Is there a Need for Immersive Workshop In Safe Medication Administration for New Anesthesia Providers?

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Outline

• Is patient safety still an issue?
• Medication safety
• Workshop Development
• Hierarchical Task Analysis
• Future Directions
Is patient safety still an issue?

- **To Err is Human: Building a Safer Health System 2000**¹
  - 44,000 deaths
  - As many as 98,000 deaths from preventable medical errors

Is patient safety still an issue?

- Preventing Medication Errors 2007
  - Change relationship between provider and patient
  - Using information technologies
  - Improved medication labeling
  - Policy: increased funding for medication administration safety research
  - Suggests increased training on medication administration

Patient safety still is an issue

- A new, evidenced-based estimate of patient harms associated with hospital care 2013³
  - Minimum of 200,000 lives harmed
  - Closer to true estimate of 400,000 lives

# Background: CDC Death Rates 2011

Table B. Deaths and death rates for 2011 and age-adjusted death rates and percentage changes in age-adjusted rates from 2010 to 2011 for the 15 leading causes of death in 2011: United States, final 2010 and preliminary 2011

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Diseases of heart</td>
<td>596,339</td>
<td>191.4</td>
<td>173.7</td>
<td>179.1</td>
<td>-3.0</td>
</tr>
<tr>
<td>2.</td>
<td>Malignant neoplasms</td>
<td>575,313</td>
<td>184.6</td>
<td>168.6</td>
<td>172.8</td>
<td>-2.4</td>
</tr>
<tr>
<td>3.</td>
<td>Chronic lower respiratory diseases</td>
<td>143,382</td>
<td>46.0</td>
<td>42.7</td>
<td>42.2</td>
<td>1.2</td>
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<tr>
<td>4.</td>
<td>Cerebrovascular diseases</td>
<td>128,931</td>
<td>41.4</td>
<td>37.9</td>
<td>39.1</td>
<td>-3.1</td>
</tr>
<tr>
<td>5.</td>
<td>Accidents (unintentional injuries)</td>
<td>122,777</td>
<td>39.4</td>
<td>38.0</td>
<td>38.0</td>
<td>0.0</td>
</tr>
<tr>
<td>6.</td>
<td>Alzheimer's disease</td>
<td>84,691</td>
<td>27.2</td>
<td>24.6</td>
<td>25.1</td>
<td>-2.0</td>
</tr>
<tr>
<td>7.</td>
<td>Diabetes mellitus</td>
<td>73,282</td>
<td>23.5</td>
<td>21.5</td>
<td>20.8</td>
<td>3.4</td>
</tr>
<tr>
<td>8.</td>
<td>Influenza and pneumonia</td>
<td>53,667</td>
<td>17.2</td>
<td>15.7</td>
<td>15.1</td>
<td>4.0</td>
</tr>
<tr>
<td>9.</td>
<td>Nephritis, nephrotic syndrome and nephrosis</td>
<td>45,731</td>
<td>14.7</td>
<td>13.4</td>
<td>15.3</td>
<td>-12.4</td>
</tr>
<tr>
<td>10.</td>
<td>Intentional self-harm (suicide)</td>
<td>38,285</td>
<td>12.3</td>
<td>12.0</td>
<td>12.1</td>
<td>-0.8</td>
</tr>
<tr>
<td>11.</td>
<td>Septicemia</td>
<td>35,539</td>
<td>11.4</td>
<td>10.5</td>
<td>10.6</td>
<td>-0.9</td>
</tr>
<tr>
<td>12.</td>
<td>Chronic liver disease and cirrhosis</td>
<td>33,539</td>
<td>10.8</td>
<td>9.7</td>
<td>9.4</td>
<td>3.2</td>
</tr>
<tr>
<td>13.</td>
<td>Essential hypertension and hypertensive renal disease</td>
<td>27,477</td>
<td>9.8</td>
<td>8.8</td>
<td>8.0</td>
<td>0.0</td>
</tr>
<tr>
<td>14.</td>
<td>Parkinson's disease</td>
<td>23,107</td>
<td>7.4</td>
<td>7.0</td>
<td>6.8</td>
<td>2.9</td>
</tr>
<tr>
<td>15.</td>
<td>Pneumonitis due to solids and liquids</td>
<td>18,090</td>
<td>5.8</td>
<td>5.3</td>
<td>5.1</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>All other causes</td>
<td>512,723</td>
<td>164.6</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Background: CDC Death Rates 2010

Background: CDC Death Rates 2010

Patient safety still is an issue

Dallas Anesthesiologist Being Sued Over Deadly Surgery Admits to Texting, Reading iPad During Procedures

Dallas Observer April 4, 2014:
Medication administration errors in anesthesia

- No national error rate
- Webster et al (2001) – 1:133\(^6\)
  - New Zealand
- Bowdel et al (2003) – 1:130\(^7\)
  - USA
- Khan and Hoda (2005) – 1:265\(^8\)
  - Pakistan
  - Japan
- Cooper et al (2012) – 1:203\(^{10}\)
  - Canada
Types of errors

• Cooper and Nossaman (2013) – Medication Error in Anesthesia: A Review
  – Incorrect dose (25 – 37)%
  – Substitution (16 – 60)%
  – Omission (9 – 21)%

How significant are medications\textsuperscript{12}

- Initial morning setup \textasciitilde 45\%
- Induction \textasciitilde 20 \pm 6\%
- Maintenance \textasciitilde 15 \pm 8\%
- Emergence \textasciitilde 12 \pm 7\%
- ~30\% of total activities in cardiac cases

How accurate are we?\(^{13}\)

- 500 sample syringes
- Experienced providers
- Controlled laboratory environment
- 59% error rate

Hospital care in general

- Prescribes – APRN/MD
- Dispenses – RN / PharmD
- Prepares – RN / PharmD
- Administers – RN (RN/RN)
- Monitors – RN
- Documents – RN
- Errors still occur!
Anesthesia: High risk profession

- **Anesthesia**
  - Prescribes – CRNA
  - Dispenses – CRNA
  - Prepares – CRNA
  - Administers – CRNA
  - Monitors – CRNA
  - Documents – CRNA
  - Except blood products

- **Others**
  - Prescribes – APRN/MD
  - Dispenses – RN / PharmD
  - Prepares – RN / PharmD
  - Administers – RN
  - Monitors – RN
  - Documents – RN

May 1, 2014
How Many Rights?

Six Rights of Medication Administration - ITDC
www.itdc.org/medcare/nursing/nm226/nm225...passing-med-notes.html
Six Rights of Medication Administration. Route, Time, Client, Dosage, Documentation. 2. Routes of...

8 rights of medication administration - Nursing Center
www.nursingcenter.com/.../8-rights-of-medication-administration.aspx
May 27, 2011 - Chances are that some of you may not have known that in addition to the well-known 5 right of medication administration, some experts have...

10 rights of medication administration - SlideShare
www.slideshare.net/.../10-rights-of-medicatio...2011
Nov 8, 2012 - 10 rights of medication administration Presentation Transcript. 10 RIGHTS OF MEDICATION ADMINISTRATION; 10 RIGHTS OF MEDICATION...

The Five Rights of Medication Administration
www.im.org/.../5-rights-of-medication-administration discontentments section IV 2011.
One of the recommendations to reduce medication errors and harm is to use the "five rights"... the right patient, the right drug, the right dose, the right route, and...

Safe Medication Administration - How Many Rights - RN.com
www.rn.com/.../medication-administration
In nursing school we all learned the five basic rights of medication administration. Over time, and with increasing number of lawsuits and medical errors, it seems...

Medication Administration Safety - Patient Safety and Quality
by RG Hughes 2008 - Cited by 30 - Related articles
The "rights" of medication administration include right patient, right drug, right time, right route, right dose. These details are critical for success. A summary of...
Current status

- Anesthesia med errors – 1:236*
- Significant part of our practice
- Heavy reliance on human performance
- Questionable accuracy
- High risk, no oversight
- How are we being educated?

* Average attained from studies mentioned on slide 10.
Current practice

- No guidelines from AANA
- No guidelines from ASA
- No standard from Council on Accreditation of Nurse Anesthesia Education Programs\(^\text{14}\)
- U.S. Pharmacopeia Convention (USP)
Current practice

• Little to no previous dilution experience
• Didactic setting – dosage calculations
• Clinical setting – hands on dilutions
  – Unsupervised, distractions
• Simulation – hands on dilutions?
• Is this sufficient, can we do better?
Current practice

As a new SRNA
SRNA’s perspective
To clinical
At clinical
At clinical
You want to make these...
But you have to make these
Your world, from this
To this...
So we do this...

\[
\int_{S} \sqrt{v + z} \, dS = \int_{0}^{\pi} (\sqrt{3} \sin \theta + z) \sqrt{3} \, d\theta
\]

\[
= \sqrt{3} \int_{0}^{2\pi} \sqrt{3} \sin \theta \left(4 - \sqrt{3} \sin \theta\right) + \frac{1}{2} \left(4 - \sqrt{3} \sin \theta\right)^{2} \, d\theta
\]

\[
= \sqrt{3} \int_{0}^{2\pi} 8 - \frac{3}{2} \sin^{2} \theta \, d\theta
\]

\[
= \sqrt{3} \int_{0}^{2\pi} 8 - \frac{3}{4} \left(1 - \cos(2\theta)\right) \, d\theta
\]

\[
= \sqrt{3} \left(\frac{29}{4} \theta + \frac{3}{8} \sin(2\theta)\right) \bigg|_{0}^{2\pi}
\]

\[
= \frac{29}{2} \sqrt{3} \pi
\]

5mg/ml

May 1, 2014
Learning environment
Medication safety workshop

• We know
  – High risk
  – Little experience

• Purpose:
  – Decrease medication errors
  – Give hand on experience pre-clinical setting
Medication selection

• Based on high-alert

• Clinical incident reporting
  – Heparin (1000U/ml vs. 10,000U/ml)
  – Ephedrine (50mg/ml ➔ 5mg/ml)
  – Midazolam (10mg/ml ➔ 1mg/ml)
  – Cefazolin (reconstitution)
  – Epinephrine (1:1000 ➔ 100mcg/ml ➔ 10mcg/ml)
Curriculum development: Hierarchical task analysis

- Origins: early management science\textsuperscript{15}
  - Increased efficiency
  - Define training requirements

- Allows processes to be broken down

- Develop step by step instructions
How detailed do you need to be\textsuperscript{16}

- Such that task is
  - understood
  - able to be performed
My attempt... too much

1. Dilution of epinephrine into a fixed volume
   1.1. Selecting the correct medication vial
      1.1.1. Verifying correct medication name: epinephrine
      1.1.2. Verify concentration: 1:1000 or 1mg/ml
      1.1.3. Note expiration date
   1.1. Verify final dilution concentration
      1.1.1. Ex: Check chart, discuss with physician, refer to standard dilutions
   1.1. Obtain supplies
      1.1.1. 2 Syringe 10ml
      1.1.2. 2 Epinephrine labels
      1.1.3. Blunt-tip needle
      1.1.4. Epinephrine vial 1ml of (1mg/ml)
   1.1. Prepare solution
      1.1.1. Perform calculation to identify amount of epinephrine to place into
              final diluent volume [(AD/CA) = amount to be removed from vial or
              syringe]
      1.1.1.1. Syringe 1 = Amount Desired / Concentration Available =
             100 mcg/(1000 mcg/ml) = 0.1ml of 1mg/ml epinephrine
      1.1.1.2. Syringe 2 = Amount Desired / Concentration Available =
             10 mcg / (100mcg/ml) = 0.1 ml of 100mcg/ml epinephrine
   1.1. Label syringe
      1.1.1.1. Syringe 1- Concentration: 100mcg/ml
      1.1.1.2. Syringe 2- Concentration: 10mcg/ml
      1.1.1.3. Date
      1.1.1.4. Initials
   1.1. Dilute medication
      1.1.1. Dilution 1 (100mcg/ml)
         1.1.1.1. Draw 9ml of 0.9% NaCl into 10ml syringe and add 1ml of
                   epinephrine 1mg/ml to make 100mcg/ml of epinephrine.
      1.1.2. Dilution 2 (10mcg/ml)
         1.1.2.1. Draw 9ml of 0.9% NaCl into 10ml syringe and add 1ml of
                   epinephrine 100mcg/ml to make 10mcg/ml of epinephrine.
   1.1. Store medication or identify port/site of infusion
   1.1. Open roller clamp
   1.1. Verify solution/carrier movement by verifying drops in drip chamber
   1.1. Clean port with EtOH (15sec) “scrub the hub”
   1.1. Attach epinephrine 10mg/ml to port
   1.1.2. Verbalize previously determined dose
   1.1.3. Administer previously determined volume
   1.1.4. Verbalize dosage administered
   1.1.5. Remove syringe
Faculty example... better, I guess

<table>
<thead>
<tr>
<th>Ephedrine Sulfate</th>
<th>I</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. *Check the label on the ampule to make sure that the correct medication is being prepared. Confirm drug name and concentration. Note the expiration date.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Assemble the diluent, appropriate size syringe (10ml) and needle, maintaining sterility. Label the syringe with drug name and concentration.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Remove protective cap from diluent. Clean the rubber diaphragm with an antiseptic wipe by rubbing in a circular motion for 15 sec. <em>Manufacturer does not guarantee sterility of rubber top.</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pull back plunger to fill syringe with the amount of air equal to the amount of NSS to be withdrawn. <em>Touch only the syringe barrel and plunger tip.</em> Inject air into the diluent. Invert vial; withdraw required amount of diluent (9ml). Replace needle with a filter needle.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Flick the upper stem of the ampules several times to move solution from the neck to the body of the ampule. Using an alcohol swab or dry gauze, break stem away from you.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. *Dispose of medication ampule. Complete the labeling of syringe with date, time (if appropriate) provider initials.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pre-workshop survey

- Year of practice as an RN
- Hospital setting: community/university
- Type of ICU: SICU, MICU...
- Experience with medication dilution
- Previous medication errors

May 1, 2014
Medication safety presentation

- Six rights
- Verifying medication, concentration, expiration
  - From medication cart
  - Before withdrawal from vial
  - After withdrawal
Medication safety presentation

CDC one and Only Campaign

- Aseptic technique
- One syringe, one patient
- Single dose vials when possible
Medication safety presentation

Here’s how you can prevent Catheter Line Associated Bacteremia (CLAB) in your patient!

Make sure you thoroughly scrub the injection port with alcohol before injecting IV medications.

Don’t forget to “Scrub the Hub.”

EHC HealthCare
Hands-on dilutions kit
Room set up
Room set up
Medication setup
Dilutions check list
Teaching at its best
Scenario for closed loop communication

Mr. Smith is a 76 yr. old patient with a history of hypertension, diabetes, and CAD. He has no know allergies. He presents to the OR for a femoral-popliteal bypass. He appears anxious and apprehensive. The CRNA suggests the administration of 2.5 mg of midazolam.
Your psychological pre-op assessment and the administration of midazolam has alleviated Mr. Smith’s anxiety regarding the procedure.

On the way back to the OR suite, the surgeon calls out—"please give my regular antibiotic".
Following a smooth IV induction, Mr. Smith becomes slightly hypotensive. Despite decreasing your agent, his pressure remains <20% below base line. After your assessment you decide to administer ephedrine
Prior to cross clamping of a major arterial vessel, the surgeon states that “in a couple of minutes” 4,000u of Heparin be administered. You prepare to administer the heparin.
The surgeon informs you that there is ongoing “oozing” and that he will soon be removing the arterial cross clamp. The blood pressure proceeds to drop despite the initiation of a blood transfusion. With the removal of the cross clamp the blood pressure falls precipitously. The anesthesia team decides on administering incremental doses of epinephrine.
Results

• Overall positive feedback
Future directions

• Sound familiar
  – “I do it this way”
  – “Do what I say, not what I do”
  – “Many ways to skin a cat”
  – “When you graduate, you’ll do it your way”
Future directions

• Give up autonomy?

WHAT WHAT WHAAAAAAT???
5-S = Visual workspace

- Sort
- Set in order
- Shine
- Standardize
- Sustain
5-S = Visual workspace

- Sort
- Set in order
- Shine
- Standardize
- Sustain
5-S = Visual workspace

- Sort
- Set in order
- Shine
- Standardize
- Sustain

Propofol 10mg/ml
Ephedrine 5mg/ml
Phenylephrine 100mcg/ml
Glycopyrolate 0.2mg/ml
Anesthesia workstations?
Future directions

• Humans replaceable?
• HemoBot

http://www.stanford.edu/group/sailsbury_robotx/cgi-bin/salisbury_lab/?page_id=265

May 1, 2014
Future directions

• Meet your robotic anesthesia provider—Sedasys
Ideas

• Reporting/detecting error - Google glass, image recognition... NSA alert
• Changing culture – failure to report = penalty
• Collaboration- Data sharing between programs
• National trainee error database
## Dilution charts

<table>
<thead>
<tr>
<th>Drug name</th>
<th>Concentration</th>
<th>supplies</th>
<th>Process</th>
<th>Final concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine</td>
<td>1:1000 (1mg/ml)</td>
<td>10ml syringe x2</td>
<td>9ml of 0.9% sodium chloride + 1ml of 1mg/ml Epinephrine 9ml of 0.9% sodium chloride + 1ml of 100mcg/ml Epinephrine</td>
<td>100mcg/ml 10mcg/ml</td>
</tr>
<tr>
<td>vasopressin</td>
<td>20units/ml</td>
<td>20ml syringe</td>
<td>19ml of 0.9% sodium chloride + 1ml of 20Unit/ml vasopressin</td>
<td>1 unit/ml</td>
</tr>
<tr>
<td>Ephedrine</td>
<td>50mg/ml</td>
<td>10ml syringe</td>
<td>9ml of 0.9% sodium chloride + 1ml of 50mg/ml Ephedrine</td>
<td>5mg/ml</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>10mg/ml</td>
<td>10ml syringe</td>
<td>9ml of 0.9% sodium chloride + 1ml of 10mg/ml Phenylephrine</td>
<td>100mcg/ml</td>
</tr>
<tr>
<td>Phenylephrine (infusion)</td>
<td>10mg/ml</td>
<td>250ml 0.9% NaCl bag</td>
<td>Remove 2ml from 250ml 0.9% sodium chloride + 2ml of 10mg/ml Phenylephrine into 250ml 0.9% sodium chloride</td>
<td>80mcg/ml</td>
</tr>
<tr>
<td>ketamine</td>
<td>50mg/ml</td>
<td>10ml syringe</td>
<td>9ml of 0.9% sodium chloride + 1ml of 50mg/ml Ketamine</td>
<td>5mg/ml</td>
</tr>
<tr>
<td>hydromorphone</td>
<td>2mg/ml</td>
<td>5ml syringe</td>
<td>3ml of 0.9% sodium chloride + 1ml of 2mg/ml Hyromorphone</td>
<td>0.5mg/ml</td>
</tr>
<tr>
<td>naloxone</td>
<td>0.4mg/ml</td>
<td>10ml syringe</td>
<td>9ml of 0.9% sodium chloride + 1ml of 0.4mg/ml naloxone</td>
<td>0.04mg/ml (40mcg/ml)</td>
</tr>
</tbody>
</table>
Review

- Healthcare still has many safety challenges
- Anesthesia providers at high risk
- Hands-on workshop, mitigating risks
Thank you
References


References


