

PEM TODAY

Translating Science to Stretcher in Pediatric Emergency Medicine

How Do You Say Severe Infection in French?

The evidence of the importance of early and aggressive management of bacterial infection in children continues to mount. For better or worse, however, such evidence will almost certainly remain retrospective and observational, as a randomized controlled trial of current best practice (early antibiotics and rapid volume expansion) could never be accomplished on ethical grounds.

The population-based study by **Launay et al** adds to our evidence base in a unique way, but methodological flaws must temper our conclusions from this investigation. These investigators examined all deaths of children, from 3 months - 14 years of age who died of bacterial infection, from 2000-2006 in a defined geographical zone in France. With regionalized care and a national database of causes of death, as well as meticulous evaluation of potential cases, this represents a unique case series.

They found (only) 23 children who were believed to have died from severe bacterial infection and were able to analyze the records of 21 thoroughly. Although there was substantial disagreement of assessments by two experts, they reported 76% of patients were

managed suboptimally. This sub-optimal care included 35 specific medical errors (31% diagnostic, 57% therapeutic, 12% "other") in 15 patients. The most frequent diagnostic error was under appreciation of severity of illness, and delay in antibiotics and/or fluids was the most common treatment error.

While these findings are consistent with other research suggesting the importance of early recognition and resuscitation of children with sepsis, the lack of a control group makes the findings here difficult to interpret. The authors could have planned this as a case control study, adding to its credibility. Indeed, from this study it is not outside the realm of possibility that this same error rate occurred in survivors of severe bacterial infection, but we have no way of knowing.



Another concern about this investigation is the number of cases identified - only 23 deaths over a 6-year period in a region with 1.6 million people. **Watson et al** found a mortality rate from sepsis in US children to be

6.2 per 100,000 population. At this rate, Launay et al. should have identified perhaps four times as many deaths. The loss of 75% of potential cases further weakens this study's conclusion.

Although unique in approach and consistent with existing research and opinion, the findings of the new study must be taken with quite a bit of sel (French for salt).

- **Barry P. Markovitz,**
Los Angeles, California

Read More: Launay E, Gras-Le Guen C, Martinot A, Assathiany R, Blanchais T, Mourdi N, Aouba A, Bouvier-Colle MH, Rozé JC, Chalumeau M. Suboptimal care in the initial management of children who died from severe bacterial infection: A population-based confidential inquiry. [Pediatr Crit Care Med. 2010;Jan 9;](#)

Watson RS et al. The Epidemiology of Severe Sepsis in Children in the United States. [Am J Respir Crit Care Med 2003; 167:695-701](#) [FULL TEXT]

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Simon Says Keep it Simple at Discharge

It's 11 pm, close to shift change in the ED and you have to determine if a 5-year-old will use a dry powder inhaler properly at home post-discharge. The nurses are busy, the RT and PA are helping someone in the trauma bay with intubation, and the discharge planner is long gone.

What do you do? You keep it simple by using a tissue box in the room. Dr **Israel Amirav** from Safed and the Faculty of Medicine in the Technion, Haifa, Israel, and Dr **Michael Newhouse** from St Joseph's Hospital and McMaster University in Hamilton, Ontario, Canada, are suggesting in the *Journal of Pediatrics* to practice with the kids.

"1) The physician or nurse demonstrates first, holding the paper with both hands; 2) Placing the paper over the open mouth; 3) Inhaling through the open mouth, thereby creating a vacuum that keeps the paper attached to the mouth for an approximately 5-second count without holding the tissue; and 4) Asking the child to carry out the same maneuver with the physician". (See pictures. Published with permission). They could have easily called it the 'Hands-in-the-air emergency room game'.

- **Ran Goldman, Vancouver, Canada**

Read more : Amirav I, Newhouse MT. To Inhale or Not to Inhale: Is That the Question? A Simple Method of DPI Instruction. [J Pediatr. 2010;156\(2\):339-339.e1](#) [FULL-TEXT]

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PEM TODAY

Translating Science to Stretcher in Pediatric Emergency Medicine

Editor:

Dr. Ran Goldman (Vancouver, Canada)

Pediatric Research Emergency Therapeutics Program
BC Children's Hospital
Vancouver, BC, Canada

Editorial Coordinator:

Ms. Julia Wei

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Procedural Sedation and Analgesia

Ketamine is the most frequently used medication for procedural sedation in children. Therefore, it is imperative that we have a good grasp on adverse events associated with its use. In recent months, the Emergency Department Ketamine Meta-Analysis Study Group published two studies examining its adverse effects, namely airway and respiratory events, emesis, and agitation. In the first of these studies, **Green et al** pooled published data to identify 8,282 pediatric patients who were given ketamine sedation. The overall rate of airway or respiratory adverse events was 3.9%, including upper airway obstruction, apnea, hypoxia ($\leq 90\%$), or laryngospasm. None of these children required intubation or paralytics.

Predictors of adverse events included age under 2 years, high IV dosing of ketamine ($\geq 2.5\text{mg/kg}$ initial dose or $\geq 5.0\text{mg/kg}$ total dose), and concurrent use of midazolam. Unexpectedly, age over 13 years and use of anticholinergic medications were also risk factors. Higher ASA class, IV vs. IM administration, and oropharyngeal procedures did not affect the incidence of adverse events. Low IM dosing ($\leq 3.0\text{mg/kg}$) appeared to be the only protective factor.

A second look at the same cohort found emesis in 8.4%, recovery agitation in 7.6% and clinically important agitation in 1.4%. Predictors of emesis were high IV dosing, IM and increasing age (peak at 12 years). Recovery agitation was associated

with both low IM and high IV dosing, with no predictors for clinically important recovery agitation. Although the incidence of recovery agitation increased with age, there was such borderline statistical significance that it was deemed not to be clinically significant. The use of anticholinergics or benzodiazepines decreased the incidence of emesis, but neither was found to affect the incidence of agitation.



These two studies dispute some common preconceptions about ketamine sedation, notably the occurrence of emergence reactions in older children and the utility of concurrent anticholinergic medications. But what about the *choice* of anticholinergic? Is glycopyrrolate preferable?

Unexpectedly, glycopyrrolate was associated with a *higher* rate of airway complications than either atropine or no anticholinergic. Atropine was associated with less emesis. Patients receiving glycopyrrolate did have a higher rate of clinically important recovery agitation. What does this mean? First, if you use anticholinergic with ketamine, atropine appears to be the better choice. Second, glycopyrrolate may be associated with airway and respiratory events.

In another sedation study, **Andolfatto and Willman** reviewed 219 children 1-20 years old given single-syringe “ketofol” (1:1 mixture of 10mg/ml each of ketamine and propofol). The total amount of medication needed to achieve adequate sedation was determined at the discretion of the ED physician. The average dose needed was 0.8mg/kg of each drug, lower than the usual dose needed of either drug alone. Only 3 patients (1.4%) had airway events, one of whom required positive-pressure ventilation, but no intubation. Two patients (0.9%) experienced emergence reactions requiring benzodiazepines. Median recovery time from ketofol was 14 minutes, compared to 25-103 minutes from ketamine alone. Overall, ketofol is not only effective in achieving procedural sedation and analgesia, but it is safe in children and results in shorter recovery times in the group studied.

Rini Jain (Fellow)
Ran Goldman
Vancouver, Canada

Read more: Green SM et al. (For the Emergency Department Ketamine Meta-Analysis Study Group). Predictors of Airway and Respiratory Adverse Events With Ketamine Sedation in the Emergency Department: An Individual-Patient Data Meta-analysis of 8,282 Children. [Ann Emerg Med. 2009; 54:158-168.](#)

Green SM et al. (For the Emergency Department Ketamine Meta-Analysis Study Group). Predictors of Emesis and Recovery Agitation With Emergency Department Ketamine Sedation: An Individual-Patient Data Meta-Analysis of 8,282 Children. [Ann Emerg Med. 2009; 54:171-180.](#)

Green SM et al. Anticholinergics and Ketamine Sedation in Children: A Secondary Analysis of Atropine Versus Glycopyrrolate. [Acad Emerg Med. 2010; 17:157-162.](#)

Andolfatto G and Willman E. A Prospective Case Series of Pediatric Procedural Sedation and Analgesia in the Emergency Department Using Single-syringe Ketamine-Propofol Combination (Ketofol). [Acad Emerg Med. 2010; 17:194-201.](#)

To the Point

Leucocytosis

This retrospective case control study conducted in an Israeli ED demonstrated that SBI was found in 39% of those with a leucocytosis of greater than 25,000 as compared to a control group with fever who had a SBI rate of 15.4%. The most common SBI in the high leucocytosis group was a lobar pneumonia at a rate of 72%.

[Arch Dis Child. 2010 Mar;95\(3\):209-12](#)

Sepsis

This retrospective cohort study, which gathered its data from 104 pediatric centers in 18 countries, demonstrated that children with severe sepsis who received adjunctive corticosteroid therapy had no change in mortality, vasoactive-ionotropic infusion days, or days on a ventilator. One month mortality rates were 15.1% versus 18.8% for those receiving and not receiving steroids respectively.

[Pediatr Crit Care Med. Mar 2010](#)

Cardiopulmonary Resuscitation

This Japanese national study demonstrated that bystander CPR improved pediatric neurological outcomes following a cardiac arrest regardless of arrest etiology. The arrests that were secondary to a cardiac causes conventional CPR were equally efficacious as compression-only CPR; however, this differed from resuscitations from non-cardiac arrests where conventional CPR had a more favorable outcome with an OR of 5.54 (2.5-17). For infants, outcomes were uniformly poor (1.7% with favorable neurological outcome).

[Lancet. 2010 Apr 17;375\(9723\):1347](#)

Ultrasound

The debate over who has ownership of the ultrasound continues with another study. This prospective study demonstrated that with focused ultrasound training, 3 Pediatric EM docs were able to determine if a hip had an effusion with an 80% sensitive and 98% specificity. Importantly, they achieved a 93% specificity and a positive predictive value of 92% for the symptomatic hip. The gold standard comparison was an ultrasound performed by the Radiology department.

[Ann Emerg Med. 2010 Mar;55\(3\):284-9](#)

Obesity and Injury

Considering obesity is reaching epidemic proportions in many countries, these authors wanted to assess if obese children have different injury patterns versus those who are not obese. Of note, 16.5% of the subjects met the author's definition for obesity, >95% weight for age (yes, no typo here!). The injury patterns were similar for upper extremity injuries, however, obese children had more lower extremity injuries and fewer head and face injuries.

[Pediatrics. 2010 Apr;125\(4\):681-5](#)

Cardiac Arrest

This retrospective study identified that having: 1) An initial cardiac rhythm, 2) A short duration of pre-hospital BLS, 3) A short interval between collapse and initial CPR, and 4) A short duration of in-hospital CPR, were factors that were predictive for better odds for obtaining a return of spontaneous circulation in 80 children with out-of-hospital non-cardiac causes of cardiac arrest, where the overall mortality rate was 92.5%.

[Am J Emerg Med. 2010 Mar;28\(3\):310](#)

PEM or Non-PEM

Ever wonder if EM vs Pediatric-trained docs treat pediatric patients differently? This retrospective cohort review of pediatric visits to 2 university-affiliated EDs in **Taiwan** showed that EM-trained doctors used radiographs and laboratory studies more often. Additionally, their LOS, admission and LWBS rates as well as recommendations for referral were all higher for ED-trained doctors. However, ED and Pediatric-trained docs treated the critical patients similarly.

[Am J Emerg Med. 2010 Mar;28\(3\):275](#)



Closer to Understanding SIDS

Periorbital Infections

This retrospective cohort study of all patients admitted with a diagnosis of periorbital or orbital cellulitis over a 14-year period of time tried to identify predictors for intraorbital or intracranial abscesses. The classic findings of proptosis, pain with extraocular movement and ophthalmoplegia were associated with an abscess. However, 50% of the proven abscess did not have these findings. Other factors which were associated with an abscess were absolute neutrophil count >10k, no signs of conjunctivitis, presence of edema, age >3 years old and previous antibiotic use.

[Pediatrics. 2010 Apr;125\(4\):e719-26](#)

Asthma

Is repeat albuterol sulfate HFA inhalation via MDI inhalers safe or even useful for the treatment of presumed acute obstructive airway disease in infants younger than 2 years? This randomized, double-blinded, multicenter study compared Albuterol HFA 180 vs. 360 micrograms. Overall, there was a clinical improvement by approximately 50% and limited adverse events. There were no significant differences in efficacy between the two groups.

[Pediatr Emerg Care. 2010 Mar;26\(3\):197](#)

Joshua Rocker,
Long Island, New York, USA

Despite the effectiveness of a number of public health campaigns, the incidence and biological basis of Sudden Infant Death Syndrome (SIDS) remains a challenge. One biological theory is about medullary serotonergic dysfunction. A group of pathologists from Boston have previously identified problems with serotonergic (5-hydroxytryptamine [5HT]) receptor binding in SIDS cases. This study of the medulla of 31 SIDS cases and 10 controls (acute deaths) from the San Diego Medical Examiner's office, California, aimed to look more closely at this homeostatic pathway. Receiving an asystolic infant and pronouncing it dead is a depressing part of our job in PEM, so while this study does not change our practice, any new research that helps explain SIDS is welcome.

Males are at higher risk for SIDS. The study found 5-HT receptor binding density significantly lower in male compared with female SIDS cases and in SIDS cases compared with controls. There was also noted to be an increase in 5-HT neurons at medullary sites in SIDS cases. The authors proposed the availability of 5-HT is therefore altered. The actual available 5-HT levels in the medulla of SIDS cases is yet to be determined, but this is obviously of interest for future work. A study in piglets indicated a blunted response to increased carbon dioxide levels in sleep when medullary 5-HT neurons were ablated.

Potential homeostatic failure of predisposed infants may explain why reducing the risk of airway smothering is so important.

Of interest to PEM specialists is the interaction of previously recognized risk factors (sex, race, prematurity, prenatal drug exposure, position placed to sleep, bed sharing and recent illness) for SIDS with serotonin receptor counts and binding densities. The study occurred during extensive public health campaigning about safe sleeping habits, yet 7 of the 31 infants were bed-sharing, and 20 were sleeping prone or on their side at the time of death.

The small number of cases and controls may limit the applicability of the results, although the group may have had more success than others, as informed consent is not required under Californian law from individual parents for research on sudden and unexpected infant death. Meanwhile, we should not get nonchalant about public health promotion, and should remember to mention good sleeping practices when talking with families of young infants in the ED.

Damian Roland (Fellow)
Ffion Davies
Leicester, UK

Read More: Duncan JR et al. Brainstem serotonergic deficiency in sudden infant death syndrome. [JAMA. 2010 Feb 3;303\(5\):430-7.](#)

Paterson DS et al. Multiple Serotonergic Brainstem Abnormalities in Sudden Infant Death Syndrome [JAMA. 2006;296\(17\):2124-2132](#)

Outcome Measurements in Simulation for PALS Scenarios

Development of simulation-based medical education (SBME) has matured substantially over the past several years as simulation technology has become more widespread in training programs. Greater emphasis has been placed on developing rigorous research methodology in simulation. Within pediatrics, in particular, simulation provides opportunities for experiential learning of knowledge and psychomotor skills that occur infrequently in the clinical setting, such as pediatric resuscitation skills. Simulation education can be utilized to teach individuals, assess performance, and to train interdisciplinary teams. In a recent article by **McGaghie et al**, the authors outline twelve features and best practices which every teacher should know in order to use simulation to maximum educational benefit. A new study by **Donoghue et al** focuses on one of these features, namely outcome measurement, which is one of the greatest challenges facing the field of SBME.

The authors analyzed a scoring instrument for clinical performance during PALS simulation scenarios. The study used a sample of subjects consisting of junior pediatric residents. Four scenarios were administered to each subject, tailored to measure performance pertinent to PALS algorithms, including pulseless arrest, tachycardia with poor perfusion, respiratory failure and shock. Four raters viewed videotaped performances of the residents and scored each subject using an instrument with trichotomous scoring system

task domains that included pulse check, CPR, IV/IO access, epinephrine, and defibrillation. The scoring instrument domains were tailored to each scenario.

The authors describe their analysis of the psychometric properties of the scoring instruments, including measures of generalizability, inter-rater reliability, discriminative and content validity. The instruments yielded scores that were both reliable and valid across multiple types of scenarios. Second-year pediatric residents outperformed first-year residents, inter-rater reliability was high and reproducibility of scores appeared to be minimally impacted by the number of raters of scenarios.

One can conclude, therefore, that these scoring instruments can be used as reliable and valid assessment tools within simulation teaching, specifically within PALS education.

The authors point out that criterion-related validity can only be assessed by knowing how performance in a simulated environment relates to performance with real patients. This is undoubtedly the “holy grail” within simulation research.

The importance of context in learning and practice has important implications for the process and method of delivery of training.

The future challenge of SBME research will require correlation of a clinician’s performance in a simulated environment with their performance in a real health care environment with actual patients. In order to realize the full potential of simulation’s predictive validity, demonstration of this type of correlation with clinical practice will be a prerequisite. Needless to say, this will be no easy task, but is necessary in order to advance the field scientifically. In order to bridge this gap, multi-institutional and interdisciplinary collaborations will be a key methodologic component, particularly within pediatrics.

- **Nicole Shilkofski, Baltimore, MD, USA**



Read More: McGaghie WC, Issenberg SB, Petrusa ER, Scalese RJ. A critical review of simulation-based medical education research: 2003-2009. [Medical Education 2010; 44: 50-63.](#) Donoghue A, Nishisaki A, Sutton R, Hales R, Boulet J. Reliability and validity of a scoring instrument for clinical performance during Pediatric Advanced Life Support simulation scenarios. [Resuscitation. 2010 Mar;81\(3\):331-6.](#)

Bronchiolitis – State of What We Know

Bronchiolitis remains a highly controversial leading cause of morbidity in infants and young children. Even the definition of bronchiolitis varies. **Zorc and Hall** help us figure out the recent evidence in a recent review in *Pediatrics*.

First, with the advance of molecular diagnostic techniques we now realize that there is a variety of viral pathogens that can cause bronchiolitis. Respiratory syncytial virus (RSV) is not alone. Recent studies have also found that infants and young children with bronchiolitis often are infected with more than one pathogen. In hospitalized children, the rate of co-infection was 10-30%, with the most common being RSV+Human Metapneumovirus (HMPV) or RSV+Rhinovirus. A Higher rate was documented in the young.

In the past few decades, increases in number of hospitalizations were reported. The mortality rate is low with < 400 deaths annually in the US. The majority of deaths occur in infants 6 months or less, with prematurity, underlying cardiac disease and immunodeficiency as high risk factors.

Individual physical examination findings are not good predictors of clinical outcome with the exception of pulse oxymetry (< 94%).

But the biggest controversy is treatment with a recent Cochrane review stating “a minority of studies finding improvement”. With bronchodilators, improvement was noticed among study and control subjects, 57%

compared to 43% respectively, but these were not statistically significant. This may be due to the clinical variability seen with bronchiolitis or due to other supportive measures provided to children that attributed to bronchodilators’ action.

Another meta-analysis that looked at hospitalization rates, found that bronchodilators had no effect. A different Cochrane systematic review comparing bronchodilators found a potential benefit with epinephrine. However, other recent studies including a multicenter **Pediatric Emergency Research Canada** (PERC) study that looked at number of hospitalizations, did not confirm a benefit with epinephrine.

The use of corticosteroids in the treatment of bronchiolitis has also been controversial. According to the multicenter trial from the **Pediatric Emergency Care Applied Research Network** (PECARN), corticosteroids (a single oral dose of dexamethasone) did not result in an improvement in clinical scores or the rate of hospitalizations.

However, in the PECARN study, the group that received both nebulized epinephrine (2 dosages) and dexamethasone, had a decreased admission rate compared to placebo. This raises the possibility of synergy between adrenergic agents and steroids. The number needed to treat to avoid admission was 11 infants. These results deserve further study and may guide future therapy. ... see next page

PEM TODAY Editorial Note

The smell of freshly pressed paper will never die. Yet, there are advantages in electronic publications like **PEM Today**, one of which is the use of WWW linking (hyperlinking) and multimedia. PEM Today is taking advantage of the non-printed material out there related to PEM, providing you in this issue and future ones, information and commentaries on online resources, images and videos related to our subspecialty.

- Ran Goldman, Vancouver, Canada

Improve Flow and See More

.....Bronchiolitis

Other treatment modalities have also been studied. Leukotriene receptor antagonist failed to show benefit so far. Hypertonic saline led to improvement in clinical scores and a decrease in length of hospital stay. Heliox, nasal continuous positive airway pressure, and surfactant are still being studied.

The current recommendations are: (1) Bronchodilators – no improvement in duration of illness or hospitalization. No routine use. May improve short-term clinical scores in a subset of patients. Use only after proven benefit in a trial of therapy. (2) Corticosteroids - no improvement in duration of illness or hospitalization. No routine use. (3) Leukotriene receptor antagonist - no improvement in duration of illness. Not recommended. (4) Nebulized hypertonic saline. May reduce inpatient hospital stay. No recommendation.

- Sharon Mace, Cleveland, OH, USA.

Read More: Zorc JJ, Hall CB. Bronchiolitis: recent evidence on diagnosis and management. [Pediatrics. 2010 Feb;125\(2\):342-9](#)

This may sound simple, but if you don't want patients to leave your ED prematurely, just improve your flow so you can see them faster. While this may seem simple, it is the essence of our business to see patients that are undifferentiated and arrive whenever they need us. Emergency patients do not call ahead to schedule an appointment. **Cross et al** from **Louisville** figured it out recently in a scientific way. In their paper in **Pediatric Emerg Care**, they retrospectively reviewed visits to their tertiary site during a one-year period. With a slightly more than 4% Left Without Being Seen (LWBS) rate out of more than 46,000 visits, they suggest that system related factors such as arrival time, arrival month, arrival day of week, patient acuity, concurrent premature departures, arrival rate and arrival period average length of stay, correlate with leaving without seeing the Doc. As in previous studies, patient level of acuity and socioeconomic status were patient-related factors affecting the decision to LWBS.

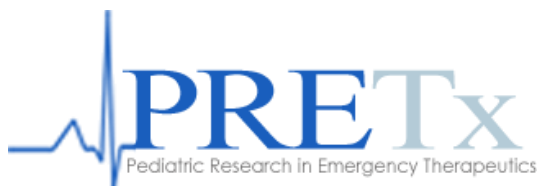


The LWBS issue is of great interest in PEM. For administrators in profit-based EDs, this is a source of revenue loss. Families may go to the ED across the street. For clinicians, the issues are around safety and providing care for children whose parents thought they should be seen by an emergency physician NOW! Are they at risk if parents leave prematurely? The literature from different parts of the world, mostly from North America, show that parents are smart. If children are at risk, and with high acuity, they rarely leave. Studies that followed-up with these families show very little morbidity and some savings, with reduced utilization of health care after LWBS (community care or return visits to the ED).

One question that is still not answered is the level of satisfaction these families may have (or not have). As EDs monitor satisfaction more often, and in some departments even remunerate their staff based on satisfaction surveys filled by parents after going home, the level of parental satisfaction may be of importance. It is definitely possible that satisfaction is unaffected. Some parents just leave because their children feel better while waiting, the fever subsides, because parents were reassured or because they just have better things to do at home. If this is the case, we may find another nail in the coffin of LWBS as a fundamental indicator for our performance in the ED.

- Ran Goldman, Vancouver, Canada

Read More: Cross KP et al. Premature Departure From the Pediatric Emergency Department: A Cohort Analysis of Process- and Patient-Related Factors. [Ped Emerg Care. 2010 May; 26\(5\):349-356](#)



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