

# Adding Up to Patient Safety:

## Utilizing Simulation as an Educational Strategy to Enhance Dosage Calculation Skills in Fundamental Level Nursing Students

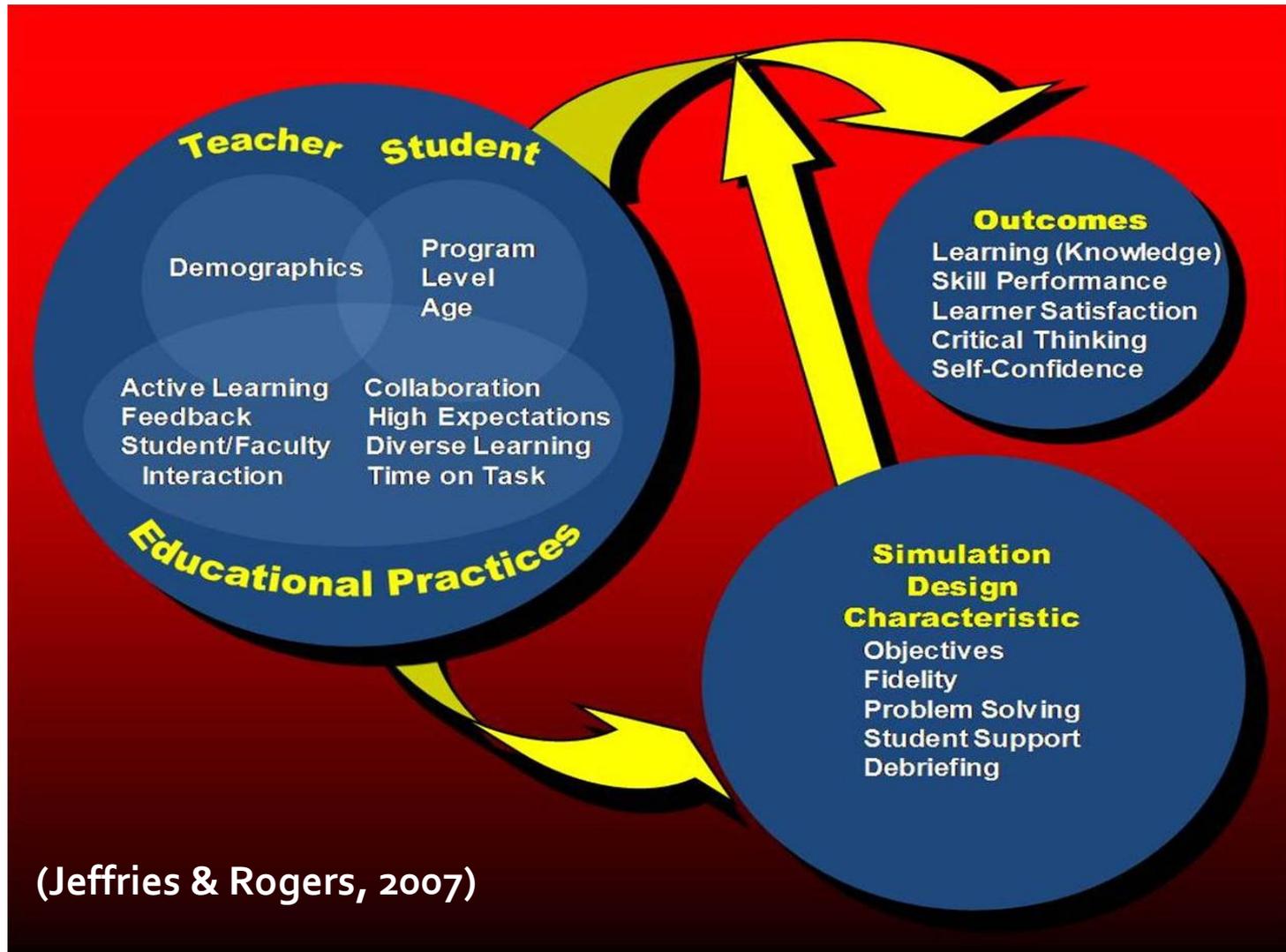
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# Objectives

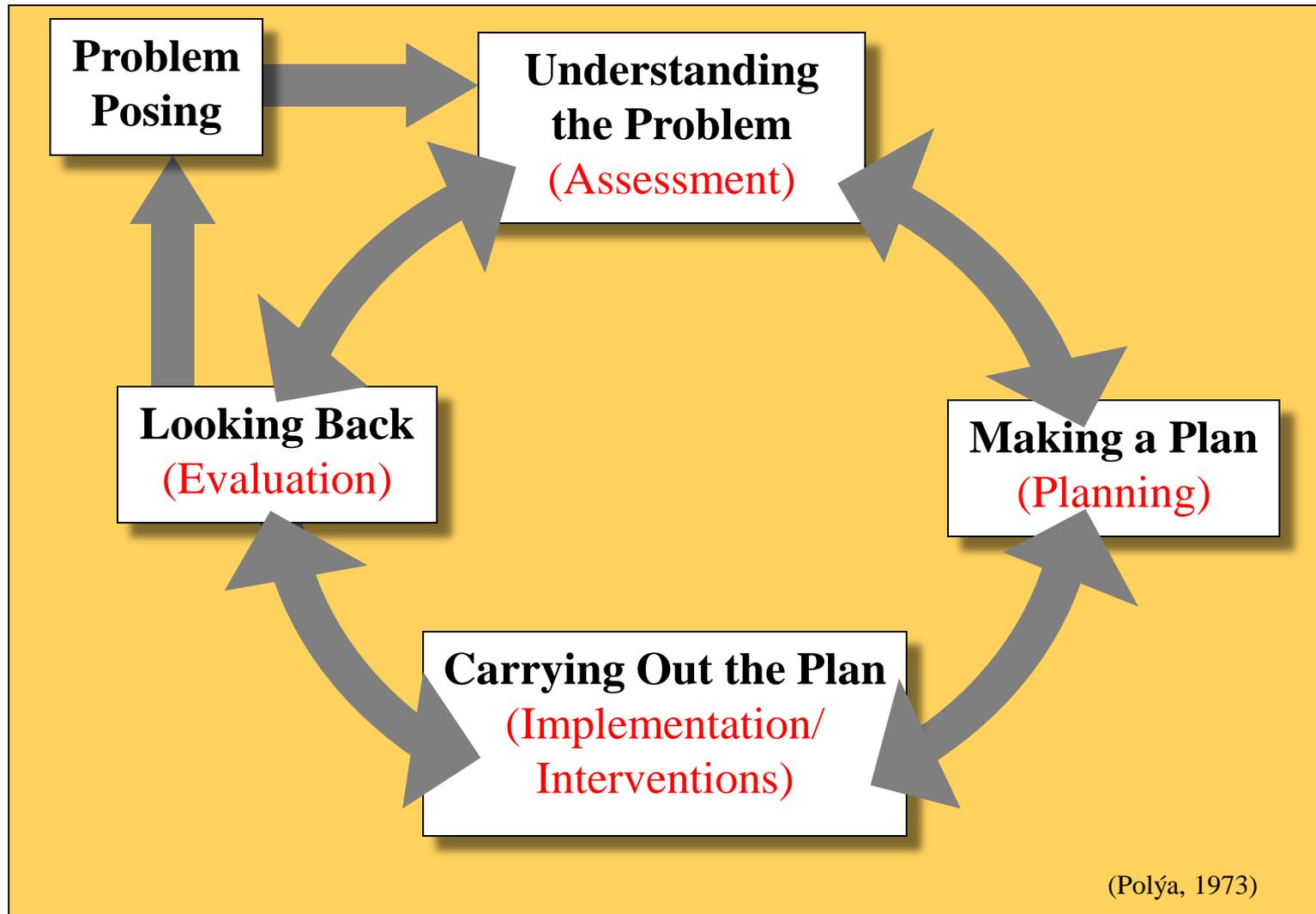
- At the end of this presentation, nurse educators will have:
  - The learner will investigate the utilization of simulation as a teaching strategy to increase the accuracy of dosage calculation skills in fundamental nursing students.
  - The learner will explore the effectiveness of an innovative evaluation strategy that encourages students to think beyond obtaining a dosage calculation result.

# The Nursing Education Simulation Framework



(Jeffries & Rogers, 2007)

# Polya's Four Phases of Problem-Solving



# Characteristics of the Sample

## ( $n = 77$ )

- Age – 20.45 years
- GPA – 3.41
- ACT math – 20.35
- Gender – 79.2% female
- Ethnicity
  - 50.6% Caucasian
  - 19.5% Hispanic
  - 11.7% African-American
  - 11.7% Asian
- Class Level – 70.1% Sophomores



# Description of Tools

- Pre and Post Dosage Calculation & Self Perceived Judgment Tool
  - K-R 20 = .85 and .93
- NLN tool for Satisfaction and Self-Confidence in Learning Scale
  - Cronbach's alpha = .93
- NLN tool for Educational Best Practices
  - Cronbach's alpha = .93
- NLN tool for Simulation Design Scale
  - Cronbach's alpha = .96



# Validating Math Skills

- **Traditional Approach**

- Zofran (ondansetron) 4 mg IM has been prescribed for a patient. A vial contains 40 mg/ 20 mL. You should prepare \_\_\_\_\_ mL of this drug for administration?

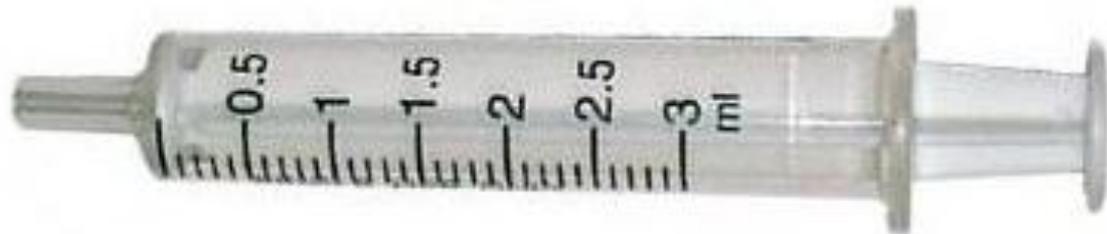
- **Active-Learning Approach**



## **PHYSICIAN'S ORDERS**

Zofran 4 mg IM now and then Q 6h PRN nausea

Please indicate on the syringe how much volume you will give by coloring the syringe in up to the correct dose.



# Self-Perceived Judgment in Dosage Calculations Scale

Judging by your calculated answer to the dosage calculations and the route the medication is to be administered; how logical does the amount of medication you calculated seem to be in your opinion?

1. Zofran

Highly Illogical	Illogical	Neutral	Logical	Highly Logical
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0 1	0 2	0 3	0 4	0 5
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# Discussion of Findings

- Results revealed that fundamental students performed significantly better on the post-test ( $m = 8.77, sd = 0.83$ ) than the pre-test ( $m = 6.60, sd = 1.94$ ) after attending a simulation experiment ( $t(76) = -10.561, p < .000$ ).
- A significant, moderate relationship was noted between the scores of the pre- and post-dosage calculation test ( $r = .38, p = .001$ ).



# Discussion of Findings

## Pre/Post Dosage Calculation Paired Samples Test

	Mean	SD	SE Mean	CI Lower	CI Upper	t	df	Sig
<u>Zofran</u>	<u>-.091</u>	<u>.289</u>	<u>.033</u>	<u>-.157</u>	<u>-.025</u>	<u>-2.757</u>	<u>76</u>	<u>.007</u>
<u>Haldol</u>	<u>-.234</u>	<u>.510</u>	<u>.058</u>	<u>-.350</u>	<u>-.118</u>	<u>-4.020</u>	<u>76</u>	<u>.000</u>
<u>Lanoxin</u>	<u>-.078</u>	<u>.354</u>	<u>.040</u>	<u>-.158</u>	<u>.002</u>	<u>-1.931</u>	<u>76</u>	<u>.057</u>
<u>Synthroid</u>	<u>-.506</u>	<u>.503</u>	<u>.057</u>	<u>-.621</u>	<u>-.392</u>	<u>-8.832</u>	<u>76</u>	<u>.000</u>
<u>Dilantin</u>	<u>-.312</u>	<u>.568</u>	<u>.065</u>	<u>-.441</u>	<u>-.183</u>	<u>-4.815</u>	<u>76</u>	<u>.000</u>
Amikacin	.000	.229	.026	-.052	.052	.000	76	1.000
<u>Symmetrel</u>	<u>-.221</u>	<u>.476</u>	<u>.054</u>	<u>-.329</u>	<u>-.113</u>	<u>-4.067</u>	<u>76</u>	<u>.000</u>
<u>Heparin</u>	<u>-.247</u>	<u>.566</u>	<u>.064</u>	<u>-.375</u>	<u>-.118</u>	<u>-3.828</u>	<u>76</u>	<u>.000</u>
<u>Aminophylline</u>	<u>-.273</u>	<u>.504</u>	<u>.057</u>	<u>-.387</u>	<u>-.158</u>	<u>-4.752</u>	<u>76</u>	<u>.000</u>
<u>Vincristine</u>	<u>-.221</u>	<u>.448</u>	<u>.051</u>	<u>-.322</u>	<u>-.119</u>	<u>-4.325</u>	<u>76</u>	<u>.000</u>

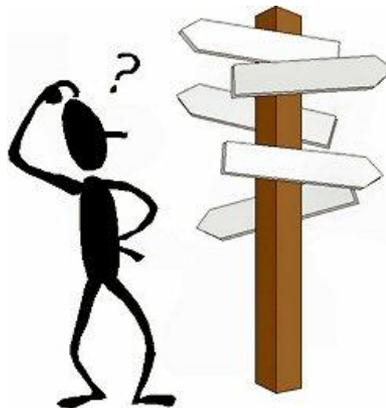
# Comparison With Evidence-Based Teaching Strategies

- Currently there are no published research studies on measuring dosage calculation skills after utilizing a simulated teaching environment.
- This study supports findings from previous research that has demonstrated that learning dosage calculation skills can occur when comparing interactive teaching strategies with the more traditional methods (Glaister, 2005; Maag, 2004).
- Previous research mandated teaching dimensional analysis specifically to improve dosage calculation skills (Greenfield, Whelan, and Cohn, 2006; Rice & Bell, 2005).
- This study demonstrated that:
  - Teachers can coach students to learn from each other that there are multiple ways to solve dosage calculation problems.
  - Students became the instigators of lively discussions on the different strategies that were utilized.
  - A particular problem-solving strategy does not have to be required to achieve successful scores on dosage calculation tests.

# Discussion of Findings

- Dosage calculation items that were perceived to be highly illogical-neutral were more likely to be incorrect, however, these items were significantly improved by the post-test.

	PRE-CALC	PRE-JUDGE	POST-CALC	POST-JUDGE
■ Dilantin	36.4%	54.6%	67.5%	83.2%
■ Synthroid	19.5%	53.3%	70.1%	78.0%
■ Heparin	41.6%	53.3%	66.2%	83.1%



# Discussion of Findings

## Pre/Post Self-Perceived Judgment Paired Samples Test

	Mean	SD	SE Mean	CI Lower	CI Upper	<i>t</i>	<i>df</i>	Sig
Zofran	-.195	1.377	.157	-.507	.118	-1.242	76	.218
Haldol	-.312	1.407	.160	-.631	.008	-1.943	76	.056
Lanoxin	-.182	1.243	.142	-.464	.100	-1.283	76	.203
<b>Synthroid</b>	<b>-.568</b>	<b>1.500</b>	<b>.174</b>	<b>-.915</b>	<b>-.220</b>	<b>-3.256</b>	<b>73</b>	<b>.002</b>
<b>Dilantin</b>	<b>-.539</b>	<b>1.399</b>	<b>.161</b>	<b>-.859</b>	<b>-.220</b>	<b>-3.361</b>	<b>75</b>	<b>.001</b>
Amikacin	-.052	1.450	.165	-.381	.277	-.314	76	.754
<b>Symmetrel</b>	<b>-.351</b>	<b>1.265</b>	<b>.144</b>	<b>-.638</b>	<b>-.064</b>	<b>-2.433</b>	<b>76</b>	<b>.017</b>
<b>Heparin</b>	<b>-.750</b>	<b>1.471</b>	<b>.169</b>	<b>-1.086</b>	<b>-.414</b>	<b>-4.445</b>	<b>75</b>	<b>.000</b>
<b>Aminophylline</b>	<b>-.787</b>	<b>1.417</b>	<b>.164</b>	<b>-1.113</b>	<b>-.461</b>	<b>-4.808</b>	<b>74</b>	<b>.000</b>
<b>Vincristine</b>	<b>-.707</b>	<b>1.459</b>	<b>.168</b>	<b>-1.042</b>	<b>-.371</b>	<b>-4.194</b>	<b>74</b>	<b>.000</b>

# Comparison With Evidence-Based Teaching Strategies

- No published research studies on self-perceived judgment and dosage calculation skills.
- This study supports findings from previous nursing research that indicates that there is no difference in judgment, or critical thinking skills, in students who attended a traditional lecture vs simulation (Brown & Chronister, 2009).
- The Lasater Critical Judgment Rubric was developed in an attempt to quantify judgment skills in students (Lasater, 2007).
  - It identified gaps in understanding
  - It served as a valuable communication tool to provide important feedback to the students
  - It helped students identify performance expectations and create goals to improve judgment skills.

# Comparison With Evidence-Based Teaching Strategies

- The tool utilized in this study:
  - Served as an introduction to critical thinking and judgment for these fundamental nursing students because it required the student to look back and analyze each calculated response.
  - Students did analyze and recalculate many dosages that had initially been incorrect and arrive at more plausible solutions.
  - This tool helped faculty identify which types of dosage calculations seemed to be illogical for the students.



# Discussion of Findings

## ■ Satisfaction and Self-Confidence

- Students were satisfied with the simulation experience ( $m = 4.55$ ,  $sd = 0.531$ ) and felt confident that they were learning skills needed to perform safely in a clinical setting ( $m = 4.32$ ,  $sd = 0.520$ ).

## ■ Educational Best Practices

- Students agreed that the educational best practices of active learning, collaboration, diverse ways of learning, and high expectations ( $m = 4.26$ ,  $sd = 0.596$ ) were met.

## ■ Simulation Design

- Evaluation of the simulation design revealed that students agreed that objectives and information were clearly given and met, they felt supported during the learning process, problem-solving skills were enhanced, feedback and guided reflection aided in the learning process, and the scenario resembled real life ( $m = 4.41$ ,  $sd = 0.513$ ).

# Comparison With Evidence-Based Teaching Strategies

- No published research on measuring self-confidence in learning while conducting a simulation on dosage calculation skills.
- Several studies showed increased self-confidence as the level of fidelity increased (Jeffries & Rizzolo, 2006; Smith & Roehrs, 2009).
- Several studies indicated no differences in self-confidence levels when comparing traditional lecture format versus simulation (Brannan, White, Bezanson, 2008; Alinier, Hunt, Gordon, and Harwood, 2006).

# Comparison With Evidence-Based Teaching Strategies

- No published research on measuring satisfaction in learning while conducting a simulation on dosage calculation skills.
- Several studies found that interactive media or simulation enhanced satisfaction in learning (Maag, 2004; Sinclair & Ferguson, 2009).
- Several studies showed increased satisfaction in learning as the level of fidelity increased although the increased satisfaction did not translate to an increased cognitive gain over students receiving a different teaching modality (Hoadley, 2009; Kardong-Edgren, Starkweather, & Ward, 2008; Jeffries & Rizzolo, 2006; Smith & Roehrs, 2009).

# Discussion of Findings

- Additional Findings
  - 14 students were able to score 100%
  - Students demonstrated incorrect formulation on the DCT
  - Students seemed to rethink irrational dosages
  - Students expressed great appreciation for the opportunity to learn in the simulation environment



# Comparison With Evidence-Based Teaching Strategies

- This study supported findings from previous research indicating the majority of errors are from incorrect formulations (Blais and Bath, 1992; Segatore, Edge, & Miller, 1993; and Jukes & Gilchrist, 2006).
- Students in this study were able to detect some irrational calculations and arrive at more plausible answers whereas previous research indicated students were unable to identify irrational responses and they demonstrated a nonchalance about the whole testing process (Blais and Bath, 1992; Jukes & Gilchrist, 2006).
- This study supports previous research findings that students who have limited math abilities as evidence by poor ACT math scores can learn how to accurately calculate dosages (Hutton, 1998).

# Contributions to Nursing Science

## ■ Nursing Education

- This study demonstrated a way to increase patient safety through a simulation teaching module on the conceptual and computational skills required for solving dosage calculations accurately.
- Students were more:
  - Confident about performing in a clinical environment
  - Confident instructor was using helpful resources
  - Confidence is linked to an ability to perform a task accurately\*
  - More satisfied overall with the learning experience
- This study demonstrated the validity and reliability of a dosage calculation instrument that resembles what occurs in a realistic environment.

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\*(Durham & Alden, 2008; Hovancsek, 2007)

# Contributions to Nursing Science

- Utilizing the NESF to develop the case study and simulation scenario helped with:
  - Incorporation of best practices through better interaction and communication between the teacher and the students
  - Collaboration of diverse student peers
  - Innovative teaching strategies and learning techniques
  - Students' increased responsibility for learning and drive for achieving higher academic standards

# Contributions to Nursing Science

- Introducing Polya's Four Phases of Problem Solving helped:
  - Organize the teaching and learning experience for the students by helping create a pattern of thinking to implement every time a dosage calculation is necessary.
  - It encouraged critical thinking and evaluation of calculated dosages which is an important process in improving patient safety.
  - It encouraged collaboration between peers and it reduced the fear of asking for help.
  - Collaboration is one way that can help improve communication skills which are vital when it comes to patient safety.\*
  - Demonstrated that the freedom to choose a problem-solving method resulted in positive dosage calculation outcomes.

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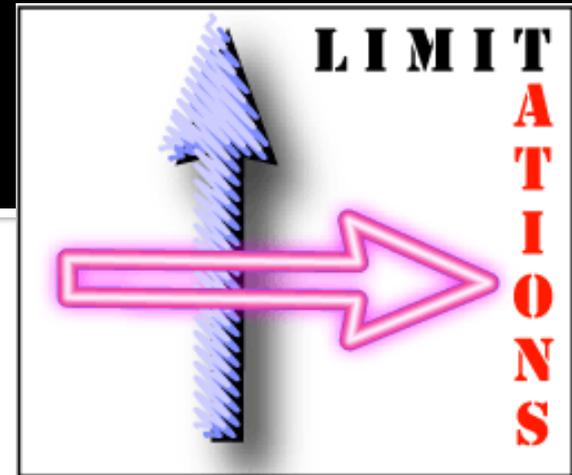
\*(Taylor & McDonald, 2007)

# Contributions to Nursing Science

- Hospitals and Acute Care Facilities
  - Testing methodology could be used in these environments
  - Simulation could be used for remediation for nurses who continue to struggle with calculation skills
  - Collaborating with colleagues would reinforce calculation skills and encourage new ways to solve problems accurately.
  - Hospitals and acute care facilities could benefit from a more realistic tool that resembles what happens in clinical practice.



# Limitations



## ■ Convenience Sample

- Religious-affiliated, private university
- Small sample size
- Students are young compared to national average

## ■ Testing Limitations

- Study had to be completed in a one week time frame to allow students to complete requirements prior to attending clinical at the hospital
- Short time frame limits the ability to know how long the students retained the information

# Recommendations

- Replicate the study with a larger sample size of students within each demographic group.
- Conduct a longitudinal study to measure retention of skills.
- Research could be conducted to see if the actual rates of dosage calculation errors are reduced in the clinical setting.



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