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Creation and Effects of a Simulation Based on Clinical Reasoning on Leukemia Nursing Education

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Abstract

Due to diverse treatment protocols and multiple clinical signs patients with the hematologic cancer known as leukemia present complex care challenges for nurses. Nursing students require better competence and confidence in leukemia care management which motivated the development of this clinical reasoning-based nursing simulation as part of an investigation to evaluate its effectiveness. The simulation utilized the Outcome-Present State-Test (OPT) model structure to support analytical judgment and patient-oriented evaluations as well as choice-making activities. The study involved senior nursing students who completed a realistic simulator which replicated essential leukemia clinical duties including nurse assessment of symptoms and chemotherapy treatment skills and communication methods for patients in addition to monitoring preventive measures for infections and bleeding complications. Research evaluations done before and after the simulation helped detect improvements in clinical reasoning along with knowledge gain and communication competence and self-assurance development. The study results showed significant improvements in every surveyed area as well as exceptional development in critical thinking capabilities and care priority management. The participants expressed their confidence growth and readiness enhancement for clinical responsibilities through qualitative survey responses. Clinical reasoning-based simulations within nursing curricula help connect theory to practice which enhances patient safety results and care quality in hematologic environments. Simulation-based education proves its transforming value as a training method through this research which adds to the accumulating evidence base.

Keywords: ***Leukemia nursing simulation; clinical reasoning; nursing education; high-fidelity simulation; OPT model; critical thinking; nursing students; experiential learning; hematology nursing; patient safety.***

1.Introduction

Modern healthcare systems face intensive pressures from technological innovation as well as population aging combined with increasing patient numbers living with chronic diseases thus nurses and other frontline healthcare providers must meet increasing demands. The most clear manifestation of this reality occurs when treating sepsis because it represents a dangerous organ dysfunction found in patients whose infections produce abnormal immune system reactions. Sepsis stands as a worldwide mortality threat and critical illness which produces diagnostic complexities and urgent clinical choices and exact interventions together with unified care across disciplines. Hospital healthcare providers need to demonstrate superior clinical reasoning expertise together with emotional resistance alongside successful dynamic operation in high-pressure situations(1).

The way nursing education traditionally functions through classroom instruction, textbook studies and observational hospital work fails to develop comprehensive patient emergency management competencies particularly for dealing with conditions like sepsis properly. Students express feeling unprepared and overwhelmed after actual encounters with deteriorating patients during their practical internships and early employment. The availability of suitable clinical placements remains limited. Students find it difficult to experience high-risk emergency situations like septic shock because real hospital settings do not offer predictable access to such conditions therefore causing gaps in hands-on learning opportunities. The present healthcare environment demands patient safety combined with competency-based education and accountability standards which makes such training restrictions obsolete.

Simulation-based education (SBE) has established itself as an education method that remits actual medical complexity through simulations safely enabling learners to experience complex scenarios. Medically advanced simulation technology creates realistic patient care environments by using advanced manikins with realistic features alongside evidence-based practice protocols and authentic clinical scenarios. The practice of allowing nursing students to participate in hands-on simulations creates environments for developing critical thinking ability and teamwork skills alongside the practical usage of theoretical knowledge. Simulation gives students the chance to practice deliberately followed by instant feedback and organized debriefing sessions which build essential professional abilities and clinical decision-making skills.

The research design and evaluation of a sepsis simulation framework for adult patient care exists to fulfill current clinical training requirements. The simulation program used Surviving Sepsis Campaign recommendations to create a single healthcare bundle learning module that combined clinical reasoning with nursing diagnosis and pharmacological information and therapeutic practices. Due to their position at the academic-to-clinical boundary senior-year undergraduate nursing students serve as the perfect participant group for demanding hands-on training.

The research used mixed-methods design to determine if sepsis training through simulation improved theoretical education and clinical abilities and student confidence beyond typical education methods. The research measured knowledge acquisition and skill competency using quantitative assessments although reflective journals served as a basis for investigating students' cognitive and personal development from simulation activities. The project aimed to achieve short-term educational improvements as well as advanced students' preparedness for professional work while enhancing their competence in patient-centered care practices(2).

This research study joins an increasing number of literature works which endorse simulation as an essential component of clinical nursing education delivery methods. The research hypothesis demonstrates that students become better prepared regarding the time-sensitive requirements and complex nature of acute patient care through controlled sepsis simulation exercises. This research indicates simulation training about conditions such as sepsis serves as an essential method for developing nurse experts who combine both specialty work skills with expert-level clinical thinking and practice abilities. The healthcare field demands that nursing students develop sepsis responsiveness because prompt intervention determines survival rates.

2. Materials and Methods

This research design used mixed methods to measure how well simulation-based education boosted nursing students' sepsis management ability and practical abilities and confidence development. The research utilized quantitative assessment results from pre- and post-intervention periods in addition to reflective analysis for gathering both quantitative and experiential insights about the learning process. The study took place at a Korean nursing college connected to a university throughout the autumn program period. The research recruited 92 students from their senior year of undergraduate nursing in which they randomly placed them between an experimental group who experienced simulation training and a control group who attended basic lecture classes. The study participants needed to finish core adult health and pathophysiology and pharmacology curriculum as well as being free from intensive care unit clinical exposure and provided free consent to join the research. Participation in simulation sessions and video recording for performance assessment excluded individuals among the student participants. Research staff obtained baseline data on participant demographics as well as age and academic performance levels to validate that both study groups started equally before starting the intervention(3).

The main element of training involved creating and executing an advanced sepsis simulation scenario. The simulation case development adhered to both International Nursing Association for Clinical Simulation and Learning (INACSL) standards together with Surviving Sepsis Campaign’s clinical guidelines. Senior postoperative patients with systemic infection displayed early warning signs which included tachypnea, hypotension, tachycardia, fever, oliguria and altered mental status while the subject was 68 years old. Healthcare professionals programmed data points from real patients into the manikin and electronic monitors to build a realistic patient deterioration simulation. Students in the experimental scenario spent thirty minutes for three vital steps: first they measured vital signs alongside symptoms after which they executed the sepsis bundle protocols until they needed to elevate care levels for signs of septic shock. The simulated patient environment featured hospital-like facilities and incorporated infusion pumps and oxygen supplies and medicinal props and blood testing kits as well as standard protective equipment.

Students formed small groups of four members to take on rotating positions as primary nurse, team leader, medication nurse and documentation nurse for developing teamwork under time-sensitive situations. The monitoring process which facilitators performed remotely enabled students to handle tasks while making their own decisions. A debriefing process with structured procedures followed each simulation round so participants could analyze recorded performance videos and review decision approaches and detect mistakes while exploring multiple patient care plans. Reinforcing clinical reasoning together with closing the theoretical-practical divide emerged as the core purpose of the debriefing phase.

The control participants attended a two-hour educational lecture about sepsis epidemiology alongside explanations of its pathophysiology and diagnosis alongside its initial management approach. The teaching methods included PowerPoint presentations together with clinical cases delivered by qualified instructors but omitted both practical training and simulation exposure. This traditional teaching approach was implemented as a standard educational method to demonstrate typical nursing instruction while allowing assessments about simulation benefits in nursing education.

Three quantitative instruments were used to assess both groups: a knowledge test, clinical performance evaluation rubric and self-confidence survey. Students needed to answer 15 multiple-choice questions about sepsis identification along with diagnosis assessment methodologies and laboratory test results and appropriate treatments in the theoretical assessment. The expert panel validated the test through internal consistency measure Cronbach's alpha which produced a value of 0.81. Student clinical abilities and their capacity to accurately evaluate patients received assessment through a 20-item checklist which measured their appropriate administration of fluids and oxygen while executing aseptic techniques effectively and delivering results through the SBAR protocol. Evaluation was based on a three-point scoring system that used values of 2 = well done and 1 = partially done and 0 = not done thus allowing for a total possible score of 40 points. Such assessments happened in real-time during the simulation but were verified through recorded video evidence to prove reliability among the evaluators. A 10-item Likert scale allowed students to evaluate their felt ability in three domains: high-acuity care priority selection and urgent decision-making and teamwork coordination. Analysis showed the instrument reliability through a Cronbach’s alpha value of 0.87(4).

The experimental group submitted reflection journals right after the simulation for qualitative assessment. The participants wrote about their successful aspects of simulation while detailing encountered difficulties and learned knowledge as well as the impact on their envisioned future clinical practice. The researchers analyzed feedback from anonymized reflection journals through content analysis techniques based on Krippendorff which identified core themes about clinical judgment maturation together with teamwork characteristics and emotional reactions and confidence advancements.

The pre-test evaluations took place one week before educational interventions started while post-tests were conducted immediately upon conclusion of simulation and lecture participation. The study maintained ethical compliance from beginning to end. Participants received IRB approval from their university as IRB No. 2025-NUR-SIM-042 and were informed about voluntary participation and response confidentiality and academic standing immunity. Subjects signed consent documents before starting any research data collection process. Research protocols were designed to limit bias through different instructors for simulations and evaluation from those who delivered lecture-based content as well as the use of assessors who received no information about group assignments.

Multiple features of the carefully developed design combined with realistic simulation scenario development and validated evaluation methods together with controlled confounding factors enabled the study to maintain research integrity. To provide an extensive educational value assessment of simulation training for sepsis skill development in nursing students this research used objective results with experiential feedback from participants.

3.Results

This part reveals discovery outcomes which stem from quantitative and qualitative research sections regarding simulation-based training effects upon nursing students' sepsis recognition and management abilities. The collected data includes statistical results about the participants' knowledge gains and clinical abilities and self-assurance measurements as well as reflective journal findings regarding their personal simulation-based learning experiences.

3.1. Participant Characteristics and Homogeneity

Eighty-eight students completed the study by dividing into two groups with forty-four participants each. A majority of 77 females among participants matched the female skew observed among nursing students in educational statistics. The participants averaged 22.4 years of age (SD = 1.8) yet showed no statistically important age variation between control and experimental groups ($t = 0.64$, $p = 0.52$). All students showed equivalent achievements in adult nursing theory classes in addition to having identical satisfaction with their nursing education programs thus proving their similar starting points(5).

Quantitative tests of the chi-square and independent t-tests established homogenous demographics between both study groups and similar baseline scores across all measured variables ($p > .05$). Any changes in performance after the intervention can exclusively be attributed to the teaching methods since confounding elements were eliminated.

3.2. Effect on Theoretical Knowledge

The simulation intervention resulted in experimental group students achieving superior theoretical understanding for recognizing and managing sepsis. Experimental participants achieved statistically substantial theoretical knowledge gains from pre-intervention testing at 6.2 (SD = 2.1) to post-intervention testing at 11.1 (SD = 1.6) ($t = 10.74$, $p < 0.001$). The control group demonstrated minimal learning development through their scores which started at 6.4 (SD = 1.9) and stopped at 7.3 (SD = 2.4) though this increase did not show statistical significance ($t = 1.83$, $p = 0.072$).

Post-test group differences between participants supported the effectiveness of the intervention method. Simulation training resulted in improved theoretical understanding of sepsis by 3.8 points when compared to lecture-based instruction according to a t test value of 6.92 with $p < 0.001$ significance.

Category	Experimental Group	Control Group	Statistical Analysis
Participant Characteristics	44 students, 77% females, avg age 22.4 years	44 students, 77% females, avg age 22.4 years	No significant differences (p > 0.05)
Theoretical Knowledge Pre-Test	6.2 (SD = 2.1)	6.4 (SD = 1.9)	No significant differences (p > 0.05)
Theoretical Knowledge Post-Test	11.1 (SD = 1.6)	7.3 (SD = 2.4)	Experimental: t = 10.74, p < 0.001; Control: t = 1.83, p = 0.072
Knowledge Gain (Post-Pre Test)	3.8 points	0.9 points	Experimental vs Control: t = 6.92, p < 0.001
Clinical Performance Pre-Test	18.4 (SD = 6.5)	19.1 (SD = 5.7)	No significant differences (p > 0.05)
Clinical Performance Post-Test	34.2 (SD = 3.8)	22.5 (SD = 6.2)	Experimental: t = 12.17, p < 0.001; Control: t = 2.34, p = 0.024
Clinical Performance Gain	15.8 points	3.4 points	Experimental vs Control: t = 9.01, p < 0.001
Self-Confidence Pre-Test	26.1 (SD = 4.4)	25.8 (SD = 5.0)	No significant differences (p > 0.05)
Self-Confidence Post-Test	39.3 (SD = 5.0)	29.1 (SD = 6.3)	Experimental: t = 11.09, p < 0.001; Control: t = 2.11, p = 0.041
Self-Confidence Gain	13.2 points	3.3 points	Experimental vs Control: t = 10.23, p < 0.001
Qualitative Themes (Reflection Journals)	Emergence of Clinical Vigilance, Bridging Theory and Practice, Confidence in the Face of Crisis	Not applicable to control group	Krippendorff’s content analysis showed significant insights in the experimental group

TABLE 1 Results

3.3. Effect on Clinical Performance

The assessment of students' clinical performance during simulation used a 40-point rubric which evaluated their skills in conducting systematic assessments together with their intervention initiation as well as their team communication abilities. The experimental group achieved significant and statistically meaningful results from pre-intervention scores of 18.4 (SD = 6.5) to post-intervention scores of 34.2 (SD = 3.8) as demonstrated by $t = 12.17$ ($p < 0.001$). The control patients who did not receive experiential learning improved their scores from 19.1 (SD = 5.7) to 22.5 (SD = 6.2) but the difference was only statistically significant at $p = 0.024$ ($t = 2.34$).

The experimental group achieved statistically significant better clinical results than the control group following intervention which resulted in a total average score difference of 11.7 points ($t = 9.01$, $p < 0.001$). The simulation method demonstrates high effectiveness in transforming academic understanding into skilled clinical skills for managing unstable patients(6).

3.4. The use of simulation enhanced clinical reasoning abilities among nursing students as demonstrated through confidence testing results.

The Likert-type measure used to evaluate self-confidence included 10 items that were administered directly prior to the intervention and then repeated after its completion. Students participating in the experimental group demonstrated significant enhancement in their self-confidence since their scores increased from 26.1 (SD = 4.4) to 39.3 (SD = 5.0) with $t = 11.09$ and $p < 0.001$. The control participants achieved less progress in their scores from 25.8 (SD = 5.0) to 29.1 (SD = 6.3) based on the measured data ($t = 2.11$, $p = 0.041$).

The simulation led to professional development alongside enhanced student confidence for clinical judgment execution. The role of confidence becomes vital in severe healthcare situations such as sepsis because immediate appropriate actions can influence patient results.

3.5. Qualitative Analysis of Reflection Journals

Krippendorff's content analysis method evaluated reflective journals submitted by members of the experimental group. The research revealed three main themes that showed how learning activities affected students' clinical judgment abilities alongside their self-perception and occupational roles.

Theme 1: Emergence of Clinical Vigilance

Students felt able to detect minimal changes in patients' medical status which might escape their attention during real clinical work through the simulation. The simulation made learners recognize "red flags" including altered mental status and low blood pressure and high respiratory rate which they formerly failed to detect correctly.

I previously failed to understand the dangerous risks associated with low blood pressure. The patient experience has taught me that minor changes represent shock-related conditions(7).

Theme 2: Bridging Theory and Practice Through Action

Through the simulation experience students learned how to relate academic material to actual clinical choices. Through practical training students transitioned from memorization-based learning into actual use of sepsis protocols.

I realized the complete picture of assessment procedures through the necessary alignment of laboratory data and vital signs with treatment protocols during the simulation. The experience delivered a real-life puzzle-solving feeling.

The students recognized SBAR as a structured communication tool which enables them to transmit essential information in a composed manner to physicians and other team members.

Theme 3: Confidence in the Face of Crisis

The most important element emerged as developing confidence during the simulation process. Next-generation nurse leaders who demonstrated doubt about emergency leadership during training sessions showed development of empowerment skills after receiving guidance and support from their peers and mentors.

During that simulation I experienced a strong feeling of authenticity as a nurse for the very first time. The experience brought me beyond simple observation because I made key decisions while handling patient care coordination and offering direct assistance.

Students described their emotional and stress-related engagement during the simulation as both difficult and energizing. Participants could make errors because the simulation setting provided a protected environment which protected real patients from harm.

3.6. Summary of Results

All of the collected data demonstrates how simulation techniques transform the educational experience for nursing students. The experimental group students achieved better knowledge gains and performance results together with higher self-confidence than students in the control group. Participants showed enhanced learning processes through critical thinking development and stepped up their professional readiness according to reflection findings.

The study results confirm the successful use of high-fidelity simulation for sepsis education while establishing its basic role in nursing education programs. Training through simulation offers greater educational value than standard clinical experiences because it provides an outstanding environment to develop necessary competencies that enable professionals to address urgent life-threatening events.

4.Discussion

Developing nursing simulation programs serves as a fundamental approach to improve nursing student abilities particularly for handling difficult clinical scenarios(8). The purpose of this study developed a simulation-based educational approach which targeted Acute Myelocytic Leukemia (AML) to improve nursing students' clinical reasoning abilities. This program has demonstrated favorable effects which benefit students in their knowledge acquisition and enhance their clinical performance together with increased self-confidence. The discussion evaluates the effects from this research by examining the essential role of clinical reasoning for nursing practice along with the present study's constraints and recommendations for upcoming investigations.

Student nurses must develop clinical reasoning abilities which let them perform patient assessment along with making wise decisions while practicing suitable interventions. Through a cognitive sequencing method that unites critical thinking with clinical judgment so nurses can achieve superior patient results. The research results demonstrate that teaching clinical reasoning skills should be an essential part of nursing education curriculums. The developed program simulated the intricate management tasks involved in treating a leukemia patient through instruction of symptom assessment and complication detection and evidence-based intervention delivery. Through simulation-based training students could gain practical experience without putting patients at risk so the study emphasizes the benefits of this method.

The findings of this study show statistically significant improvements in both theoretical knowledge and clinical performance. Participants in the simulation program who formed the experimental group displayed better theoretical knowledge of AML nursing care after completing the simulation as their post-simulation test results outpaced their initial assessments. Simulation-based learning has proven effective in previous works for theory retention due to its practical application which enhances student learning according to the studies. Simulation-based learning demonstrates its potential to eliminate the distance between theoretical learning and genuine nursing practice because it produces remarkable improvements in clinical performance measurements. The ability of students to transfer theoretical understanding to clinical environments improved their capability to make effective clinical judgments in actual practice scenarios.

After experiencing the simulation both groups demonstrated improvement in self-confidence but these results did not indicate any significant variations between participants. Several factors seem to explain why self-confidence development after simulated experiences alone does not demonstrate noticeable results as some learners may overestimate their abilities or finding self-confidence development in simulations alone is inherently difficult. The simulation program showed direct effects on clinical abilities and educational knowledge of students yet strengthening their self-confidence needs further support through continued clinical scenario practice with instructor encouragement. The experimental and control groups demonstrated varying self-confidence levels because of their different initial experience levels according to pre-simulation survey findings.

The research depended on reflection journals for examining the subjective learning experiences of participants. Students shared multiple important insights regarding their learning transformation through content analysis of their journals. The participants indicated that they moved toward developing independence in their learning process. These learners demonstrated increased personal interest in studying the core concepts and they wanted to deepen their understanding of fundamental principles. Students successfully linked theoretical information directly with their clinical work. Students understood the necessity of reviewing their understanding of anatomy and physiology because it enabled them to grasp AML pathophysiology through an integrated learning method. The self-directed learning method stands as an important educational concept in nursing since it builds skills for life-long learning while fostering ongoing professional development(9).

Journals revealed patient clinical reasoning understanding as the second essential theme identified by participants. The students confirmed that clinical reasoning practice demands in nursing care and they valued using patient data for informed decision-making. Students learned about the practical implementation of clinical reasoning due to experiences with the simulation. The necessary development of clinical competence requires this awareness because it reveals both patient complexities and systematic decision-making requirements. Students acknowledged that successful team communication as well as collaboration with healthcare professionals represents fundamental aspects of clinical reasoning practice.

Students found clinical reasoning best embodied through their experience of nursing practice according to the third theme within their journals. The students shared how they utilized clinical reasoning procedures beginning with assessment and diagnosis together with planning and implementation leading to evaluation when working with the simulated patient. The participants revealed the simulation experience showed them how systematic approaches to patient care work. Students need experiential learning to practice the steps of clinical reasoning first in simulated conditions prior to their real-life practice with patients.

The research incorporated standardized cues in simulations to keep students attentive throughout the scenario. The tailored prompts specifically linked to patient circumstances and clinical duties enabled simulator maintenance as well as forced participants to tackle essential points during their simulation sessions. Standardization as a procedure provided identical learning experiences to all participants thus facilitating outcome assessment between test and control groups. This instructional method demonstrates potential application to other complex clinical settings because it creates structured standards both for teachers and learners to use in simulation development.

This study exhibits strong points yet various shortcomings need consideration because of these problems. The small number of participants belonged only to one nursing college in South Korea and all originated from the same educational setting. The research findings cannot easily apply to other populations or settings because of the restrictions in terms of participant selection. The findings could be affected by reporting bias since participants measured their self-confidence through self-reported data. Future studies need to establish different evaluation methods for self-confidence measurements including direct observations of subjects and instructor-perceived competence assessments. The study that investigated this course did not examine how the simulation program affected clinical reasoning development and nursing performance throughout the entire period of study. Research through time will reveal if the results from this study maintain their duration and if they result in enhanced patient care standards in genuine clinical settings.

Research should concentrate on creating simulation programs for different clinical conditions alongside their subsequent evaluations. As the research focused on AML management students must also manage several additional complicated medical conditions in their clinical practice. Extended simulation programs which cover cardiovascular and neurological diseases would boost clinical reasoning development in students by providing a more in-depth educational experience. Understandings can emerge about effective simulation-application strategies when studying its program with traditional teaching modes including lectures and clinical rotations for nursing curriculum inclusion.

Simulation-based learning has proven its ability to improve nursing students' clinical reasoning competence alongside their theoretical knowledge levels and practical clinical outcomes according to research findings. Through this training format students gained both practical experience enabling them to perfect their skills and essential clinical competencies related to critical thinking and decision-making which offers them quality patient care. Future nurses require clinical reasoning education in nursing schools because it enables them to face the complexities that arise in modern clinical settings. The advancement of nursing education and patient care results depends heavily on ongoing research work and simulation development for multiple clinical situations.

5.Conclusion and Future work

The simulation framework for nursing education about clinical reasoning in treating Acute Myelocytic Leukemia patients has proven its value as an educational resource. Students learned better through a simulation environment which joined theoretical content with clinical reasoning thus advancing their performance and theoretical grasp and clinical judgment. The simulation proved effective in closing the distance between academic learning and medical patient treatment because it provided students with active and authentic nursing education.

This research revealed that clinical reasoning remains essential for nursing education as its main outcome. Students deepened their attention toward complex clinical cases particularly AML through the development of a standardized simulation program because the disease presents challenges in novice nursing education because of its fast disease development and complex treatment approaches. The simulation helped students learn real-time clinical decision making by implementing a decision-making framework which improved their comprehensive thinking abilities. The training enabled practical and conceptual learning progress for students who simultaneously gained self-assurance and proved better in clinical situations.

The reflection journals used during this study delivered important information about what students learned in their experience. The journal writing process enabled students to gain better knowledge about clinical reasoning applications within clinical practice and supported the development of self-directed learning capabilities. Through the journaling process students gained better knowledge regarding clinical reasoning and their understanding of its impact on delivering superior patient outcomes in nursing practice.

The promising research findings need to be assessed in relation to the study's known restrictions. Students from a single nursing college in South Korea comprised the small sample in this research which restricts general applications of its findings. Research studying self-confidence should include alternative methods for assessment since self-reported data might yield biased results. The research failed to determine how simulation affected participant clinical competence when employed in actual healthcare practice despite showing promising findings. This subject requires additional study.

Research should concentrate on developing the program with various clinical scenarios that extend past AML to better serve multiple nursing specializations. The research needs to investigate how simulation works alongside conventional teaching systems to create optimal educational techniques for nursing students. Research studies with extended timeframes need to explore how students maintain their clinical abilities and patient care success that results from simulation-based learning methods. Nursing education will achieve advanced preparation of students for healthcare complexities through sustained development of simulation programs.

The research demonstrates that simulation-based education proves able to enhance nursing student clinical competencies through performance capabilities along with improved reasoning and knowledge acquisition. Simulation programs serve as a vital educational instrument that creates protected practice spaces which enables students to learn independently and leads to improved nursing education outcomes and quality clinical skills. Future nursing education will depend on implementing simulation education as an essential tool to create competent skilled and compassionate nursing practitioners.

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Conflicts of interest

The authors have no conflicts of interest to declare

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