The Impact of High-Fidelity Simulation on Student Registered Nurse Anesthetists' Knowledge Acquisition and Long-term Pharmacologic Knowledge Retention

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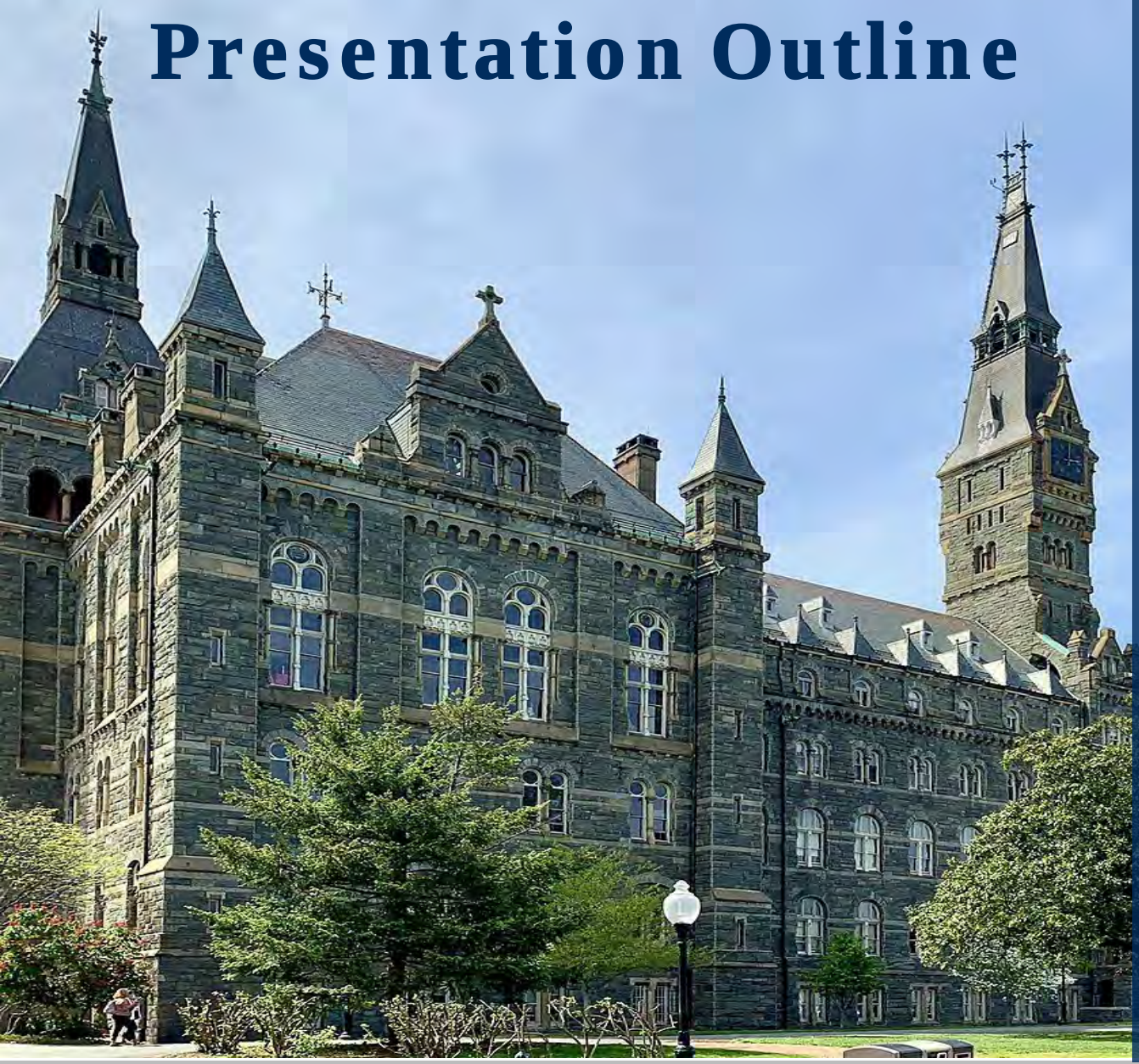
Presentation Outline



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Background

- SRNAs receive an immense volume of information through didactic pharmacology lectures and are expected to retain this information throughout their training and beyond graduation.

- Acquiring and retaining in-depth knowledge of pharmacological principles is essential for SRNAs to provide safe and effective anesthesia to patients as well as successfully pass the National Certification Exam (NCE)[1].

Background

- An educational model that promotes long-term knowledge retention of pharmacology material presented in the curriculum would benefit students and educators alike.

- **Improved pharmacological detail retention throughout SRNA training could inform clinical decision making and optimize anesthesia training outcomes.**

Problem

- For students in front-loaded nurse anesthesia programs, there can be a 2- to 3- year gap between receiving didactic pharmacology lectures and taking the NCE.

- Pharmacology-specific objectives are traditionally taught in a **didactic format**.[2-4] This method of teaching **can result in knowledge decay without continual recall**.[5]

Review of the Literature

- **High-fidelity simulation (HFS)** is an educational technique that realistically replicates a clinical event to allow participants to practice how they would respond in real-life, high-risk scenarios.[6]

- Systematic review and meta-analysis (N=609 studies) (Roizen et al.)[7]
  - Examined effects of HFS on knowledge and skill retention in **healthcare professions**.
  - Findings: **Simulation improves outcomes in knowledge level** compared with didactic instruction alone.

- Systematic review and meta-analysis (N=77 studies) (Lorello et al.)[8]
  - Examined simulation-based **anesthesia training**
  - Findings: **Simulation to teach anesthesia students is more effective** in obtaining new clinical skills compared with lectures alone.

Review of the Literature

- Many nurse anesthesia programs currently incorporate HFS into their curriculums[9] to emphasize technical skills and critical event management, but **do not use HFS to meet program objectives related to** the basic sciences, such as **pharmacology**.[10]

- Pilot Study (N=15 participants) (Gisriel et al.)[11]
  - A didactic nurse anesthesia pharmacology curriculum was supplemented with a simulation-based learning experience
  - On the pre-test, **baseline knowledge was equal** between 2 sets of medications that were taught in the same 4-week time period through formal lectures
  - **Initial post-test** immediately following the simulation intervention:
    - Scores were 20% higher on content supplemented with simulation
    - Scores were 1% lower on material taught through didactic lectures alone
  - **30-day post-test**
    - Scores were the same as initial post-test on content supplemented with simulation
    - Scores were 15% lower on material taught through didactic lectures alone
  - Limitations: Under-powered and measured knowledge retention after 30 days

Purpose Statement

The purpose of this study is to determine the **effectiveness of supplementing didactic lectures with HFS** in order to improve pharmacologic knowledge acquisition and long-term knowledge retention in Student Registered Nurse Anesthetists.

Research Questions

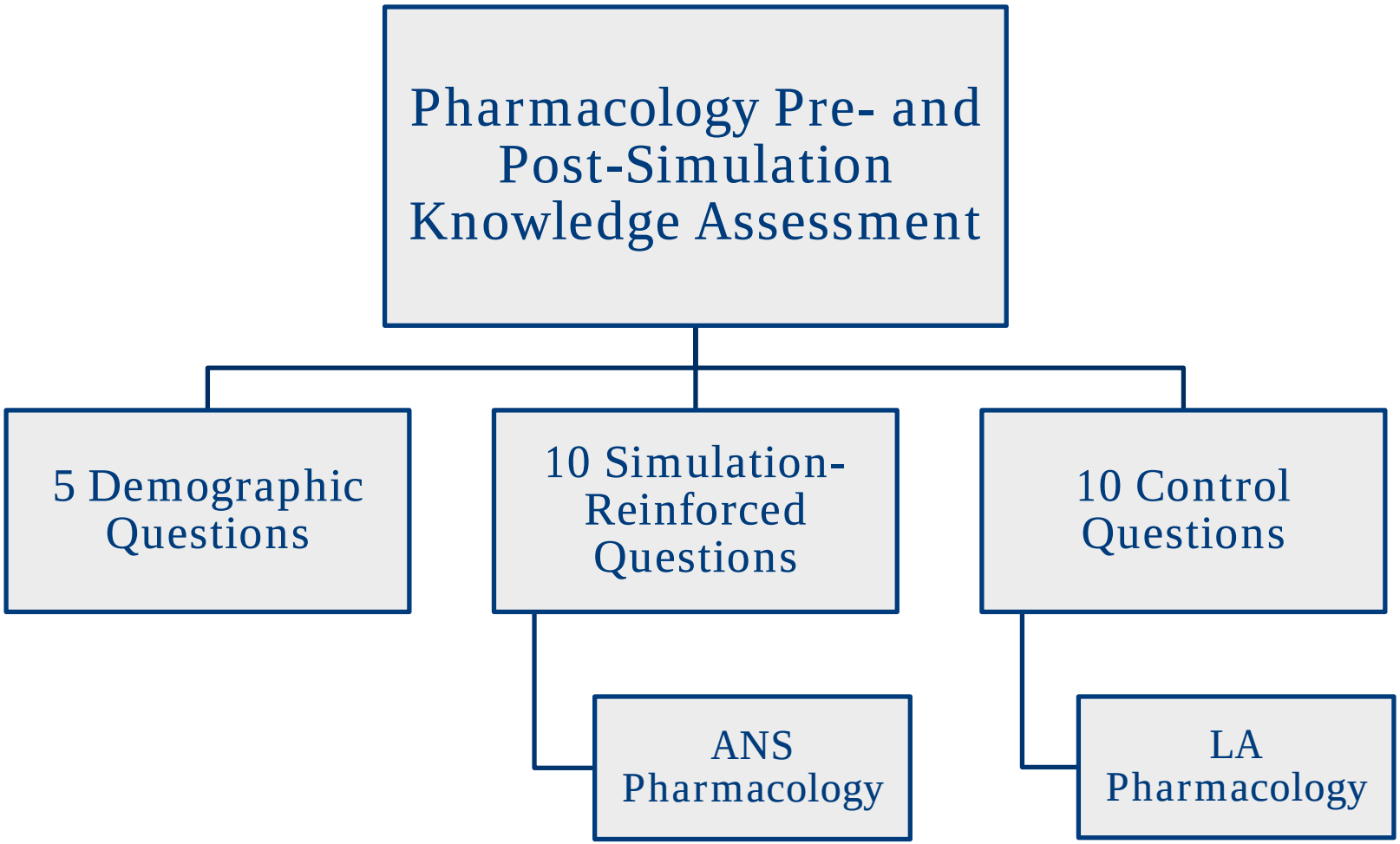
1. Does incorporating a HFS intervention, specifically focused on pharmacology concepts, provide an advantage over didactic instruction alone in **short-term knowledge acquisition** of pharmacology?

2. Does incorporating a HFS intervention, specifically focused on pharmacology concepts, provide an advantage over didactic instruction alone in **long-term knowledge retention** of pharmacology?

Methodology

Design	• Quantitative, quasi-experimental, one-group, pre- and post-test
Setting	• Private Mid-Atlantic University School of Nursing simulation laboratory • Simulated OR equipped with an anesthesia machine, high-fidelity mannequin, and anesthesia cart with medications and endotracheal intubation equipment
Participants	• Convenience sample of 36 first-year SRNA's enrolled in a front-loaded DNAP program • Participants had not yet entered clinical rotations
Protection of Human Subjects	• Exempted by Georgetown University Institutional Review Board • Collaborative Institutional Training Initiative Human Research Curriculum completion • Informed Consent

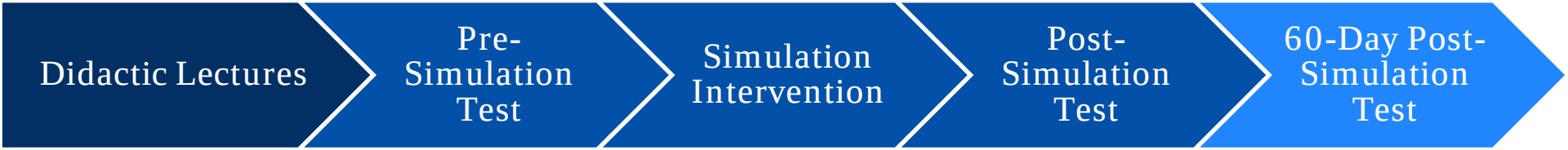
Methodology: Data Collection Tool



ANS = Autonomic Nervous System
LA = Local Anesthetic

Methodology: Timeline

October 2021 *March 2022* *May 2022*



Participants receive 2 lectures over ANS and LA pharmacology in the same 1-month time frame

First knowledge assessment taken prior to simulation

4 scenarios related to ANS pharmacology with debriefing

Second knowledge assessment taken after debriefing

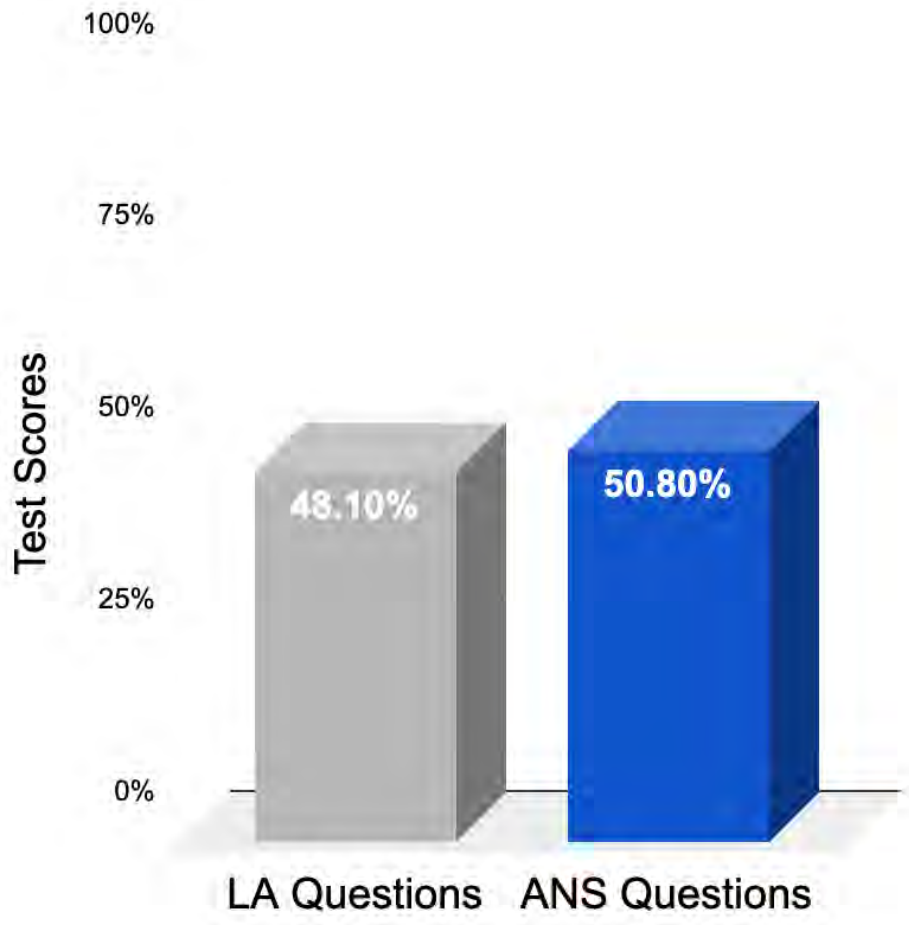
Third knowledge assessment taken 60 days following simulation

Results: Sample Demographics

Variable	Sample (*n*=26)
Gender	
Female (*n*)	**18** (69.2%)
Male (*n*)	**8** (30.8%)
Age (*mean* ± *SD*)	**28.4** ± 3.5 years
RN Experience (*mean* ± *SD*)	**4.1** ± 2.0 years
ICU Experience (*mean* ± *SD*)	**3.6** ± 1.8 years
ICU Worked Prior to CRNA Program	
Medical (*n*)	**8** (30.8%)
Cardiac (*n*)	**6** (23.1%)
Surgical (*n*)	**5** (19.2%)
General/Mixed (*n*)	**2** (7.7%)
Neuro (*n*)	**2** (7.7%)
Pediatric (*n*)	**2** (7.7%)
Neonatal (*n*)	**1** (3.8%)

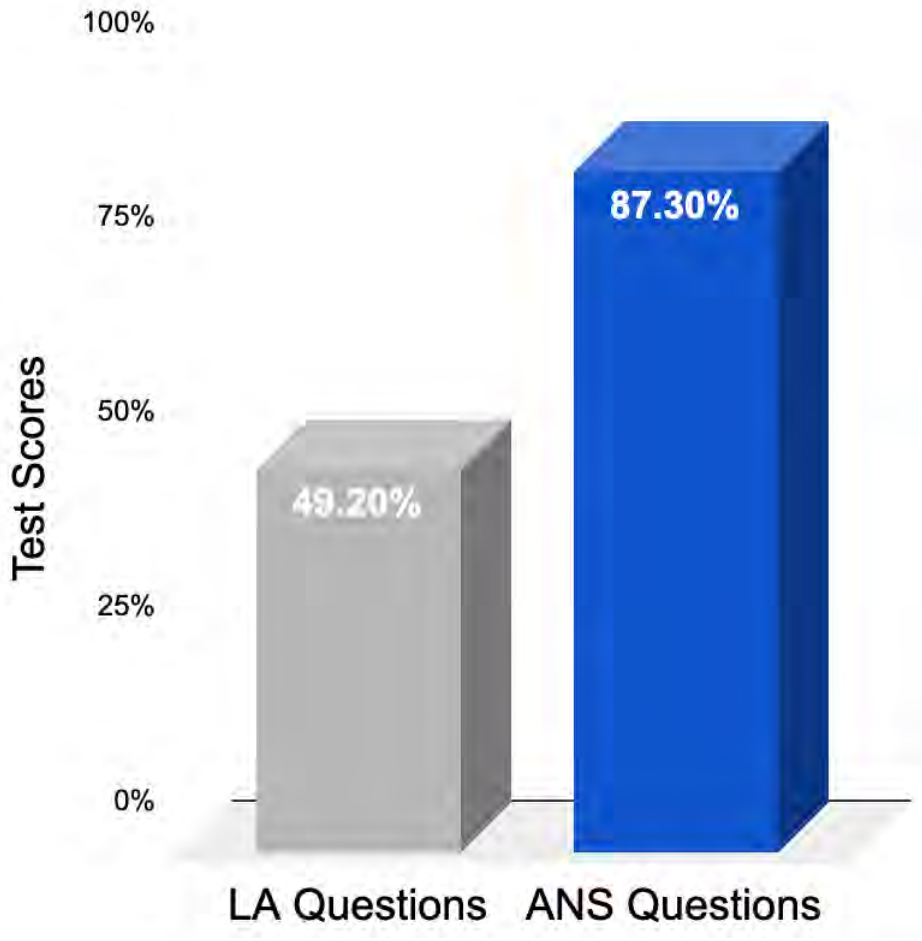
Results:
Pre-Simulation Knowledge Assessment

Baseline knowledge was equivalent between ANS and LA pharmacology.



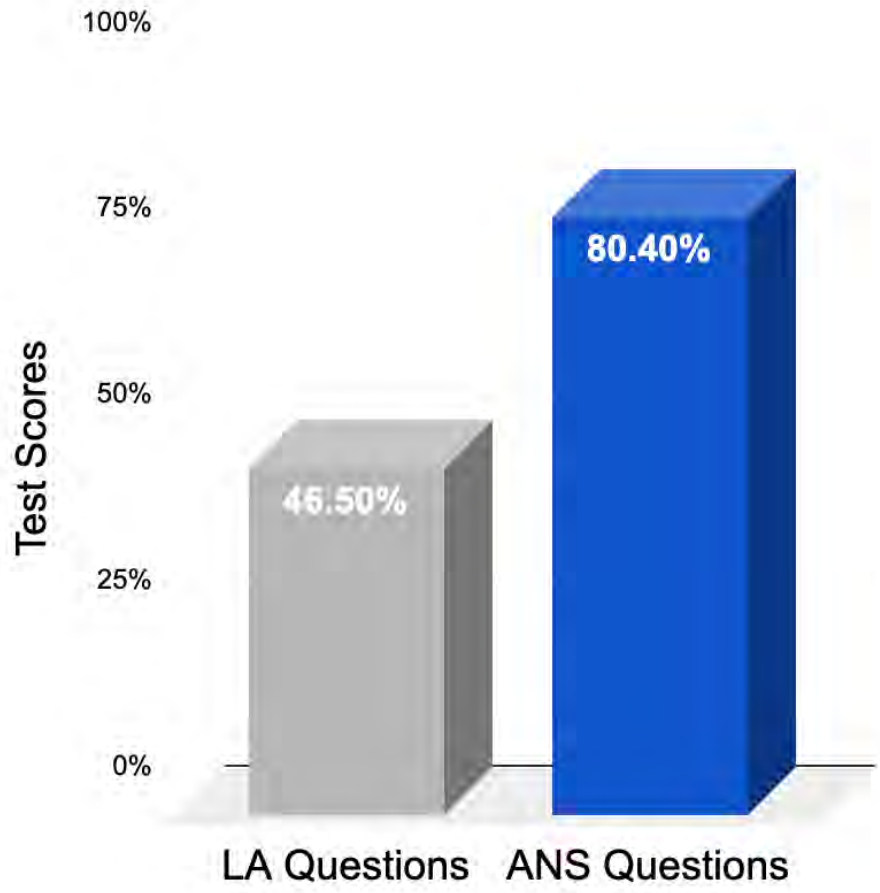
Results:
Initial Post-Simulation Knowledge Assessment

HFS improved **short-term knowledge acquisition** of pharmacology.

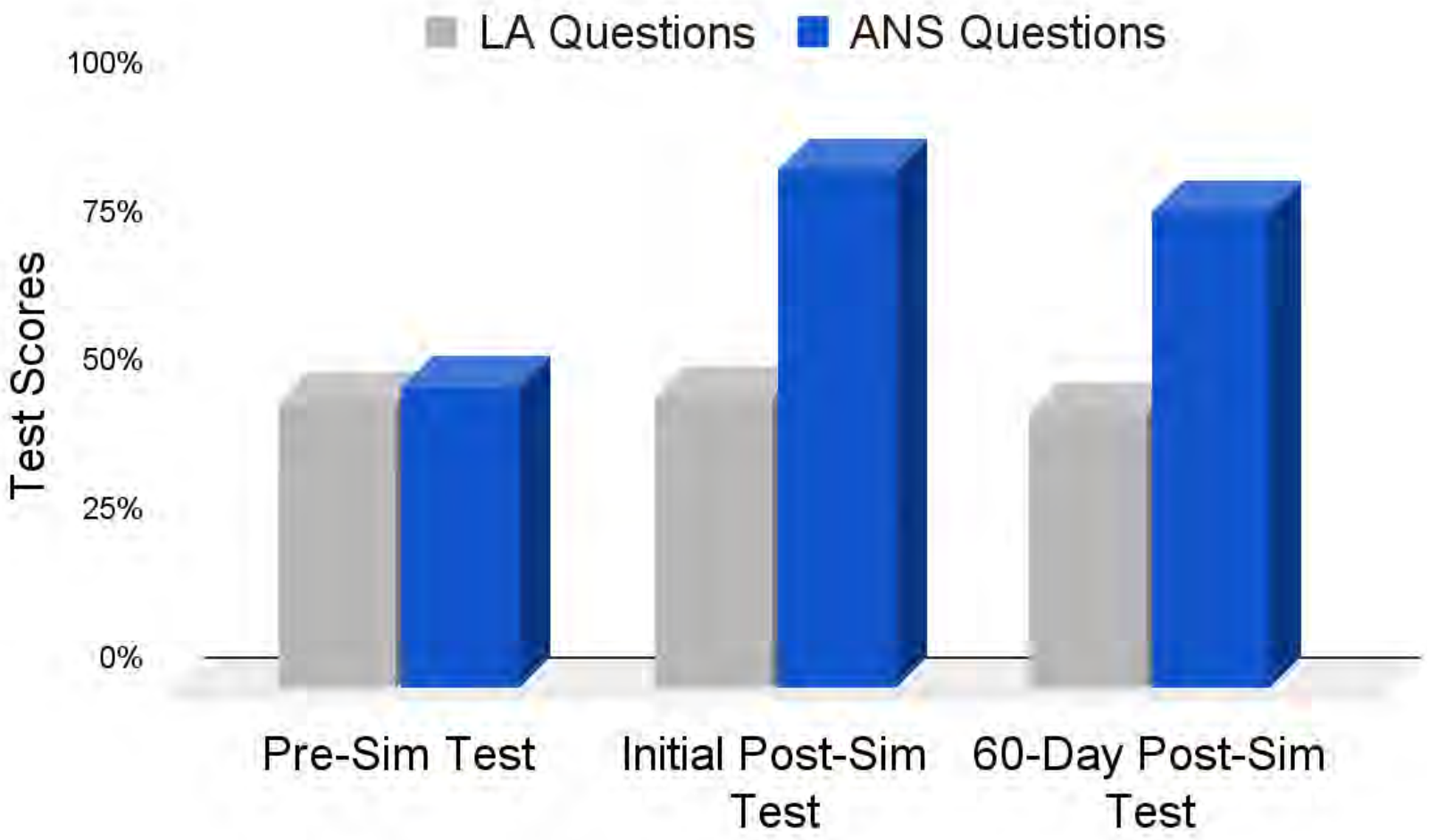


Results:
60-Day Post-Simulation Knowledge Assessment

HFS improved **long-term knowledge retention** of pharmacology.



Results: Overview



Discussion: Knowledge Acquisition of Pharmacology

Current Study: **HFS enhances knowledge acquisition of pharmacology.**

This is consistent with findings related to undergraduate nursing students[12] and graduate nurse anesthesia students[11].

- Systematic review and meta-analysis (N=20 studies) (Gill et al.)[12]
  - Compared teaching strategies in undergraduate nursing pharmacology courses
  - Findings:
    - Simulation was one of the most beneficial methods for pharmacology knowledge acquisition
    - Traditional lectures were among the least effective strategies for teaching pharmacology to undergraduate nursing students.

- Pilot Study (N=15 participants) (Gisriel et al.)[11]
  - A didactic nurse anesthesia pharmacology curriculum was supplemented with a simulation-based learning experience
  - **Initial post-simulation test** scores were 20% higher on content supplemented with the simulation intervention. Scores were 1% lower on material taught through didactic lectures alone.
  - Findings:
    - HFS supplementation improves knowledge acquisition of pharmacology over traditional lectures alone in SRNAs.

Discussion: Knowledge Retention of Pharmacology

Current Study: **HFS enhances knowledge retention of pharmacology.**

This positive impact of HFS is consistent with the findings of undergraduate medical students[13] and nurse anesthesia students[11].

- Parallel group randomized study (N=90 participants) (Arcoraci et al.)[13]
  - Compared simulation compared to lecture alone in undergraduate medical students.
  - Findings:
    - Simulation applied to pharmacology is associated with more effective learning and long-lasting retention compared to lecture alone.

- Pilot Study (N=15 participants) (Gisriel et al.)[11]
  - A didactic nurse anesthesia pharmacology curriculum was supplemented with a simulation-based learning experience
  - **30-day post-simulation test** scores were the same as the initial post-test on content supplemented with the simulation intervention. Scores were 15% lower on material taught through didactic lectures alone.
  - Findings:
    - HFS supplementation improves knowledge retention of pharmacology and protects against knowledge decay over traditional lectures alone in SRNAs.

Discussion: Barriers to Implementing HFS

- Simulation education and high-fidelity simulators are expensive.[14-16]
- High running costs linked to human and capital resource allocation.[15]
  - Program budget constraints
  - Time to learn equipment and tailor curriculum
  - Potential repairs
- Lack of economic evaluation on return of investment in simulation education leaves reported expenses without proper context.[16,17]
  - If HFS increases clinical competency, then potential costs may be outweighed by patient safety benefits.

Discussion: Implications

Current Study: Supplementing didactic nurse anesthesia pharmacology lectures with an educational simulation-based intervention enhances short-term knowledge acquisition and **prevents knowledge decay of pharmacology for at least 60 days**.

- HFS is already a well-established supplement for developing clinical skills in anesthesia.[9]
- Pharmacology is an essential component to clinical education. Investing additional resources into HFS to supplement traditional pharmacology lectures may be worth the associated costs.
- Important implications extending beyond nurse anesthesia curriculums and into other healthcare disciplines.

Increasing pharmacologic knowledge retention will provide a strong basis for optimal clinical decision-making, which may mitigate the potential for medication errors and improve patient safety.

Limitations

- Potential for increased familiarity with questions due to several exposures to the same knowledge assessments.
  - Answer choice selection based on recalling and selecting previous answers versus remembering what was learned.
- Discussing questions or looking up answers in time period between simulation intervention and 60-day post-simulation knowledge assessment.
  - Unlikely to have occurred.
- 5-month gap between students receiving the 2 pharmacology lectures and taking the first knowledge assessment.
  - Decay of knowledge during this period produced “failing” baseline scores.

Future Recommendations

- Randomized control groups
  - Different instructional methods with same class of medications.
    - Compare group that receives an additional traditional lecture to a group that receives a simulation intervention.
  - Recruit participants from multiple nurse anesthesia programs
- Extend time period of testing knowledge retention

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