

Nursing Medication Calculation Traditional versus Contemporary eDose Facilitated Learning: The University of Calgary Experience

Marianna Marangoni-Zuege RPN RN BN

Patricia Morgan RN MSN

Patricia Ceri RN MN







Our Journey with eDose

- Where we were
- Alternative approaches to dosage calculation
- eDose
- Implementation process
- Intro to students
- Intro to faculty
 - Clinical faculty
 - Faculty as a whole
- Integration in revised curriculum

Learning Objectives

- Consider assessment and implementation processes utilized by U of Calgary Nursing Faculty to promote accuracy in medication calculation
- Compare traditional and simulation-based learning of calculation for medication administration

Dosage Calculation in BN Curriculum

- Safety and medication administration
 - Medication-related errors identified as most common source or medical error (Rothchild, 2005)
 - Contribution of calculation in errors not well quantified (Wright, 2010)
- Undergraduate programs role in preparing learners for optimal practice (Baker, 2004)
 - Teaching
 - Evaluating

Calculation as a Source of Med Error

- Wrong dose errors
 - Inability to conceptualize the calculation to be performed
 - Lack of mathematical skills (arithmetical operations/computation competence)
 - Technical measurement competence
 - Infrequent use of calculation skills in practice settings
 - Errors of inattention
 - Decimal points
 - Increased with anxiety, fatigue, distraction

Technology and Errors

- Medication delivery systems
 - Prepared IV medications
 - Unit dose systems
 - Bar-code systems
- Technology of Infusion pumps
 - “Opaqueness of delivery” (To Err is Human, 2000)
 - Less hands on contact with mathematical processes

Other Possible Contributing Factors

- Anxiety
 - Test anxiety
 - Math phobia
 - Fear of making an error
 - Hi stakes
- Confidence
 - In math ability
 - In complex problem solving
- Exam quality

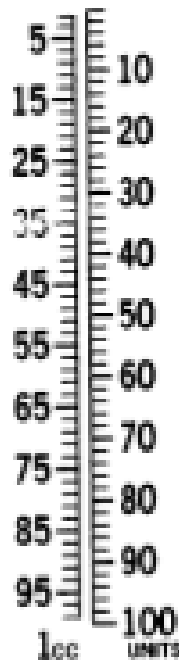
Math Policy (revised 2008)

- Policy: *Compulsory math test will be implemented for all 200 and 300 level clinical courses* and as deemed appropriate by course coordinators of courses at the 400 and 500 levels. Compulsory preparatory quizzes will be implemented prior to testing. The use of calculators is permitted in the courses at the 200 level and beyond.
- Mastery of 90% will need to be achieved within a specified timeframe prior to completion of the clinical course. Failure to meet this requirement will result in failure of the course.
- Students will have two opportunities to achieve 90% on any given math test.
- The student will not be permitted to administer medications in the clinical area until the required mastery has been achieved.

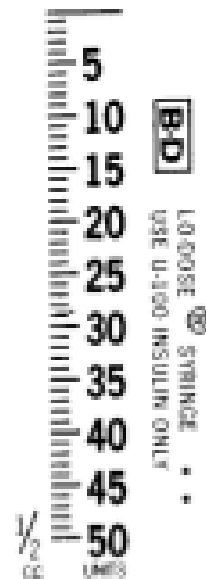
Traditional Approach

- Workbook based learning
 - Curran, Math for Meds (9th ed.)
- Clinical Instructor supported
 - Mandatory assignments
 - In-lab test (90% pass mark)
 - Remediation
 - Rewrite (2 opportunities)
 - High stakes, looming threat of failure

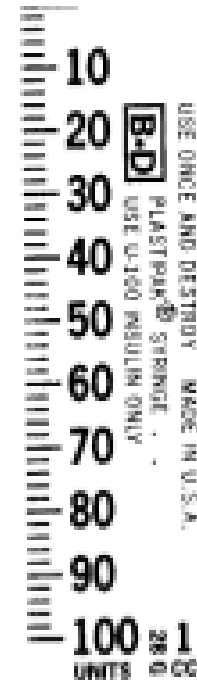
Curran: Math for Meds: Dosages and Solutions



1. 37 U Regular



2. 17 U Regular
12 U Lente



3. 48 U NPH

Example of Test Question

- The physician's order is to infuse 1 unit of packed red blood cells (300 mL) over 1½ hours. Calculate the mL the patient will receive per hour.
- The blood tubing delivers 15 gtt/mL. Calculate the flow rate (drip rate).
 - If the unit of packed red blood cells commences at 1110h, when would you expect it to be completed?

Example Test Question

The physician order reads: Penicillin G potassium 500 000 units IV q8h. You prepare to reconstitute the powder using this vial ...
VIAL

PENICILLIN G POTASSIUM for injection

Preparation of Solution: Use sterile water for injection

RECONSTITUTION

- 1000 000 unit vial

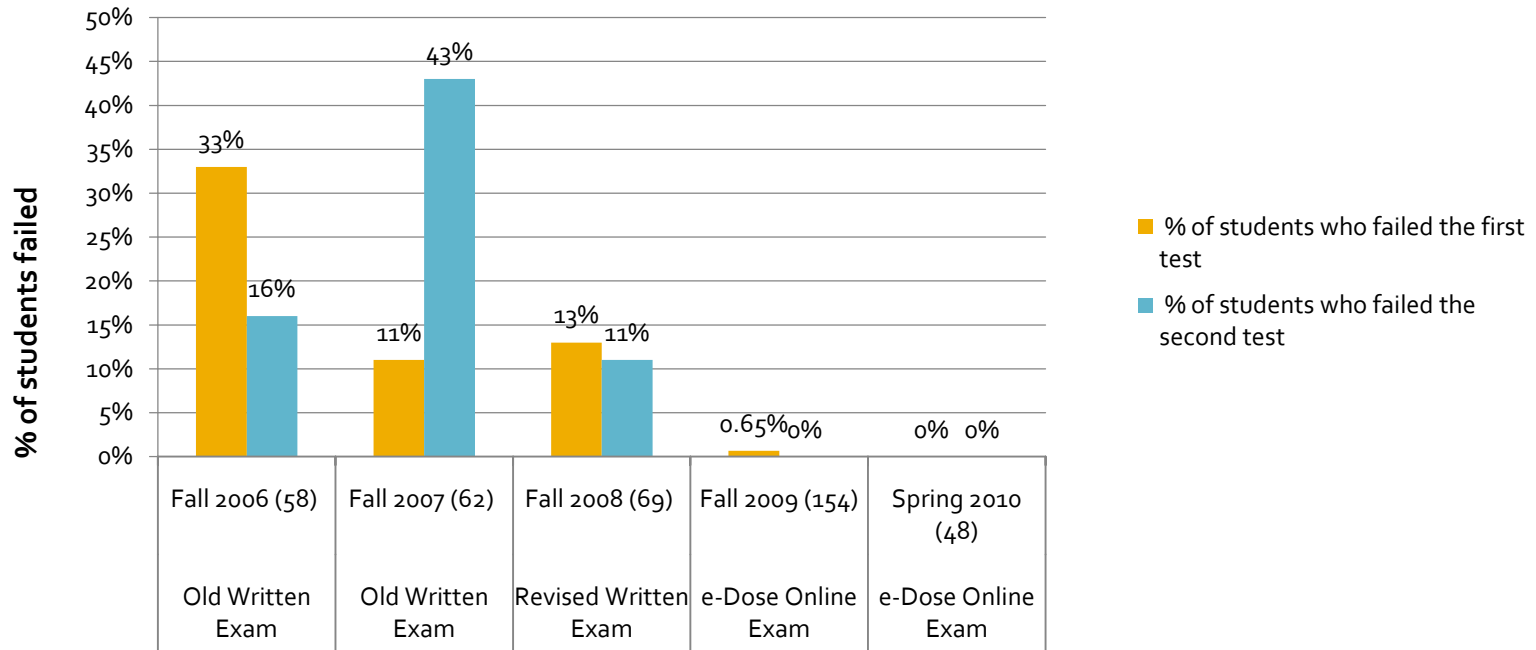
<u>Diluent</u>	<u>Desired Concentration</u>
9.6 mL	150 000 units/mL
4.6 mL	200 000 units/mL
3.6 mL	250 000 units/mL

STORAGE

- Prepared solutions may be kept in the refrigerator for one week
- Choose the most appropriate 'desired concentration' and clearly label the vial above with the required information that a nurse must document after reconstitution.
- What volume of solution will you withdraw from the vial to prepare the ordered dosage?
- Using a 50 mL minibag of Normal Saline you prepare the intravenous solution. What is the concentration of the Penicillin G in the minibag?
- Calculate the rate of flow, in drops per minute, to deliver the drug in 45 minutes. The drop factor is 10 gtts/mL.
- Calculate the rate of flow in milliliters per hour.
- How many units of Penicillin G are administered in 24 hours?
- What volume of Normal Saline does the patient receive via minibag each 24-hour period?
- The Physician has ordered Solu-Medrol 220 mg IVPB q4hrs for Mr. Stein who has Normal saline infusing at 100 mL/hr.
- Reconstitute with 8 mL Bacteriostatic Water for Injection. When reconstituted as directed each 8 mL contains methylprednisolone sodium succinate equivalent to 500 mg methyl-prednisolone (62.5 mg per mL)
- How much solution will the nurse withdraw from the vial?
- The Parenteral drug guide states to further dilute Solu-Medrol in 100 mL Normal Saline (minibag) and give IVPB over 60 minutes.
- After adding the Solu-Medrol to the mini bag, what will the concentration of the medication be?
- At what rate will the IV pump be set? (mL/hr)
- How many mg of Solu-Medrol will Mr. Stein receive in a 24 hour period?

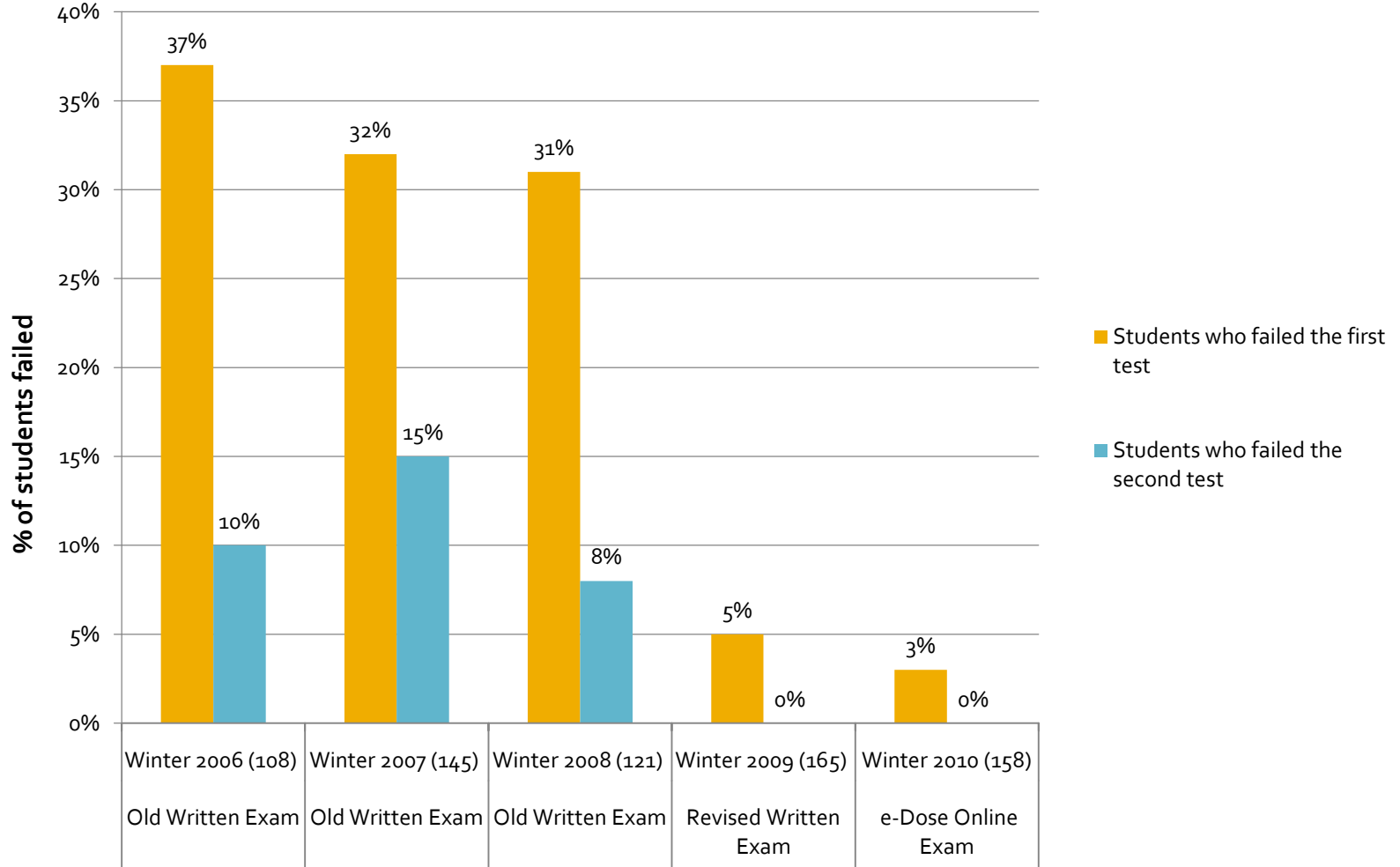
Our results in BNRT/BNAT

The percentage of Nzog BNAT students between Fall 2006 - Spring 2010 who failed the Math Test



Year, Number of Students & Method of Testing

The percentage of N209 BNRT students between Winter 2006 - Winter 2010 who failed the Math Test



Year, Number of Students & Method of Testing

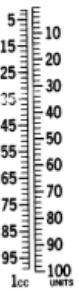
Looking for Options

- Survey literature
- Explore available on-line/electronic resources
- Faculty presentation
- Pilot of eDose
- Evaluation
- Implementation



MIND THE GAP

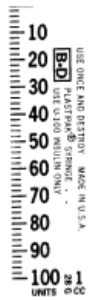
eDose



1. 37 U Regular



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METI Learning

Home Folder 12/31 Pencil Magnifying Glass Graduation Cap Information Exit & Save X

Injections

Trying the Calculation Yourself

ROUTINELY SCHEDULED MEDICINES		DATE	ADMINISTRATION TIMES
MEDICINE (Approved Name)	START DATE		
Gentamicin	2/15/2011	0600	
DOSE	ROUTE	SPECIAL INSTRUCTIONS	
80mg	I.V.		
DOCTOR'S SIGNATURE			
Dr. Jones			

Gentamicin 40mg / 1mL

1mL

2mL

4mL

8mL

Division Model

$\frac{80 \text{ mg}}{40 \text{ mg}} \times 1 \text{ mL} = \text{DRAG ANSWER HERE}$

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Administrator Role

- Coordinates access to program for faculty and students
- Consults to curriculum regarding design and points of inclusion
- Manages data
- Sets and releases exams
- Organizes exam locations, supervision
- In-exam problem solving

Admin role continued

- Communicates with METI
 - Glitches
 - Suggestions for improvement
 - Tech support
- Local tech support for students
- Maintenance of Communication binder
 - Recognize ongoing concerns, issues
 - Student access #s
- Ongoing faculty communication

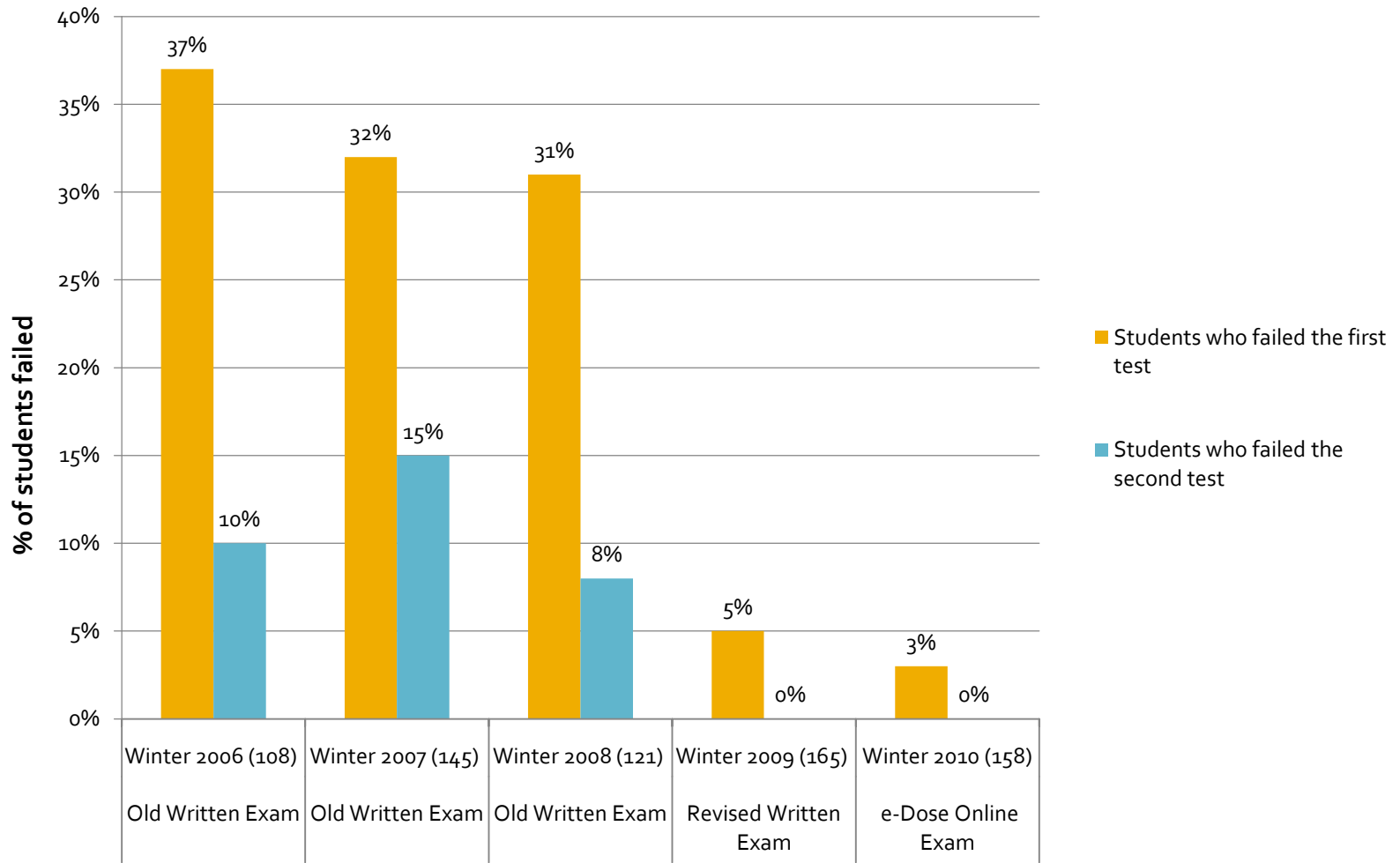
Inclusion in Curriculum (old and new)

- Nursing 203 Fundamentals of Nursing Practice
 - Pre-numeracy exam
 - Student feedback re current math competency
 - Required component of course,
 - Complete/incomplete
 - Framed as info for student re math readiness for calculations

Nursing 209

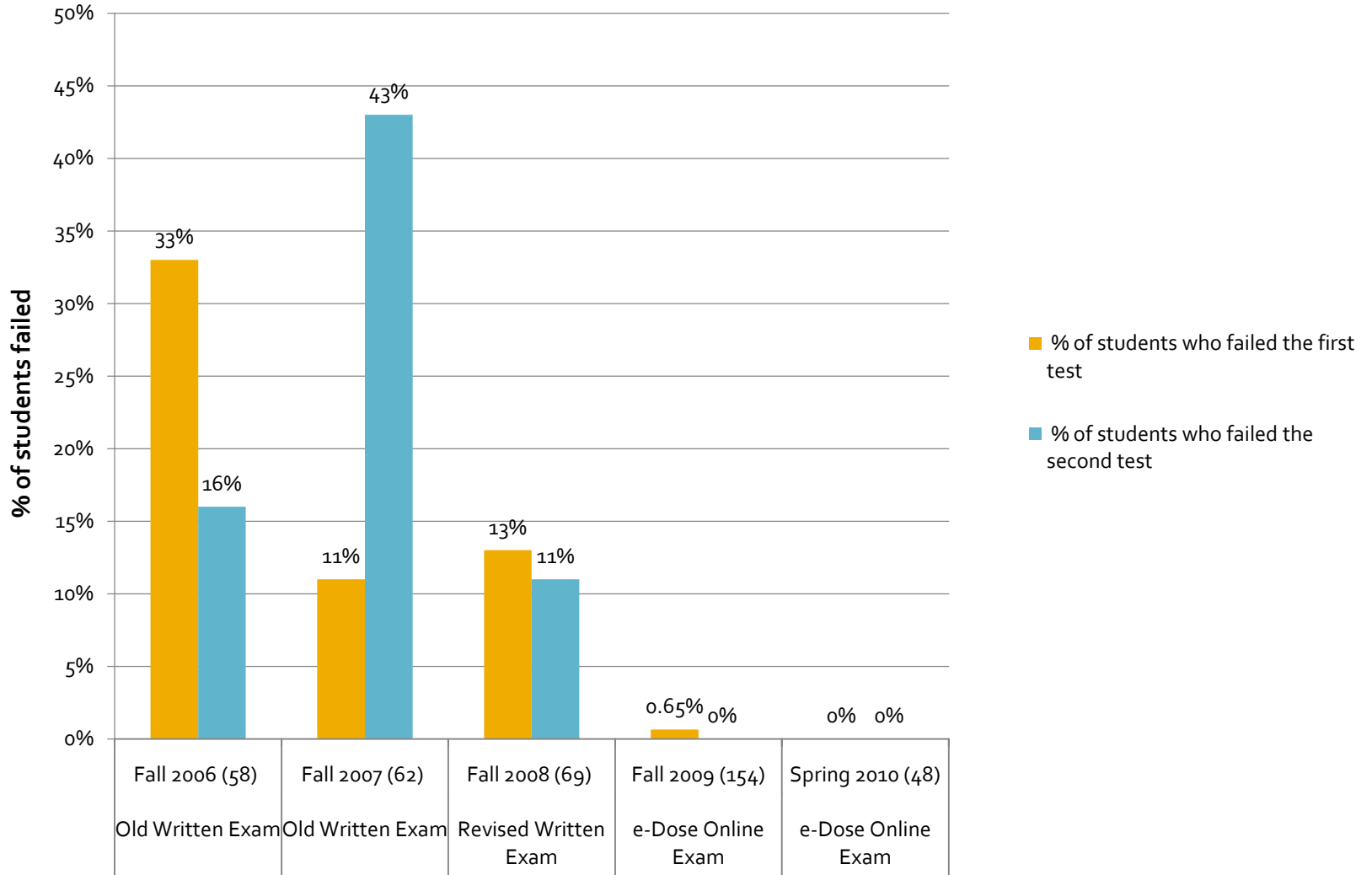
- First clinical practice course, medical and surgical
- MDCS (medication dosage calculation skills)
 - Introduction
 - Medication Orders and S.I. Units
 - Tablets and Capsules
 - Liquid Medicines
 - Injections
- AA - Authentic Assessment

The percentage of N209 BNRT students between Winter 2006 - Winter 2010 who failed the Math Test



Year, Number of Students & Method of Testing

The percentage of N209 BNAT students between Fall 2006 - Spring 2010 who failed the Math Test

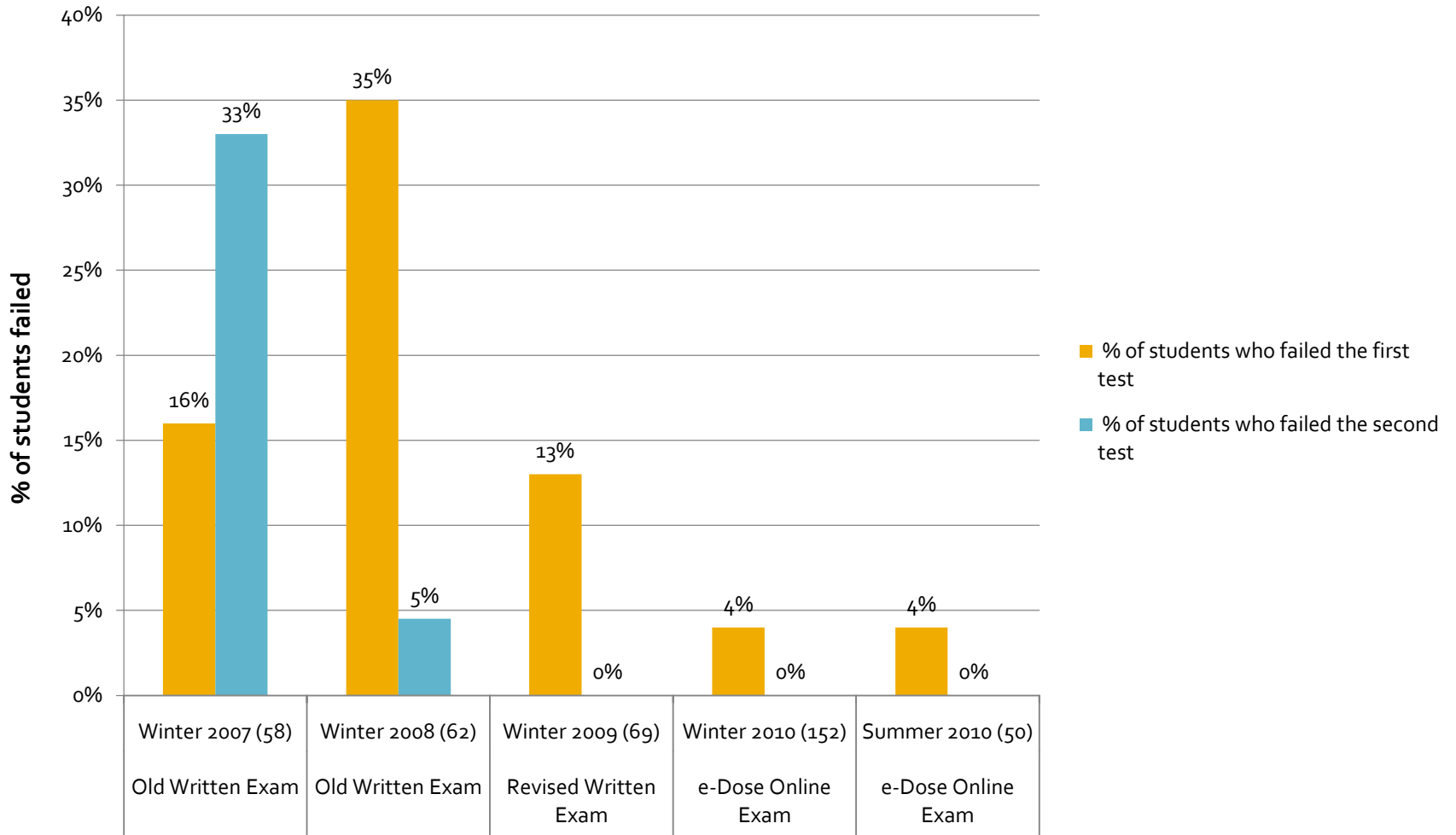


Year, Number of Students & Method of Testing

Nursing 302

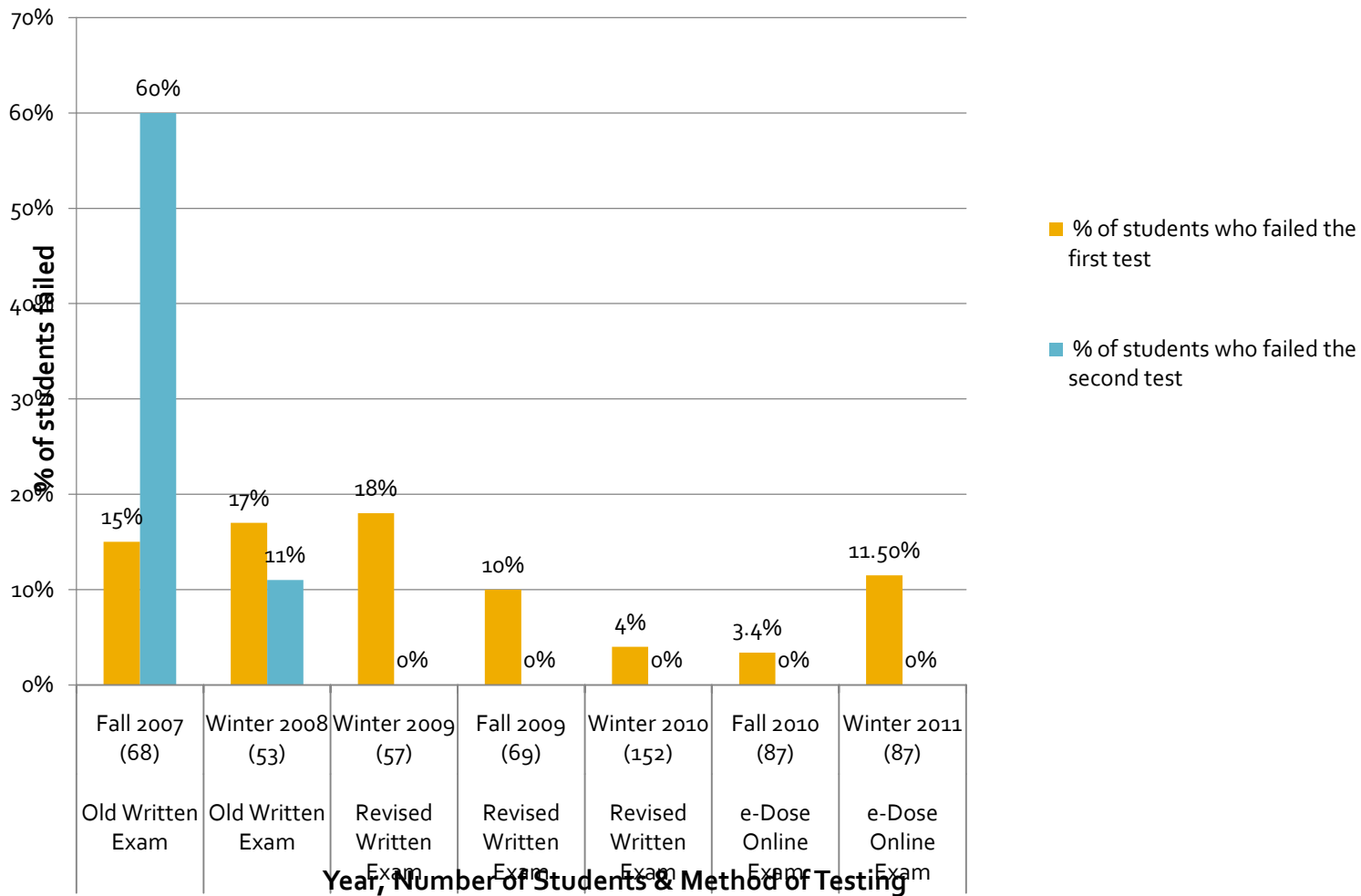
- 2nd Clinical practice course medical-surgical course
- IV medication administration
- Need to explicitly make case for calculating dosing using drops per minute
- Information Prior to AA
 - Exam does not include calculation steps, use scrap paper
 - Calculator usage (controversy in faculty)
- Rounding errors

The percentage of N302 BNAT students between Winter 2007 - Summer 2010 who failed the Math Test



Year, Number of Students & Method of Testing

The percentage of N302 BNRT students between Fall 2007 - Winter 2011 who failed the Math Test



Remediation

- Time spent in review
- Independence in remediation (with e Dose)
 - 100% second writing pass
 - Lets student focus on areas of concern
 - Rounding
 - Drop calculation
- A few students in more senior courses offered course to assist with remediation (peer leadership).

Student Feedback

- Anecdotal
 - “I feel that it is very beneficial seeing and hearing what you are learning”
 - “I really liked the program. It allowed you to pick and chose what you needed to focus on...to repeat practice...”
 - “it’s a good tutorial for students who struggle...I enjoyed the interactive nature of the program and that it was presented slowly with animations.”

On-line Survey Results

- The math was too easy
 - The tests stressful but fair; it was good to see what you should have done
 - Expensive, cannot resell the program
 - Liked having different ways to solve problems
 - You could practice over and over until it made sense
 - You can work at your own pace
- (44/135 students completed the survey)

Hot Tips for Operationalization in Curriculum

- Things we will continue to do
 - 2 Administrators
 - Ongoing engagement of faculty
 - Course coordinators
 - Clinical faculty
 - Centralized testing area

Ongoing Implementation/Evaluation

- Things we are changing
 - More explicit orientation for students and clinical faculty
 - Use of ADA prior to AA
 - Practice Instructor Survey
- Research suggestions
 - Application of knowledge in practice settings
 - What are the factors which affect accurate and timely dosage calculation in the practice setting



References (1/2)

- Andrew S, Salamonson Y, Halcomb EJ. Nursing students' confidence in medication calculation predicts exam performance. *Nurse Education Today*. 2009;29:2:217-223.
- Aronson JK. Medication errors: what they are, how they happen, and how to avoid them *QJ Med* 2009;102: 513-521.
- Baker G. et al (The Canadian Adverse Events Study: The Incidence of Adverse Events among Hospital Patients in Canada. *CMAJ* 2004;170(11), 1678-86
- Coben D, Hall C, Hutton M, Rowe D, Weeks K, Woolley N. Numeracy test is unrealistic for the clinical environment. *Nursing Standard* 2008;22:22:33.
- Costello M. Predictors of Success on medication calculation tests. *Nurse Educator*. 2011. 36:1:11-12.
- Figge HL. Reducing medication errors using technological innovations. *US Pharmacist*. 2009;34(3).
- Hughes, Y. (2005) First, Do no harm: reducing pediatric medication errors. *AJN*. 2005;105:5:79-92.
- Hutton, M, Coben, D, Hall C, Rowe D., Sabin M, Weeks K, Woolley N. Nurse Numeracy for nursing, report of a pilot study to compare two practical simulation tools. An online medication dosage assessment and practical assessment in the style of objective structured clinical examination. *Education Today* 2010;30:7:608-614.

References (2/2)

- Institute of Medicine. *To Err is Human*. 2000. National Academy Press, Washington
- Medication Self-Assessment 2000-2010. Institute for Safe Medication Practice Canada. www.ismp-canada.org/mssa.htm
- Rothchild, J et al. The Critical Care Study: The Incidence and Nature of Adverse Events and Serious Medical Errors in Intensive Care. *Crit Care Med*. 2005;33 (8), 1694-1700
- Weeks KW, Lyne P, Torrance C. Written drug dosage errors made by students: the threat to clinical effectiveness and the need for a new approach. *Clinical Effectiveness in Nursing*. 2000: March: 20-29.
- Wright K. Student nurses need more than maths to improve their drug calculating skills. *Nurse Education Today*. 2007;27:4:278-285.
- Wright K. Do calculations errors by nurses cause medication errors in clinical practice? A literature review. *Nurse Education Today*. 2010: 30:1:85-97.
- Wright, K. An exploration into the most effective way to teach drug calculation skills to nursing students. *Nurse Education Today*. 2005: 25:6:430-436.