

## Testing Committee Resources

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### MaricopaNursing Testing Policy

- Students must achieve 76% (non-rounded) on course proctored test/quiz points to pass the course.
- Final Exam will be Comprehensive and given at the end of the semester
- While the final exam is comprehensive, this does not preclude faculty from giving comprehensive proctored exams and quizzes.
- Standardized End-of-Course/Program Exams – Program Benchmarks
  - Block I – Fundamentals HESI
  - Block II – Mental Health HESI
  - Block III – Med/Surg HESI
  - Block IV – Exit Exam HESI
- Other Non-Benchmarking options (non-proctored points only)
  - Block II – Med/Surg HESI – customized
  - Block III – OB - standardized
- Grade grievance must follow the protocol established in the MaricopaNursing Student Handbook.
- Academic misconduct Must follow the guidelines within the MaricopaNursing Program Student Handbook.

### Exam Weight Progression

	Block I	Block II	Block III	Block IV
Proctored Unit Quizzes/Exams	45%	50%	50%	55%
Comprehensive Final Exam	25%	25%	25%	25%
Standardized HESI Exam	5%	5%	5%	5%
<b>% of Total Grade</b>	<b>75%</b>	<b>80%</b>	<b>80%</b>	<b>85%</b>

### MaricopaNursing Testing Guidelines

#### Blueprint – Leveled to Blocks

	Block 1	Block 2	Block 3	Block 4
Low Level K/C	30-40%	20-30%	10-20%	0-10%
High Level A/A	60-70%	70-80%	80-90%	90-100%
Alternative Item - Includes NextGen and Medication Calculations (FITB)	10-20%	20-30%	30-40%	Up to 50%
Mastery	<10%	<10%	<10%	<10%

### Item/Exam Development

- All exams should be peer-reviewed for content validity
- Textbook test items should be avoided. Modification is required to ensure the security of questions.
- NextGen Items – NextGen items should not be used as proctored points unless they are used in teaching, before the exam, allowing the student sufficient time to reach mastery. Item styles may include these styles as provided by the NCSBN's NextGen NCLEX®.
  - Cloze
  - Extended Drag and Drop
  - Matrix
  - Enhanced Hot Spot
  - Extended Multiple Response (SATA)
- Alternative Items options – students should experience all types in the classroom and testing environments.
  - Select all that apply- Multiple Response (5 or 6 answer options) (most difficult)
  - Fill in the blank – math calculations only (most difficult & time-consuming)
  - Drag and drop – Ordered response (most time consuming)
  - Hot spot
  - Multiple choice (4 answer options)
    - Chart exhibit (most difficult & time-consuming)
    - Tables and graphs (most difficult & time-consuming)
    - Audio
    - Video
- Medication Calculation Testing – Testing for medication calculation should be reflective of the style used for teaching, allowing students sufficient time to reach mastery. Medication Calculation Instruction should follow the guidelines of the Medication Calculation Best-Practice research provided within this document.

### Item Writing Style

- Provide written rationales for each item for individual test review purposes.
- Each item should pose a question, ending in a question mark.
- Each item should begin with an upper case and end with a period.
- 'Client' should be used rather than patient; prescription/prescribed rather than order; parent rather than mom/dad; health care provider rather than doctor.
- Proper names should be avoided – refer to "The nurse" and "The client."
- Important words in the stem should be bolded, such as: **priority, most, select all that apply, best, first.**
- Negatively referenced stems should be avoided.
- All test items should stand alone.
- Medications should be generic names only – no brand names.
- Eliminate age, culture, sex unless pertinent to the question.
- Eliminate bias.

**Length of the Exam- Leveled to Blocks**

- NCLEX® does not have a time limit per item
- The duration of the exam should be based on the number of minutes per test item.
- Allowing an unlimited amount of time will often lead to students changing answers.
- Considerations may be needed for alternative items that are more time consuming:
  - Fill-in-the-blank
  - Drag and drop
  - Chart exhibit
  - Tables and graphs

	Block 1	Block 2	Block 3	Block 4
Time per item recommendations- determined by faculty - based on number of alternative items and % of high-level items per exam.	1.5 – 2.5 mins/item	1.5 – 2.5 mins/item	1.5 – 2.5 mins/item	1.5 – 2.5 mins/item

**Item Analysis**

	Range	What it Means	Considerations
KR20	0.0 to +1.0	The higher the number, the more reliable an exam is considered	<ul style="list-style-type: none"> <li>When the item difficulty of several items is a high number (high % = easy questions), the KR20 will be lower</li> <li>The way to improve a KR20 is to:               <ul style="list-style-type: none"> <li>Have more test takers</li> <li>Improve individual items.</li> </ul> </li> </ul>
Item Difficulty (p-value)	30% to 80%	Tells the % of students that got an item correct	<ul style="list-style-type: none"> <li>Optimal = 63% for a 4-option multiple-choice exam.</li> <li>Items &gt;90% are considered too easy; unless pre-identified as Mastery.</li> <li>Items &lt; 30% are considered too difficult.</li> <li>In a four-option multiple-choice item, 30% can be achieved by guessing alone.</li> </ul>
Item Discrimination Ratio (IDR)	> 40%	Excellent Discriminator	<ul style="list-style-type: none"> <li><u>Calculate IDR by using this formula</u> (Upper-scoring 27%) – (Lower-scoring 27%)</li> <li>A negative IDR occurs when more low-scoring students answer the item correctly than high-scoring students.</li> </ul>
	> 25%	Acceptable Discriminator	
	< 25%	Poor Discriminator	
Point Biserial (PBCC)	> 0.25	Acceptable Item	<ul style="list-style-type: none"> <li>The higher the number, the better the question is at discriminating between high and low achievers.</li> <li>If PBCC is a negative number, then low-achieving students got it right, and high-achieving students got it wrong. Item must be revised.</li> </ul>
	< 0.25	Review and Edit	

Course: \_\_\_\_\_ Analyzed Date/Time: \_\_\_\_\_ KR Score: \_\_\_\_\_ Faculty Members: \_\_\_\_\_ &amp; \_\_\_\_\_

Test #: \_\_\_\_\_ Administered Date/Time: \_\_\_\_\_ Median/Possible: \_\_\_\_\_ N: \_\_\_\_\_

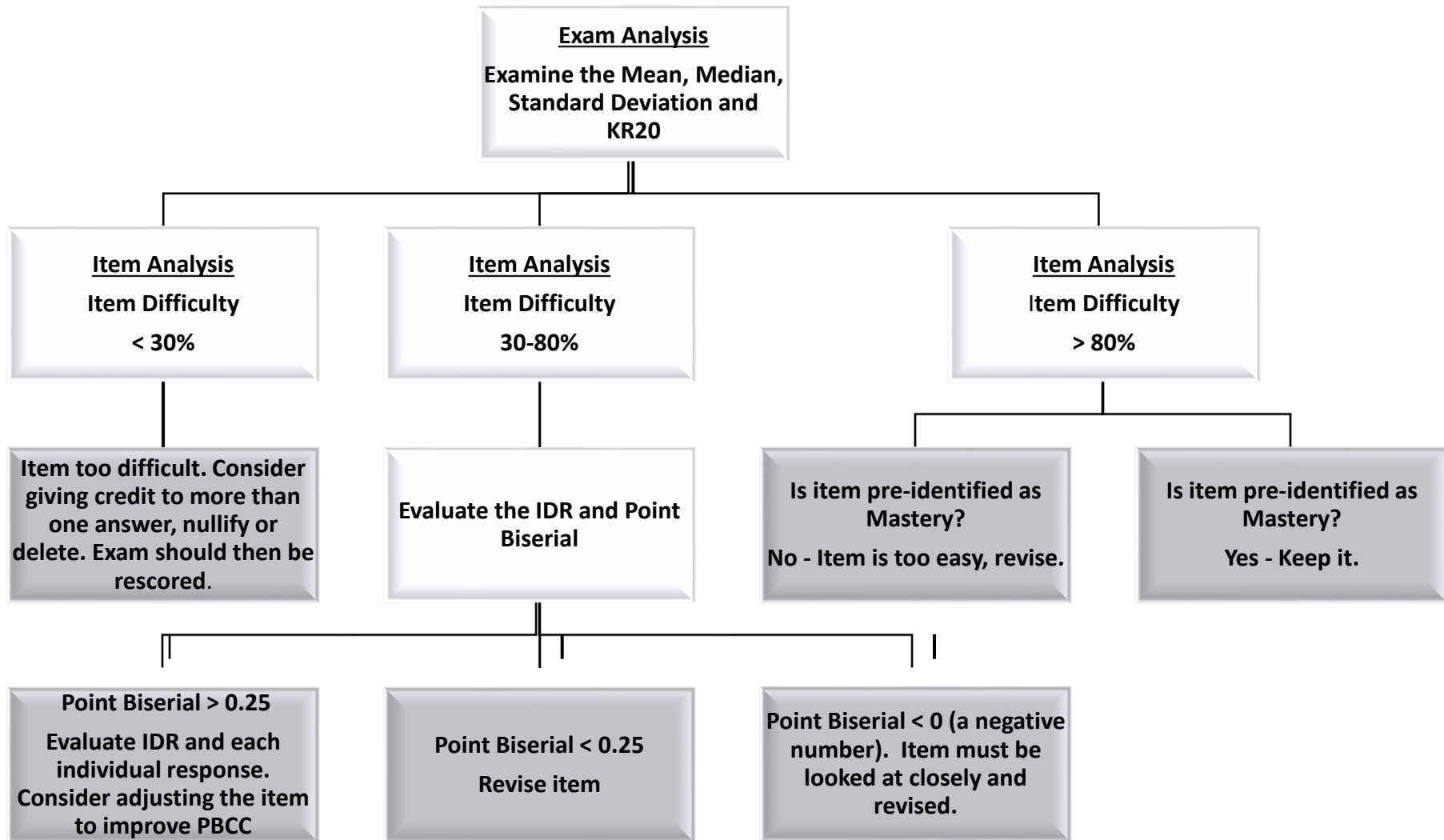
	Point Biserial > 0.25	Point Biserial 0.25 - 0	Point Biserial Negative	Total
<b>P Value</b> 0-30%				
<b>P Value:</b> Very Difficult: 31-50%				
<b>P Value:</b> Difficult: 51-62%				
<b>P Value:</b> Average: 63-80%				
<b>P Value:</b> Easy: 81-95%				
<b>P-Value:</b> Very Easy if not predesignated as Mastery: 96-100%				
Total Number of Items				

**KR Score:** Reliability – Trustworthiness/consistency of results. Range 0.0 to +1.0 – higher is better  
**p-Value:** % correct, Level of item Difficulty. Range should be in 30% - 80%.  
**Point Biserial:** Discrimination ability of each question with consideration of the upper and lower performers > 0.25 – Acceptable – higher is better

**Black:** Invalid question, adjust scores per department guidelines and rewrite.  
**Dark Gray:** Item needs revision: furthest from Ideal.  
**Light Gray:** Consider revision – approaching ideal.  
**White:** Ideal for discrimination & level of difficulty

 Alternative Overall % of exam: \_\_\_\_\_ Number of Select All That Apply Questions: \_\_\_\_\_ Fill in the Blank (Math): \_\_\_\_\_ Chart Exhibit: \_\_\_\_\_  
 Hot Spot: \_\_\_\_\_ Graph: \_\_\_\_\_ Drag and Drop: \_\_\_\_\_ Audio/Video: \_\_\_\_\_ Total Number: \_\_\_\_\_

Questions Adjusted:	Questions to be Revised:	Summary of scores after adjustments:		
Example: #3 – accept C or D, #10 - nullify	(list by number)	A	92-100	#
		B	84-91	
		C	76-83	
		D	68-75	
		F	< 68	



### Item Analysis Outcome

- Grades should not be posted until after the adjustments are made.
- Review with a second faculty member the items being adjusted.
- Complete analysis and archive, in case there is a student grievance related to the exam.
- Item outcomes should be consistent on each campus site.
- For items identified as “poor” consider the following:
  - Give credit for more than one choice. (preferred action)
  - Nullify the test item by giving credit for all choices.
- Revise the questions identified in the analysis.
  - When revising items, the first step is to create 4 plausible answer options.
  - Clarify any questions where credit was given for more than one choice, and it was not multiple response.

### Recommended Honesty Statement

Evidence shows that when students are faced with reminders of honesty before testing events, they are less likely to be dishonest. It is suggested that this statement be signed before each exam, such as on the exam face sheet.

*Example A:*

*"On my honor, I will maintain the highest standards of honesty, integrity, and personal responsibility. This means I will not lie, cheat, or steal, and as a member of this academic community, I am committed to creating an environment of respect and mutual trust."*

*Example B:*

*ANA Nursing Code of Ethics Provision 6 states that Nurses will demonstrate and commit to:*

- *Moral Self Respect*
- *Wholeness of Character*
- *Professional Growth and Maintenance of Competence*
- *Preservations of Integrity*

### Environment and Exam Security

- Testing security should be consistent within the program.
- The faculty should actively proctor in-person during the examination.
- Students should not leave the room for any reason without a proctor escort.
- Lockdown browsers should be used for electronic testing to prevent accessing other sites.
- Students not taking the exam at the same time should be given a variation of the exam that fulfills the same blueprint.
- The instructor may provide an English dictionary for students to use at the front of the room. Medical terminology, if a part of the question, will not be provided.
- English translation dictionaries should not be used during testing.

*Recommended Test Day Rules:*

- *Students should only have a pencil at their desk or computer.*
- *All books, notebooks, backpacks, purses, or other luggage used to transport class material should be in the front, back, or sides of the room.*



- *All electronic devices and cell phones should be turned off and secured at the front of the room.*
- *No hats, ball caps, or visors should be worn during the exam.*
- *Earplugs may be worn during the exam if approved by the instructor.*
- *All food should be placed at the front of the room. Drinks may be allowed at the instructor's discretion.*
- *Once the exam has started, the Student should only leave the testing area at the instructor's discretion.*
- *If a calculator is required for the exam, the student should only use the calculator provided by the instructor.*
- *The instructor should not answer any content-related questions about the exam once the exam begins.*
- *Calculators (scratch paper, pencils, scantrons, etc.) should be provided by the instructor and turned in at the end of the exam.*

### **Test Review and Remediation**

- Exam review should take place in a timely manner; within 2 weeks of the exam date.
- Review and remediation should be consistent within the course and program.
- Students should be offered written suggestions for improvement of study and testing strategies for each exam (for failing or passing grade) and be made aware of campus student success services.
- The Exam Autopsy can be used for a student to recognize trends of unsuccessful behavior.

### **Offsite – Online Testing**

- During the campus shutdown of 2020, an offsite-online testing policy was initiated. These temporary evidence-based guidelines are contained within a separate document called ***MaricopaNursing (Offsite) Online Testing Guidelines - Spring 2020***



**Exam Autopsy**

Student: \_\_\_\_\_ Date: \_\_\_\_\_ Course: \_\_\_\_\_ Test # \_\_\_\_\_ Score: \_\_\_\_\_

To be completed by the students. Indicate the question number of each item answered incorrectly and select the corresponding reason.

Item #	Insufficient Information or Knowledge						Test Anxiety			Careless Mistakes				Lack of Test Wisdom				Other					
	I did not read the textbook thoroughly	The information was not in my notes	I studied the material but could not remember it	I knew the main ideas but needed the details	I knew the material but could not apply it	I studied the wrong information	Misread or did not understand the terms	I had a mental block	I was tired during the test and could not concentrate	I panicked during the exam	I made careless mistakes, but knew the correct answer	I changed the answer to the wrong one	I misread the directions	I misread or misunderstood the question	I wrote an incomplete response	I did not eliminate obviously incorrect answers	I did not select the best choice	I did not notice key words	I made poor use of the time provided	I ran out of time/did not budget my time well			
Totals																							

*Adapted with permission from Fresno State Support Net Exam Autopsy*

## **Exam Autopsy Student Success Guide**

### **Pre-Exam**

- Read and highlight the textbook
- Combine notes from book and lecture
- Prepare a study guide – use your learning style ([www.vark.com](http://www.vark.com))
- Participate in a study group
- Clarify all questions
- Rest and eat well before the exam
- Prepare for each class by reading and doing pre-assignments
- Attend all classes and labs
- Review class notes within 24 hours of lecture
- Review previous notes before the next lecture

### **During the Exam**

- Glance through the exam before beginning
- Read all instructions
- Ask for clarification if unclear
- Underline keywords
- Skip hard questions taking too much time and go back to them

### **Insufficient Information or Knowledge**

Insufficient information or knowledge is the result of poor or inadequate study skills and preparation. If you continue to have difficulty, see the student success departments on campus. They can help with strategies and life management skills. Below are some specific suggestions.

- *I did not read the textbook thoroughly*
  - Take notes while reading – reread before the exam; summarize the readings; highlight key ideas while reading
- *The information was not in my notes*
  - Record lecture if allowed and update notes after class
- *I studied the material but could not remember it*
  - May not have been focused on when studying; allow yourself more preparation time to review in detail the 1<sup>st</sup> time and “brush up” before the exam.
- *I knew the main ideas but needed the details*
  - May not have been focused on when studying; allow yourself more preparation time to review in detail the 1<sup>st</sup> time and “brush up” before the exam.
- *I knew the material but could not apply it*
  - Create patient scenarios for each topic – apply while studying.
- *I studied the wrong information*
  - Clarify the areas of content; review the test blueprint if available.
- *Missed or did not understand the terms*
  - Make flashcards of all unfamiliar words while studying.

### **Test Anxiety**

Test anxiety is common in nursing school. You cannot eliminate test anxiety but need to learn how to control your stress levels while testing. Counseling services on campus can assist in managing the anxiety you are experiencing. Here are some other suggestions.

- Get a good night of sleep the night before the exam. Do not study 2-4 hours before bedtime; otherwise, you will not sleep restfully.
- Prepare a method of meditation or relaxation that can be used during the exam. Reflect in your mind, on a word, phrase, image, or positive affirmation that brings you calm. Use it while studying and during the exam, hang it on your bathroom mirror and reflect on it each day.
- Take a brisk walk around campus before the exam; think positive thoughts.

### **Careless Mistakes**

Careless mistakes are often the result of going too fast or too slow. The person that moves too rapidly through the exam glosses over key points and misses keywords. The person that goes too slow, second guesses themselves and changes answers. It is essential to develop both speed and accuracy when taking an exam.

- Budget enough time to review your exam before submitting but **do not** change answers unless you are 100% confident that you've marked it incorrectly
- Remember, the NCLEX® does not allow for exam review, so learn how to take each item and move forward.

### **Lack of Test Wisdom**

Learning to take nursing exams is a skill that needs development. Learn how to take these types of exams and practice, practice, practice!

- Practice exam items in “study mode” where you take a question, select your answer and read the correct answer with rationale.
- Practice exam items in “testing mode” where you take 75+ items in a single setting, timing yourself, and ‘simulating’ an exam. This will develop your “mental muscle” to sustain concentration over a sustained period of time.

### **Student Success Strategies**

- High-risk students should be identified, provided with, and encouraged to create a success plan with the guidance of the faculty. A high-risk student is considered to have one or more of the following:
  - Received < 80% on the previous Block proctored points
  - Current Block exam grade of <76%
  - HESI score of < 850
  - Past failure in the nursing program
- MaricopaNursing Learning Contract should be initiated for each at-risk student with a success plan.

*General Success Plan Recommendations*

- *Review HESI remediation for all HESI block tests. Use your areas of weakness to create a study plan, review, and remediate.*
- *Math calculation and remediation.*
- *Practice 100 NCLEX® test questions per week.*
  - *Homework mode: take an item, review answer, and read the rationale*
  - *Testing mode: take many items with a time limitation, then check answers – simulate the testing environment.*
- *Counselor center for stress management, test anxiety, and life skills.*
- *Disability Resources and Services for disabilities.*



**Student Learning Contract**

**Student Name:** \_\_\_\_\_

**Date Initiated:** \_\_\_\_\_

**Course: NUR** \_\_\_\_\_

<b>Opportunities for Performance Improvement</b>	<b>Reflection from Student Handbook, Student Learning Outcomes and/or KSAs</b>	<b>Action Plan for Improvement (include dates for achievement)</b>	<b>Date of Expected Achievement</b>	<b>Student's Self-Improvement Plan</b>	<b>Outcome</b>

Instructor Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Student Signature \_\_\_\_\_

Date \_\_\_\_\_

Date(s) of Follow-Up Conference: \_\_\_\_\_

### Testing Guidelines and Success Resources

Arizona State Board of Nursing (2019). *Advisory Opinion: Testing Guidelines for Pre-Licensure Nursing Programs in Arizona*. Retrieved from [https://www.azbn.gov/sites/default/files/2019-12/11106\\_AO%2BTesting%2BGuidelines%2Bfor%2BPre%2BLicensure%2BPrograms%2B11-2019.pdf](https://www.azbn.gov/sites/default/files/2019-12/11106_AO%2BTesting%2BGuidelines%2Bfor%2BPre%2BLicensure%2BPrograms%2B11-2019.pdf)

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MaricopaNursing Testing Committee Resources, Updated Sp. 2021



## Medication Calculation Best-Practice (dev. Jan 2020)

### Purpose

Faculty teaching nursing within Maricopa Community Colleges reports a lack of uniform evidence-based guidelines for teaching, testing, and remediation of medication calculations resulting in an inconsistent testing environment for students.

### Goal

All students in the MaricopaNursing Program will gain the mathematical knowledge, skills, and abilities to provide safe nursing care.

#### **2019 NCLEX-RN® Test Plan Statements regarding Medication Administration**

- Acknowledge and document practice error (e.g., incident report for medication error).
- Perform calculations needed for medication administration.
- Use clinical decision making/critical thinking when calculating dosages.
- Educate the client about medications.
- Prepare and administer medications using the rights of medication administration.
- Review pertinent data before medication administration (e.g., contraindications, lab results, allergies, potential interactions).
- Participate in medication reconciliation process.
- Titrate the dosage of medication based on assessment and ordered parameters (e.g., giving insulin according to blood glucose levels, titrating medication to maintain specific blood pressure).
- Evaluate the appropriateness and accuracy of medication orders for the client.
- Administer controlled substances within regulatory guidelines (e.g., witness, waste).
- Handle and maintain medication in a safe and controlled environment.
- Identify a contraindication to the administration of a medication to the client.
- Identify actual and potential incompatibilities of prescribed client medications.
- Provide information to the client on common side effects/adverse effects/potential interactions of medications and inform the client when to notify the primary health care provider.
- Notify the primary health care provider of side effects, adverse effects, and contraindications of medications and parenteral therapy.
- Evaluate client response to medication (e.g., therapeutic effects, side effects, adverse reactions).
- Handle and/or administer high-risk medication.

#### **2018 NCLEX-RN® Practice Analysis Statements regarding Medication Administration – Rank order of Top 50 items.**

1. Prepare and administer medications using rights of medication administration
7. Handle and/or administer high-risk medications
11. Evaluate appropriateness and accuracy of medication order for the client
12. Handle and maintain medication in a safe and controlled environment
16. Handle and/or administer controlled substances within regulatory guidelines
18. Evaluate client response to a medication
21. Perform calculations needed for medication administration
22. Titrate the dosage of medication based on assessment and ordered parameters
43. Acknowledge and document practice errors and near misses (e.g., incident report for med. error)





### The Problem – In Practice

- Similar packaging, look-alike/sound-alike, complex dosing/complex patients (critical care, pediatrics, emergency department, etc.), 40% of errors related to the wrong dose, 16% of errors associated with the wrong drug (cited causes were name confusion, similar packaging/labeling) (Hughes & Blegin, 2008).
- Human factors- training, attention to detail, time pressure (Hughes & Blegin, 2008).
- Recommendations for safety in practice: (1) Training- simulation of medication errors- “duplicate the complexity of the nurse-patient interaction and related cognitive thought”; (2) Calculation testing new grads; Problem-based practice projects; Use of interactive education tool (Hughes & Blegin, 2008).
- The current format of medication calculations assesses (1) reading comprehension (Newton et al., 2010); (2) data finding (Wright, 2007); conceptualization (Coben & Weeks, 2014); anxiety (McMullan et al., 2012) (Williams & Davis, 2016).

### The Problem – In Education

- Just before graduation, nursing students' pharm knowledge and calculation skills are limited. (Dilles, et al., 2011).
- Most students were able to correctly calculate items involving addition, subtraction, multiplication, and division of whole numbers. When the items dealt with fractions, decimals, and percent, the average correct response rate varied from 38% to 92% and 42% to 97% (Brown, 2008) (Clochesy, 2018).
- Analysis of medication calculation errors include (1) 68% of errors relate to set-up; (2) 19% relate to math; (3) 13% relate to the conversion of units (Kohtz et al., 2010). 43% of students perceived that they had sufficient math skills and 31% perceived that they had good math skills, yet the average student score on a medication calculation test was 70% and 22% of students were unable to solve half of the problems (Bagnasco, Galverna, Aleo, Grugnetti, Rosa, & Sasso (2016).
- Medication/pharmacology education should accompany math education; standards need to be developed. Education should focus on mathematical & conceptual drug calculations. (Fleming, et al., 2013). Conceptual errors are common (Weeks et al., 2013). Students struggle more if no relevance provided for the question but still struggle somewhat even if relevance is provided (Clochesy, 2018). Three major classifications of errors: (1) conceptual, (2) arithmetical, and (3) computational have been identified. These errors involve being unable to formulate an equation from information given, unable to operate a given equation, or simple arithmetical errors, respectively (Eastwood et al., 2011).

### Predictors of Success

- Math scholastic achievement test (SAT) grade, the number of high school math courses, and high school algebra grades were predictive. While the number of high school science courses, high school grade point average and experience with dimensional analysis did not predict success (Costello et al., 2011).



- Nursing students' confidence in medication calculations predicts math exam performance (Andrew et al., 2009).
- There is a consistent relationship between anxiety and decreased math calculation performance. (McMullan, et al., 2011). There is a relationship between mathematics anxiety, beliefs about mathematics, mathematics self-efficacy, and mathematics performance (Middleton, 2008).

## Instructional Guidelines – Best practices for teaching medication calculations

### ***Use of case studies and simulation for medication calculation integration***

- Placing medication calculations into case studies improves the accuracy of medication calculations (Coyne et al., 2013) (Latimer et al., 2017).
- Medication instruction should include: (1) the rights of medication administration; (2) dealing with distraction during medication administration; (3) computer usage; (4) interdisciplinary communication (Krautscheid et al., 2011).
  - The rights of medication should include the right orders, drug, dose, route, frequency, and patient, along with the more recently added rights, which include the right drug information, right policies, right administration (administer safely and identify problems), right to stop, think and be vigilant (Hughes & Blegen, 2008).
- A simulation instruction improved students' medication calculation test grades from baseline (Costello, 2011) (Shanks et al., 2011).
- An authentic environment has a significant impact on students' ability to accurately calculate medication dosages (Weeks et al., 2013)

### ***Create a culture of safety and support***

- Increasing awareness of medication errors and their prevention create a culture of safety (Dilles et al., 2011).
- If nursing students are to become competent, skillful, and safe practitioners, their learning will require extensive support from their academic institutions and clinical mentors (Vaismoradi et al., 2014).
- Error reporting (IOM, 2007)

### ***Methods for instructional design and techniques***

- Techniques for integrating medication calculations should include (1) scaffolded medication calculation competency; (2) use of case studies to consolidate learning concepts; (3) understanding professional roles involved in the medication cycle; and (4) short videos demonstrating the system factors associated with med errors and their prevention (Latimer et al., 2017).
- Time should be set aside in curricula for nursing students to learn how to perform basic numerical and drug calculations. This learning should be reinforced through regular practice and assessment (McMullen et al., 2010). Nursing faculty should stress the essentials of best practices, provide students with ample opportunities for practice (Treiber & Jones, 2018)



- For students to be competent, they must perform calculation competence, conceptual competence, and technical measurement competence (Weeks et al., 2013).
- Medication math must be put into nursing context, and clinical implications should be clearly illustrated so that students understand the importance of safety (Koharchick, Hardy, King, & Garibo, 2014). The focus should remain on practice opportunities, conceptual learning, and simulation (Mackie & Bruce, 2016).
- The use of actual equipment (syringes, vials, IV bags, etc....) will benefit the students' learning (Koharchick, Hardy, King, & Garibo, 2014). Incorporate patient assessment data, lab values, and vital signs into the process. Have students compare medication orders, the medication administration record (MAR), and drug references (Hurley, 2017)
- There is no difference between e-learning and classroom teaching in drug dose calculations (Bjoerg et al., 2014).
- There is no significant difference in overall student performance, or the occurrence of conceptual errors between students taught dimensional analysis and those shown with conventional methods (Kohtz et al., 2010). Dimensional analysis group scored with greater accuracy than the traditional math group (Greenfield et al., 2006) (Rice et al., 2005).

### **Remediation**

- Analysis of mistakes made on proficiency examinations suggests the grounds for mitigating recurring errors (Koharchik et al., 2014).

### **Medication Calculation Best-Practice Resources**

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### Annotated Bibliography & Abstracts

Brown, S.T., Kirkpatrick, M.K., Mangum, D., Avery, J. (2008). A review of narrative pedagogy strategies to transform traditional nursing education. *Journal of Nursing Education*, 47 (6), 283-286.

Students were able to correctly calculate items involving addition, subtraction, multiplication, and division of whole numbers. When the items dealt with fractions, decimals, and percent, the average correct response rate varied from 38% to 92% (1988) and 42% to 97% (2003).

Costello, M. (2011). The use of simulation in medication calculation instruction: A pilot study, *Nurse Educator* (36)5: 181-182.

Mathematical competence is essential to students' understanding of medication calculation. A simulation instruction improved students' medication calculation test grades from baseline.

Coyne, E., Needham, J. & Rands, H. (2013). Enhancing student nurses' medication knowledge, integrating theoretical knowledge into practice. *Nurse Education Today*, 33(9), 1014-1019.

Teaching interventions such as basic math skills, using formulas for medications, and linking the medication to patient case studies have improved the accuracy of student's medication calculation, specifically, understanding the correct formula to use and identifying errors of calculation.

Dilles, T., Vander Stichele, R., Van Bortel, L. & Elseviers, M. (2011) Nursing students' pharmacological knowledge and calculation skills. Ready for practice? *Nurse Education Today*, 31, 499-505.

Study reveals that just before graduation, nursing students pharm knowledge and calculation skills are limited. Schools need to address the shortcomings, and in practice, awareness is needed regarding possible limitations of the newly graduated.

Greenfield, S., Whelan, B., Cohn, E. (2006). Use of dimensional analysis to reduce medication errors, *Journal of Nursing Education*, 45(2), 91-94.

Analysis of the collected data from a medication dosage calculation examination revealed the dimensional analysis group scored with greater accuracy than the traditional math group.

Koharchik, L., Hardy, E. King, M. & Garibo, Y. (2014) Evidence-based approach to improve nursing student dosage calculation proficiency. *Teaching and Learning in Nursing*, 9(2), 69-74.

A multifaceted approach using best practices improves the success of student nurses in medication calculation proficiency. The analysis of mistakes made on proficiency examinations suggests the grounds for mitigating recurring errors. Specific strategies and teaching points are outlined to help students avoid pitfalls in medication calculations.





Kohtz, C. & Gowda, C. (2010). Teaching Drug Calculation in Nursing Education A Comparison Study, *Nurse Educator*, (35) 2, 83-86.

The findings of this study found no significant difference in overall student performance or the occurrence of conceptual errors between students taught DA, and those taught conventional methods. Although further study and larger studies are needed, these preliminary findings suggest that either approach may be equally effective in teaching students drug calculation. Based on this, the selected approach may be teacher choice and/or program preference. However, regardless of the approach used, only 50 of the 79 students (63.29%) received a passing score of 90% accuracy. Therefore, more work is needed by faculty to identify the root cause of students' difficulties and to design a meaningful and effective learning experience to promote accurate drug calculation among students.

Latimer, S., Hewitt, J., Stanbrough, R. & McAndrew, R (2017) Reducing medication errors: Teaching strategies that increase nursing students' awareness of medication errors and their prevention. *Nurse Education Today*, 52, 7-9.

A suite of teaching strategies has been developed that will raise students' awareness of medication error, producing situations, and their prevention. Some strategies include targeted classroom education about med errors early in the curriculum, teaching aimed at improving students' knowledge of med errors with the use of high-fidelity simulation to demonstrate best practice, and interventions focused on instilling a culture of safety. Four teaching strategies include 1) scaffolded medication calc competency, 2) use of case studies to consolidate learning concepts, 3) understanding professional roles involved in the medication cycle, and 4) short videos demonstrating the system factors associated with med errors and their prevention.

McMullen, M., Jones, R. & Lea, S. (2010). Patient safety: numerical skills and drug calculation abilities of nursing students and Registered nurses. *Journal of Advanced Nursing*, 66(4), 891-899.

A correlational study suggests that time should be set aside in curricula for nursing students to learn how to perform basic numerical and drug calculations. This learning should be reinforced through regular practice and assessment. There is a consistent relationship between anxiety and decreased math calculation performance. We might want to consider mindfulness exercises, etc. as part of remediation.

Middleton, D. (2008). A standardized nursing mathematics competency program, *Nurse Educator* 33(3): 122-124.

Mathematics competency in nursing is an ongoing problem. The author utilized a standardized mathematics competency program based on current practices reported in the nursing literature. Dimensional analysis is the method that students used to find solutions to nursing problems that require mathematics and is important to the success of the program.

Rice, J., Bell, M. (2005). Using dimensional analysis to improve drug dosage calculation ability, *Journal of Nursing Education* 44(7), 315-318.

This article provides evidence of the value of dimensional analysis as an effective teaching strategy for calculating drug dosages.

Shanks, L., & Enlow, M. (2011). Medication calculation competency, *American Journal of Nursing* 111(10): 67-69.

The difficulty that some nurses have in accurately calculating medication dosages is a safety issue that needs to be addressed. Training using simulation may improve medical calculation skills.

Simonsen, B., Daehlin, G., Johansson, I., Farup, P. (2014). Improvement of drug dose calculations by classroom teaching or e-learning: a randomized controlled trial in nurses. *British Medical Journal*, Open 2014.

The study was not able to demonstrate any differences between e-learning and classroom teaching in drug dose calculations concerning learning outcome, certainty, or risk of error. The overall learning outcome was without practical significance, and the conversion of units was the only topic that was significantly improved after the course. An independent factor in favor of classroom teaching was weak pretest knowledge. In contrast, factors suggesting the use of e-learning could be the need for training in relevant work-specific tasks and time effective repetition.

Vaismoradi, M., Jordan, S., Turunen, H. & Bondas, T. (2014) Nursing students' perspectives of the cause of medication errors. *Nurse Education Today*, 34, 434-440.

Nursing curricula need to increase investment in medication management. If nursing students are to become competent, skillful, and safe practitioners, their learning will require extensive support from their academic institutions and clinical mentors.



## Next Gen NCLEX® Guidelines

### Teaching Next Gen

- With the NCSBN® Next Generation NCLEX® (NGN) beginning April 1, 2023, these guidelines should start in the Fall 2021 semester for all MaricopaNursing Students.
- The NCSBN® Clinical Judgment Measurement Model (CJMM) use should be incorporated into every course.
  - Level 3
    - Recognize Cues
    - Analyze Cues
    - Prioritize Hypotheses
    - Generate Solutions
    - Take Action
    - Evaluate
    - Outcomes
  - Level 4
    - Environmental Factors
    - Individual Factors
- Before using Next Gen style items as proctored points, the instructor must expose and teach students how to take this item's style. Before testing an item for proctored points, each student should be involved with **a minimum of three classroom teaching activities**.
  - Use Next Gen Items as a part of classroom lectures, pre/post classroom activities, and small group activities.
  - Have students build their own Next Gen items to use with classmates as an activity or online discussion.
  - Use Next Gen items as non-proctored quiz points as faculty become comfortable writing the items and students become comfortable taking the items.
  - Introduce Next Gen items in a mock exam before testing as proctored points.

### Leveling of Test Item Onboarding

- Incorporate non-proctored point quizzes in the earlier part of the semester and Next Gen questions as proctored exam items in the latter half of the semester.
- Test Next Gen items in each Block towards the middle to end of the semester, after teaching this way and having a mock exam.

### Terminology

- A Next Gen "case" items consist of 6 questions, each measuring one of the six items in Level 3 of the CJMM.
- Stand-alone items measure all six items in Level 3 of the CJMM within 1 item.

Next Gen Items Types – (Specific examples of each will be provided to faculty during Spring 2021 training sessions – Archived in the Canvas Curriculum Course)

Items Style Types	
<b>Multiple Choice</b>	Matrix multiple choice
<b>Multiple Response</b>	Multiple response select all that apply Multiple response select N Multiple response grouping Multiple response matrix
<b>Drag-and-Drop</b>	Drag-and-drop cloze Drag-and-drop rationale
<b>Drop Down</b>	Drop-down cloze Drop-down rationale Drop-down table
<b>Highlight</b>	Highlight text Highlight table
Stand-Alone Items	
<b>Bow-Tie</b>	<b>Trends</b>

Piloting Next Gen items before testing as proctored points

- It is highly encouraged that the items be piloted before being used on a proctored exam. Piloting can take place in classroom activities or on proctored exams with no points attached.

% of Proctored Next Gen Exam Points

- NCSBN Next Gen Exam (May 2021)
  - The student taking the minimum number of items: 18 NG items of 70 total items = 25.7%
  - The student taking the maximum number of items: 25 NG items of 135 total items = 18.5%
- Progression of exam % (% of **total** course proctored points)
  - Block 1 = 5-10%
  - Block 2 = 10-20%
  - Block 3 = 15-30%
  - Block 4 = 20-40%



- Every course final exam should include one - 6 question Next Gen case item.
- Example: If the course total proctored points for the semester = 340
  - Block 1 = 17 to 34 points of NG items
  - Block 2 = 34 to 68 points of NG items
  - Block 3 = 51 to 102 points of NG items
  - Block 4 = 68 to 136 points of NG items
- \*\*Keep in mind that a single NG items may be worth more than one point, depending on how it is scored.

### Grading and Scoring

- NCLEX® Next Gen Scoring Rules
  - 0/1 – student gets the item either right or wrong (full credit or no credit)
  - +/- (plus/minus) - students earn points for correct answers, and points are removed for incorrect answers. The student will never lose points on an item (the lowest score is "0" and never negative)
  - Rationale Rule – a 2-part item when students need to get both the answer and rationale correct to obtain the point.
- Scoring SATA - Give one point for each correct response and take away one point for each incorrect answer with the lowest possible score of 0 points for the question. This rewards all correct answers but includes consequences for wrong responses (prevents a student from marking every answer and getting all points).

### Analytics

- To be developed. Need more information on how to determine the analytics on these items to -determine validity and reliability best. Currently, there is no published benchmark or best practice.

### Resources

- Faculty Videos & Tutorials – Canvas Share Locations: MaricopaNursing – Curriculum
  - Next Gen Information > Tutorials provided on teaching the NCJMM and writing Next Gen items.
- NCSBN Next Generation Project - <https://www.ncsbn.org/next-generation-nclex.htm>

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