Pediatric Toxidrome Simulation Curriculum: Salicylate Toxidrome

Created: November 4, 2013
Updated: June 24, 2014
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2. Description of Scenario

Scenario Overview
This scenario teaches learners to recognize and manage pediatric salicylate toxicity and its complications: metabolic acidosis, respiratory alkalosis, electrolyte abnormalities and cerebral dysfunction.

The scenario is simulation based with an integrated team communication focus.

Learners will identify the signs and symptoms of a salicylate toxidrome and learn the appropriate evaluation for and management of salicylate toxicity (Appendix A).

The learners should recognize the seriousness of the situation and organize a full resuscitation team. The primary complications for the team to recognize and manage are acid/base and metabolic disturbances, as well as altered mental status.

Educational Rationale on How the Scenario Generalizes to Real-Life Circumstances
Methyl salicylate is a compound found in many over-the-counter topical pain relievers and herbal remedies. When absorbed into the gastrointestinal system, it is rapidly hydrolyzed into salicylic acid, the active component of aspirin. The toxidrome is the same as with other salicylates. Consequences of toxic exposures may be severe including: respiratory alkalosis due to stimulation of the brainstem’s respiratory center (may be less pronounced or absent in young children), metabolic acidosis due to uncoupling of oxidative phosphorylation within mitochondria and generation of ketone bodies, central nervous system dysfunction and cerebral edema, pulmonary edema and electrolyte disturbances including hypokalemia. Dehydration may also occur due to losses through diaphoresis and emesis, as well as due to an increased metabolic rate. Other symptoms include fever, tinnitus and emesis. Toxicity may occur with doses of 150mg/kg with severe consequences seen with ingestions of >300mg/kg. Due to the concentrated nature of oil of wintergreen (98% methyl salicylate) an ingestion of 5 mL or less may be fatal.

The goal of this course is to provide the learner with an opportunity to manage a life threatening pediatric salicylate overdose, where the correct steps need to be taken in a limited period of time.

Key elements include the primary survey (including assessment of mental status), eliciting critical history (potential medication/ingestion exposures), organizing a team for assistance early, and recognizing and treating salicylate toxicity (airway support, fluid resuscitation, electrolyte correction, urine alkalinization, dialysis).

Duration of Training Session: 1 hour

Frequency of Scenario: Goal is to have each learner experience this scenario approximately once/year. We have a non-mandatory curriculum that offers a different scenario every 2 weeks. This particular scenario is offered approximately once a year.

Number of Trainees per Session: 5 to 10. This scenario is most realistic and achieves maximal learning, if all participants are functioning in their “normal” roles, with the same number of participants as would typically be expected. E.g.: nurses perform nursing roles, physicians perform physician roles, if a more experienced physician would normally function as the team leader, s/he plays that role in the simulation. If a response team at your institution normally consists of ~ 7 respondents, that should be the target number of trainees. If necessary, trainees or confederates can “act” to cover any unfilled
roles, or those roles can be left unfilled. The instructor should be aware however, that realism will be compromised, and learning objectives may be harder to achieve, if these compromises are made.
### 3. Target Trainees

<table>
<thead>
<tr>
<th>Primary:</th>
<th>Pediatric and emergency medicine residents, pediatric emergency medicine fellows, faculty, and nurses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary:</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Pediatric Salicylate Toxidrome
4. Prerequisite Knowledge & Skills

**Required background knowledge:**

- Anatomy related to the pediatric airway
- Application and use of airway adjuncts (oral, nasal airway), when appropriate
- Toxidrome of salicylate ingestion
- Skills required for the management of salicylates toxicity: fluid resuscitation, electrolyte correction, urine alkalinization, dialysis
- TeamSTEPPS communication terminology (Appendix F)

**Required background skills expected in trainees prior to receiving training in the target course:**

- Airway assessment
- Breathing assessment
- Circulation assessment
- Mental status assessment
5. Goals and Objectives

Goal 1: Recognition and Management of Altered Mental Status
The learner will improve skills in recognizing altered mental status in a pediatric patient in a safe and professional manner. (*ACGME Competencies: Medical Knowledge*¹, *Patient Care*², *Interpersonal and Communication Skills*³, *Professionalism*⁴, *System-based Practice*⁵, *Technical skills*⁶)

**Objective 1a - Demonstrate Initial patient assessment**¹,²,³,⁴
The learner will be expected to discuss what s/he would look for in an initial history and physical examination (primary survey) of a patient presenting to the emergency department.

**Objective 1b - Identify altered mental status**¹,²,³
The learner should identify signs of altered mental status (agitation, verbal/physical response, eye opening, ability to protect airway).

**Objective 1c - Apply appropriate monitoring**¹,²,³
The learner should be familiar with and apply basic monitoring standards for a patient with altered mental status (cardiorespiratory monitors, pulse oximetry, blood pressure, and temperature). S/he should obtain a patient weight or accurate estimate (i.e. Broselow-Luten Tape).

**Objective 1d - Demonstrate equipment setup**¹,²,³,⁶
The learner should be able to set up the equipment required to provide airway protection and/or ventilatory support in a patient with altered mental status: airway adjuncts (nasal/oral airways), supplemental oxygen, bag-mask ventilation, suction, endotracheal tube with stylet, and laryngoscope. S/he should know and select an appropriate size nasal airway, face mask, bag, endotracheal tube, and laryngoscope for the patient.

**Objective 1e - Demonstrate understanding of the relevant anatomy**¹
The learner should be able to identify pediatric anatomy that could impede ventilation. The neck should not be flexed or hyper extended. The airway should be evaluated for patency.

Goal 2: Recognition and Management of Salicylate Toxicity
The learner will recognize and treat salicylate toxicity in a safe and professional manner. (*ACGME Competencies: Medical Knowledge*¹, *Patient Care*², *Interpersonal and Communication Skills*³, *Professionalism*⁴, *System-based Practice*⁵, *Technical skills*⁶)

**Objective 2a - Recognize salicylate toxidrome**¹,²
The learner should identify physical exam findings consistent with salicylate toxicity: fever, tachypnea, altered mental status. The learner should also recognize the overlap with other potential causes of these symptoms including infection and other toxidromes. They should seek information from caregivers about potential exposures, and state that a toxidrome is part of the differential diagnosis.
5. Goals and Objectives

**Objective 2b- Evaluate for salicylate toxidrome**
The learner should identify the need for laboratory evaluation of a patient with a potential toxic salicylate ingestion and order/obtain a blood gas, electrolytes, serum glucose and serum salicylate level.

**Objective 2c- Management of salicylate toxidrome**[^1,2]
The learner should evaluate for the need for fluid resuscitation in the setting of salicylate toxidrome. They should recognize hypokalemia and correct deficiencies for optimal management. They should identify urine alkalization with intravenous sodium bicarbonate as the principle therapy for salicylate toxicity. They may require references to determine the correct dosing (D5W + 3 amps [150 mEq] sodium bicarbonate at 1.5-2 times maintenance; If acidemic start with an initial bolus of 1-2mEq/kg sodium bicarbonate before the drip). The learner should also identify the potential need for emergent hemodialysis and demonstrate the ability to acquire the addition resources and personnel needed for such therapy.

**Objective 2d– Apply appropriate monitoring**[^1, 2, 3]
The learner should recognize the need for ongoing monitoring (cardiorespiratory monitors, pulse oximetry, blood pressure, and temperature) and laboratory evaluation (serial urine pHs, blood gases, serum potassium levels).

**Goal 3: Teamwork and Communication Skills**
The learner will become more skilled in the management and leadership of emergency personnel including physicians, nurses, and ancillary personnel. *(ACGME Competencies: Medical Knowledge[^1], Patient Care[^2], Interpersonal and Communication Skills[^3], Professionalism[^4], System-based Practice[^5], Technical skills[^6]*)

**Objective 3a – Demonstrate ability to organize and manage a medical team**[^3, 4, 5]
The learner will be exposed to a full-scale manikin-based simulation in which the learners are faced with a life threatening emergency due to salicylate toxidrome and secondary respiratory failure. They will be expected to clearly identify (verbally or with visual cues) and maintain a team leader (orders, priorities verbally stated by team leader) and team member roles (questions, information directed to team leader).

**Objective 3b – Demonstrate effective team communication skills**[^3, 4, 5]
The learner will be required to direct available resources to manage salicylate toxicity. The team will be expected to brief at the beginning of the scenario and huddle during the scenario. The goal of briefing and huddling is to create a shared mental model, so that the team is on the same page regarding working diagnoses, treatment priorities and plan of care. S/he will coordinate, direct and communicate with a resuscitation team using directed call-out and check-back.
6. Instructor Notes

These are general “tips”. Everything in this section is included to help maximize the learning experience. They represent “Lessons Learned” from our experiences.

1. **Environmental Set Up (See Section 10)**
   - Try to re-create the location, look, and feel of the participants’ work environment.
   - Place simulator in a gown, diaper, etc. in order to maximize realism.

2. **Pre-Simulation Introduction**
   - Share a “learning contract” with participants. An example of some elements you may include: “We believe each of you is intelligent, well-trained, and doing their best” (adapted from the Center for Medical Simulation, Cambridge, MA). “We recognize this is a fictitious environment. We ask you to stretch your imagination, go beyond your comfort zone and help promote each others’ learning”.
   - Share ground rules with participants. (e.g., “Treat others with respect, maintain confidentiality, etc.”)
   - Share the agenda. (e.g., “We will begin with a 15 min simulation followed by a 30 min debrief.”)
   - Orient your participants. (e.g., Review capabilities of simulator being used. Review location/availability of equipment/supplies. Identify facilitator to whom requests/questions should be directed during the simulation.)
   - Review safety issues. (e.g., correct use of defibrillator.)
   - Review principles of teamwork and communication – TeamSTEPPS (See Appendix B). Review expectations of team leaders and members: take time to plan before a patient arrives (brief) and “get the team on the same page” (huddle).

3. **Scenario Notes**
   - A “trigger” is a critical time or event that signifies the start or end of a Stage in the scenario. These are the critical steps that help the scenario progress. Please review these prior to conducting your session.
   - Prompts: Sometimes learners get stuck- miss a physical exam finding, critical piece of history or don’t know/fail to implement a critical action that’s needed to help the team meet a learning objective or advance to the next stage. When this happens, the facilitator, who is actively monitoring the team’s progress, may choose to ask a question, state a cue or have a third party “drop a critical hint” in order to mobilize the team towards meeting the objectives. The instructor needs to balance, “keeping the team from failing to met the learning objectives” with the team’s opportunity to work through a problem. Be careful not to shift it from self-discovery to a lecture!

4. **Debriefing (See Appendix C)**
   - Remember: Try to have participants step away from the simulator, into a different space (e.g., chairs in a circle or separate room). This physical cue helps participants shift from “doing” - a clinical focus to “reflecting” - a learning focus.
   - Remind participants that the debriefing time is intended to focus on the group’s performance.

5. **Learner considerations**
   - Each group of learners’ needs will vary. Thus, we have included a range of potential objectives, which can be tailored to suit different learner groups. For example, for our less experienced clinical providers, we focus more on the medical decision making goals. For our more advanced providers, we focus more on the team work and communication goals.
6. Instructor Notes

- Consider “titrating” the learning objectives. E.g., for learners that have limited medical knowledge regarding toxic ingestions, considering ingestion in the differential diagnosis and knowing how to contact a toxicologist/poison control center will be all that we require to move them from Stage 2 to Stage 3. For experienced providers, we will want them to obtain electrolytes, order sodium bicarbonate for urine alkalinization and know how to contact services to arrange for hemodialysis before we will advance from Stage 2 to Stage 3.

- If you are instructing more experienced learners, consider titrating the scenario’s signal to noise ratio. E.g., for resident learner groups, we will run the scenario as written. For those with more experience, we might add more “noise”. This could be an actor playing the role of a grandma who gives less history and/or is crying or questioning the team.

- Participants: The most realistic and richest learning experiences occur when all the participants are performing their “normal” roles. E.g., physician functions as physician, nurse as a nurse, respiratory therapist as a respiratory therapist. If your learner group does not contain the full spectrum of “normal team members,” you may have to either ask some participants to function in different roles or provide “actors” to fill the necessary roles. Recognize that realism is going to be lost and learning opportunities missed. E.g., If the group is all physicians, none of your learners may have drug measuring/administration experience. As an instructor, you will need to make decisions on how much you want them to do in order to “get credit,” and be able to advance to the next stage in the scenario. Is it enough to be able to order the drug? Do they need to find the vial? Draw it up? Administer it to the simulator? Your answer should be driven on helping your learners to achieve the learning objectives.
7. Common Errors and Prevention Strategies

Common errors observed in trainees and strategies for helping address the errors

a. **Failure to include a toxidrome on differential diagnosis.**
   
   **Strategy:** Review potential causes of abrupt changes in mental status and vital signs.

b. **Failure to recognize salicylate toxidrome.**
   
   **Strategy:** Review signs of salicylate toxicity: fever, tachypnea, altered mental status, metabolic acidosis. Discuss importance of focused history including possible toxic exposures.

c. **Failure to treat salicylate toxidrome.**
   
   **Strategy:** Review treatment of salicylate toxicity: fluid resuscitation, intravenous sodium bicarbonate for urine alkalinization, correction of electrolyte abnormalities, dialysis.

d. **Fixation error:** focus on endotracheal intubation leading to failure address the metabolic sequelae of salicylate ingestion while further compromising the patient’s acid-base status.
   
   **Strategy:** Review how to assess airway and breathing and when intubation is emergently indicated. Discuss options for basic airway management: assessment, positioning, airway adjuncts (oral/nasal airways), bag mask ventilation (BMV) as progressive steps in airway management, if needed. Review that when patients with salicylate toxicity are ventilated using conventional settings, they are unable to regulate their acidemia by hyperventilation, leading to increased CNS penetration of the drug and worsened neurotoxicity.

e. **Inefficient teamwork**
   
   **Strategy:** Review need to brief (discuss team roles) prior to a critical situation and huddle (ad-hoc planning to re-establish situation awareness) during a crisis.

f. **Inefficient communication: lack of call-out**
   
   **Strategy:** Review importance of directed communication:
   
   “Survey MD- What’s the airway status?”

g. **Inefficient communication: lack of check-back**
   
   **Strategy:** Review use of closed-loop communication:
   
   Team Leader- “Give sodium bicarb 15 mEq.”
   Med Prep RN- “Sodium bicarb 15 mEq.”
   Team Leader- “That’s correct.”

General strategies to solve the problems

- Increase knowledge base: assigned reading, lectures, TeamSTEPPS training
- Debriefing focused to re-evaluate critical thinking and structure planning of actions
- Teaching points based on errors
- Regular simulation training to avoid previous mistakes
8. Cognitive Training

Key methods for delivering cognitive training include the following:

- Salicylate Toxicity PowerPoint Handouts (See Appendix G)
# 9. Skill Training

<table>
<thead>
<tr>
<th>Participants:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor #1: Team Leader</td>
</tr>
<tr>
<td>Doctor #2: Airway Physician</td>
</tr>
<tr>
<td>Doctor #3: Survey Physician</td>
</tr>
<tr>
<td>Nurse #1: Medication Administration Nurse</td>
</tr>
<tr>
<td>Nurse #2: Documenting or Circulating Nurse</td>
</tr>
<tr>
<td>Instructor #1: Attending PEM or EM physician</td>
</tr>
<tr>
<td>Instructor #2:</td>
</tr>
<tr>
<td>If a 2\textsuperscript{nd} instructor is available, cast them as “grandma,” available to answer questions.</td>
</tr>
<tr>
<td>If a 2\textsuperscript{nd} instructor isn’t available, the facilitator can play the role of grandma as well.</td>
</tr>
</tbody>
</table>

To begin:
- This scenario works best if learners function in their normal roles (physicians function as physicians, nurses as nurses). If your learners consist only of physicians, please ask 1-2 of them to function as nurses during the scenario. To maximize the realism of the scenario, it helps to ask them to do everything a nurse would normally do at your institution.
- If your learners have not been introduced to the concept of specific team roles (including a team leader) and responsibilities, we recommend discussing your institutional standard prior to the start of the scenario. If your learners are already familiar with this concept, we recommend reminding them of your institution’s code team roles and responsibilities prior to the start of the scenario. Based on your learners needs/experience, the instructor can decide whether to assign roles or allow them to determine their own roles during the brief. Depending on the needs of your learners, you may choose to have the learners remain in the same roles throughout the scenario or rotate. Please state your expectation to the group. (i.e., “Now that we have reviewed the code team roles and responsibilities, I will assign the team leader to be Dr. Hobbs. Dr. Hobbs, you will have the opportunity to assign all other roles and organize your team after I introduce you to the scenario (prelude)”).
- Remind them that an instructor/facilitator (identify who) will be available to answer questions (i.e., history, labs) and assist them (if they are having difficulty examining SimBaby or finding equipment). Not all results or requests may be available at the time the request is made.
- All learners will be read the Prelude outside the simulation area.
- Following the Prelude, give the team 2 minutes to brief. This is their opportunity to organize their team prior to receiving the triage history.
- The team will then be read the Triage history outside the simulation area and then be permitted to enter the “patient’s room”.
- Remind them that “grandma” (identify who) is also available to answer questions.

**Prelude: 0-3 minutes**

**Introduction:**
We just received a phone call from a grandma. Her 15 month old grandson seems very agitated and has a fever. She states that he was perfectly fine when he went down for his nap 2 hours ago. She’ll be here in 2 minutes. You have 2 minutes to organize your team.

(Give the team 2 minutes to brief).
Triage history:
The triage nurse is bringing back the grandmother and Henry, a 15 mo old boy. Henry was in good health this morning and spent the day at her grandmother’s house. He has not been sick recently. He is very agitated and has a temperature of 38.0°C.

Grandma is available to answer questions. (___) will be playing the role of grandma.

(The team can now enter the simulation room to meet the patient).

Stage 1: Medical Assessment
3-5 minutes
Triggers: Team leader orders labs including blood gas

Additional History and Medical Information if asked:

Henry: 15 mo boy.

Chief Complaint: Fever and agitation

History: He was in good health this morning. He spent the day at his grandmother’s house. The grandmother put him down for a nap in her room. She became concerned when she went to check on him 2 hours later and noticed that he was very hot and seemed confused. There was emesis in the bed when she found him. The grandmother drove Henry to the ED. He has not been sick (no cold, cough, fever, emesis, diarrhea) prior to the nap.

PMH:
- Healthy, no medical problems
- Immunizations up to date

Medications:
- Henry is not on any medications.
- If asked, the grandmother takes anti-hypertensive medications and naproxen for arthritis. She also uses topical medications including Bengay and Oil of Wintergreen for her arthritis. If asked the topical medications are kept at her bedside, and she can call home to see if they have been opened.

Social:
Lives with mom and dad; cared for by grandma 2 times weekly.

Allergies:
None
9. Skill Training

Initial Examination (becomes available with appropriate monitors, evaluation):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhythm</td>
<td>Sinus tachycardia</td>
</tr>
<tr>
<td>HR</td>
<td>185 bpm</td>
</tr>
<tr>
<td>BP</td>
<td>115/69</td>
</tr>
<tr>
<td>Sat</td>
<td>99%</td>
</tr>
<tr>
<td>RR</td>
<td>45/min</td>
</tr>
<tr>
<td>Temp</td>
<td>38.2</td>
</tr>
<tr>
<td>Wt</td>
<td>15 kg</td>
</tr>
</tbody>
</table>

Appearance: Sleepy, agitated with stimuli.

HEENT: Neck supple, tacky mucous membranes

Respiratory: Tachypneic. Clear breath sounds bilaterally. No retractions, nasal flaring or grunting.

Circulation: Tachycardic with regular rhythm. Cap refill <2 seconds. 1+ pulses.

Abdomen: Soft, non-tender, non-distended

Neuro: Pupils 3mm, equal, round and reactive to light. Localizes to painful stimuli. Opens eyes spontaneously.

Skin: Sweaty, no rash or bruises

Stage 2: Salicylate Toxidrome
5-15 minutes

Triggers: Start- Blood gas ordered
End- Sodium bicarbonate bolus is given

Physical Examination:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhythm</td>
<td>Sinus tachycardia</td>
</tr>
<tr>
<td>HR</td>
<td>165 bpm</td>
</tr>
<tr>
<td>BP</td>
<td>110/62</td>
</tr>
<tr>
<td>Sat</td>
<td>99%</td>
</tr>
<tr>
<td>RR</td>
<td>45/min</td>
</tr>
<tr>
<td>Temp</td>
<td>38.0</td>
</tr>
</tbody>
</table>

If requested:

Appearance: Sleepy, agitated with stimuli. If salicylate ingestion not stated as a potential diagnosis by 5 minutes in this Stage, the RN states a minty smell from the patient

HEENT: Neck supple, tacky mucous membranes

Respiratory: Tachypneic. Clear breath sounds bilaterally. No retractions, nasal flaring or grunting.
9. Skill Training

**Circulation:** Tachycardic with regular rhythm. Cap refill <2 seconds. 1+ pulses.

**Abdomen:** Soft, non-tender, non-distended

**Neuro:** Pupils 3mm, equal, round and reactive to light. Localizes to painful stimuli. Opens eyes spontaneously.

**Skin:** Sweaty, no rash or bruises

*If requested:* Grandmother has called home to her husband. The tube of Bengay is still closed but the bottle of oil of wintergreen was opened and is spilled all over the floor. The bottle contained 12 ounces when purchased and she thinks it was approximately half full, last time she used it.

*Potential Interventions:*

- If requested: Doctor #2, #3, and Nurse #2 are available to participate.
- If requested: Oral airway is available, but makes patient vomit if attempted.
- If requested: Nasal airway is available, but makes patient agitated.
- If requested: IV access obtained on first attempt.
- If requested: A normal saline bolus is pushed over 3 minutes.
- If requested: Bedside electrolytes and venous blood gas are available 2 minutes after obtaining sample. 7.18/32/75/-18 AG 22. Na 134, K 2.8, Cl 104, Bicarb 8, BUN 24, Cr 0.2
- If requested: Glucose 75
- If requested: Dextrose is available for bolus administration.
- If requested: Urinalysis, urine culture and/or urine tox screen are collected by cath and sent to lab.
- If requested: Blood work other than bedside blood gas, electrolytes and serum glucose are sent to lab.
- If requested: Antibiotics may be ordered from pharmacy.
- If requested: Acetaminophen or ibuprofen may be given for fever.
- If requested: A toxicology expert is available to discuss the management of salicylate ingestion.
- If requested: The x-ray technician will not be available to take x-rays for 15 minutes.
- If requested: Intubation equipment available: endotracheal tubes, laryngoscopes, suction, colorimeter.

**Optional Stage 3: Intubation**

*15-25 minutes*

**Triggers:**

- Start- Decline in GCS to 6
- End- Confirmation of endotracheal intubation

**Physical Examination:**

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Sinus tachycardia</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>189 bpm</td>
</tr>
<tr>
<td>BP</td>
<td>85/43</td>
</tr>
</tbody>
</table>
9. Skill Training

If requested:

**Appearance:** Unresponsive,
**HEENT:** Neck supple, tacky mucous membranes
**Respiratory:** Poor respiratory effort. Clear breath sounds bilaterally. No retractions, nasal flaring or grunting.
**Circulation:** Tachycardic with regular rhythm. Cap refill 3-4 seconds. 1+ pulses.
**Abdomen:** Soft, non-tender, non-distended
**Neuro:** does not open eyes or vocalize, does not withdraw to pain
**Skin:** Sweaty, no rash or bruises

*If requested:* Grandmother has called home to her husband. The tube of Bengay is still closed but the bottle of oil of wintergreen was opened and is spilled all over the floor.

**Potential Interventions:**

- If requested: Doctor #2, #3, and Nurse #2 are available to participate.
- If requested: Oral airway is available.
- If requested: Nasal airway is available.
- If requested: A normal saline bolus is pushed over 3 minutes.
- If requested: Bedside venous blood gas is available 2 minutes after obtaining sample. 7.02/65/68/-22.
- If requested: Rapid sequence intubation medications available: atropine, fentanyl, midazolam, etomidate, rocuronium, lidocaine and succinylcholine.
- If requested: X-ray technichian is available to take post-intubation chest x-ray.
- If requested: A PICU consultation will be available in 15 minutes.
- If requested: RT will be available in 15 minutes.

Stage 4: Resolution
15-20 minutes or
25-30 minutes (with Stage 3)

**Triggers:**
- Start- Sodium bicarbonate bolus given or ET tube placement confirmed
- End- Sodium bicarbonate drip ordered and nephrology has been consulted regarding dialysis or 10 minutes total in this stage

**Physical Examination:**

<table>
<thead>
<tr>
<th>Physical Examination</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rhythm</strong></td>
<td>Sinus tachycardia</td>
</tr>
<tr>
<td><strong>HR</strong></td>
<td>145 bpm</td>
</tr>
<tr>
<td><strong>BP</strong></td>
<td>110/62</td>
</tr>
<tr>
<td><strong>Sat</strong></td>
<td>99%</td>
</tr>
</tbody>
</table>
9. Skill Training

**RR** 45/min (bagged rate if intubated)
**Temp** 37.8

*If requested:*

**Appearance:** Sleepy, agitated with stimuli.
**HEENT:** Neck supple, tacky mucous membranes
**Respiratory:** Tachypneic. Clear breath sounds bilaterally. No retractions, nasal flaring or grunting.
**Circulation:** Tachycardic with regular rhythm. Cap refill <2 seconds. 1+ pulses.
**Abdomen:** Soft, non-tender, non-distended
**Neuro:** Pupils 3mm, equal, round and reactive to light. Localizes to painful stimuli. Opens eyes spontaneously. (Unresponsive if intubated; withdraws to pain if no paralytic given)
**Skin:** No rash or bruises, sweaty

*Potential Interventions, if requested:*

- If requested: Sodium bicarbonate available for loading dose.
- If requested: Nephrology consult en route for consultation.
- If requested: Critical care en route for consultation.

*If ending scenario here consider asking:*
- Any additional evaluations/interventions team would like
- Anticipated disposition of patient
10. Equipment Set-up

Before each simulation, ensure the anticipated resuscitation equipment is available for the team’s use.

**Resources**
- PALS reference cards, material
- Patient Weight Estimator (e.g. Broselow-Luten tape)
- Pediatric Resuscitation Medication references (e.g.: Broselow tape, reference cards)
- Documentation forms

**Universal Precautions**
- Staff gowns
- Gloves
- Mask and face shields

**Medications (consider having all or only a limited number of medications available)**
- Adenosine
- Amiodarone
- Atropine
- Dextrose
- Epinephrine 1:10,000
- Etomidate
- Fentanyl
- Histamine 1 antagonist (e.g. diphenhydramine)
- Histamine 2 antagonist (e.g. ranitidine)
- Ketamine
- Lidocaine
- Midazolam
- Normal Saline/Lactated Ringers
- Rocuronium
- Sodium bicarbonate
- Steroids (e.g. methylprednisolone or dexamethasone)
- Succinylcholine
- Vecuronium

**Equipment**
- Simulator in hospital gown, on bed
- Monitor – NIBP, HR, RR, Oxygen saturation, temperature
- Blood Pressure cuff, Heart Rate monitor leads, Oxygen saturation probe, defibrillator cables
- Oxygen hook-up on wall or cylinder
- Bag-mask system, multiple size masks
- O₂ Mask, simple and/or non-rebreather
- Suction
- Thermometer
- Temperature probe
- Nasal, oral airways, multiple sizes
10. Equipment Set-up

Equipment Cont’d

- Shoulder roll
- Endotracheal tubes - 3.0, 3.5, 4.0, 4.5, 5.0, cuffed or uncuffed, stylets
- Laryngoscope, Miller and Mac blades, multiple sizes
- End-tidal CO2 colorimeter
- Nasogastric tube(s)
- Stethoscopes
- IV/Angiocaths, various sizes
- IO needles, 2 sizes
- Gauze, Tape
- IV tubing
- IV pumps, pressure bags
- Syringes, multiple sizes
- Bedside blood sample processors: glucose, electrolytes, gases
- Specimen tubes
- Crash cart & backboard
- Defibrillator
11. Assessment Methods

Type(s) of Assessment Methods Used in This Course:

- [ ] Pre-test Only
- [ ] Pre-test & Post-test
- [ ] Post-test Only
- ✓ Medical Management Evaluation (Appendix C)
- ✓ Crisis Resource Management Evaluation (Appendix D)
- ✓ Simulation Session Evaluation (Appendix E)
# 12. Appendices

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
</tr>
</thead>
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<td>Appendix A</td>
<td>Pediatric Salicylate Toxidrome Scenario Algorithm</td>
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<td>Appendix B</td>
<td>Debriefing Overview</td>
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<td>Appendix C</td>
<td>Pediatric Salicylate Toxidrome Medical Management Evaluation/Debriefing Form</td>
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<td>Appendix D</td>
<td>Pediatric Salicylate Toxidrome Crisis Resource Management Evaluation/Debriefing Form</td>
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<tr>
<td>Appendix E</td>
<td>Pediatric Salicylate Toxidrome Simulation Session Evaluation Form</td>
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<td>Appendix G</td>
<td>Lecture Slides/Handouts</td>
</tr>
<tr>
<td>Appendix H</td>
<td>References</td>
</tr>
</tbody>
</table>
Appendix A: Scenario Algorithm

SCENARIO TIMELINE

Prelude:
Start Timer: 0–3 min.
Scenario intro and team brief

Stage 1: Medical Assessment
3-5 min.
Triggers: Start 3 min into scenario or
Team leader orders blood gas
End: 5 min into scenario

Stage 2: Salicylate Toxidrome
6-16 min.
Triggers: Start 5 min into scenario
End: 15 min into scenario or when
bicarbonate bolus is given

Stage 3: Intubation
16-26 min.
Triggers: Start 15 min into scenario or when
bicarbonate bolus is given
End: 26 min into scenario or with
confirmation of endotracheal tube
placement

Stage 4: Resolution
16-20 min. (without Stage 3)
25-30 min. (with Stage 3)
Triggers: Start 15 min or with
confirmation of the endotracheal tube
placement
End: sodium bicarbonate drip ordered
and nephrology has been consulted

VITAL SIGNS

- Rhythm: sinus
- HR: 105 bpm
- BP: 115/69
- SAT: 99%
- RR: 45/min
- Temp: 38.2°C
- Wt: 15kg

- Rhythm: sinus tachycardia
- HR: 105 bpm
- BP: 110/62
- SAT: 99%
- RR: 45/min
- Temp: 38.0°C

- Rhythm: sinus tachycardia
- HR: 105 bpm
- BP: 85/43
- SAT: 94%
- RR: 12/min
- Temp: 38.0°C

- Rhythm: sinus tachycardia
- HR: 145 bpm
- BP: 110/62
- SAT: 99%
- RR: 45/min (bagged rate if
intubated)
- Temp: 37.8°C

FACILITATOR INFORMATION

- Allow team to brief outside
the simulation room

- Pt. sleepy, agitated with stimuli
- CR < 3 sec
- If requested, additional exam
information available

- Pt. sleepy, agitated with stimuli
- CR < 2 sec
- If requested, additional exam
information available

- Pt. unresponsive
- CR 3-4 sec
- Does not open eyes or vocalize
- If requested, additional exam
information available

- Pt. sleepy, agitated with stimuli
- CR < 2 sec
- If requested, additional exam
information available

Pediatric Salicylate Toxidrome
Simulation creates the opportunity to debrief.

We believe that the focus of each simulation should be the DEBRIEF. Simulation creates the opportunity to examine our medical management, technical skills and teamwork and communication skills. It facilitates discussion about challenges in a safe environment in order to improve the quality of patient care.

Framework for debriefing:
Each debrief should consist of 4 components:

- Introduction
- Discussion of emotions
- Discussion of medical management and technical skills
- Discussion of teamwork and communication skills

1) **Introduction**
This “sets the stage” for debriefing and creates expectations.
What you might say:
- This is an opportunity to reflect and learn, improve our medical care, team work, and communication.
- Everyone should be able to ask questions and share their thoughts.
- Once you leave this session, we encourage open discussion of the concepts, but ask you to not to discuss individual performance.

2) **Emotional experience discussion**
There are a couple of camps regarding discussing emotions. One perspective is that until emotions are dealt with, it’s difficult for adult learners to “move on” and switch gears to process thoughts, actions and opportunities for improvement. Another perspective is that adult learners should process their emotions independently.

Our perspective is the first. If a group or team member is emotionally charged (sad, mad or frustrated) regarding something that did or didn’t happen in a scenario, it’s usually difficult for the individual or the group to be actively engaged, receptive to feedback and able to promote learning, until the emotions are addressed.

**Example: Medication Error:** One team member may think it is all his/her fault. S/he may feel embarrassed, judged, etc. If he/she can verbalize this, other team members may offer different perspectives, which enable the team to process the error together, potentially identifying contributing systems issues. If emotions are not addressed - 3 separate people may feel embarrassed, responsible and not engage in a discussion, failing to identify systems issues which led to the error.

What you might say:
- *How did that feel?*
- *Can you tell me more? Why?*
Appendix B: Debriefing Overview

3) Medical management and technical skills
This portion of the discussion focuses on the medical aspects of the scenario. It’s usually more comfortable to begin with these “facts”.

What you might say:
- Let’s begin by discussing medical management.
- What did you think was wrong with the patient? Can someone briefly summarize what happened in this scenario?
- How did you reach those conclusions?

4) Teamwork and communication (a.k.a. crew resource management, non-technical skills, human factors)
This portion of the discussion focuses on how the team worked together. It can be emotionally charged and difficult to discuss without feeling personal. The challenge is to try to generalize specifics into themes.

What you might say:
- Let’s talk about how you functioned as a team.
- What did your team do well?
- What could your team do differently next time?
- That is something I see often. Has anyone else experienced that? How have you seen that handled?

4) Summarizing
- This is your opportunity to ensure the key learning points are highlighted
- Try to identify approximately three take-home points
- You may ask the participants’ to identify take home points or call them out yourself.

    Medical management/technical skills examples:
    (a) This was a case of pediatric salicylate toxicity leading to altered mental status and metabolic acidosis.
    (b) Signs of salicylate toxicity including fever, tachypnea, acid/base and metabolic disturbances and altered mental status.
    (c) Management of salicylate toxicity including fluid resuscitation as needed, urine alkalinization with intravenous sodium bicarbonate, hemodialysis, potential intubation

    Teamwork/ communication examples:
    a) Recognize need for a full resuscitation team when a patient develops altered mental status.
    b) Designate leadership and team member roles to ensure coordinated team functioning.
    c) Use brief or huddle to create a shared mental model for the working diagnosis and treatment plan.
Appendix B: Debriefing Overview

General Debriefing Goals:
- Try to facilitate the TEAM’s discussion (avoid dominating the conversation)
- Ask open ended questions (avoid yes/no questions)
- Discuss the team performance (not the individual)
Pediatric Salicylate Toxidrome: Medical Management

This checklist identifies core medical management skills. We recommend focusing on 2-4 of these issues.

<table>
<thead>
<tr>
<th>Assessment of ABCDE’s</th>
<th>□ Done Well</th>
<th>□ Needs Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific comments:</td>
<td></td>
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<td></td>
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</tbody>
</table>

What did you think of the assessment of the ABCDE’s? What could you do differently?

<table>
<thead>
<tr>
<th>Obtaining significant history</th>
<th>□ Done Well</th>
<th>□ Needs Work</th>
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</thead>
<tbody>
<tr>
<td>Specific comments:</td>
<td></td>
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</table>

What’s in a SAMPLE history? Signs and symptoms, Allergies, Medications, Past Medical History, Last meal, Events. What made you think/not think about potential exposures/ingestions?

<table>
<thead>
<tr>
<th>Avoiding premature diagnostic closure</th>
<th>□ Done Well</th>
<th>□ Needs Work</th>
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</thead>
<tbody>
<tr>
<td>Specific comments:</td>
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</table>

Discussion Points: What other potential etiologies could cause these signs and symptoms? How did you decide what the most likely cause was? What other studies and therapies would you pursue in the case?

<table>
<thead>
<tr>
<th>Recognizing salicylate toxicity</th>
<th>□ Done Well</th>
<th>□ Needs Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific comments:</td>
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</table>

Discuss Points: What are the signs of salicylate toxicity- altered mental status, fever, tachypnea, metabolic gap acidosis. What would have helped you identify the cause sooner?

<table>
<thead>
<tr>
<th>Managing salicylate toxicity</th>
<th>□ Done Well</th>
<th>□ Needs Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific comments:</td>
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</tbody>
</table>
Appendix D: Crisis Resource Management Evaluation and Debriefing Form

Discuss Points: What’s the treatment for salicylate toxicity? Sodium bicarbonate hemodialysis for severe toxicity. What is the risk of intubating patients with salicylate toxicity? Pediatric Salicylate Toxidrome: Crisis Resource Management Evaluation
This checklist identifies core teamwork and communication skills. We recommend focusing on 2-4 of these issues.

| Recognize Emergent Situation and Call for Help | □ Done Well | □ Needs Work |

Specific comments:

| Discussion Points: What helped you recognize this was an emergent situation and call for more help? What hindered you? |

| Leader Identified | □ Done Well | □ Needs Work |

Specific comments:

| Discussion Points: What helped the leader be effective? What hindered having clear leadership? |

| Roles Delegated/Maintained | □ Done Well | □ Needs Work |

Specific comments:

| What helped/ hindered delegation/maintaining roles? |

| Directed Messages | □ Done Well | □ Needs Work |

Specific comments:

| Discussion Points: How were orders given- “Into the air” or directed at specific individuals? What did that impact you? How could they be delivered more effectively? |

| Closed Loop Communication | □ Done Well | □ Needs Work |

Specific comments:

| Discussion Points: Describe closed loop communication. |
Appendix D: Crisis Resource Management Evaluation and Debriefing Form

<table>
<thead>
<tr>
<th>Section</th>
<th>Done Well</th>
<th>Needs Work</th>
<th>Specific comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing Knowledge</td>
<td></td>
<td></td>
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<tr>
<td>Discussion Points:</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>How did team members share info?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What thoughts guided your actions?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recognize Limitations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion Points:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What did you think about your ability to “complete all your tasks”?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What could have been done?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reevaluation/Summarizing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion Points:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At what points is it valuable for the team leader to reevaluate/summarize?</td>
<td></td>
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</tr>
<tr>
<td>How can a summary be provided?</td>
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</tr>
<tr>
<td>What can you do as a team member when you want one?</td>
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</tbody>
</table>
## Appendix E: Simulation Evaluation Form

**Simulation Session Evaluation Form**

<table>
<thead>
<tr>
<th>Facilitator: ______________________________</th>
<th>Date: __________________</th>
</tr>
</thead>
</table>

**Case Presented:** Salicylate Toxidrome

<table>
<thead>
<tr>
<th>1. This simulation case provided is relevant to my work.</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

| 2. The simulation case was realistic.                  | 1                 | 2        | 3       | 4     | 5              |

| 3. This simulation case was effective in teaching basic resuscitation skills. | 1                 | 2        | 3       | 4     | 5              |

| 4. This simulation case was effective in teaching case-specific management skills. | 1                 | 2        | 3       | 4     | 5              |

| 5. The debriefing after the case was useful.          | 1                 | 2        | 3       | 4     | 5              |

Can you list/describe 1 or more ways this simulation session will change how you do your job?

How could we improve this scenario?

Comments:
# Appendix F: TeamSTEPPS References

## TeamSTEPPS Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptableity</td>
<td>The ability to adjust strategies and altering a course of action in response to changing conditions (internal and external).</td>
</tr>
<tr>
<td>Brief</td>
<td>Discussion prior to start that assigns essential roles, establishes expectation, anticipated outcomes, and likely contingencies.</td>
</tr>
<tr>
<td>Call-Out</td>
<td>A tactic used to communicate critical information during an emergent event. Helps the team prepare for vital next steps in patient care. <em>(Example: “Airway status?” – “Airway clear”; “Breath sounds?” – “Breath sounds decreased on right”)</em></td>
</tr>
<tr>
<td>Check-Back</td>
<td>A communication strategy that requires a verification of information. The sender initiates the message; the receiver accepts it and restates the message. In return, the sender verifies that the re-statement of the original message is correct or amends if not. <em>(Example: “Give 25 mg Benadryl IV push” – “25 mg Benadryl IV push” – “That’s correct”)</em></td>
</tr>
<tr>
<td>CUS</td>
<td>Signal phrases that denote “I am Concerned, I am Uncomfortable, This is a Safety Issue.” When spoken, all team members will understand clearly not only the issue but the magnitude of the issue.</td>
</tr>
<tr>
<td>Debrief</td>
<td>Brief, informal information exchange session designed to improve team performance and effectiveness.</td>
</tr>
<tr>
<td>DESC Script</td>
<td>A technique for managing and resolving conflict. Describe the specific situation or behavior; provide concrete data. Express how the situation makes you feel/what your concerns are. Suggest other alternatives and seek agreement. Consequences should be stated in terms of impact on established team goals; strive for consensus.</td>
</tr>
<tr>
<td>Huddle</td>
<td>Ad hoc planning to re-establish Situation Awareness; designed to reinforce plans already in place, and assess the need to adjust the plan.</td>
</tr>
<tr>
<td>I'M SAFE</td>
<td>A checklist to determine both your coworkers’ and your ability to perform safely: I = Illness; M = Medication; S = Stress; A = Alcohol and Drugs; F = Fatigue; E = Eating and Elimination.</td>
</tr>
<tr>
<td>SBAR</td>
<td>A framework for team members to structure information when communicating to one another. S = Situation (What is going on with the patient?) B = Background (What is the clinical background or context?) A = Assessment (What do I think the problem is?) R = Recommendation (What would I do to correct it?)</td>
</tr>
<tr>
<td>Shared Mental Model</td>
<td>An organizing knowledge structure of relevant facts and relationships about a task or situation that are commonly held by team members</td>
</tr>
<tr>
<td>Situation Awareness</td>
<td>The ability to identify, process, and comprehend the critical elements of information about what is happening to the team with regards to the mission. It is knowing “What is going on around you” and “What is likely to happen next”.</td>
</tr>
<tr>
<td>Situation Monitoring</td>
<td>The process of actively scanning and assessing elements of the situation to gain information or maintain an accurate awareness or understanding of the situation in which the team functions.</td>
</tr>
<tr>
<td>Two-Challenge Rule</td>
<td>Assertively voicing concern at least two times to ensure it has been heard.</td>
</tr>
</tbody>
</table>
Pediatric Salicylate Toxicity

Rebekah Burns, MD
Suzan Mazor, MD

Primary Survey

• A is for Airway
  — Patent, obstructed, maintainable
• B is for Breathing
  — Independent, needs assistance, breath sounds
• C is for Circulation
  — Central pulses, heart rate, capillary refill
• D is for Disability
  — Mental status (AVPU), check glucose
• E is for Exposure
  — Remove clothing, check and control temperature
Pediatric Salicylate Toxicity

- Therapeutic dose 10mg/kg
- Minimum toxic dose 150 mg/kg
- Severe toxicity >300mg/kg

Pediatric Salicylate Toxicity - Pathophysiology

- Metabolic
  - Stimulation of brainstem -> hyperventilation and respiratory alkalosis (less likely in children)
  - Interferes with Krebs cycle -> decreased ATP production
  - Uncouples oxidative phosphorylation -> accumulation of pyruvic and lactic acid, releases heat
  - Induces fatty acid metabolism -> ketone body production
Pediatric Salicylate Toxicity-Pathophysiology

- Pulmonary
  - Increased capillary permeability -> pulmonary edema
- Neurologic
  - Uncoupling of oxidative phosphorylation
  - Neuronal dysfunction, cerebral edema
  - COX inhibition -> ototoxicity, tinnitus
- Musculoskeletal
  - Uncoupling of oxidative phosphorylation -> rhabdomyolysis

Pediatric Salicylate Toxicity-Pathophysiology

- Gastrointestinal
  - Local irritation -> nausea, emesis
  - Stimulation of medullary chemoreceptor trigger zone -> nausea, emesis
- Hematologic
  - COX inhibition -> irreversible platelet dysfunction
  - Interruption of vitamin K metabolism -> hypoprothrombinemia
Pediatric Salicylate Toxicity-Presentation
- Symptoms
  - Tinnitus
  - Nausea/vomiting
- Physical exam
  - Fever
  - Tachypnea
  - Altered mental status
  - Diaphoresis
  - Crackles (pulmonary edema)

Pediatric Salicylate Toxicity-Lab Evaluation
- Metabolic gap acidosis
- Respiratory alkalosis
- Hypokalemia (may worsen with treatment)
- Elevated serum salicylate level
- Thrombocytopenia (late finding)
Pediatric Salicylate Toxicity - Treatment

- Activated charcoal- 1g can absorb 550 mg of salicylic acid
- Treatment of dehydration and electrolyte abnormalities
- Urine alkalinization
  - IV sodium bicarbonate bolus of 1-2 mEq/kg if acidemic followed by
  - IV D5 W + 3 amps (150 mEq)/L sodium bicarbonate at 1.5-2 times maintenance
- Titrate to goal urine pH of 7.5-8
- Hemodialysis

Pediatric Salicylate Toxicity - Indications for HD

- Renal failure
- Pulmonary edema
- Acute lung injury
- Persistent CNS disturbances
- Worsening hemodynamic instability
- Persistent acid-base or electrolyte abnormalities
- Salicylate concentration>100 mg/dL
Pediatric Salicylate Toxicity - Risk with Mechanical Ventilation

- Intubation may be required due to altered mental status or pulmonary edema but should be avoided if possible
- Ventilator settings should allow for hyperventilation to continue to compensate for the metabolic acidosis
- Conventional settings have been shown to lead to worsening acidosis, increased neurotoxicity and death
Appendix H: References


