Criteria of Hospital Inpatient Admission of Pediatric Dental Patient

Shahad S Alkhuwaiter*

Some dental conditions that are presented to the pediatric emergency department need hospital inpatient admission to facilitate supportive care, provide dental treatment and monitor the physiologic state of the child. The decision to treat the pediatric dental patient as an outpatient or inpatient is very important to control the overuse of hospital resources and at the same time not placing the child at the risk of rapid deterioration. However, no available guidelines or validated measures for the correct decision to treat the patient in either inpatient or outpatient care settings that can be used specifically for pediatric dental patients presented to the emergency department. Up to date, the decision of admitting pediatric patients is usually based on the severity of illness that can be measured by using The Pediatric Risk of Admission (PRISA II) Score. This review gives an overview of indications and clinical criteria of hospital inpatient admission of pediatric patients subsequent to traumatic and non-traumatic dental conditions.

Keywords: *Hospitalization, inpatients, pediatric, dental*

INTRODUCTION

A multidisciplinary and integral approach is sometimes needed for traumatic and non-traumatic dental conditions. In a 5-year retrospective study among pediatric dental patients, there was increasing in both emergency department visits and hospital admissions.[1] The most common hospitalizations were related to non-traumatic dental conditions which are odontogenic facial cellulitis (16.8%) [2,3] and periapical abscess.[4]

Hospital inpatient admission of pediatric patients facilitates supportive care including maintaining optimal hydration, nutritional support, fever, and pain management, and allows close physiologic monitoring of the child. Moreover, a dental intervention can be provided safely for the potentially unstable child.

Many factors can affect the course and outcome of the treatment. However, no available criteria or validated measures can be used to aid in the decision of either to treat the patient in an inpatient or outpatient care settings specific for pediatric dental conditions presented to the emergency department.

The availability of standardized and objective admission criteria is needed as it might impact the parameters related to the quality of care, including but not limited to the length of hospital stay (LOS), admission rate, and need to move the patient to a higher level of care.

In a pilot study, Sainuddin *et al*, (2017) suggested new admission scoring criteria for an adult patient with odontogenic infections, they found that the proposed criteria helped the junior doctors in the admission decision and the patients were identified more objectively and correctly.[5]

Another study recommended considering mandibular odontogenic infections as a significant factor during admission decisions along with the basic signs and symptoms of inflammation.[6]

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For the pediatric dental patient, this is the first study that outlined important clinical findings and factors that can be used to aid in the decision of hospital inpatient admission specific for pediatric dental conditions. The purpose of this review was to give an overview of indications and clinical criteria of hospital inpatient admission of pediatric patients subsequent to traumatic and non-traumatic dental conditions.

Overview of Hospital Inpatient Admission of Pediatric Patient

Admission can be defined as treating the patient in an inpatient unit. Either because the therapy can only be provided in the hospital or the physiologic state of the child need to be monitored.[7] Routine in-patient general pediatric team will take care of a healthy child who has complications as a subsequent to dental conditions. However, for a patient with a medical condition who will require subspecialty pediatric care, the need for intermediate care will be justifiable.[8] Normal cardiovascular parameters include pink or capillary refill 1–2 seconds. The respiratory is within normal parameters, with no retractions. Any variation needs to be assessed for possible admission.[9] The services that will be provided to the patient include, frequent monitoring of vital signs, nursing intervention, ensure of optimal hydration, and subspecialty assessment if needed.[8] Up to date, the decision of admitting the pediatric patients is usually based on the severity of illness that can be measured by using The Pediatric Risk of Admission (PRISA II) Score. This score is mainly based on historical, physiological factors, and delivered therapy.[7, 10]

A. Historical factors including but not limited to:

- Age of the child.
- Presenting chief complaint and diagnosis.
- Acute and chronic medical history, a specific score for:

  Immunocompromised (sickle cell disease, oncologic disease, transplantation, steroids, acquired or congenital immunodeficiency).

  Dependence on the medical device (tracheostomy, long-term venous catheter, dialysis catheter or shunt, ventricular drainage catheter, feeding tube, home apnea monitor, and home oxygen).

  Controller asthma medications (any asthma medication other than bronchodilators).

Common medical conditions that might be encountered by the pediatric dentist that require subspecialty pediatric care include:[8]

1. Respiratory diseases; especially if there is airway compromised complicated by the odontogenic infection or maxillofacial traumatic injury.
2. Patient with controlled cardiac disease and hemodynamically stable. Especially in the presence of extensive and rapidly progressive infection and the child is at increased risk of infective endocarditis.
3. Neurologic diseases, which include head trauma without severe neurologic signs and seizure disorder, if the patient is stable and responsive to therapy, but needs respiratory monitoring.
4. Hematologic/Oncologic Diseases:

   If the patient is moderately unstable with potential cardiopulmonary compromise who require close monitoring and assessment.
   - Stress, infection, pain all are precipitant of sickle cell crises.
   - Oral soft tissue injury in a patient with a bleeding disorder.
   - Patient with sloid tumor or cancer and under treatment with chemotherapy with low immunity.
5. Endocrine/Metabolic Diseases:
   - Moderate diabetic ketoacidosis.
   - Moderate electrolyte and/or metabolic abnormalities; Hypoglycemia or hyperglycemia.
6. Renal Diseases; if the patient requires blood pressure monitoring, patients in chronic hemodialysis or peritoneal dialysis or with renal failure.

B. Physiologic states that are usually encountered by the pediatric dentist include:

- NPO (no oral intake) status: >12 hours for children >12 months old, >8 hours for infants 1–12 months old, and >6 hours for neonates <1 months old.
- Acute coma or stroke.
- Absolute neutrophil count $<500 \times 10^9$/L.
- Platelet count $<20{,}000 \times 10^9$/L.
- Decreased mental status: listless, irritable, lethargic, obtunded, or comatose.
- Low temperature: (children <35.0°C).
- Low systolic blood pressure: (children <83 mm Hg).
- High diastolic blood pressure: (children >70 mm Hg).
- High WBC count ($>20{,}000 \times 10^9$/L).
- Electrolyte disturbance.

C. Common therapies in pediatrics:

- Analgesics/antipyretics.
- Intravenous fluids.
- Bronchodilators.
- Oxygen.

On the other hand, Pediatric Early Warning Score is used to detect early signs of clinical deterioration and physiological instability. It can be used in a hospitalized child or those presented to the emergency department. Also, used to determine the severity of medical illness that necessitates close monitoring of the patient and a more advanced intervention and management before the deterioration in the cardiovascular or respiratory system occurs. This system is usually based on a child's behavior or mental status, circulatory, and respiratory systems. [9,11,12]

For patients with severe, life-threatening, or unstable and who require invasive and/or continuous monitoring, admission to the pediatric intensive care unit is required.[9]

Assessment of dehydration in pediatrics can be estimated by the clinical signs and symptoms. The three most important clinical signs are; prolonged capillary refill time (>3 sec), abnormal skin turgor, and abnormal respiratory pattern. These signs are clinically useful in detecting dehydration of >5%.[13-15] Dehydration severity is based on loss of total body weight during the illness and divided into three categories; mild (<3% loss of body weight); moderate (loss of 3%-9%); severe (loss of >10%). Dehydration of >5% and unable to tolerate oral fluids is one of the reported indications of potential

admission. In these cases, the child needs I.V replacement of deficit fluids (Table 1). [13-15]

When the physiologic condition improves and return of baseline vital signs, the patient can be discharged based on basic criteria: [8]

- Hemodynamically stable for 6-12 hours.
- Stable respiratory status. With minimal oxygen requirements.
- Stable cardiac condition with controlled arrhythmia.
- The neurology status is stable with controlled seizures.
- No longer need of hemodynamic monitoring devices.

Criteria and Significant Factors for Admitting Pediatric Dental Patient

The decision to treat the pediatric dental patient as an outpatient or inpatient is very important, so controlling the overuse of hospital resources and at the same time not placing the child at the risk of rapid and progressive deterioration.

Factors that may affect the decision of admission of the pediatric dental patient include:

1. Nature, source, and severity of the dental condition.
2. Medical condition.
3. Physiological parameters (cardiovascular, respiratory, hydration).
4. Age "younger age is associated with more inpatient hospitalization". [16]
5. Behavioral problems.
6. Pain management difficulties.
7. Service availability.

Complex chronic conditions (CCC) is a significant factor in hospitalization for non-traumatic dental conditions (NTDCs). Previous studies also reported the same factor, children who have CCCs are higher in the utilization of hospital and dental care and more of recurrent admissions.[16-18] Even the mean length of hospital stay is higher significantly for the patient with two or more CCCs (11 days), compared to those without CCCs (4.3 days).[16]

The possible reason for inpatient admission for children with CCCs is related to their safety [16] or maybe this is the preferable protocol by the patient's physician, so the patient will be under their supervision and if any preparation needed for dental intervention.

Traumatic Dental and Maxillofacial Injuries

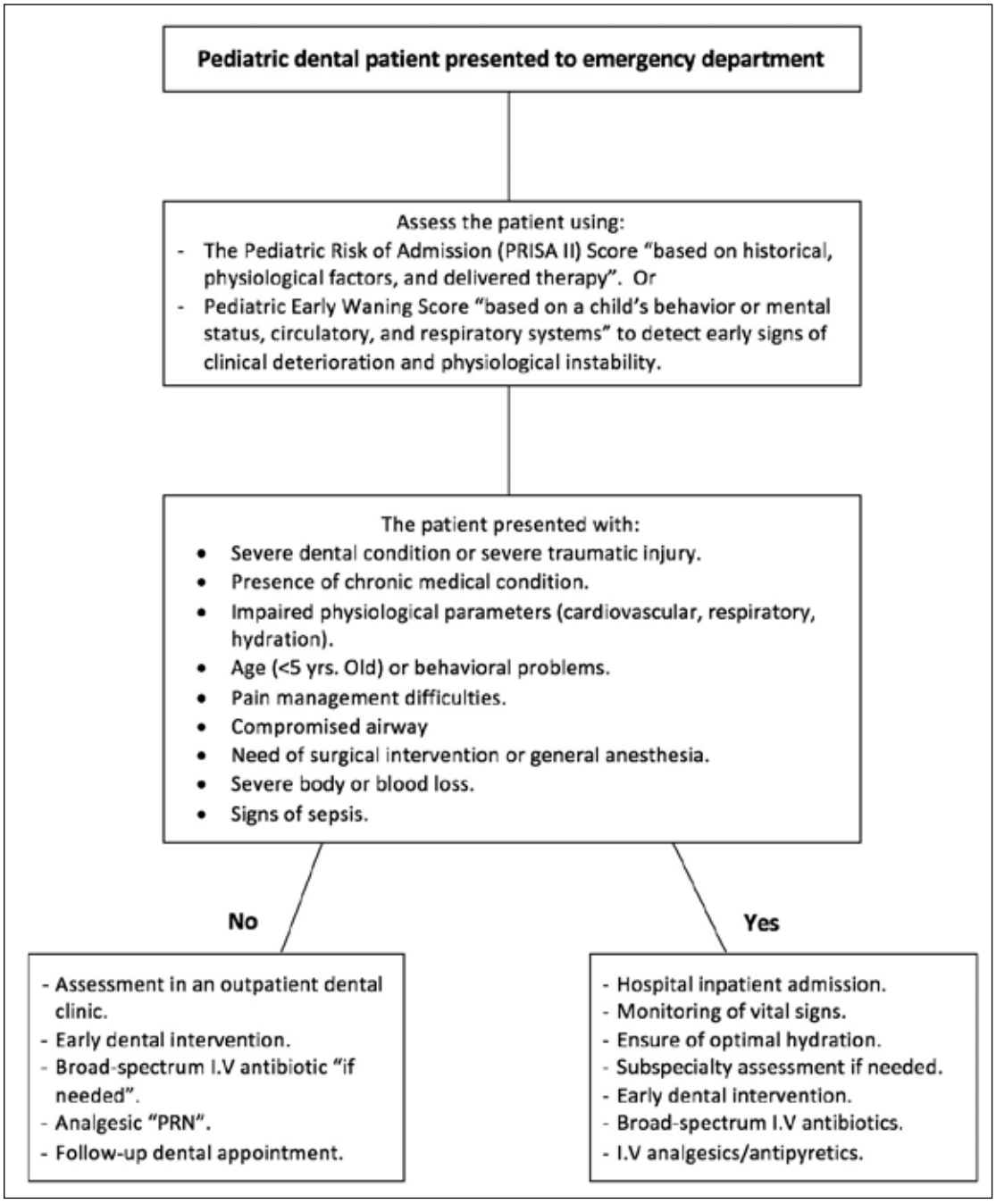
During the assessment of a patient with maxillofacial traumatic injury, many factors need to be considered for the pediatric patient: [19-27]

1. The anatomic and physiologic differences between the adult and children make the child more susceptible to secondary brain injury, the rapid development of hypothermia, and a higher risk of airway obstruction or compromise.
2. High risk of blood loss even with minor injuries. And due to the low total blood body volume, hypotension is more rapidly develop. Also, due to the low body mass and total surface area, the child is more prone to heat and fluid loss.
3. The child is more susceptible to internal organ injuries due to the elasticity of the skeleton, which results in concomitant systemic injuries with maxillofacial trauma.
4. The association between concussion and facial fractures was reported in about 1/3 of the pediatric patient.
5. Rapid clinical deterioration in children due to the high metabolic rate.

Table 1: Dehydration signs and symptoms Adapted from Ref. (55, 56, 57).

Dehydration Symptom	Minimal (<3% Loss of Body Weight)	Mild–Moderate (3%–9% Loss of Body Weight)	Severe (≥10% Loss of Body Weight)
Conscious state	Normal	Restless, irritable (arousable)	Lethargic (drowsy to unconscious)
Heart rate	Normal	Normal or mild tachycardia	Tachycardia
Breathing	Normal	Normal; Tachypnea	Tachypnea; Deep
Pulse quality	Normal	Normal to decreased	Weak, thread, or difficult to palpate
Systolic blood pressure	Normal	Normal to mild hypotension	Hypotension (circulatory collapse)
Anterior fontanelle & Eyes	Normal	Slightly sunken	Deeply sunken
Mucous membranes	Normal (Moist)	Dry	Severe dryness
Tears	Normal	Normal to reduced	Absent
Skin fold elasticity	Normal (Instant recoil)	Decreased (Recoil in <2 s)	Markedly decreased (Recoil in >2 s)
Capillary refill time	Normal (capillary refill 1-2 seconds)	Prolonged (capillary refill 2-3 seconds)	Markedly prolonged (capillary refill >3 seconds)
Extremities	Warm	Cool	Cold, mottled, cyanotic
Urinary output	Normal to decreased	Decreased	Minimal
Estimated fluid deficit	30–50 mL/kg	100 mL/kg	>100 mL/kg
Calculation of deficit:	Deficit (mL) = % dehydration × weight (kg) × 10		
Calculation of maintenance fluid	* **4-2-1 rule (100-50-20 rule)**: 4 ml/kg/hr (100 mL/kg/day) for the 1st 10 kg + 2 ml/kg/hr (50 mL/kg/day) for the 2nd 10 kg + 1 ml/kg/hr (20 mL/kg/day) for the remainder. * **Maximum rate of 120 mL/hr**.		

Figure 1. Flowchart for pediatric dental patients with TDCs or NTDCs attending the emergency department.



As per the National Trauma Data Bank, if the pediatric patients presented with facial fractures in comparison to those without; the severity of the injury is higher, prolonged in-patient hospital stay, more care needed in the intensive care unit, more hospital overall charges.[20,28]

The incidence of systemic injury combined with facial trauma is as high as 10.4%-88%.[19] So it is important to rule out intracranial and cervical spine injury that might be concomitant with facial fractures.[21] The more complex and extensive fracture, the more probability of having an additional injury.[29,30]

The factors that may have an impact on the admission decision, course of treatment, and duration of hospitalization that needs to be considered for admitting a pediatric patient with the maxillofacial traumatic injury include:

- Preexisting medical illness.
- Severity, location and type of maxillofacial traumatic injury.
- Presence and location of associated injuries.
- Treatment approach.
- Systemic complications "intracranial hemorrhage and cervical spine injury".
- The amount of fluid or blood loss.
- Symptoms of airway distress "Agitation, cyanosis, and obtundation".[31]

- Low Glasgow Coma Scale (GCS) "there was a significant association between low GCS and midface fractures with intracranial hemorrhage and cervical spine injury".[21]
- Signs and symptoms of severe head injuries "the patient cannot remember the accident, had a history of unconsciousness, headache, there had been nausea or vomiting, behavioral changes "irritability, confusion, drowsy", changes in eye vision or movements, size of the pupil, slurred speech, irregular breathing pattern, and fluid leakage from the ears or nose".[32]
- A traumatized patient that needs to be intubated "the presence of bilateral fracture of the mandible, extensive oral bleeding, loss of protective laryngeal reflexes, <8 Glasgow Coma Scale (GCS), seizures, deteriorating arterial blood gases, extensive swelling or edema, long transfers in a patient with complex facial fractures".[33]
- The need for treatment under general anesthesia.
- The surgical treatment approach "This treatment approach was more with mandibular symphysis and body fractures".[34]

The decision of best management is based on the consciousness level of the patient, injury severity, aspiration risk, obstruction after extensive edema.[22,31,35]

Non Traumatic Dental Conditions (NTDCs)

Orofacial infection

In the pediatric population, orofacial infection is a frequent health care problem and a common cause of emergency visits.[1,36] Most commonly caused by an odontogenic infection which is subsequent to dental caries by more than half of the cases.[37] Orofacial infection in children is different than in adults in that it progresses very rapidly. So initial assessment and planned intervention is the best treatment strategy to prevent systemic complications.[38,39]

The child usually presented in the emergency department with systemic manifestations which include; facial swelling, asymmetry, airway compromise, tachycardia, neck involvement, lymphadenopathy, severe pain, erythema, high fever, dysphagia, poor oral intake or dehydration, trismus (normal maximal mouth opening in a child is ranging from 35 to 45 mm), general malaise, and nausea. So, the administration of intravenous antibiotics and hospital admission is recommended in this case. [2, 40-42]

The following factors that should be considered in deciding the hospitalization of the pediatric dental patient: [3,41,43-49]

1. The medical condition of the child is reported to be a significant factor that will increase the possibility of systemic complications, the duration of in-patient hospital stay, and more usage of hospital resources.[3,50,51]
2. Signs of sepsis include both Systemic Inflammatory Response Syndrome (SIRS) and the presence of a proven odontogenic infection.
3. Poor oral intake with signs of dehydration: (low systolic blood pressure, reduced skin turgor, or an elevated serum urea concentration).
4. Home care is questionable.
5. The need of surgical treatment.
6. Unresolved infection that was managed by oral antibiotics in an outpatient care setting.
7. Rapid and extensive progression of the infection.
8. Airway compromise or obstruction subsequent to swelling, edema, backward displacement of the tongue, and severe trismus "limiting mouth opening < than 10 mm".
9. The child presented with a complication in the upper facial region, including orbital cellulitis, cavernous sinus thrombosis.
10. Or presented with a lower facial complication (Ludwig's angina). Moreover, deep neck space infection associated with mandibular odontogenic infection has been reported in an adult patient.
11. Elevated inflammatory markers; leukocytosis and C reactive protein (CRP).
12. Stage of infection (Cellulitis vs Abscess), severity scores of severe odontogenic infections according to the space affected; ranging from severity score 1 "Low risk to airway or vital structures" and up to score 3 "High risk to airway or vital structures". The more involved anatomic spaces and the higher severity score of the infection, the more length of hospital stay (Table 1; available at Flynn et al. Severe Odontogenic Infections. J Oral Maxillofac Surg 2006).[49]

The administration of intravenous antibiotics is justifiable in most cases, but it is not a significant factor for infection resolution.

On the other hand, the immediate surgical intervention along with intravenous antibiotics will result in the resolution of the symptoms, will shorten the length of hospital stay, reduce the complications and the total treatment cost. [2,42,52,53]

The surgical treatment should be the priority. Flynn reported that no antibiotic is superior over another and no significant difference between shorter (3 to 4 days) and the longer (7 days) course of antibiotic therapy. The choice of antibiotic is mainly based on the medical history including history of any allergy, severity of infection (inpatient vs outpatient), but in general, the broader-spectrum is most effective for orofacial odontogenic infections.[54] The duration of the in-patient stay is significantly related to the time of surgical intervention. In one study it was correlated with the source and type of the abscess, a small submucous abscess was associated with a shorter stay.[53] Kara *et al*, reported that the hospital in-patient stay was correlated with the age of the patient, older patients had longer stay compared to the younger child.[52] Most of the studies agreed that, the more rapid dental intervention, the shorter inpatient stay, and the more favorable overall outcome.[42] As previously reported, children who did tooth extraction within the first 48 hours, had significantly shorter compared to those who had the extraction after 48 hours.[52] Also, the adjunctive antibiotic in a patient with systemic signs of sepsis is an important factor to fasten recovery, especially in immunosuppressive patients.[42]

Thus, the timing of dental intervention is the most significant factor related to the length of inpatient stay. But at the same time other factors need to be considered; such as the medical stability of the child, the ability to anesthetize the area or the availability of general anesthesia.

Table 2: Summary of proposed criteria for admitting pediatric dental patient.

Nature, source, and severity of dental condition:	
Traumatic: • Severe injury that require surgical approach. • Concomitant systemic injuries. • Low level of consciousness. • Fluid or blood loss. • Risk of aspiration. • Airway obstruction subsequent to extensive fracture or edema. • Severe maxillofacial trauma with soft tissue involvement.	**Non-Traumatic:** **Odontogenic infection** • Acute severe facial swelling, score 2 or 3 (risk to airway or vital structures). • Airway compromise or obstruction. • Severe pain "uncontrolled by oral analgesic". • Poor oral intake or dehydration. • Trismus. • Signs of sepsis. • The need of surgical intervention. • Unresolved progressive infection. • Orbital cellulitis, cavernous sinus thrombosis. • Ludwig's angina or deep neck space infection. • Elevated inflammatory markers leukocytosis and CRP (normal < 10 mg/L). • Inability to obtain adequate local anesthesia (need of general anesthesia). **Herpetic gingivostomatitis** • The presence of comorbid conditions (require IV Aciclovir). • Presented with complications. • Dehydration. • Severe pain.
Child characteristics:	
• Age of the child is <5 yrs. old. • Severe behavioral problems. • Questionable home care.	
Physiological parameters:	
• NPO (no oral intake) status.† • Pale or capillary refill >3 seconds. • Acute coma or stroke. • Absolute neutrophil count <500 × 10^9/L. • Platelet count <20,000 × 10^9/L. • Decreased mental status. • Low temperature <35.0°C. • Low systolic blood pressure, children: <83 mm Hg.	• High diastolic blood pressure, children: >70 mm Hg. • High WBC count >20,000 × 10^9/L. • Severe electrolyte disturbance. • Increased heart rate, children: >136 beats/min. • Increased respiratory rate, children: >60 breaths/min or using accessory muscles. • Decreased hemoglobin <9.3 g/dL.
Medical condition:	**Required therapy:**
• Immunocompromised child. ‡ • Dependence on medical device. • Respiratory disease (on controller asthma medications). • Cardiac disease. • Neurologic diseases. • Hematologic/Oncologic disease. • Endocrine/Metabolic disease. • Renal or liver disease.	• Intravenous analgesics/antipyretics • Intravenous antibiotic. • Intravenous fluids. • Bronchodilators. • Oxygen. • Blood transfusion.

Sepsis in pediatric patient are signs and symptoms of inflammation + infection, with the following diagnostic criteria: "one of the criteria must be abnormal temperature or leukocyte count".

1. Hyper- or hypothermia (core temperature >38.5 or <36°C).
2. Tachycardia (mean heart rate >2 SD above normal for age in the absence of external stimulus or chronic drugs; may be absent in hypothermic patients), and
3. Mean respiratory rate >2 SD above normal for age or mechanical ventilation.
4. Leukocyte count elevated or depressed for age or >10% immature neutrophils.
5. At least one of the following indications of altered organ function: altered mental status, hypoxemia, increased serum lactate level, or bounding pulses.

(The physiologic and laboratory variables are age-specific ranges).

† NPO: >12 hours for children >12 months old, >8 hours for infants 1–12 months old, and >6 hours for neonates <1 months old.

‡ Sickle cell disease, oncologic disease, transplantation, steroids, acquired or congenital immunodeficiency, uncontrolled diabetes mellitus, asplenism or status post splenectomy.

Gingivostomatitis

Primary herpetic gingivostomatitis is an oral infection caused by HSV-1, which usually affects children aged 6 months to 5 years. Fever, headache, irritability, anorexia, and malaise are systemic manifestations of primary herpetic gingivostomatitis (PHGS) in children.[55] Severe systemic complications have been reported.[56] Dehydration is one of its complications that require hospitalization. It is a self-limited infection, with only supportive care is needed. Insurance of adequate hydration along with pain control is very important in managing children with gingivostomatitis.

Criteria of in-patient admission include but are not limited to:[57]

- A child who is unable to maintain optimal hydration.
- Immunocompromised who require IV Aciclovir.
- Patients who develop eczema herpeticum, HSV encephalitis or pneumonitis.
- Severe uncontrolled pain.

The most significant reported factors attributed to the hospitalization of patients with herpetic gingivostomatitis were the presence of the comorbid condition and fluid or electrolyte imbalance with the mean length of stay was 3.9 days.[58] Previous studies demonstrated that the administration of acyclovir within the first 72- 96 hours will reduce the duration of symptoms.[59,60] However, a recent retrospective study found that using acyclovir either early within 72 hours or later, has no significant impact on the duration of fever or length of hospital stay.[56]

Admitting Pediatric Dental Patient During COVID-19 Pandemic

During the COVID-19 pandemic, the proposed criteria in this study will help in the decision-making process and is beneficial in prioritizing patient care to determine the patient that requires hospital admission for dental intervention and most importantly to ensure a balance between limiting patient admission and ensuring patient's safety. The American Dental Association (ADA) had defined the dental emergency which is a potentially life-threatening condition that requires immediate intervention, which includes (uncontrolled bleeding, cellulitis, and trauma involving facial bones, which are potentially compromising the patient's airway). [61]

If the suspected pediatric patient presented with a dental emergency and the cardiovascular or respiratory systems are impaired, some factors that should be considered include:

- The patient and staff safety.
- Prioritization of the most urgent dental conditions.
- Professional clinical judgment.
- A screening for COVID-19 status before admission for detecting the symptoms attributable to the disease is recommended.[62]

CONCLUSION

The proposed criteria in this study along with the clinical judgment will aid in the prioritization of admitting pediatric dental patients subsequent to traumatic and non-traumatic dental conditions. These criteria could be beneficial as they constitute potential signs of clinical and physiologic deterioration. However, a scoring system of these proposed criteria is needed to improve the quality of care provided to the pediatric patients as well as to avoid over or underutilization of hospital resources. Moreover, the increasing cost of inpatient hospital care can be minimized by having criteria that are customizable to different medical/dental institutions.

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