation. This can be achieved with basic medical equipment and essential drugs that dentists without advanced life support training can feel comfortable using.

**Emergency Equipment**

**Emergency oxygen** - The basic goal of nearly all emergencies in the dental office is to maintain sufficient oxygenation of the brain and heart. Thus, oxygen should be available for every emergency except hyperventilation. It should be provided with a clear face mask for patients with spontaneous breathing, and a bag-valve mask for the apneic patient in both adult and pediatric sizes. The oxygen should be available as a portable unit with an "E" size cylinder that is capable of delivering greater than 90% oxygen at a flow of 5 L/min for a minimum of 60 minutes (Figure 1).

**Suctioning equipment** - Although usually available in the treatment room, a portable suction unit is useful for suctioning fluids and vomit if the emergency occurs in another area of the office (waiting room).

**Automated electronic defibrillator (AED)** - The AED is used during cardiac arrest to shock a defibrillating heart. Resuscitation with BLS during cardiac arrest is most successful if defibrillation is performed within 3 to 5 minutes of collapse. Manual, automatic or semiautomatic defibrillators are available. Manual defibrillators require interpretation of a monitor or cardiac rhythm strip by a trained rescuer. Automated and semi-automated AEDs analyze the patient's rhythm and advises the rescuer to defibrillate if ventricular tachycardia or ventricular fibrillation is present or to continue CPR if no pulse is present. The AED should accept adult and pediatric paddles.

**Pulse oximeter and blood pressure monitor** - While pulse oximeters are usually found in dental offices where sedation and general anesthesia is administered to patients, they are useful in monitoring the effectiveness of CPR efforts. The pulse oximeter monitors the patient's pulse rate and the percent oxygenation of the blood. This frees up a staff member during an emergency from manually monitoring the patient with a stethoscope or digitally. More upscale models also provide blood pressure monitoring.

**Emergency Drugs**

Emergency drugs may be divided into two categories. The first category is drugs that are essential and should be part of every emergency drug kit. The second category consists of drugs that are useful but are optional depending on the practitioner's training in emergency medical procedures and whether sedation and general anesthesia are used for behavior and anxiety management. Thus, emergency drug kits will vary from office to office. A dentist trained to administer general and intravenous sedation with greater proficiency in venipuncture would have a more comprehensive drug kit than a dentist without such training. For dentists not proficient in venipuncture, optional drugs that can be administered orally, intramuscularly/intralingually and intranasally will be discussed.

At the very least, a basic dental office emergency drug kit should contain the eight drugs summarized in Table 1.

For the dentists with advanced training and skills in sedation and general anesthesia, the additional emergency drugs in Table 3 may be added to the drug kit.

**Emergency Treatment**

The following steps are taken for all emergencies:

- Discontinue dental treatment
- Activate the office emergency system
### Table 1. Essential Emergency Drugs.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Indication</th>
<th>Initial Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>Almost any emergency</td>
<td>100% inhalation</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>Anaphylaxis</td>
<td>Adult 1:1000 Child 1:2000 0.01 mg/kg IM every 15 minutes as needed</td>
</tr>
<tr>
<td></td>
<td>Asthma unresponsive to albuterol/salbutamol</td>
<td></td>
</tr>
<tr>
<td>Nitroglycerin</td>
<td>Angina pain</td>
<td>0.3-0.4 mg sublingual</td>
</tr>
<tr>
<td>Antihistamine (diphenhydramine)</td>
<td>Allergic reactions</td>
<td>Adult: 25-50 mg or 25-50 mg qid orally</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child: 1 mg/kg orally qid</td>
</tr>
<tr>
<td></td>
<td>(See table 2 for dosage by age)</td>
<td></td>
</tr>
<tr>
<td>Albuterol/salbutamol</td>
<td>Asthmatic bronchospasm</td>
<td>2 sprays inhalation</td>
</tr>
<tr>
<td>Aspirin</td>
<td>Myocardial infarction</td>
<td>160-325 mg</td>
</tr>
<tr>
<td>Sugared drink, juice</td>
<td>Hypoglycemia (patient conscious)</td>
<td>Administer until patient recovers.</td>
</tr>
<tr>
<td>Glucagon</td>
<td>Hypoglycemia (patient unconscious)</td>
<td>Adult: 1 mg IM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child: 0.5 mg IM stat, 0.5 mg 20 minutes later</td>
</tr>
<tr>
<td>Ammonia inhalant ampules</td>
<td>Syncope</td>
<td>Crush ampule between fingers and hold under nose</td>
</tr>
</tbody>
</table>


### Table 2. Oral Diphenhydramine Liquid Dosing (12.5mg/5ml).

<table>
<thead>
<tr>
<th>Age</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 3 months</td>
<td>Consult physician</td>
</tr>
<tr>
<td>4-11 months (12-17 lbs)</td>
<td>¼ tsp every 4-6 hours</td>
</tr>
<tr>
<td>12-23 months (18-23 lbs)</td>
<td>½ tsp every 4-6 hours</td>
</tr>
<tr>
<td>2-3 years (24-35 lbs)</td>
<td>¾ tsp every 4-6 hours</td>
</tr>
<tr>
<td>4-5 years (36-47 lbs)</td>
<td>1 tsp every 4-6 hours</td>
</tr>
<tr>
<td>6-8 years (48-59 lbs)</td>
<td>1¼ tsp every 4-6 hours</td>
</tr>
<tr>
<td>9-10 years (60-71 lbs)</td>
<td>1½ tsp every 4-6 hours</td>
</tr>
<tr>
<td>11 yrs (71-95 lbs)</td>
<td>1¾ tsp every 4-6 hours</td>
</tr>
<tr>
<td>12+ years (96+ lbs)</td>
<td>2 tsp every 4-6 hours</td>
</tr>
</tbody>
</table>


### Table 3. Additional Emergency Drugs.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Indication</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td>Clinically significant bradycardia</td>
<td>0.5 mg IV or IM</td>
</tr>
<tr>
<td>Ephedrine</td>
<td>Clinically significant hypotension</td>
<td>5 mg IV or IM</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>Adrenal insufficiency</td>
<td>100 mg IV or IM</td>
</tr>
<tr>
<td></td>
<td>Recurrent anaphylaxis</td>
<td>100 mg IV or IM</td>
</tr>
<tr>
<td>Morphine or nitrous oxide</td>
<td>Angina pain unresponsive to nitroglycerin</td>
<td>Titrate 2 mg IV, 5 mg IM ~ 35% N2O inhalation</td>
</tr>
<tr>
<td>Naloxone</td>
<td>Reversal of opioid overdose</td>
<td>0.1mg IV</td>
</tr>
<tr>
<td>Lorazepam or Midazolam</td>
<td>Status epileptic</td>
<td>4 mg IM or IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 mg IM or IV</td>
</tr>
<tr>
<td>Flumazenil</td>
<td>Benzodiazepine overdose</td>
<td>0.1 mg IV</td>
</tr>
</tbody>
</table>

• Call for assistance
• The oxygen and emergency drug kit is brought to the site of the emergency
• Attend to the patient
• Position the patient to ensure an open and unobstructed airway
• Monitor vital signs
• Support respiration and circulation
• Provide definitive treatment
• Notify 911 if it is determined to be needed

The following sections will discuss the definitive treatment for the most popular emergencies encountered in the dental office.

**Syncope**

Syncope is the most common emergency seen in dental offices (50% to 60% of all emergencies). Although it occurs predominately in adults, since all pediatric dental patients are accompanied by an adult, it can readily occur in a pediatric dental office. Syncope occurs as a result of a “fight or flight” response and the absence of patient muscular movement, leading to a transient loss of consciousness. It is most common in young adults, most commonly between the ages of 16 to 35 years, and in men more than women, probably as a result of being told to “Take it like a man” during a stressful situation. Pediatric patients rarely develop syncope because they do not hide their fears and readily react emotionally and physically during a stressful situation. If a pediatric patient or an adult older than 40 years exhibits syncope without predisposing factors, they should be sent for medical consultation.

Predisposing factors for syncope can be divided into two categories, psychogenic or non-psychogenic factors.

**Psychogenic factors include:**

- Fright
- Anxiety (due to the anticipation of discomfort or the fee)
- Stress
- Receipt of unwelcome news (treatment or the treatment fee)
- Sudden and unanticipated pain (injection or during treatment)
- The sight of blood (gauze, dental instruments)

A parent, with a history of negative dental experiences, accompanying their child for an emergency dental extraction, who was informed of the treatment fee, and is standing in the treatment room doorway, observing the extracted tooth in blood soaked gauze, is a prime candidate to develop syncope.

**Non-psychogenic factors include:**

- Sitting in an upright position (especially during the injection) or immobility while standing resulting in blood pooling in the peripheral extremities, decreasing the flow of blood to the brain.
- Hunger from dieting or missed meals resulting in decreased glucose supply to the brain.
- Exhaustion
- Poor physical condition
- Hot, humid environments

The physiological mechanism for the onset of syncope is:

- Stress causes increased amounts of catecholines (epinephrine, norepinephrine) to be released into the circulatory system to prepare the individual for increased muscle activity (fight or flight reaction in a threatening situation).
- The responses to the catecholine release are decreased peripheral vascular resistance and increased blood flow to the peripheral skeletal muscles.

If muscle activity occurs (fight or flight), the blood volume diverted to the muscles is returned to the heart. If muscle activity does not occur (sitting or standing still), there is increased peripheral pooling of the blood in the extremities and a decreased return of blood to the heart. This leads to a decrease in the circulating blood volume, a drop in arterial blood pressure and diminished cerebral blood flow resulting in syncope. Not managing the body's mechanism to compensate for the decreased circulatory volume in a timely manner leads to:

- Reflex bradycardia
- Decreased cardiac output
- Decreased blood pressure
- Cerebral ischemia
- Convulsions

The signs and symptoms of syncope are divided into early and late stages.

**In the early stage the patient:**

- Expresses feeling warm
- Exhibits loss of color with an ashen-gray skin tone
Monitor vital signs
Administer aromatic ammonia ampoules. Crush the ampule between the fingers and position it under the patient's nose. The irritating fumes stimulate movement of the extremities and aids in blood return from the peripheral areas to the heart and brain.

• Postsyncope management: If recovery occurs in less than 15 minutes, postpone further dental treatment. If recovery is delayed by more than 15 minutes, contact EMS while continuing definitive care until arrival of trained emergency care providers.

• Determine precipitating factors: Determine the cause of the syncope (anxiety, the sight of blood, unexpected pain, hypoglycemia, etc.).

In the late stage the patient exhibits:
• Pupillary dilation
• Yawning
• Hyperpnea
• Cold extremities
• Hypotension
• Bradycardia
• Visual disturbances
• Dizziness
• Loss of consciousness

Emergency Management
The first step in the management of syncope is prevention. This is accomplished by:
• Taking a thorough medical and dental history to identify any predisposing factors that might contribute to syncope, i.e., previous history of syncope, a fear of dental treatment due to previous traumatic dental experiences or pain, and hypoglycemia.
• Patients, especially those that are anxious, should eat a light meal prior to treatment to maintain a stable blood glucose level during stressful treatment.
• Patients should be treated in a supine or semi-supine position (30-45 degrees), especially during the injection.
• Consider the use of anxiety techniques such as premedication and nitrous oxide anxiolysis.

Should a patient experience syncope, the following steps should be taken:
• Discontinue treatment
• Assess the level of consciousness: Evaluate the patient’s lack of response to sensory stimulation.
• Activate the office emergency system: Call for help and have oxygen and the emergency drug kit brought to the site of the emergency.
• Position the patient: The patient should be in a supine position with the feet elevated slightly.
• Assess airway and circulation: Assess the patient’s breathing and airway patency and adjust the head and jaw position accordingly; monitor the pulse and blood pressure.
• Provide definitive care:
  ○ Administer oxygen
  ○ Monitor vital signs
  ○ Administer aromatic ammonia ampoules. Crush the ampule between the fingers and position it under the patient's nose. The irritating fumes stimulate movement of the extremities and aids in blood return from the peripheral areas to the heart and brain.

Allergic Reactions
Allergic reactions are hypersensitive responses by the body's immune system to antigens that are recognized as foreign bodies, with subsequent antibody formation. There are four types:
• Anaphylaxis (immediate)
• Cytotoxic (antimembrane)
• Immune complex (serum-sickness like)
• Cell mediated (delayed)

In this course the discussion will be limited to the anaphylactic and cell mediated types.

For an allergic reaction to occur, the patient must have been previously exposed to the antigen (sensitizing dose). The subsequent exposure to the antigen (challenge dose) causes the reaction. The latent period (the time between the sensitizing dose and the challenge dose) when the IgE antibody is produced varies in duration. The duration and severity of the reaction will vary by the individual.

Anaphylactic Allergic Reactions
An anaphylactic reaction is due primarily to the release of histamine from IgE sensitized mast cells. Histamine produces inflammation and vascular effects such as:
• Cardiovascular
  ○ Capillary dilation and increased capillary permeability resulting in blushing and edema formation.
  ○ Decreased venous return, blood, pressure and cardiac output.
• Stimulation of secretions
  ○ Increased secretions by the mucous,
Angioedema to the larynx leading to airway obstruction
Rhinitis
Cardiovascular reactions
Circulatory collapse due to vasodilation presented by light headedness, weakness, syncope and ischemic chest pain
Dysrhythmias - as above plus palpitations
Cardiac arrest

The progression of symptoms is:
1. Skin
2. Eyes, nose, GI
3. Respiratory system
4. Cardiovascular system

Emergency Management
Should a patient experience an anaphylactic episode, the following steps should be taken:
• Assess the problem: Recognize and acknowledge itching, hives, edema, flushed skin.
• Discontinue treatment
• Activate the office emergency system: Call for help and have oxygen and the emergency drug kit brought to the site of the emergency.
• Position the patient: The patient should be positioned comfortably.
• Assess airway and circulation: Assess the patient’s breathing and airway patency and adjust the head and jaw position accordingly. Monitor the patient’s pulse and blood pressure. Provide BLS as needed. If the patient’s condition continues to worsen, contact EMS.
• Provide definitive care: Administer epinephrine. Epinephrine counteracts most of the effects of histamine. It produces bronchodilation, raises blood and the heart rate via its α and β effects and counters skin rash, urticaria and angioedema by an unknown mechanism.

While available in 1 ml ampules of 1:1000 (0.30 mg/dose) for adults and 1:2000 (0.15 mg/dose) for children that is drawn into and administered via a syringe, a more efficient manner of administration during an emergency is with an EpiPen.

EpiPen (0.3 mg epinephrine) and EpiPen Jr (0.15 mg epinephrine) are preloaded epinephrine autoinjectors. They are extremely easy to use and are routinely available with prescription to the public for everyday allergic reactions (insect bites, food allergies).
Directions for use are:
1. Pull off the blue safety release cap (Figure 2).
2. Swing and firmly push the orange tip against the outer thigh so it “clicks.” HOLD the EpiPen on the thigh for approximately 10 seconds to deliver the drug. Do not inject intravenously as this can cause ventricular tachycardia or into the buttock as this may reduce drug efficacy (Figure 3).

Epinephrine is administered every 15 minutes until recovery or help arrives.

Mild or Delayed Allergic Reactions
As described by the name, mild or delayed allergic reactions present as a less severe reaction to allergens than anaphylaxis. They can occur as a reaction to such things as oral antibiotics, latex and (cold cure) acrylics. The signs and symptoms are limited to urticaria (itching), edema and erythema of the skin, mucosa and conjunctiva.

Treatment consists of:
• Discontinuing the source of the allergy.
• Administration of oral diphenhydramine at a dosage of 1 mg/kg every six hours for children or 25-50 mg for adults every 6 hours for 24 to 48 hours. Diphenhydramine is available in an oral form 12.5 mg/5 ml (see Table 2 for oral dosage by age) and 1 ml ampules or Min-i-jet (50 mg/ml) (Figure 4).

Acute Asthmatic Attack
Asthma is defined as a chronic inflammatory disorder that is characterized by reversible obstruction of the airways. Approximately 5% of adults and 10% of children in the United States suffer from asthma. Asthma is the most chronic childhood disease. Half of all cases develop before patients reach 10 years of age. It appears more frequently in inner city African-American and Hispanic populations. While acute asthmatic episodes are usually self-limiting, it can present as a clinical condition termed status asthmaticus which does not respond to bronchodilators.

Asthma is classified into 2 categories; extrinsic (allergic asthma) and intrinsic (non-allergic asthma).

Extrinsic asthma occurs more often in children. It is triggered by specific allergens such as
pollens, dust, molds and highly allergenic foods such as milk, eggs, fish, chocolate, shellfish and tomatoes. Drugs and chemicals such as penicillin, vaccines, aspirin and sulfites can trigger an allergic asthmatic attack. Approximately 50% of asthmatic children outgrow extrinsic asthma by late teens or early twenties.

Intrinsic asthma usually develops in adults older than age 35 years. Attacks are precipitated by non-allergic factors; respiratory infection, physical exertion, environmental and air pollution. Psychological and physiologic stress can induce an attack. The stress of disciplinary action by a parent or entering the treatment area in a dental office can trigger an asthmatic attack in children and adults.

With either type of asthma the mechanism for initiating an attack is the same. The allergen or non-allergen factors stimulates the vagus nerve to release acetylcholine which produces constriction of the airways and increased glandular secretions which plug the small airways in the lungs leading to bronchial edema and airway obstruction.

The signs and symptoms of an acute asthmatic attack are:

- Shortness of breath
- Wheezing and coughing
- Tightness in the chest
- Hypoventilation
- Cyanosis
- Tachycardia

The management of an asthmatic patient begins with the pretreatment history. Ask the patient:

- How attacks occur and their severity
- What triggers attacks
- What medications are taken

If the patient uses a self-administered bronchodilator aerosol during acute asthmatic attacks e.g., albuterol (Proventil, Ventolin) isoproterenol (Isuprel) or metaproterenol (Metaprel, Alupent), they should bring it to their appointment. The bronchodilators produce bronchial smooth muscle relaxation. Albuterol has the least side effects of all the bronchodilators and should be the drug of choice for inclusion in the emergency drug kit.

The steps in emergency management of an acute asthmatic episode are:

- Terminate treatment and remove all dental materials and instruments from the patient’s mouth.
- Sit the patient upright or in a comfortable position with the arms thrown forward over a chair back (Figure 5).
- Administer a bronchodilator supplied by the patient or from the emergency drug kit. The directions for use of the aerosol inhaler are:
  - The patient holds the inhaler 1 or 2 inches in front of their mouth.
  - The inhaler is placed in the mouth.
  - As the patient breathes in slowly through their mouth, they press down on the inhaler one time.
  - The patient continues breathing as deep as they can and holds their breath for 10 seconds.
  - Improvement should occur within 15 seconds.
  - If there is no improvement, the process should be repeated (Figure 6).
- If after three doses of the bronchodilator there is no improvement, take additional measures:
  - Administer oxygen
  - Call for medical assistance

Figure 5. Patient Sitting Upright in Comfortable Position with Arms Crossed Forward Over a Chair Back.
Early subjective symptoms of the central nervous system include dizziness, anxiety and confusion and may be followed by diplopia, tinnitus, drowsiness and circumoral numbness or tingling.

Objective signs include muscle twitching, tremors, excessive talking, slowed speech and shivering followed by overt seizure activity. Unconsciousness and respiratory arrest may occur.

Local anesthetic toxicity is preventable by following proper injection technique, i.e., aspiration during slow injection to detect intravascular injection. Clinicians should be knowledgeable of maximum dosages based on weight (Table 4).

If lidocaine topical anesthetic is used, it should be factored into the total administered dose of lidocaine as it can infiltrate into the vascular system. After injection, the patient should be observed for any possible toxic response as early recognition and intervention is the key to a successful outcome.

Emergency Management
Should a patient experience local anesthetic toxicity, the following steps should be taken:
• Stop treatment.
• Assess and support the airway, breathing and circulation.
• Administer oxygen via mask.
• Monitor vital signs.
• If the patient exhibits tonic-clonic seizures, follow the protocol for seizures (see the section on Seizures). With proper airway management the seizure should subside within two minutes as the level of local anesthetic decreases and the patient regains consciousness.
• Contact EMS if consciousness is not regained within 2 minutes.

Anesthetic Toxicity (Overdose)
While rare in adults, young children are more likely to experience toxic reactions because of their lower weight and immature physiology. Most adverse drug reactions occur within 5-10 minutes of injection. Local anesthetic toxicity is caused by high blood levels of anesthetic as a result of:
• Exceeding recommended local anesthetic dosages
• Inadvertent intravascular injection
• Repeated injections
• Idiosyncratic responses
• Interactive effects with other agents (sedatives)

The signs and symptoms of local anesthetic toxicity are biphasic; initial excitation, followed by depression. During the initial excitation stage, there is CNS stimulation of the heart rate and blood pressure increases. As blood plasma levels of the anesthetic increase, vasodilatation occurs followed by depression of the myocardium with subsequent fall in blood pressure. Bradycardia and cardiac arrest may follow.

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Allergic Reaction to Local Anesthetics
Although allergic reactions to injectable amide local anesthetics are rare, patients may exhibit a reaction to the bisulfite preservative added to anesthetics containing epinephrine. Patients with a sulfa allergy should not receive articaine. Patients may also exhibit allergic reactions to benzocaine topical anesthetics. Allergies can manifest in a variety of ways including urticaria, dermatitis, angioedema, fever, photosensitivity and anaphylaxis. If the patient exhibits an
allergic reaction to a local anesthetic or any of its additives, follow the protocol for management of allergic reactions.

**Anesthetic Reaction to Vasoconstrictors**

Vasoconstrictors (epinephrine and levonordefrin) are added to local anesthetics to counteract their vasodilatory action by constricting blood vessels, thus decreasing blood flow to the injection area. The absorption of the local anesthetic into the cardiovascular system is slowed resulting in lower anesthetic levels, minimizing the risk of local anesthetic toxicity and increasing the duration of anesthesia by allowing the local anesthesia to remain around the nerve for a longer period of time.

If too much vasoconstrictor is injected or the anesthetic is injected intravascularly, the vasoconstrictor is absorbed into the vascular system just as the anesthetic. Overuse of gingival retraction cord, especially in patients with a history of cardiovascular disease can cause vasoconstrictor toxicity. Increased vasoconstrictor into the blood stream causes moderate increases in systolic and diastolic blood pressures, cardiac output and stroke volume. These actions lead to an overall decrease in cardiac efficiency.

After reviewing the pre-operative medical history, the vasoconstrictor use should be avoided or minimized in:

- Patients with uncontrolled hyperthyroidism.
- Patients with severe cardiovascular disease.
- Less than 6 months after myocardial infarction, post-coronary bypass surgery or cerebrovascular incident.
- Daily episodes of angina pectoris.
- Cardiac dysrhythmias
- Patients receiving halogenated general anesthetic agents.
- Patients receiving nonspecific ß-blockers, MAO inhibitors, or tricyclic antidepressants.

The signs and symptoms of vasoconstrictor toxicity are:

- Anxiety
- Tachycardia/palpitations
- Restlessness
- Headache
- Tachypnea (abnormal rapid breathing)
- Chest pain
- Cardiac arrest

**Emergency Management**

Should a patient experience vasoconstrictor toxicity, the following steps should be taken:

- Stop treatment
- Reassure the patient
- Assess and support airway, breathing and circulation
- Administer oxygen
- Monitor vital signs
- Contact EMS

**Diabetes Mellitus – Hyperglycemia/Hypoglycemia**

Diabetes mellitus is a disorder characterized by inadequate insulin production by the pancreas
leading to compromised carbohydrate, fat and protein metabolism. If untreated, it leads to hyperglycemia (increased blood glucose levels). The most common type of diabetes in children is Type I diabetes (juvenile diabetes). There is little or no pancreatic β cell function and thus daily injections of insulin are required. Blood glucose levels are difficult to control leading to emergencies involving hyperglycemia or hypoglycemia (decreased blood glucose levels).

In hyperglycemia, blood glucose levels are extremely elevated due to low or absent plasma insulin levels for a long period of time. Because of the absence of insulin, glucose cannot enter cells, forcing the cells to metabolize fat and proteins to produce glucose. In the process ketones and other metabolic acids are produced leading to a condition known as diabetic ketoacidosis which, if not treated over a period of days, can lead to coma and death. Because it takes several days for ketoacidosis to occur, hyperglycemic patients do not exhibit acute emergency symptoms.

The emergency situation most likely encountered in the dental office is a patient with hypoglycemia or insulin shock. This condition is caused by an excessively high level of insulin due to the patient taking their daily dose of insulin with inadequate intake of carbohydrates. It can also occur when excessive amounts of carbohydrates are utilized during increased exercise and stress leading to low blood glucose levels. As glucose and oxygen are the primary metabolites for brain cells, the decreased serum glucose level leads to neurologic symptoms. If a diabetic patient, who is doing well, suddenly develops symptoms, it is most likely due to hypoglycemia rather than hyperglycemia.

The signs and symptoms of hypoglycemia are:
- Lethargy
- Change in mood
- Nausea
- Strange behavior
- Tachycardia
- Hypertension
- Anxiety
- Sweating

**Emergency Management**

Should a patient experience hypoglycemia, the following steps should be taken:
- Recognize and acknowledge the signs and symptoms.
- Discontinue treatment
- Activate the office emergency system. Call for help and have oxygen and the emergency drug kit brought to the site of the emergency.
- Position the patient so the patient is comfortable.
- Assess the patient's breathing and airway patency and adjust the head and jaw position accordingly. Monitor the patient's pulse and blood pressure. Provide BLS as needed. If the patient's condition continues to worsen, contact EMS.
- Provide definitive care:
  - Administer glucose
    - If the patient is conscious, the source of glucose (sugared soft drink, juice, Instaglucose) may be administered orally.
    - If the patient is unconscious, having uncontrolled seizures or can't swallow, administer 50% dextrose intravenously or Glucagon intramuscularly until consciousness is regained.

If you're not sure if the patient's blood glucose level is too low or too high, give the glucose. There is no danger of giving too much.

**Glucagon**

Glucagon, a hormone secreted by the pancreas, raises blood glucose levels. It has an effect opposite that of insulin which lowers blood glucose levels. The pancreas releases glucagon when blood sugar levels fall too low. Glucagon causes the liver to convert stored glycogen into glucose, which is released into the bloodstream. It is available in injectable form (Glucagen) for intramuscular administration.

A glucagon emergency kit contains a bottle of glucagon (dry powder) and a syringe of clear liquid (Figure 7).

The directions for use are:
- Remove the flip-off seal from the bottle of glucagon.
- Remove the needle protector from the syringe and inject the entire contents of the syringe into the bottle of glucagon.
- Remove the syringe and shake the bottle gently until the liquid is clear.
- Hold the bottle upside down, reinsert the needle and withdraw all of the solution from the bottle.
Seizures are temporary alterations in brain function resulting in an abrupt onset of motor, sensory or psychic symptoms. Except when seizures follow one another closely for an extended period of time, they are not considered life-threatening. Emergency management of a patient experiencing a seizure is essentially preventing injury during the seizure and supportive therapy post seizure.

There are multiple causes of seizures:
- Congenital abnormalities
- Perinatal injuries
- Metabolic and toxic disorders
- Head trauma
- Tumors
- Vascular diseases
- Degenerative disorders
- Infectious diseases
- Elevated body temperature (febrile seizures)
  - Most commonly occurs between 6 months and 3 years
  - Fever of 38.8° C (102°F)
  - Infection not associated with the CNS
  - Seizures are short (<5 minutes)
  - Are insignificant in the dental setting

While all patients with epilepsy have seizures, many more patients have a single seizure during life and do not have epilepsy. Ten percent of the U.S. population will have at least one seizure in their lifetime, while the incidence of epilepsy is less than 1%.

There are three major forms of seizures:
- Grand mal
- Petit Mal
- Psychomotor

Grand Mal Seizures
Grand mal seizures (tonic-clonic seizures) are the most common form found in epilepsy. They can also be brought on by cerebrovascular accidents, meningitis, encephalitis, drug withdrawal, photic stimulation, fatigue and intoxicants. The entire seizure may be broken down into prodromal, preictal, ictal and post-ictal phases which last no more than 15 minutes. However, it may take up to 2 hours for normal, preictal cerebral function to return.

- If tolerated, follow with 15 grams of a carbohydrate and a fat containing food (crackers and cheese).

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return. A grand mal seizure that lasts for hours or days is termed status epilepticus and can lead to death if not managed.

In the prodromal phase the patient may exhibit changes that may be evident only to a relative, such as increased anxiety or depression. A patient with a history of seizures may recognize the development of an “aura” consisting of olfactory, visual, gustatory or auditory changes. If the aura is noted by the patient or the dental staff, treatment should be terminated immediately before it progresses to the preictal phase.

The preictal phase is clinically manifested by:
- A loss of consciousness.
- If standing, falling to the floor (most prevalent time for injuries).
- Myoclonic jerks.
- Increase in heart rate and blood pressure.
- Diaphragmatic muscles go into spasm.

The ictal phase (tonic component) is clinically manifested by:
- Alternating muscular relaxation and violent contractions.
- Frothing at the mouth due to mixing of saliva and air.
- Bleeding from the mouth due to biting the lateral borders of the tongue.
- Lasting 2 to 5 minutes.

The postictal phase is clinically manifested by:
- Tonic-clonic movements cease.
- Breathing returns to normal.
- Consciousness gradually returns with disorientation.
- Relaxation occurs.
- Muscular flaccidity resulting in urinary or fecal incontinence.
- Total amnesia of the seizure.

Emergency Management
Should a patient exhibit a grand mal seizure, the following steps should be taken:

Prodromal and Preictal Phase
- Recognize aura.
- Discontinue treatment and move bracket table and instruments out of the way.

Ictal Phase
- Activate the office emergency team.
- Position the patient in a supine position with the feet elevated or roll patient on their side to prevent aspiration.
- Protect the patient from bodily injury, however do not place objects in the mouth to prevent soft tissue injury.
- Assess and perform BLS as needed.

Postictal Phase
- Administer oxygen.
- Monitor vital signs.
- Reassure patient and permit recovery.
- Depending on the patient’s history and if accompanied by an adult discharge patient to home or to the hospital or physician.

Petit Mal Seizures
Petit mal seizures occur in 25% of all epilepsy patients and 5% of pediatric epilepsy patients (are most common between ages 3-15 years). They occur frequently (multiple daily episodes) usually shortly after awakening or during periods of inactivity.

The clinical manifestations are:
- Unresponsiveness
- Eyelid clonus (rapid or cyclic blinking)
- Tonic or atonic features
- If standing, the patient will remain standing
- There is no aura or postictal state
- The duration does not exceed 10 seconds

Emergency Management
Should a patient exhibit a petit mal seizure, the following steps should be taken:
- Recognize the problem based on the patient’s medical history.
- Recognize the problem (lack of response to stimulation).
- Discontinue dental treatment.
- Activate the office emergency team.
- Position the patient in a supine position with the feet elevated.
- Once the seizure ceases (<5 minutes) reassure the patient.
- Discharge patient once fully recovered.
If the seizure lasts more than 5 minutes:
• Activate EMS.
• Perform BLS as needed.

Psychomotor Seizures
Psychomotor seizures show characteristics not seen in grand mal and petit mal seizures. The patient will exhibit impairment of consciousness and incoherent speech. There is turning of the head, shifting of the eyes and lip smacking. The patient exhibits amnesia of the seizure. The management involves protecting the patient from injury.

Cardiac Arrest
Cardiac arrest is a rare occurrence in the pediatric population. When it does occur, the outcome can be devastating. Death may result or if the patient is resuscitated, permanent brain damage is possible. The etiology of cardiac arrest in a child differs from an adult. Cardiac arrest in the pediatric patient is the result of prolonged respiratory depression and apnea. These situations are often associated with local anesthesia toxicity as a result of overdose or intravascular injection and with the administration of CNS depressant drugs for behavior management.

Comprehensive BLS training is not within the scope of the course and it is recommended the reader seek out formal BLS instruction. Because the etiologies for cardiac arrest differ for adults (cardiac disease) and children (depleted oxygen in the myocardium) differ, the 2010 American Heart Association guidelines for BLS differ.

For unwitnessed and witnessed cardiac arrests with two or more rescuers present, assess the patient, initiate CPR, activate the emergency response system and obtain an automated external defibrillator (AED) simultaneously.

For the lone rescuer, the sequence varies:
• If the cardiac arrest is witnessed, the lone rescuer first activates the emergency response system, obtains an AED, and starts CPR. This approach is the same as for adult with cardiac arrest.
• If the cardiac arrest is unwitnessed, the lone rescuer should first perform two minutes of CPR, activate the emergency response system, and obtain an AED. This approach differs from that recommended for adult cardiac arrest which is call for help, activate the emergency response system and initiate CPR and obtain an AED.

Comprehensive CPR training is not within the scope of this course, and it is recommended the reader seek out formal BLS instruction. It is important for BLS providers to realize because of different etiologies for cardiac arrest in adults (cardiac disease) and children (depleted oxygen in the myocardium) there is a significant difference in BLS protocols for adults and children.

In adults, after initial assessment of the unresponsive patient, EMS is activated immediately (before starting BLS) so access to trained personnel and defibrillation equipment is available as soon as possible. In children, since the likely cause of cardiac arrest is lack of oxygen in cardiac muscle, BLS is started immediately and EMS is contacted after delivery of BLS for 2 minutes. If two rescuers are present, one starts BLS while the other activates EMS and obtains the defibrillation equipment.

Conclusion
In summary, although pediatric medical emergencies are a rare occurrence in the dental office, when it does occur, it is important the staff is well-trained in emergency management so efficient and timely treatment is administered to the physically and physiologically immature pediatric patient. Preparation includes the use of comprehensive medical and dental histories, at minimum BLS training for staff and providers, initiation of an office emergency team, organization of an emergency drug kit and equipment, and periodic reviews and simulation.
Course Test Preview
To receive Continuing Education credit for this course, you must complete the online test. Please go to:

1. The most common medical emergency in a dental office is:
   a. Mild allergy
   b. Seizures
   c. Syncope
   d. Local anesthesia overdose

2. Adequate preparation to manage medical emergencies include _____________.
   a. providing BLS training for providers and staff
   b. initiating an office emergency team
   c. organizing an emergency drug kit
   d. All of the above.

3. A duty of the first person on the scene of an emergency is _____________.
   a. alerting other staff members
   b. contacting EMS
   c. retrieving the emergency drug kit
   d. direct EMS to the site of the emergency

4. Essential emergency equipment includes:
   a. Laryngoscope
   b. Various sized intubation tubes
   c. An “E” sized tank of oxygen
   d. A and B

5. Epinephrine is recommended for managing _____________.
   a. anaphylaxis
   b. asthma unresponsive to albuterol
   c. seizures
   d. A and B

6. Glucagon is used in the management of _____________.
   a. seizures
   b. anaphylaxis
   c. hypoglycemia
   d. psychogenic syncope

7. Flumazenil is used in the management of _____________.
   a. status epilepticus
   b. benzodiazepine overdose
   c. local anesthesia overdose
   d. B and C

8. Syncope would most likely occur in a _____________.
   a. 24 year old male
   b. 18 year old female
   c. 45 year old female
   d. 5 year old male
9. **A non-psychogenic predisposing factor for syncope is _____________.**
   a. the sight of bloody gauze
   b. sitting upright during local anesthesia administration
   c. sudden and unanticipated pain
   d. receipt of the treatment fee

10. **The physiological mechanism for the onset of syncope is _____________.**
    a. increased amounts of catecholamines released into the circulatory system
    b. muscle inactivity in the extremities
    c. diminished cerebral blood flow
    d. All of the above.

11. **A symptom during the early stage of syncope is:**
    a. Warm feeling
    b. Cold extremities
    c. Bradycardia
    d. Visual disturbances

12. **A patient experiencing syncope should be positioned _____________.**
    a. in a semi-supine position at a 30 to 45 degree angle
    b. with the head and upper body pushed forward
    c. in a supine position with the feet elevated
    d. in a vertical standing position

13. **The definitive care for syncope includes:**
    a. Administer oxygen
    b. Monitor vital signs
    c. Administer aromatic ampules
    d. All of the above.

14. **Anaphylactic reactions are caused by _____________.**
    a. release of catecholamines into the circulatory system
    b. intravascular injections
    c. release of histamine from IgE sensitized mast cells
    d. increased insulin production

15. **The appropriate dose of epinephrine to a 5 year old child experiencing anaphylaxis is _____________.**
    a. 1 ml of 1:1000 epinephrine
    b. 1 ml of 1:10,000 epinephrine
    c. 1 ml of 1:2000 epinephrine
    d. 1 ml of 1:20,000 epinephrine

16. **Mild allergic reaction in a 5 year old child is treated by administering _____________.**
    a. oral diphenhydramine 1 mg/kg every six hours
    b. a one time dose of oral diphenhydramine 25 mg
    c. 1 ml of 1:1000 epinephrine intramuscularly
    d. 1 ml of 1:2000 epinephrine intramuscularly
17. The position for managing a patient experiencing an acute asthmatic episode is _____________.
   a. a supine position with legs elevated 
   b. upright with arms thrown forward over a chair 
   c. a semi-supine position at a 30 to 45 degree angle 
   d. supine with the head tilted to the side

18. If a five year old patient experiencing an acute asthmatic attack does not show improvement after three doses of a bronchodilator, _____________.
   a. administer oxygen 
   b. call for medical assistance 
   c. administer epinephrine 1:2000 intravenously or intramuscularly 
   d. All of the above.

19. Anesthetic toxicity may be a result of _____________.
   a. exceeding recommended local anesthetic dosages 
   b. intravascular injection 
   c. interactive effects with sedatives 
   d. All of the above.

20. Emergency management of local anesthesia toxicity in a five year old includes:
   a. Administer 1 ml epinephrine 1:1000 
   b. Administer oxygen via a mask 
   c. Administer 1 ml of flumazenil 0.1 mg IV 
   d. Administer oral diphenhydramine 1 mg/kg

21. Diabetic mellitus patients may experience:
   a. Hyperglycemia 
   b. Hypoglycemia 
   c. Diabetic ketoacidosis 
   d. All of the above.

22. An initial dose 0.5cc of glucagon IM is the drug of choice for treating _____________.
   a. a conscious 23 lb patient exhibiting hypoglycemia 
   b. an unconscious 23 lb patient exhibiting hypoglycemia 
   c. a conscious 23 lb patient exhibiting signs of hyperglycemia 
   d. an unconscious 23 lb patient exhibiting signs of hyperglycemia

23. During the ictal phase of a seizure, _____________.
   a. position the patient in a supine position with the feet elevated 
   b. protect the patient from bodily injury 
   c. place objects in the mouth to prevent soft tissue injury 
   d. A and B

24. The etiology of cardiac arrest in children and adults _____________.
   a. are the same 
   b. is due to cardiac disease in adult 
   c. is due to prolonged respiratory depression and apnea in children 
   d. B and C
25. **The proper sequence of BLS for a child in cardiac arrest, witnessed by 2 rescuers, is:**
   a. Assess the patient, obtain an AED, initiate CPR, activate the emergency response system.
   b. Assess the patient, initiate CPR, activate the emergency response system, and obtain an AED simultaneously.
   c. Initiate CPR, assess the patient, activate the emergency response system, obtain an AED.
   d. Activate the emergency response system, assess the patient, initiate CPR, obtain an AED.
References

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Dr. Steven Schwartz is the director of the Pediatric Dental Residency Program at Staten Island University Hospital and is a Diplomat of the American Board of Pediatric Dentistry.

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