Clinical Simulation in Nursing (2016) 12, S13-S15

Clinical Simulation in Nursing

www.elsevier.com/locate/ecsn

Standards of Best Practice: Simulation

INACSL Standards of Best Practice: Simulation^SM Outcomes and Objectives

INACSL Standards Committee

KEYWORDS
simulation;
standard;
objectives;
outcomes;
evaluation

Cite this article:

INACSL Standards Committee (2016, December). INACSL Standards of Best Practice: Simulation^SM Outcomes and objectives. *Clinical Simulation in Nursing, 12*(S), S13-S15. http://dx.doi.org/10.1016/j.ecns.2016.09.006.

As the science of simulation continues to evolve, so does the need for additions and revisions to the INACSL Standards of Best Practice: Simulation^SM. Therefore, the INACSL Standards of Best Practice: Simulation are living documents.

Standard

All simulation-based experiences begin with the development of measureable objectives designed to achieve expected outcomes.

Background

Outcomes

Outcomes are an integral component of instructional and research design. Educators, clinicians, and researchers utilize outcome measures to determine the impact of simulation-based experiences. The Kirkpatrick Model is a commonly used ranking model that evaluates training programs and transfer of learning outcomes.[1] This model depicts four sequential levels of evaluation: (a) *Reaction*—measures participant's satisfaction with training, (b) *Learning*—measures knowledge, skills, and attitudes (KSAs) gained from training, (c) *Behavior*—measures changes that occurred as a result of training, and (d) *Results*—improving quality and safety; increased return on investment following training such as productivity, revenue, and employee retention.

Objectives

Once the simulation-based experience outcome measures have been determined, the next step is to develop objectives. Objectives are the guiding tools to facilitate achievement of simulation-based outcomes and the hallmark of sound educational design. Objectives may be broad or specific as a blueprint for simulation design. Bloom's Taxonomy[2] provides a framework for developing and leveling objectives to meet expected outcomes. The taxonomy classifies three domains of learning: cognitive, psychomotor, and affective. Each learning domain has a hierarchical taxonomy applicable to simulation activities. The revised Bloom's Taxonomy[3] hierarchy progresses from the lower level objectives, remember and understand to the higher level objectives, apply, analyze,

1876-1399/$ - see front matter © 2016 International Nursing Association for Clinical Simulation and Learning. Published by Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.ecns.2016.09.006

evaluate, and create. These verbs provide structure and communicate the KSAs the participant is intended to achieve as a result of participating in a simulation activity.

To have achievable outcomes, clearly defined, measurable objectives are necessary. In the field of corporate management, Doran[4] created the acronym S.M.A.R.T. (specific, measurable, assignable, realistic, and time related) as a framework to develop meaningful, measurable objectives. Organizations have adapted the criteria with differing, yet similar criteria. The S.M.A.R.T framework is used to write objectives that focus on the desired KSAs that simulation participants should demonstrate on completion of simulation-based experiences.

The Center for Disease Control[5] provides academia and the health care industry with the following S.M.A.R.T. criteria for writing objectives:

- Specific: What exactly are we going to do for whom?
- Measurable: Is it quantifiable and can we measure it?
- Achievable: Can we get it done in the proposed time frame with the resources and support we have available?
- Realistic: Will it have an effect on the desired goal or outcome?
- Time phased: When will this objective be accomplished?

Potential consequences of not following this standard can lead to ambiguity, unintended outcomes, and failure to meet objectives of the simulation-based experience. This may include skewed assessment and evaluation results; decreased participant satisfaction; failure to achieve desired KSAs; and/or lack of change in quality and safety indicators.

Criteria Necessary to Meet This Standard

1. Determine expected outcomes for simulation-based activities and/or programs.
2. Construct S.M.A.R.T. objectives based on expected outcomes.

Criterion 1: Determine expected outcomes for simulation-based activities and/or programs.

Required elements:

- Expected Outcomes are:
  - Consistent with an organization's, mission, vision, and program outcomes.
  - Driven by the objectives and concepts within program curricula.[6]
  - Represent the multiple cultures and diversity of patients as seen in health care practice.[7]
  - Threaded throughout a program or course.
  - Based on a needs assessment or an area of interest.
  - Addressed by one or more level of evaluation that may include[1]:
    - Individual and aggregate outcomes.
    - Intended KSAs.
    - Changes in behavior/performance.
    - Return on investment.
    - Participant satisfaction.
  - Communicated to participants before the simulation-based experience.
  - Revised as necessary.
  - Follow INACSL Standard: Simulation Design.

Criterion 2: Construct Specific, Measurable, Achievable, Realistic, Time-phased objectives based on expected outcomes.

Required elements:

- Specific objectives
  - Identify participants, scenario, fidelity, facilitation, debriefing, assessment, and evaluation methods.
  - Encompass cognitive (knowledge), affective (attitude), and psychomotor (skills) domains of learning.
  - Clearly identify the targeted learning domain.
  - Address multiple domains of learning.
  - Utilize Bloom's Taxonomy[2] hierarchical classification of learning domains to level objectives from simple to complex.
  - Level the objectives based on the participant's KSAs.
  - Select one action verb for each objective.
  - Avoid verbs with vague meanings.
  - Recognize specificity has greater measurability.
  - Consider "what" will change for "whom" and "how."
    - Identify "what" will be accomplished.
    - Determine "who" will be involved.
    - Consider "how" the objective will be measured.

- Measurable objectives
  - Essential for formative, summative, and high-stakes evaluation (see INACSL Standard: Participant Evaluation).
  - Establish a baseline as a reference point to quantify change.
  - Determine evaluation criteria.
  - Assess the outcome via a method of measurement or an instrument that is reliable, valid, and feasible to obtain.
- Achievable objectives
  - Leveled to participant's knowledge, experience, and skill level.
  - Feasible within a reasonable time frame.
  - Resources are available to attain expected outcomes participants.
- Realistic objectives
  - Consistent with an organization's, mission, vision, and program outcomes.

 - ○ Links the objectives to the expected outcomes.
 - ○ Appropriate to the KSAs of the participant.
 - ○ Aligned with current evidence-based practice, guidelines, standards, and literature.
- Time-phased objectives
 - ○ Determine a specific time frame to accomplish the objective (i.e., minutes, hours, days).
 - ○ Use the specific time frame to plan, implement, and evaluate outcomes.

References

1. Kirkpatrick, D. L. (1994). *Evaluating training programs: The four levels*. San Francisco, CA: Berrett-Koehler Publishers, Inc.
2. Bloom, B. S. (Ed.). (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain*. New York: Longman.
3. Anderson, L. W., & Krathwohl, D. R., et al. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Boston, MA: Allyn & Bacon.
4. Doran, G. T. (1981). There's a S.M.A.R.T. way to write management's goals and objectives. *Management Review*, *70*(11), 35-36.
5. Center for Disease Control and Prevention. (2009). *Evaluation briefs: Writing SMART objectives*. Retrieved from http://www.cdc.gov/healthyyouth/evaluation/pdf/brief3b.pdf.
6. Jeffries, P. R., Dreifuerst, K., Kardong-Edgren, S., & Hayden, J. (2015). Faculty development when initiating simulation programs: Lessons learned from the national simulation study. *Journal of Nursing Regulation*, *5*(4), 17-23.
7. Foronda, C., Baptiste, D., Reinholdt, M. M., & Ousman, K. (2016). Cultural humility: A concept analysis. *Journal of Transcultural Nursing*, *27*(3), 210-217. http://dx.doi.org/10.1177/1043659615592677.

Bibliography

Alexander, M., Durham, C. F., Hooper, J. I., Jeffries, P. R., Goldman, N., Kardong-Edgren, S., …, & Tillman, C. (2015). NCSBN simulation guidelines for prelicensure nursing programs. *Journal of Nursing Regulation*, *6*(3), 39-42.

Campbell, J. (2015). *SMART criteria*. Salem Press Encyclopedia. Retrieved from http://eds.b.ebscohost.com/eds/detail/detail?sid=d9fb5a11-0354-4fe0-9467-fe196a1da731%40sessionmgr112&vid=1&hid=119&bdata=JnNpdGU9ZWRzLWxpdmUmc2NvcGU9c2l0ZQ%3d%3d#AN=100259301&db=ers.

Cook, D. A. (2014). How much evidence does it take? A cumulative meta-analysis of outcomes of simulation-based education. *Medical Education*, *48*(8), 750-760. http://dx.doi.org/10.1111/medu.12473.

Drucker, P. F. (1954). The objectives of a business. In Drucker, P. F. (Ed.), *The practice of management*. New York: Harper & Row. (pp. 62-87).

Groom, J., Henderson, D., & Sittner, B. (2014). NLN/Jeffries simulation framework state of the science project: Simulation design characteristics. *Clinical Simulation in Nursing*, *10*(7), 337-344. http://dx.doi.org/10.1016/j.ecns.2013.02.004.

Hartley, J., & Davies, I. K. (1976). Preinstructional strategies: The role of pretests, behavioral objectives, overviews and advance organizers. *Review of Educational Research*, *46*(2), 239-265, Retrieved from http://www.jstor.org/stable/1170040.

Hayden, J., Smiley, R., Alexander, M. A., Kardong-Edgren, S., & Jeffries, P. (2014). The NCSBN National Simulation Study: A longitudinal, randomized, controlled study replacing clinical hours with simulation in prelicensure nursing education. *Journal of Nursing Regulation*, *5*(2), S1-S64, Retrieved from https://www.ncsbn.org/JNR_Simulation_Supplement.pdf.

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into Practice*, *41*(4), 212-218.

Lawlor, K. B., & Hornyak, M. J. (2012). SMART goals: How the application of SMART goals can contribute to achievement of student learning outcomes. *Developments in Business Simulation and Experiential Learning*, *39*, 259-267.

Lioce, L., Meakim, C. H., Fey, M. K., Chmil, J. V., Mariani, B., & Alinier, G. (2015). Standards of best practice: Simulation standard IX: Simulation design. *Clinical Simulation in Nursing*, *11*(6), 309-315. http://dx.doi.org/10.1016/j.ecns.2015.03.005.

Mager, R. F. (2012). *Preparing instructional objectives: A critical tool in the development of effective instruction*. Carefree, AZ: Mager Associates, Inc.

McGaghie, W. C., Issenberg, S. B., Petrusa, E. R., & Scalese, R. J. (2010). A critical review of simulation-based medical education research: 2003–2009. *Medical Education*, *44*(1), 50-63. http://dx.doi.org/10.1111/j.1365-2923.2009.03547.x.

National League for Nursing. (2015). *A vision for teaching with simulation: A living document from the national league for nursing NLN board of governors*. Retrieved from http://www.nln.org/docs/default-source/about/nln-vision-series-(position-statements)/vision-statement-a-vision-for-teaching-with-simulation.pdf?sfvrsn=2.

Teacher & Educational Development, University of New Mexico School of Medicine. (2005). *Effective Use of Performance Objectives for Learning and Assessment, 1 − 6*. Retrieved from http://ccoe.rbhs.rutgers.edu/forms/EffectiveUseofLearningObjectives.pdf.

Original INACSL Standard

The INACSL Board of Directors. (2011). Standard III: Participant objectives. *Clinical Simulation in Nursing*, *7*(4S), s10-s11. http://dx.doi.org/10.1016/j.ecns.2011.05.007.

Subsequent INACSL Standard

Lioce, L., Reed, C. C., Lemon, D., King, M. A., Martinez, P. A., Franklin, A. E., …, & Borum, J. C. (2013). Standards of best practice: Simulation standard III: Participant objectives. *Clinical Simulation in Nursing*, *9*(6S), S15-S18. http://dx.doi.org/10.1016/j.ecns.2013.04.005.

About the International Nursing Association for Clinical Simulation and Learning

The International Nursing Association for Clinical Simulation and Learning (INACSL) is the global leader in transforming practice to improve patient safety through excellence in health care simulation. INACSL is a community of practice for simulation where members can network with simulation leaders, educators, researchers, and industry partners. INACSL also provides the INACSL Standards of Best Practice: Simulation^{SM}, an evidence-based framework to guide simulation design, implementation, debriefing, evaluation, and research.

Clinical Simulation in Nursing (2016) 12, S5-S12

Clinical Simulation in Nursing
www.elsevier.com/locate/ecsn

Standards of Best Practice: Simulation

INACSL Standards of Best Practice: Simulation[SM] Simulation Design

INACSL Standards Committee

KEYWORDS
pedagogy;
simulation design;
simulation format;
needs assessment;
objectives;
prebriefing;
debriefing;
fidelity;
facilitation

Cite this article:

INACSL Standards Committee (2016, December). INACSL standards of best practice: Simulation[SM] Simulation design. *Clinical Simulation in Nursing, 12*(S), S5-S12. http://dx.doi.org/10.1016/j.ecns.2016.09.005.

As the science of simulation continues to evolve, so does the need for additions and revisions to the INACSL Standards of Best Practice: Simulation[SM]. Therefore, the INACSL Standards of Best Practice: Simulation are living documents.

Standard

Simulation-based experiences are purposefully designed to meet identified objectives and optimize achievement of expected outcomes.

Background

Standardized simulation design provides a framework for developing effective simulation-based experiences. The design of simulation-based experiences incorporates best practices from adult learning,[1] education,[2,3] instructional design,[4,5] clinical standards of care,[6,7] evaluation,[8-11] and simulation pedagogy.[12-16] Purposeful simulation design promotes essential structure, process, and outcomes that are consistent with programmatic goals and/or institutional mission. The design of effective health care simulations facilitates consistent outcomes and strengthens the overall value of the simulation-based experience in all settings.

All simulation-based experiences require purposeful and systematic, yet flexible and cyclical planning. To achieve expected outcomes, the design and development of simulations should consider criteria that facilitate the effectiveness of simulation-based experiences.

Potential consequences of not following this standard may include ineffective assessment of participants and inability of participants to meet identified objectives or achieve expected outcomes. In addition, not following this standard can result in suboptimal or inefficient utilization of resources when designing simulation activities.

1876-1399/$ - see front matter © 2016 International Nursing Association for Clinical Simulation and Learning. Published by Elsevier Inc. All rights reserved
http://dx.doi.org/10.1016/j.ecns.2016.09.005

Criteria Necessary to Meet This Standard

1. Perform a needs assessment to provide the foundational evidence of the need for a well-designed simulation-based experience.
2. Construct measureable objectives.
3. Structure the format of a simulation based on the purpose, theory, and modality for the simulation-based experience.
4. Design a scenario or case to provide the context for the simulation-based experience.
5. Use various types of fidelity to create the required perception of realism.
6. Maintain a facilitative approach that is participant centered and driven by the objectives, participant's knowledge or level of experience, and the expected outcomes.
7. Begin simulation-based experiences with a prebriefing.
8. Follow simulation-based experiences with a debriefing and/or feedback session.
9. Include an evaluation of the participant(s), facilitator(s), the simulation-based experience, the facility, and the support team.
10. Provide preparation materials and resources to promote participants' ability to meet identified objectives and achieve expected outcomes of the simulation-based experience.
11. Pilot test simulation-based experiences before full implementation.

Criterion 1: Perform a needs assessment to provide the foundational evidence of the need for a well-designed simulation-based experience.

Required Elements:

- The needs assessment may include analysis of:
  - Underlying causes of a concern (e.g., root cause or gap analysis).
  - Organizational analysis (e.g., Strengths, Weaknesses, Opportunities and Threats analysis).
  - Surveys of stakeholders, participants, clinicians, and/or educators.
  - Outcome data (e.g., from pilot testing; previous simulation-based experiences; aggregate health care data).
  - Standards (e.g., certifying bodies, rules and regulations, practice guidelines).
- The needs assessment includes an examination of knowledge, skills, attitudes, and/or behaviors of individuals; organizational initiatives; systems analysis; clinical practice guidelines; quality improvement programs; and/or patient safety goals.
- Use the results of the needs assessment to guide the development of an overarching goal or broad objective for the simulation, which in turn directs the designer(s) in the development of simulation-specific objectives (see INACSL Standard: Objectives and Outcomes).
- Use the results of the needs assessment to create innovative and interactive simulation-based experiences that aim to:
  - Enhance curriculum in the classroom and/or clinical areas.
  - Provide opportunities for standardized clinical experiences.
  - Address competencies.
  - Improve quality of care and patient safety.
  - Promote readiness for clinical practice.

Criterion 2: Construct measureable objectives.

Required Elements:

- Develop broad and specific objectives to address identified needs and optimize the achievement of expected outcomes.
- Together, broad and specific objectives provide a blueprint for the design of a simulation-based experience.
  - Broad objectives reflect the purpose of the simulation-based experience and are related to organizational goals.
  - Specific objectives are related to participant performance measures.
- During the design phase, determine which objectives will or will not be available to the participant(s) before the experience.
  - Objectives that provide general information and context for the participant(s) should be disclosed (e.g., provide care for a patient with heart failure).
  - Participant performance measures or critical action checklists should not be disclosed.
- Use the measureable objectives to drive the design, development, and approach for the simulation-based experience (see INACSL Standard: Objectives and Outcomes).
- The facilitator assumes responsibility for guiding the achievement of the full set of objectives throughout the simulation-based experience (see INACSL Standard: Facilitation).

Criterion 3: Structure the format of a simulation based on the purpose, theory, and modality for the simulation-based experience.

Required Elements:

- Select the format of the simulation-based experience based on the needs assessment, resources, and broad objectives, taking into account the targeted participants.
- Use the purpose of a simulation-based experience to design and develop either a formative and/or summative encounter.
- Choose a theoretical and/or conceptual framework[15,17,18] based on the identified purpose and the

targeted participants (e.g., adult learners, inter-professional teams,[19] etc.).

- Select the appropriate modality for the simulation-based experience. The modality is the platform for the experience. Modalities can include simulated clinical immersion, in situ simulation, computer-assisted simulation, virtual reality, procedural simulation, and/or hybrid simulation. These modalities are achieved using standardized patients, manikins, haptic devices, avatars, partial task trainers, and so forth.
- Structure all simulation-based experiences to include a starting point, structured participant activities, and an end point.
  - The starting point represents the initial circumstances of the patient or situation when the participants start their engagement in the simulation-based experience.
  - Structured participant activities are designed for participant engagement (e.g., a simulated case or an unfolding scenario, and/or psychomotor skill teaching/evaluation).
  - The end point is the stage at which the simulation-based experience is expected to end, usually when expected learning outcomes have been demonstrated, time is exhausted, or the scenario can proceed no further.

Criterion 4: Design a scenario or case to provide the context for the simulation-based experience.

Required Elements:

- Use a process to design a scenario or case that ensures the quality and validity of the content and supports the objectives and expected outcomes.
- Design the scenario or case to include:
  - A situation and backstory to provide a realistic starting point from which the structured activity begins. The full picture of this context may be given verbally to the participants, found in the patient's file, or be revealed if requested through adequate inquiry on the part of participants.
  - Clinical progression and cues to provide a framework for the advancement of the clinical case or scenario in response to participant actions, including standardization of cues to guide the participant(s). Cues should be linked to performance measures and used to refocus participants when they stray from the intended objectives. Cues should be delivered to participants in a variety of ways, including verbally (e.g., through the patient, provider, or embedded participant), visually (e.g., through changes in vital signs on a monitor), through additional data (e.g., new laboratory results), and so forth (see INACSL Standard: Facilitation).
  - Time frames to facilitate progression of the scenario and ensure that there is reasonable time to achieve the objectives.
  - A script of a scenario or case that is developed for consistency and standardization to increase scenario repeatability/reliability. Variation from the planned dialogue may add distractions that could interfere with the objectives and affect validity and/or reliability of the scenario or case.
  - Identification of critical actions/performance measures that are required to evaluate achievement of scenario objectives. Each measure should be evidence based. Use subject matter experts to strengthen validity of the simulation scenario and the critical performance measures.

Criterion 5: Use various types of fidelity to create the required perception of realism.

Required Elements:

- Design the simulation through attention to physical, conceptual, and psychological aspects of fidelity that can contribute to the attainment of objectives.
  - Physical (or environmental) fidelity relates to how realistically the physical context of the simulation-based activity replicates the actual environment in which the situation would occur in real life. Physical fidelity includes such factors as the patient(s), simulator/manikin, standardized patient, environment, equipment, embedded actors, and related props.
  - Conceptual fidelity ensures that all elements of the scenario or case relate to each other in a realistic way so that the case makes sense as a whole to the participant(s) (e.g., vital signs are consistent with the diagnosis). To maximize conceptual fidelity, cases or scenarios should be reviewed by subject matter expert(s) and pilot tested before use with participants.
  - Psychological fidelity maximizes the simulation environment by mimicking the contextual elements found in clinical environments, for example, an active voice for the patient(s) to allow realistic conversation, noise and lighting typically associated with the simulated setting, distractions, family members, other health care team members, time pressure, and competing priorities. Psychological fidelity works synergistically with physical and conceptual fidelity to promote participant engagement.
- Develop the simulation using the appropriate types of fidelity that create the required perception of realism that will allow participants to engage in a relevant manner.[13,20]

As appropriate, use moulage to replicate features or characteristics of the patient situation and select manikins that represent the race and culture of the patients in the scenario in order to promote the sensory perceptions of participants and support the fidelity of the scenario.[21]

Criterion 6: Maintain a facilitative approach that is participant-centered and driven by the objectives, participant's knowledge or level of experience, and the expected outcomes.

Required Elements:

- Determine the facilitative approach during in the design phase.
- Use a level of facilitator involvement inversely proportional to the participant's knowledge and experience.
- Use a consistent facilitative approach among facilitators for each scenario, case, or simulation-based experience to achieve intervention fidelity.[22] (See INACSL Standard: Facilitation)
- Use facilitators who have formal training in simulation-based pedagogy (see INACSL Standard: Facilitation).

Criterion 7: Begin simulation-based experiences with a prebriefing.

Required Elements:

- Conduct a pre-briefing[23,24] to set the stage for the simulation-based experience by identifying participants' expectations that may differ depending on the level of experience of the participant(s) and theoretical framework.
- Conduct a prebriefing that is structured, planned for consistency, and completed immediately before the scenario/case.
- Incorporate into the prebriefing, activities that help establishment an environment of integrity, trust, and respect. Identify in the prebriefing expectations for the participant(s) and the facilitator(s). This includes establishment of ground rules and a fiction contract (see INACSL Standard: Professional Integrity and INACSL Standard: Facilitation).
- Incorporate into the prebriefing an orientation of the participant(s) to the space, equipment, simulator, method of evaluation, roles (participants/facilitator/standardized patient), time allotment, broad and/or specific objectives, patient situation, and limitations (see INACSL Standard: Facilitation).
- Consider use of a written or recorded prebriefing plan to standardize the process and content for each scenario/case. A written or recorded prebriefing plan should be required for simulation-based experiences when used for high-stakes evaluations.

Criterion 8: Follow simulation-based experiences with a debriefing and/or feedback session.

Required Elements:

- Identify the debriefing or feedback method for the simulation-based experience during the design phase.
- Use a planned debriefing or feedback session to enrich learning and contribute to the consistency of the simulation-based experiences for participants and facilitators. Debriefing and feedback are different, but both are critical elements that should be structured using best practices. In the case of a skills-based or testing simulation activity, debriefing may be replaced by feedback, so the participants are guided to further improve or confirm their practice.
- Use debriefing facilitators who have formal training in debriefing techniques.
- Follow INACSL Standard: Debriefing.

Criterion 9: Include an evaluation of the participant(s), facilitator(s), the simulation-based experience, the facility, and the support team.

Required Elements:

- Determine the evaluation processes in the design phase to ensure quality and effectiveness of simulation-based experiences.
- Adopt an evaluation framework to guide selection and/or development of a valid and reliable tool to measure expected outcomes.
- Ensure that participants are clear on the method of participant evaluation (formative, summative, and/or high-stakes) before or at the onset of the simulation.
- Include in the evaluation process input from participants, peers, and stakeholders.
- Use assessment data to assist in evaluating the simulation program for quality process improvement.
- Follow INACSL Standard: Participant Evaluation.

Criterion 10: Provide preparation materials and resources to promote participants' ability to meet identified objectives and achieve expected outcomes of the simulation-based experience.

Required Elements:

- The designer and facilitator are responsible for ensuring that preparatory activities address the knowledge, skills, attitudes, and behaviors that will be expected of the participants during the simulation-based experience.
- Determine necessary participant preparation in the design phase once all the elements of the simulation-based experience have been identified.
- Design and develop preparation activities and resources to promote the best possible opportunity for participants to be successful in addressing the simulation objectives. These may include:
  - Activities and/or resources to develop understanding of the concepts and content related to the simulation (e.g., reading assignments, concept mapping, course-work, didactic sessions, answering simulation-

specific questions, watching preparatory audiovisuals, completing a pretest, reviewing health record documents, skill review and practice, etc.).
  - Information regarding codes of conduct, confidentiality, and expectations (see INACSL Standard: Professional Integrity).
- Allow for participants to complete preparation activities in advance of the simulation prebriefing.

Criterion 11: Pilot test simulation-based experiences before full implementation.

Required Elements:

- On completion of the design, pilot test the entire simulation-based experiences to ensure that it accomplishes its intended purpose, provides opportunity to achieve objectives, and is effective when used with participants.
- Identify any confusing, missing, or underdeveloped elements of the simulation-based experience during pilot testing and correct before the actual simulation encounter.
- Use an audience similar to the target participant group as the optimal test environment.
- Include in the pilot test an evaluation of the evaluation tool(s), checklists, and other measures to assess for validity and to ensure consistency and reliability (i.e., content validity, expert review, inter-rater reliability, etc.).

Design Templates

Design Templates are available for educators to use that feature evidence-based design and standardize the design process. Samples of template resources are available (see references).

References

1. Clapper, T. C. (2010). Beyond Knowles: What those conducting simulation need to know about adult learning theory. *Clinical Simulation in Nursing*, *6*(1), 7-14. http://dx.doi.org/10.1016/j.ecns.2009.07.003.
2. Kolb, A. Y., Kolb, D. A., Passarelli, A., & Sharma, G. (2014). On becoming an experiential educator: The educator role profile. *Simulation & Gaming*, *45*(2), 204-234. http://dx.doi.org/10.1177/1046878114534383.
3. Shinnick, M. A., & Woo, M. A. (2015). Learning style impact on knowledge gains in human patient simulation. *Nurse Education Today*, *35*(1), 63-67. http://dx.doi.org/10.1016/j.nedt.2014.05.013, 5p.
4. Anderson, J. M., Aylor, M. E., & Leonard, D. T. (2008). Instructional design dogma: Creating planned learning experiences in simulation. *Journal of Critical Care*, *23*(4), 595-602. http://dx.doi.org/10.1016/j.jcrc.2008.03.003.
5. Robinson, B., & Dearmon, V. (2013). Evidence-based nursing education: Effective use of instructional design and simulated learning environments to enhance knowledge transfer in undergraduate nursing students. *Journal of Professional Nursing*, *29*, 203-209.
6. Barsuk, J. H., Cohen, E. R., Feinglass, J., McGaghie, W. C., & Wayne, D. B. (2009). Use of simulation-based education to reduce catheter-related bloodstream infections. *Archives of Internal Medicine*, *169*(15), 1420-1423. http://dx.doi.org/10.1001/archinternmed.2009.215.
7. Draycott, T., Sibanda, T., Owen, L., Akande, V., Winter, C., Reading, S., & Whitelaw, A. (2006). Does training in obstetric emergencies improve neonatal outcome? *BJOG: An International Journal of Obstetrics & Gynaecology*, *113*(2), 177-182.
8. Foronda, C., Siwei, L., & Bauman, E. (2013). Evaluation of simulation in undergraduate nurse education: An integrative review. *Clinical Simulation in Nursing*, *9*(10), e409-e416. http://dx.doi.org/10.1016/j.ecns.2012.11.003.
9. O'Brien, J., Hagler, D., & Thompson, M. (2015). Designing simulation scenarios to support performance assessment validity. *The Journal of Continuing Education in Nursing*, *46*(11), 492-497.
10. Schmutz, J., Eppich, W. J., Hoffmann, F., Heimberg, E., & Manser, T. (2014). Five steps to develop checklists for evaluating clinical performance: An integrative approach. *Academic Medicine*, *89*(7), 996-1005. http://dx.doi.org/10.1097/ACM.0000000000000289.
11. Zendejas, B., Brydges, R., Wang, A., & Cook, D. (2013). Patient outcomes in simulation-based medical education: A systematic review. *JGIM: Journal of General Internal Medicine*, *28*(8), 1078-1089. http://dx.doi.org/10.1007/s11606-012-2264-5.
12. Alinier, G. (2011). Developing high-fidelity health care simulation scenarios: A guide for educators and professionals. *Simulation & Gaming*, *42*(1), 9-26. http://dx.doi.org/10.1177/1046878109355683.
13. Gore, T., & Lioce, L. (2014). Creating effective simulation environments. In Ulrich, B., & Mancini, B. (Eds.), *Mastering simulation: A handbook for success*. Indianapolis, IN: Sigma Theta Tau International. (pp. 49-86).
14. Issenberg, B., McGaghie, W., Petrusa, E., Gordon, D., & Scalese, R. (2005). Features and uses of high-fidelity medical simulations that lead to effective learning: A BEME systematic review. *Medical Teacher*, *27*(1), 10-28.
15. National League for Nursing. (2016). In Jeffries, P. (Ed.), *The NLN Jeffries Simulation Theory [Monograph]*. Philadelphia: Wolters Kluwer.
16. Waxman, K. T. (2010). The development of evidence-based clinical simulation scenarios: Guidelines for nurse educators. *Journal of Nursing Education*, *49*(1), 29-35. http://dx.doi.org/10.3928/01484834-20090916-07.
17. Nestel, D., & Bearman, M. (2015). Theory and simulation-based education: Definitions, worldviews and applications. *Clinical Simulation in Nursing*, *11*(8), 349-354. http://dx.doi.org/10.1016/j.ecns.2015.05.013.
18. Rooney, D., Hopwood, N., Boud, D., & Kelly, M. (2015). The role of simulation in pedagogies of higher education for the health professions: Through a practice-based lens. *Vocations and Learning*, *8*(3), 269-285.
19. IPEC. (2013). *Interprofessional education collaborative*. Retrieved from https://ipecollaborative.org/About_IPEC.html.
20. Graham, C. L., & Atz, T. (2015). Baccalaureate minority nursing students' perceptions of high-fidelity simulation. *Clinical Simulation in Nursing*, *11*(11), 482-488. http://dx.doi.org/10.1016/j.ecns.2015.10.003.
21. Smith-Stoner, M. (2011). Using moulage to enhance educational instruction. *Nurse Educator*, *36*(1), 21-24. http://dx.doi.org/10.1097/NNE.0b013e3182001e98.
22. Jeffries, P. R., Dreifuerst, K., Kardong-Edgren, S., & Hayden, J. (2015). Faculty development when initiating simulation programs: Lessons learned from the national simulation study. *Journal of Nursing Regulation*, *5*(4), 17-23.
23. Chamberlain, J. (2015). Prebriefing in nursing simulation: A concept analysis using Rodger's methodology. *Clinical Simulation in Nursing*, *11*(7), e318-e322. http://dx.doi.org/10.1016/j.ecns.2015.05.003.
24. McDermott, D. S. (2016). The prebriefing concept: A Delphi study of CHSE experts. *Clinical Simulation in Nursing*, *12*(6), 219-227. http://dx.doi.org/10.1016/j.ecns.2016.02.001.

Bibliography

Criterion 1. Needs Assessment

Alinier, G. (2011). Developing high-fidelity health care simulation scenarios: A guide for educators and professionals. *Simulation & Gaming*, *42*(1), 9-26, http://dx.doi.org/10.1177/1046878109355683.

Anderson, J. M., Aylor, M. E., & Leonard, D. T. (2008). Instructional design dogma: Creating planned learning experiences in simulation. *Journal of Critical Care*, *23*, 595-602. http://dx.doi.org/10.1016/j.jcrc.2008.03.003.

McNiesh, S. G. (2015). Cultural norms of clinical simulation in undergraduate nursing education. *Global Qualitative Nursing Research*, *2*, 1-10.

Robinson, B. K., & Dearmon, V. (2013). Evidence-based nursing education: Effective use of instructional design and simulated learning environments to enhance knowledge transfer in undergraduate nursing students. *Journal of Professional Nursing*, *29*(4), 203-209. http://dx.doi.org/10.1016/j.profnurs.2012.04.022.

Scerbo, M. W., Bosseau Murray, W., Alinier, G., Antonius, T., Caird, J., Stricker, E., & Kyle, R. (2011). A path to better healthcare simulation systems: Leveraging the integrated systems design approach. *Simulation in Healthcare*, *6*(7), S20-S23. http://dx.doi.org/10.1097/SIH.0b013e318227cf41.

Criterion 2. Measurable Objectives

Arthur, C., Levett-Jones, T., & Kable, A. (2012). Quality indicators for the design and implementation of simulation experiences: A Delphi study. *Nurse Education Today*, *33*, 1357-1361. http://dx.doi.org/10.1016/j.nedt.2012.07.012.

Baker, A. C., Jensen, P. J., & Kolb, D. A. (2005). Conversation as experiential learning. *Management Learning*, *36*(4), 411-427.

Brewer, E. P. (2011). Successful techniques for using human patient simulation in nursing education. *Journal of Nursing Scholarship*, *43*(3), 311-317. http://dx.doi.org/10.1111/j.1547-5069.2011.01405.x.

Edmondson, A. C. (2002). *Managing the risk of learning: Psychological safety in work teams*. London, England: Blackwell.

Gore, T. N., & Lioce, L. (2014). Creating effective simulation environments. In Ulrich, B., & Mancini, B. (Eds.), *Mastering simulation: A handbook for success*. Indianapolis, IN: Sigma Theta Tau International. (pp. 49-86).

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education*, *4*(2), 193-212.

Nembhard, I. M., & Edmondson, A. C. (2006). Making it safe: The effects of leader inclusiveness and professional status on psychological safety and improvement efforts in health care teams. *Journal of Organizational Behavior*, *27*(7), 941-966.

Rosen, M. A., Salas, E., Silvestri, S., Wu, T. S., & Lazzara, E. H. (2008). A measurement tool for simulation-based training in emergency medicine: The simulation module for assessment of resident targeted event responses (SMARTER) approach. *Simulation in Healthcare*, *3*(3), 170-179. http://dx.doi.org/10.1097/SIH.0b013e318173038d.

Criterion 3. Format of Simulation

Alinier, G. (2007). A typology of educationally focused medical simulation tools. *Medical Teacher*, *29*(8), 243-250. http://dx.doi.org/10.1080/01421590701551185.

Bronander, K. (2011). *Modalities of simulation*. Retrieved from http://medicine.nevada.edu/Documents/unsom/ofd/inter-professional/IPEWorkshopModalities1.pdf.

Childs, J. C., Sepples, S. B., & Chambers, K. (2007). Designing simulations for nursing education. In Jeffries, P. R. (Ed.), *Simulation in nursing education: From conceptualization to evaluation* (1st ed.). New York, NY: National League for Nursing. (pp. 35-41).

Cook, D. A., Hamstra, S. J., Brydges, R., Zendejas, B., Szostek, J. H., Wang, A. T., & Hatala, R. (2013). Comparative effectiveness of instructional design features in simulation-based education: Systematic review and meta-analysis. *Medical Teacher*, *35*, e867-e898.

Dieckmann, P., Lippert, A., Rall, M., & Glavin, R. (2010). When things don't go as expected: Scenario lifesavers. *Simulation in Healthcare*, *5*(4), 219-225. http://dx.doi.org/10.1097/SIH.0b013e3181e77f74.

Foisy-Doll, C., & Leighton, K. (Eds.). (in press). *Simulation champions: Fostering courage, caring, and connection*. Philadelphia, PA: Wolters Kluwer Inc.

Horn, M., & Carter, N. (2007). Practical suggestions for implementing simulations. In Jeffries, P. R. (Ed.), *Simulation in nursing education: From conceptualization to evaluation* (1st ed.). New York, NY: National League for Nursing. (pp. 59-72).

Jeffries, P. R. (Ed.). (2012). *Simulation in nursing education: From conceptualization to evaluation* (2nd ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Jeffries, P. R. (2005). A framework for designing, implementing, and evaluating simulations used as teaching strategies in nursing. *Nursing Education Perspectives*, *26*(2), 96-103.

Jeffries, P. R., & Rogers, K. J. (2012). Theoretical framework for simulation design. In Jeffries, P. R. (Ed.), *Simulation in nursing education: From conceptualization to evaluation* (2nd ed.). New York, NY: National League for Nursing. (pp. 25-43).

Kaakinen, J., & Arwood, E. (2009). Systematic review of nursing simulation literature for use of learning theory. *International Journal of Nursing Education Scholarship*, *6*(1). Article 16.

Melnyk, B. M. (2013). *From Simulations to Real World: Improving Healthcare and Patient Outcomes With Evidence-Based Practice*. Paper presented at the 12th Annual International Nursing Simulation/Learning Resource Centers Conference. Las Vegas, Nevada.

Nestel, D., Mobley, B. L., Hunt, E. A., & Eppich, W. J. (2014). Confederates in health care simulations: Not as simple as it Seems. *Clinical Simulation in Nursing*, *10*(12), 611-616. http://dx.doi.org/10.1016/j.ecns.2014.09.007.

O'Regan, S., Molloy, E., Watterson, L., & Nestel, D. (2016). Observer roles that optimise learning in healthcare simulation education: A systematic review. *Advances in Simulation*. http://dx.doi.org/10.1186/s41077-015-0004-8. Retrieved from http://advancesinsimulation.biomedcentral.com/articles/10.1186/s41077-015-0004-8.

Rodgers, D. (2013). *How simulation works: Learning theory and simulation*. In 13th Annual International Meeting on Simulation in Healthcare (IMSH). Orlando, FL.

Rourke, L., Schmidt, M., & Garga, N. (2010). Theory-based research of high-fidelity simulation use in nursing education: A review of the literature. *International Journal of Nursing Education Scholarship*, *7*(1). Article 11 http://dx.doi.org/10.2202/1548-923X.1965.

Schaefer, J., Vanderbilt, A., Cason, C., Bauman, E., Glavin, R., Lee, F., & Navedo, D. (2011). Literature review: Instructional design and pedagogy science in healthcare simulation. *Simulation in Healthcare*, *6*(7), S30-S41. http://dx.doi.org/10.1097/SIH.0b013e31822237b4.

Wiggins, G., & McTighe, J. (2005). *Understanding by design* (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.

Criterion 4. Clinical Scenario or Case

Alinier, G. (2007). A typology of educationally focused medical simulation tools. *Medical Teacher*, *29*(8), 243-250.

Blazeck, A., & Zewe, G. (2013). Simulating simulation: Promoting perfect practice with learning bundled supported videos in an applied, learner-driven curriculum design. *Clinical Simulation in Nursing*, *9*(1), e21-e24. http://dx.doi.org/10.1016/j.ecns.2011.07.002.

Maran, N. J., & Glavin, R. J. (2003). Low-to high-fidelity simulation across continuum of medical education? *Medical education*, *37*(s1), 22-28.

Rosen, M. A., Salas, E., Silvestri, S., Wu, T. S., & Lazzara, E. H. (2008). A measurement tool for simulation-based training in emergency medicine: The simulation module for assessment of resident targeted event responses (SMARTER) approach. *Simulation in Healthcare*, *3*(3), 170-179. http://dx.doi.org/10.1097/SIH.0b013e318173038d.

Waxman, K. (2010). The development of evidence-based clinical simulation scenarios: Guidelines for nurse educators. *Journal of Nursing Education*, *49*(1), 29-35, Retrieved from http://dx.doi.org/10.3928/01484834-20090916-07.

Criterion 5. Fidelity

Dieckmann, P., Gaba, D., & Rall, M. (2007). Deepening the theoretical foundations of patient simulation as social practice. *Simulation in Healthcare*, *2*(3), 183-193. http://dx.doi.org/10.1097/SIH.0b013e3180f637f5.

Edmondson, A. C. (2002). Managing the risk of learning: Psychological safety in work teams. In West, M. (Ed.), *International handbook of organizational teamwork* (1st ed.). London: Blackwell. (pp. 1-37).

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly*, *44*(2), 350-383.

Gore, T. N., & Lioce, L. (2014). Creating effective simulation environments. In Ulrich, B., & Mancini, B. (Eds.), *Mastering simulation: A handbook for success*. Indianapolis, IN: Sigma Theta Tau International. (pp. 49-86).

Nanji, K. C., Baca, K., & Raemer, D. B. (2013). The effect of an olfactory and visual cue on realism and engagement in a health care simulation experience. *Simulation in Healthcare*, *8*(3), 143-147. http://dx.doi.org/10.1097/SIH.0b013e31827d27f9.

Nembhard, I. M., & Edmondson, A. C. (2011). Making it safe: The effects of leader inclusiveness and professional status on psychological safety and improvement efforts in health care teams. In Kanes, C. (Ed.), *Elaborating professionalism: Studies in practice and theory*. Netherlands: Springer. (pp. 77-105).

Rudolph, J. W., Simon, R., & Raemer, D. B. (2007). Which reality matters? Questions on the path to high engagement in healthcare simulation. *Simulation in Healthcare*, *2*(3), 161-163. http://dx.doi.org/10.1097/-SIH.0b013e31813d1035.

Criterion 6. Facilitative Approach

Alinier, G. (2011). Developing high-fidelity health care simulation scenarios: A guide for educators and professionals. *Simulation & Gaming*, *42*(1), 9-26. http://dx.doi.org/10.1177/1046878109355683.

Clapper, T. C. (2010). Beyond Knowles: What those conducting simulation need to know about adult learning theory. *Clinical Simulation in Nursing*, *6*(1), e7-e14.

Hayden, J. K., Smiley, R. A., Alexander, M., Kardong-Edgren, S., & Jeffries, P. R. (2014). The national simulation study: A longitudinal, randomized, controlled study replacing clinical hours with simulation in prelicensure nursing education. *Journal of Nursing Regulation*, *5*(Suppl 2), S3-S40.

Kelly, M & Guinea, S. (in press). Facilitating healthcare simulations. In Nestel D., Kelly M., Jolly B.; & Watson M. (Eds.) *Healthcare simulation education: Evidence, theory and practice*. John Wiley & Sons: West Sussex.

Criterion 7. Prebriefing

Alinier, G. (2011). Developing high-fidelity health care simulation scenarios: A guide for educators and professionals. *Simulation & Gaming*, *42*(1), 9-26. http://dx.doi.org/10.1177/1046878109355683.

Bruce, S. A., Scherer, Y. K., Curran, C. C., Urschel, D. M., Erdley, S., & Ball, L. S. (2009). A collaborative exercise between graduate and undergraduate nursing students using a computer-assisted simulator in a mock cardiac arrest. *Nursing Education Perspectives*, *30*, 22-27.

Chamberlain, J. (2015). Prebriefing in nursing simulation: A concept analysis using Rodger's methodology. *Clinical Simulation in Nursing*, *11*(7), e318-e322. http://dx.doi.org/10.1016/j.ecns.2015.05.003.

Deckers, C. (2011). *Designing high fidelity simulation to maximize student registered nursing decision-making ability*. Malibu, CA: Pepperdine University. (Unpublished doctoral dissertation).

Eggenberger, T., Keller, K., & Locsin, R. C. (2010). Valuing caring behaviors within simulated emergent nursing situations. *International Journal for Human Caring*, *14*(2), 23-29.

Fanning, R., & Gaba, D. M. (2007). The role of debriefing in simulation-based learning. *Simulation in Healthcare*, *2*(2), 115-125. http://dx.doi.org/10.1097/SIH.0b013e3180315539.

Gaba, D. M. (2013). Simulations that are challenging to the psyche of participants: How much should we worry and about what? *Simulation in Healthcare*, *8*, 4-7. http://dx.doi.org/10.1097/SIH.0b013e3182845a6f.

Hermanns, M., Lilly, M. L., & Crawley, B. (2011). Using clinical simulation to enhance psychiatric nursing training of baccalaureate students. *Clinical Simulation in Nursing*, *7*, e41-e46. http://dx.doi.org/10.1016/j.ecns.2010.05.001.

Husebo, S. E., Friberg, F., Soreide, E., & Rystedt, H. (2012). Instructional problems in briefings: How to prepare nursing students for simulation-based cardiopulmonary resuscitation training. *Clinical Simulation in Nursing*, *8*(7), e307-e318. http://dx.doi.org/10.1016/j.ecns.2010.12.002.

Kember, D. (1997). A reconceptualisation of the research into university academics' conceptions of teaching. *Learning and Instruction*, *7*(3), 255-275. http://dx.doi.org/10.1016/S0959-4752(96)00028-X.

McDermott, D. S. (2016). The prebriefing concept: A Delphi study of CHSE experts. *Clinical Simulation in Nursing*, *12*(6), 219-227. http://dx.doi.org/10.1016/j.ecns.2016.02.001.

Page-Cutrara, K. (2014). Use of prebriefing in nursing simulation: A literature review. *Journal of Nursing Education*, *53*(3), 136-141.

Riley, R. H. (Ed.). (2016). *Manual of simulation in healthcare* (2nd ed.). New York, NY: Oxford University Press.

Rudolph, J., Raemer, D., & Simon, R. (2014). Establishing a safe container for learning in simulation: The role of the presimulation briefing. *Simulation in Healthcare*, *9*(6), 339-349. http://dx.doi.org/10.1097/SIH.0000000000000047.

Rudolph, J. W., Simon, R., Dufresne, R. L., & Raemer, D. B. (2006). There's no such thing as "nonjudgmental" debriefing: A theory and method for debriefing with good judgment. *Simulation in Healthcare*, *1*(1), 49-55.

Criterion 8. Debriefing

Ahmed, M., Sevdalis, N., Paige, J., Paragi-Gururaja, R., Nestel, D., & Arora, S. (2012). Identifying best practice guidelines for debriefing in surgery: A tri-continental study. *The American Journal of Surgery*, *203*(4), 523-529.

Chung, H. S., Dieckmann, P., & Issenberg, S. B. (2013). It is time to consider cultural differences in debriefing. *Simulation in Healthcare*, *8*(3), 166-170. http://dx.doi.org/10.1097/SIH.0b013e318291d9ef.

Dieckmann, P., Friss, S. M., Lippert, A., & Ostergaard, D. (2009). The art and science of debriefing in simulation: Ideal and practice. *Medical Teacher*, *31*, e287-e294.

Dismukes, R. K., Gaba, D. M., & Howard, S. K. (2006). So many roads: Facilitated debriefing in healthcare. *Simulation in Healthcare*, *1*(1), 23-25.

Fey, M. K., Scrandis, D., Daniels, A., & Haut, C. (2014). Learning through debriefing: Students' perspectives. *Clinical Simulation in Nursing*, *10*(5), e249-e256. http://dx.doi.org/10.1016/j.ecns.2013.12.009.

Raemer, D., Anderson, M., Cheng, A., Fanning, R., Nadkarni, V., & Savoldelli, G. (2011). Research regarding debriefing as part of the learning process. *Simulation in Healthcare*, *6*(S), S52-S57.

Criterion 9. Evaluation

Arthur, C., Levett-Jones, T., & Kable, A. (2012). Quality indicators for the design and implementation of simulation experiences: A Delphi study. *Nurse Education Today*, *33*, 1357-1361.

Bambini, D., Washburn, J., & Perkins, R. (2009). Outcomes of clinical simulation for novice nursing students: Communication, confidence, clinical judgment. *Nursing Education Perspectives*, *30*(2), 79-82. http://dx.doi.org/10.1043/1536-5026-030.002.0079.

Brewer, E. P. (2011). Successful techniques for using human patient simulation in nursing education. *Journal of Nursing Scholarship*, *43*(3), 311-317.

Kelly, M. A., Hager, P., & Gallagher, R. (2014). What matters most? Students' rankings of simulation components which contribute to clinical judgement. *Journal of Nursing Education*, *53*(2), 97-101.

Motolo, I., Devine, L. A., Chung, H. S., Sullivan, J., & Issenberg, S. B. (2013). Simulation in healthcare education: A best evidence practical guide. AMEE Guide No. 82. *Medical Teacher*, *35*, e1511-e1530. http://dx.doi.org/10.3109/0142159X.2013.818632.

Willhaus, J., Burleson, G., Palaganas, J., & Jeffries, P. (2014). Authoring simulations for high-stakes student evaluation. *Clinical Simulation in Nursing*, *10*(4), e177-e182. http://dx.doi.org/10.1016/j.ecns.2013.11.006.

Criterion 10. Participant Preparation

Alinier, G. (2011). Developing high-fidelity health care simulation scenarios: A guide for educators and professionals. *Simulation & Gaming*, *42*(1), 9-26. http://dx.doi.org/10.1177/1046878109355683.

Jeffries, P. R. (2005). A framework for designing, implementing, and evaluating simulations used as teaching strategies in nursing. *Nursing Education Perspectives*, *26*(2), 96-103.

Zendejas, B., Cook, D. A., & Farley, D. R. (2010). Teaching first or teaching last: Does the timing matter in simulation-based surgical scenarios? *Journal of Surgical Education*, *67*(6), 432-438. http://dx.doi.org/10.1016/j.jsurg.2010.05.001.

Template References

Alinier, G. (2011). Developing high-fidelity health care simulation scenarios: A guide for educators and professionals. *Simulation & Gaming*, *42*(1), 9-26. http://dx.doi.org/10.1177/1046878109355683.

Al-Shidhani, T. A. (2010). Curriculum development for medical education: A six-step approach. *Sultan Qaboos University Medical Journal*, *10*(3), 416-417.

Bartlett, J. L. (2015). A simulation template for a new simulation program. *Clinical Simulation in Nursing*, *11*(11), 479-481. http://dx.doi.org/10.1016/j.ecns.2015.09.003.

Meakim, C. H., & Mariani, B. (2013). Simulation Design Template. Tool presented at one day workshop for staff educators. In *Designing and debriefing: Critical tools for effective simulation*. Voorhees, NJ: Kennedy Health System.

National Health Education and Training in Simulation (NHETSim). (n.d.). Retrieved from http://www.nhet-sim.edu.au/

National League for Nursing. (2010). *Simulation design template*. Retrieved from http://sirc.nln.org/videos/module05/Simulation-Form.pdf.

University of Texas Medical Branch. (2009). *Template for standardized patient script*. Retrieved from http://www.utmb.edu/ocs/SP%20Case%20Template%20Sept%202014.pdf.

Waxman, K. (2010). The development of evidence-based clinical simulation scenarios: Guidelines for nurse educators. *Journal of Nursing Education*, *49*(1), 29-35. http://dx.doi.org/10.3928/01484834-20090916-07.

Original INACSL Standard

Lioce, L., Meakim, C. H., Fey, M. K., Chmil, J. V., Mariani, B., & Alinier, G. (2015). Standards of best practice: Simulation standard IX: Simulation design. *Clinical Simulation in Nursing*, *11*(6), 309-315. http://dx.doi.org/10/1016/j.ecns.2015.03.005.

About the International Nursing Association for Clinical Simulation and Learning

The International Nursing Association for Clinical Simulation and Learning (INACSL) is the global leader in transforming practice to improve patient safety through excellence in health care simulation. INACSL is a community of practice for simulation where members can network with simulation leaders, educators, researchers, and industry partners. INACSL also provides the INACSL Standards of Best Practice: Simulation^{SM}, an evidence-based framework to guide simulation design, implementation, debriefing, evaluation, and research.

Smart strategies for doctors and doctors-in-training: heuristics in medicine

Odette Wegwarth,[1,2] Wolfgang Gaissmaier[1,2] & Gerd Gigerenzer[1,2]

CONTEXT How do doctors make sound decisions when confronted with probabilistic data, time pressures and a heavy workload? One theory that has been embraced by many researchers is based on optimisation, which emphasises the need to integrate all information in order to arrive at sound decisions. This notion makes heuristics, which use less than complete information, appear as second-best strategies. In this article, we challenge this pessimistic view of heuristics.

METHODS We introduce two medical problems that involve decision making to the reader: one concerns coronary care issues and the other macrolide prescriptions. In both settings, decision-making tools grounded in the principles of optimisation and heuristics, respectively, have been developed to assist doctors in making decisions. We explain the structure of each of these tools and compare their performance in terms of their facilitation of correct predictions.

RESULTS For decisions concerning both the coronary care unit and the prescribing of macrolides, we demonstrate that sacrificing information does not necessarily imply a forfeiting of predictive accuracy, but can sometimes even lead to better decisions. Subsequently, we discuss common misconceptions about heuristics and explain when and why ignoring parts of the available information can lead to the making of more robust predictions.

CONCLUSIONS Heuristics are neither good nor bad *per se*, but, if applied in situations to which they have been adapted, can be helpful companions for doctors and doctors-in-training. This, however, requires that heuristics in medicine be openly discussed, criticised, refined and then taught to doctors-in-training rather than being simply dismissed as harmful or irrelevant. A more uniform use of explicit and accepted heuristics has the potential to reduce variations in diagnoses and to improve medical care for patients.

*Medical Education 2009: **43**: 721–728*
doi:10.1111/j.1365-2923.2009.03359.x

[1]Center of Adaptive Behavior and Cognition, Max Planck Institute for Human Development, Berlin, Germany
[2]Harding Center for Risk Literacy, Max Planck Institute for Human Development, Berlin, Germany

Correspondence: Odette Wegwarth, Max Planck Institute for Human Development, Lentzeallee 94, 14195 Berlin, Germany.
Tel: 00 49 30 82406 695; Fax: 00 49 30 82406 394;
E-mail: wegwarth@mpib-berlin.mpg.de

INTRODUCTION

There was a time in history when diagnosing diseases was of little importance to doctors because virtually all patients, regardless of their illness, received the same treatments, such as blood-letting or cupping. Times, however, have changed. Today, making a diagnostic or treatment decision involves handling a large body of probabilistic information and processing it under pressures of time and a heavy workload. How do doctors manage this task?

Over the last decades, psychologists have examined how humans integrate probabilistic information into their reasoning under various conditions and how they should ideally do so. Much of the resulting work has embraced the idea of optimisation, which holds that all information available must be integrated in a defined manner in order for sound reasoning to take place; otherwise, second-best solutions are inevitable. One theory that has strengthened this belief and spawned many variants of replicating studies, both in the field of medical decision making[1,2] and elsewhere, is Tversky and Kahneman's[3–5] heuristics and biases programme. In psychology, heuristics are defined as simple decision-making strategies, also called 'rules of thumb', that make use of less than complete information. In order to conclude, however, that cognitive bias is at work when somebody uses a heuristic, one needs to set a prior norm of what constitutes sound reasoning. Within the heuristics and biases programme, this norm was defined by the laws of probability, and thus any deviation from these laws was defined as a bias. Although Kahneman and Tversky, who investigated the unconscious use of heuristics, initially considered that heuristics enable humans to arrive at mainly good decisions, they and other researchers advocating the heuristics and biases programme focused on the bias aspect only. This has led to the commonplace supposition that using less than complete information, regardless of whether this use is unconscious or deliberate, leads to non-optimal or faulty decision making. The medical community quickly adopted the heuristics and biases view[6–8] and left it largely unrevised until now. For instance, in the late 1990s, Elstein[9] still described heuristics as 'mental shortcuts commonly used in decision making that can lead to faulty reasoning or conclusions' (p 791) and blamed the practice for many errors in clinical reasoning. However, more and more researchers are beginning to realise, especially in fundamentally uncertain domains such as medicine, that expertise and good decision making involve the ignoring of some information.[10–14] But is the practice of ignoring information truly desirable in the context of making important medical decisions?

In this paper, we are going to challenge the negative view of heuristics held in both the psychological and medical communities. We focus on the deliberate use of heuristics in the design of tools that help doctors make good diagnostic and treatment decisions and demonstrate when and why using less than complete information represents a viable approach to medical decision making. We will end this article with a call for including the science of heuristics in medical education in order to curb the uneducated use of heuristics and thereby improve health care.

HOW SMART ARE SIMPLE HEURISTICS IN MEDICINE?

Diagnostic decisions: the coronary care unit

Imagine the following situation: a man is rushed to hospital with serious chest pain. The doctor suspects acute ischaemic heart disease and needs to make a quick decision: should the patient be assigned to the coronary care unit or to a regular nursing bed for monitoring? How do doctors make such decisions? And how should they?

One strategy is to rely on intuition. For instance, in a rural Michigan hospital, doctors sent some 90% of patients to the coronary care unit. Yet only 25% of patients admitted to the unit actually had myocardial infarction.[15] Similar results (ranging from 12% to 42%) were found in larger hospitals. This phenomenon is also known as 'defensive' decision making. It occurs in an environment where doctors can be sued for doing too little, but not for doing too much.

Given that defensive decision making leads to cost-intensive over-diagnosis and over-treatment, researchers at the University of Michigan Hospital tried to solve the coronary care unit problem by training the rural hospital's doctors to use a decision support tool based on logistic regression.[16] This tool, called the Heart Disease Predictive Instrument (HDPI), offers all relevant information in a combined and weighted form, yielding a chart with some 50 probabilities (Fig. 1).

If a doctor wanted to determine a patient's probability of having acute heart disease based on this chart, she needed to check the presence and absence of combinations of seven symptoms and insert the relevant probabilities into a pocket calculator. Yet although this procedure led to a systematic order of information through which it provided guidance,

History	ST&T Ø	ST⇔	T⇑⇓	ST⇔	ST⇔&T⇑⇓	ST⇑⇓&T⇑⇓
Chest pain = chief complaint						
ECG (ST, T wave Δ's)						
No MI and no NTG	19%	35%	42%	54%	62%	78%
MI or NTG	27%	46%	53%	64%	73%	85%
MI and NTG	37%	58%	65%	75%	80%	90%
Chest pain, not chief complaint						
ECG (ST, T wave Δ's)						
History	ST&T Ø	ST⇔	T⇑⇓	ST⇔	ST⇔&T⇑⇓	ST⇑⇓&T⇑⇓
No MI and no NTG	10%	21%	26%	36%	45%	64%
MI or NTG	16%	29%	36%	48%	56%	74%
MI and NTG	22%	40%	47%	59%	67%	82%
No chest pain						
ECG (ST, T wave Δ's)						
History	ST&T Ø	ST⇔	T⇑⇓	ST⇔	ST⇔&T⇑⇓	ST⇑⇓&T⇑⇓
No MI and no NTG	4%	9%	12%	17%	23%	39%
MI or NTG	6%	14%	17%	25%	32%	51%
MI and NTG	10%	20%	25%	35%	43%	62%

Figure 1 The Heart Disease Predictive Instrument (HDPI), a decision-support tool in the form of a pocket-sized card (Source: [15]). ECG = electrocardiogram; ST = certain anomaly in electrocardiogram; MI = myocardial infarction; NTG = Nitroglycerin use for chest pain relief

many doctors disliked using the HDPI because of its complexity and lack of transparency.[17,18] What was the solution? Should these doctors have continued to classify patients according to (defensive) intuitions that were suboptimal but frugal, or should they have based their classifications on complex calculations that are alien but possibly more accurate?

Fast and frugal decision tree

Eventually, Green and Mehr[15] found an alternative to (defensive) intuition and complex tools: smart heuristics. These correspond to natural intuitions but can have the predictive accuracy of complex statistical models. An unexpected observation initially led hospital researchers to try a heuristic model. When studying the impact of the HDPI on doctors' decision making, the researchers noticed that once doctors had been introduced to the tool, which improved the quality of their decision making, its subsequent withdrawal did not affect the quality of their decisions: these, surprisingly, remained at the improved level. It was out of the question that the doctors might have memorised the probabilities on the chart or calculated the logistic regression in their heads. What else could have caused this effect? The researchers suspected that the doctors might, instead, have simply learned the important variables and that the quantitative computation itself was of little importance. This interpretation led to the deliberate construction of a simple decision-making heuristic for the coronary care unit allocation problem that used only minimal information and computation. Inspired by this idea, Green and Mehr[15] constructed a simple fast and frugal decision-making tree (Fig. 2). (For more details on the general properties of fast and frugal trees and

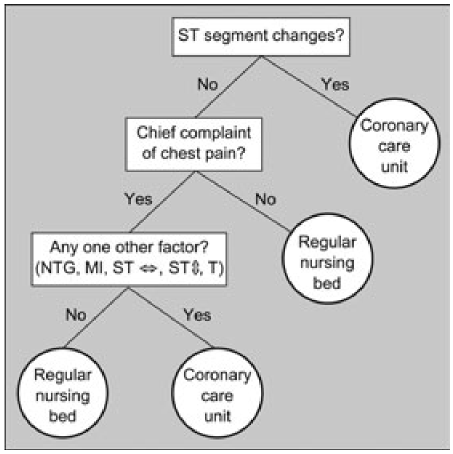

Figure 2 Fast and frugal decision tree for coronary care unit allocation (Source: [15]). ST = certain anomaly in electrocardiogram; MI = myocardial infarction; NTG = Nitroglycerin use for chest pain relief

their construction, see [19].) It ignores all 50 probabilities and asks only a few Yes/No questions. If a patient's electrocardiogram has a certain anomaly (the so-called ST segment change), he or she is immediately admitted to the coronary care unit. No other information is searched for. If that is not the case, a second variable is considered: does chest pain represent the patient's primary complaint? If not, the patient is immediately classified as low risk and assigned to a regular nursing bed. No further information is considered. If the answer is yes, a third and final question is asked to classify the patient.

How accurate is the fast and frugal tree?

Like the HDPI, the fast and frugal tree can be evaluated by multiple performance criteria. One of these is accuracy, where the decision-making strategy should have, firstly, high sensitivity, so that it sends most patients who actually have a serious heart disease to the coronary care unit, and, secondly, high specificity, so that it sends few patients into the care unit unnecessarily. A second criterion is its ability to make decisions fast, which is essential when slow decision making can cost a life. A third criterion is frugality, which represents the ability to make good decisions with only limited information. The second and third criteria – speed and frugality – are inter-related and in both respects the fast and frugal tree is, by design, superior to the HDPI system, as might be doctors' intuition. So how accurate are decisions based on the fast and frugal decision-making tree compared with those based on the HDPI or on defensive intuition?

The answer is shown in Fig. 3. The y-axis represents the proportion of patients correctly assigned to the coronary care unit, as indicated by a subsequent heart attack; the x-axis represents the proportion of patients incorrectly assigned. The diagonal line represents chance performance. A point in the upper left corner would represent a perfect strategy, although that does not exist in the uncertain world of medical diagnosis. As the triangle shows, doctors' intuition initially performed at chance level or even slightly below it. The HDPI did better. Its performance is shown by squares, which represent various trade-offs between the two possible errors (false alarms, misses).

The fast and frugal tree, in turn, was more accurate than both doctors' intuitive judgement and the HDPI in classifying actual heart attack patients. It correctly

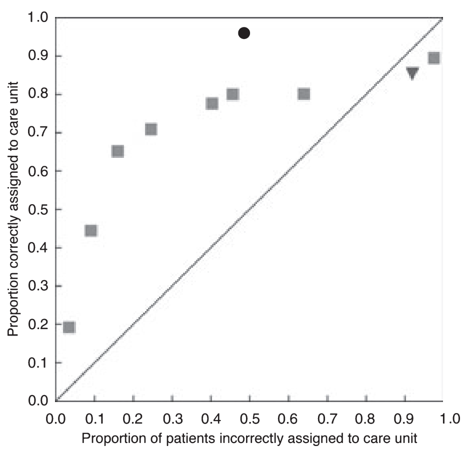

Figure 3 Accuracy of coronary care unit decisions made by doctors, according to the Heart Disease Predictive Instrument (■), (defensive) intuition (▼) and the fast and frugal tree (•). Accuracy is measured by the proportion of patients correctly assigned to the coronary care unit and the proportion of patients incorrectly sent to the unit. (Source: [15])

assigned the largest proportion of patients who subsequently had myocardial infarction to the coronary care unit. At the same time, it had a comparatively low false alarm rate. Note that the HDPI system used more information than the smart heuristic and could make use of sophisticated statistical calculations. Nevertheless, in this complex situation, using less information turned out to be of more benefit.

Treatment decisions: macrolide prescription

The heuristic approach has also been applied to target macrolide prescription in children with community-acquired pneumonia (CAP).[20] Macrolides represent the first-line antibiotic treatment for CAP, which is mainly caused by *Streptococcus pneumoniae*; infections caused by *Mycoplasma pneumoniae* are rare. However, macrolides no longer cover all bacterial causes of CAP. A study of schoolchildren in Pittsburgh found macrolide resistance in 48% of all group A streptococci isolated from throat cultures.[21] Given these alarming resistance patterns, the Active Bacterial Core Surveillance/Emerging Infections Program Network has urged doctors to reduce the inappropriate prescribing of macrolides, particularly to young children.[20]

Thus, after confirming a diagnosis of CAP in a child, the doctor must decide on the antibiotic prescription and further diagnostic testing. Although macrolides remain the antibiotic of choice in patients with *M. pneumoniae*, there are alternative antibiotics for other frequent bacterial infections. Rapid detection of *M. pneumoniae* is now possible by means of polymerase chain reaction analysis, but applying this test to all children with symptoms of CAP is costly. Moreover, most doctors prescribe a first-line antibiotic while they are awaiting the test result.

For such situations where time is crucial, information is uncertain and both costs and resistance rates need to be curbed, researchers[20] deliberately developed and tested two decision-support tools. One of these was a scoring system based on logistic regression. To ascertain a child's risk of having *M. pneumoniae*-triggered CAP with this scoring system, the doctor must verify the child's age and duration of fever, look up the respective scores for each of these in a table, and then sum up the scores before consulting an interpretation sheet. The other tool was a fast and frugal tree based on a heuristic approach and designed to help doctors rapidly identify the risk of *M. pneumoniae* as the cause of CAP in children. The fast and frugal tree (Fig. 4) adheres to the following heuristic rule: 'Prescribe macrolides only if the child is older than 3 years *and* has had fever for more than 2 days. Otherwise, do not prescribe macrolides.'[22]

How well did the two tools perform?

When doctors based their prescriptions on the scoring system, they were able to correctly identify 75% of all cases as being at high risk or very high risk for *M. pneumoniae*. The simple decision-making tree performed nearly as well: it correctly identified 72% of all cases as being at high risk or very high risk for *M. pneumoniae*. However, although both tools would help to curtail the superfluous prescription of macrolides to a considerable extent, the tree is yet more transparent: whereas the scoring system requires the user to look up data in a table, the fast and frugal decision tree, which asks, at most, two Yes/No questions, can easily be memorised.

MISCONCEPTIONS ABOUT HEURISTICS

These two examples reveal that common beliefs about heuristics are actually misconceptions. One of these misconceptions holds that humans use heuristics only because they have limited cognitive capacities. This often-repeated phrase incorrectly attributes the reasons for using heuristics exclusively to the limitations of the human mind, which is seen as an impoverished instrument. However, external reasons (e.g. that a problem is computationally intractable, the future is uncertain and the goals are ambiguous) can suffice for minds and computers to rely on heuristics. For instance, when former chess world champion Garry Kasparov played against the IBM supercomputer Deep Blue, both relied on heuristics, not only because both had limited capacities, but because the problem was computationally intractable: even the most brilliant minds and fastest machines were unable to compute its solution. Limitations of attention, memory and reasoning can, of course, contribute to the use of heuristics, but external reasons are sufficient.

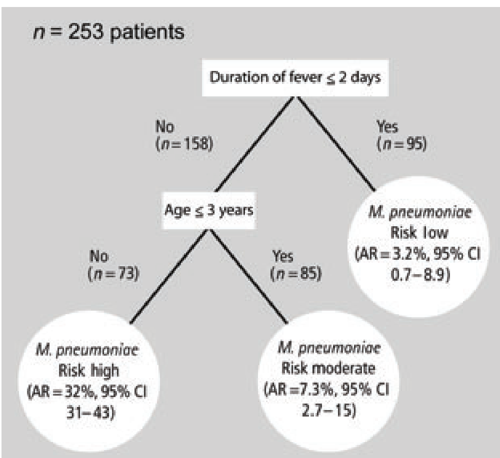

Figure 4 A fast and frugal tree for ruling out *Mycoplasma pneumoniae* infection in children with community-acquired pneumonia (CAP) (Source: [20]). AR = absolute risk; CI = confidence interval

Another misconception is that limited cognitive capacities are always bad. This belief is often implied but rarely stated, perhaps because it seems so obvious. However, although limited capacities may constrain functions, they may also, in fact, enable them.[23,24] For instance, large memory capacities in neural networks can prevent language acquisition in children, whereas starting small (limited capacity) and with simple sentences (baby talk) facilitates learning.[25] Luria's[26] famous mnemonist with almost unlimited memory could perfectly recall lengthy texts, but his memory was flooded by detail, making it difficult for him to summarise the gist of a text and think on an abstract level.

In comparison with optimising, heuristics are suspected of leading to second-best outcomes. If the optimal strategy is not known or too slow, however, using heuristics may well be the *only* solution. Moreover, every optimisation model is optimal only in relation to a set of mathematically convenient assumptions. Given that these assumptions do not hold in the real world, the outcome of optimisation can be disappointing; in such cases, optimisation theories are second-best.[11–13,27]

Another common misconception is that decision-making processes that use more information are always better than those that use less. In most models of rationality, it is taken for granted that the quality of decisions (or predictions) always improves – or at least cannot diminish – with an increasing amount of information. This assumption, however, is incorrect; the relationship between amount of information and quality of prediction is often illustrated by an inverse U-shaped curve.[28,29] Specifically, when uncertainty is high, as it is in numerous medical situations, the decision maker needs to ignore part of the available information in order to make robust predictions. For instance, in contexts where only a little information was available, the predictions made by a fast and frugal decision tree proved to be as robust as those supported by the benchmark of statistics, logistic regression, and only 1% point less so than decisions supported by the benchmark of machine learning, the classification and regression tree (CART), in various areas ranging from medicine to sports to economics.[19] Similarly, a simple strategy called 'take the best' was more accurate than complex strategies such as a CART and a neural network in making predictions in the majority of 20 different decision-making situations.[30] Experts have been found to base their judgements on surprisingly little information,[31] and professional golf and handball players tend to make better decisions when they have less time to do so or when they act on the first idea that comes to mind.[32,33] But how exactly is this 'less-is-more' effect possible?

WHEN LESS IS MORE: ROBUSTNESS

To understand when and why less is more, it is important to understand the concept of robustness. In situations where decisions are liable to error – as they are in situations that involve uncertainty – robustness plays the key role in the less-is-more effect. The important distinction here is between data fitting and data prediction. *Data fitting* means fitting the parameters of a model to a body of data that is already known so that the model simply explains what has already happened. Here, using more information (free parameters) never hurts. By contrast, *data prediction* means testing whether a model can also predict comparable future events or outcomes. Here, however, using more information can hurt. If there are two diagnostic models, A and B, and A fits the known dataset better than B but predicts a comparable, yet new dataset less accurately than B, then model A is over-fitted to the known dataset. Over-fitting occurs when a model, by using too much information (free parameters), fits 'noise' and idiosyncrasies of the present dataset that do not generalise to a new sample. Yet, especially for situations whose structure is not known in advance, a model's most important feature is that it generalises well. A model's ability to predict (generalise to) new data – such as new patients – is called 'robustness'. Over-fitting, however, conflicts with the robustness of a model. To make the two concepts more transparent, suppose for a moment that you need a new dress. One means of meeting this need is to visit a tailor, who will take all your body measurements, assign these to the fabric you choose and create a dress that will fit you perfectly. That is what happens when a model is fitted to known data. Now suppose that a dear friend with similar general body features such as weight and size desperately needs a dress for an important event and asks if she can borrow yours. You, of course, agree. Your friend arrives at your door, eagerly tries on the dress, but sees that it does not fit her properly because some aspects of it are overly fitted to your body alone. This situation is akin to what happens when a statistical model is overly fitted to a specific set of data and is subsequently less able to predict another comparable set of data. By contrast, if you had chosen simply to buy an off-the-rack dress according to your size and weight, your friend might have been luckier: because of its less specific parameters, the dress would have been more likely to fit your friend as well. This analogy describes why a model that uses less information is more likely to generalise to comparable yet new data.

Like several other decision-related tasks in medicine, predicting heart attacks is far from error-free and no one case is 100% identical to another. In the original sample of several thousand New England patients on which it was validated,[16] the HDPI may well have provided a better fit than a fast and frugal tree. Yet, assuming that the predictive instrument is indeed an excellent tool for diagnosing patients in New England, it does not necessarily follow that it will perform equally well in Seattle, where new groups of patients will deviate in unknown ways from the original sample. In other words, the model that was best in the original population is not guaranteed to be best in these new populations. A fast and frugal heuristic that focuses only on the key variables is thus likely to be more robust and has a chance of performing better than the system that used more information. A world that is not perfectly predictable therefore requires that we ignore some information, as has been mathematically proven for specific situations.[30,34–36]

However, less information is not always better. Too little information can also be detrimental and eventually leads to under-fitting. In order to avoid both over- and under-fitting, a variety of methods have been developed to help us decide which of several models (e.g. decision-making support tools) has the right degree of complexity.[37] However, people seem to have a good sense of what information is important.[38] Although no general rule determines in advance how much and which information should be ignored, as a rule of thumb one can say that the more uncertain and the more redundant the information, the more of it should be ignored.[39]

THE (UNAPPRECIATED) POWER OF SIMPLICITY

Suppose that you regularly use the fast and frugal tree in Fig. 2 to allocate patients to either a care unit or a regular nursing bed. One of the patients you send to a nursing bed has a heart attack and dies. His relatives ask why the patient was not in the care unit and their lawyer finds out that you checked only two predictors and ignored all other information. The relatives sue you for malpractice. How many doctors are willing to take this risk?

The irony of the situation is that doctors often feel pressured to hide the ways by which they make decisions or to pretend the decisions were made on the basis of something more complicated. Part of this behaviour is rooted in the strong underlying belief that using heuristics will result in biases or in second-best solutions. The virtue of less-is-more is not yet fully understood and appreciated. As a consequence, the quality of treatment can suffer from covert and uneducated use of heuristics. In recent years, medical researchers have begun to see the potential of fast and frugal decision making and to appreciate it as a powerful alternative to the prescriptions of classical decision theory in patient care.[40]

However, any change in methodology must be supported by legal reforms that free doctors from the fear of being punished for doing the best they can for their patients. Effective litigation law would start from the simple insight that less *can* be more and that no medical decision is absolutely certain.[41]

Systematic training of doctors to use rules of thumb would allow them to make empirically sound, quick and transparent diagnostic decisions. McDonald[42] (p 56) emphasised this issue over a decade ago: 'The heuristics of medicine should be discussed, criticised, refined, and then taught. More uniform use of explicit and better heuristics could lead to less practice variation and more efficient medical care.'

Although we cannot present a complete curriculum describing how exactly the science of heuristics should be taught in medical education, what we can do is indicate some important milestones that should be met. Today's medical students should learn and understand that heuristics are neither good nor bad *per se*, but that their reliability and usefulness interplays with environmental circumstances, such as the inherent uncertainty of a specific situation. To broaden students' knowledge of what kind of environmental circumstances can be exploited in what fashion by what heuristic mechanisms seems as crucial as to teach them the building blocks from which heuristics can be constructed and adjusted for other problems or populations. After the basics have been delivered, a clinical teacher might continue, for instance, by introducing students to the various methods of constructing fast and frugal trees. In medicine, such trees are usually intended to first reduce misses and then decrease false alarms. This asymmetry will be reflected in the construction rules, which are aimed at achieving a large number of correct hits (e.g. correct assignments to coronary care units) at the first decisional level. For instance, one possible rule is to rank available information (e.g. chest pain) by sensitivity and to start the tree with the most sensitive piece of information. Practical units, where medical students can try out the success of different rules for self-chosen medical questions, will help to deepen students' understanding of heuristic tools and might even inspire novel research in the field of medical decision-making support tools.

As Green reported (personal conversation), doctors at the Michigan Hospital still enjoy using the fast and frugal tree, more than a decade after its use was initiated. Truly efficient health care requires that we master the complementary arts of focusing on what is important and discarding what can simply be ignored.

Contributors: all authors contributed equally to the study design, data collection, analysis and interpretation. All authors contributed to the write-up and critical revision of the paper and approved the final manuscript.
Acknowledgements: none.
Funding: none.
Conflicts of interest: none.
Ethical approval: not applicable.

REFERENCES

1 Heller RF, Saltzstein HD, Caspe W. Heuristics in medical and non-medical decision making. *Q J Exp Psychol* 1992;**44A** (2):221–35.
2 Dawson NV, Arkes HR, Siciliano C, Blinkhorn R, Lakshmanan M, Petrelli M. Hindsight bias: an impediment to accurate probability estimation in clinicopathologic conferences. *Med Decis Making* 1988;**8**:259–64.
3 Tversky A, Kahneman D. Judgement under uncertainty: heuristics and biases. *Science* 1974;**185**:1124–31.
4 Kahneman D, Tversky A. Subjective probability: a judgement of representativeness. *Cognit Psychol* 1972;**3**:430–54.
5 Tversky A, Kahneman D. Availability: a heuristic for judging frequency and probability. *Cognit Psychol* 1973;**5**:207–32.
6 Bornstein BH, Emler AC. Rationality in medical decision making: a review of the literature on doctors' decision-making biases. *J Eval Clin Pract* 2001;**7** (2):97–107.
7 Klein JG. Five pitfalls in decisions about diagnosis and prescribing. *BMJ* 2005;**330**:781–3.
8 Detmer DE, Fryback DG, Gassner K. Heuristics and biases in medical decision making. *J Med Educ* 1978;**53**:682–3.
9 Elstein AS. Heuristics and biases: selected errors in clinical reasoning. *Acad Med* 1999;**74**:791–4.
10 DeMiguel V, Garlappi L, Uppal R. Optimal versus naive diversification: how inefficient is the 1/N portfolio

strategy? *Rev Financ Stud* 2009;in press, doi:10.1093/rfs/hhm1075.

11 Brighton H. Robust inference with simple cognitive models. In: Lebiere C, Wray R, eds. *Between a Rock and a Hard Place: Cognitive Science Principles meet AI-Hard Problems.* Association for the Advancement of Artificial Intelligence Spring Symposium; Technical Report SS-06-03. Menlo Park, CA: AAAI Press 2006;17–22.

12 Brighton H, Gigerenzer G. Bayesian brains and cognitive mechanisms: harmony or dissonance? In: Chater N, Oaksford M, eds. *The Probabilistic Mind: Prospects for Bayesian Cognitive Science.* New York, NY: Oxford University Press 2008;189–208.

13 Czerlinski J, Gigerenzer G, Goldstein DG. How good are simple heuristics? In: Gigerenzer G, Todd PM, ABC Research Group, eds. *Simple Heuristics that Make us Smart.* New York, NY: Oxford University Press 1999;97–118.

14 Reyna VF, Lloyd FJ. Physician decision making and cardiac risk: effects of knowledge, risk perception, risk tolerance, and fuzzy processing. *J Exp Psychol Appl* 2006;**12** (3):179–95.

15 Green LA, Mehr DR. What alters physicians' decisions to admit to the coronary care unit? *J Fam Pract* 1997;**45**:219–26.

16 Pozen MW, D'Agostino RB, Selker HP, Sytkowski PA, Hood WB. A predictive instrument to improve coronary-care-unit admission practices in acute ischaemic heart disease. *N Engl J Med* 1984;**310**:1273–8.

17 Corey GA, Merenstein JH. Applying the acute ischaemic heart disease predictive instrument. *J Fam Pract* 1987;**25**:127–33.

18 Pearson SD, Goldman L, Garcia TB, Cook EF, Lee TH. Physician response to a prediction rule for the triage of emergency department patients with chest pain. *J Gen Intern Med* 1994;**9**:241–7.

19 Martignon L, Katsikopoulos KV, Woike JK. Categorisation with limited resources: a family of simple heuristics. *J Math Psychol* 2008;**52**:352–61.

20 Fischer JE, Steiner F, Zucol F, Berger C, Martignon L, Bossart W, Altwegg M, Nadal D. Use of simple heuristics to target macrolide prescription in children with community-acquired pneumonia. *Arch Pediatr Adolesc Med* 2002;**156**:1005–8.

21 Martin JM, Green M, Barbadora KA, Wald ER. Erythromycin-resistant group A streptococci in schoolchildren in Pittsburgh. *N Engl J Med* 2002;**346**:1200–6.

22 Katsikopoulos KV, Pachur T, Machery E, Wallin A. From Meehl to fast and frugal heuristics (and back): new insights into how to bridge the clinical–actuarial divide. *Theory Psychol* 2008;**18** (4):443–64.

23 Hertwig R, Todd PM. More is not always better: the benefits of cognitive limits. In: Hardman D, Macchi L. *The Psychology of Reasoning and Decision Making: a Handbook.* Chichester: Wiley 2003:213–31.

24 Gaissmaier W, Schooler LJ, Mata R. An ecological perspective to cognitive limits: modelling environment–mind interactions with ACT-R. *Judgment Decis Making* 2008;**3**:278–91.

25 Elman JL. Learning and development in neural networks: the importance of starting small. *Cognition* 1993;**48**:71–99.

26 Luria AR. *The Mind of a Mnemonist.* Cambridge, MA: Harvard University Press 1968.

27 Bookstaber R, Langsam J. On the optimality of coarse behaviour rules. *J Theor Biol* 1985;**116**:161–93.

28 Pitt MA, Myung IJ, Zhang S. Toward a method of selecting among computational models of cognition. *Psychol Rev* 2002;**109**:472–91.

29 Gigerenzer G, Todd PM, ABC Research Group. *Simple Heuristics that Make us Smart.* New York, NY: Oxford University Press 1999.

30 Brighton H, Gigerenzer G. How heuristics exploit uncertainty. In: Todd PM, Gigerenzer G, ABC Research Group, eds. *Ecological Rationality: Intelligence in the World.* New York, NY: Oxford University Press. In press.

31 Shanteau J. How much information does an expert use? Is it relevant? *Acta Psychol* 1992;**81**:75–86.

32 Beilock SL, Carr TH, MacMahon C, Starkes JL. When paying attention becomes counterproductive: impact of divided versus skill-focused attention on novice and experienced performance of sensorimotor skills. *J Exp Psychol Appl* 2002;**8**:6–16.

33 Johnson JG, Raab M. Take the first: option generation and resulting choices. *Organ Behav Hum Decis Process* 2003;**91**:215–29.

34 Akaike H. Information theory and an extension of the maximum likelihood principle. In: Petrov BN, Csáki F, eds. *Second International Symposium on Information Theory.* Budapest: Akedemiai Kiado 1973;267–81.

35 Foster M, Sober E. How to tell when simpler, more unified, or less ad hoc theories will provide more accurate predictions. *Br J Philos Sci* 1994;**45**:1–35.

36 Geman SE, Bienenstock E, Doursat R. Neural networks and the bias/variance dilemma. *Neural Comput* 1992;**4**:1–58.

37 Marewski JN, Olsson H. Beyond the null ritual: formal modelling of psychological processes. *J Psychol* 2009;**217**:49–60.

38 Pachur T, Bröder A, Marewski J. The recognition heuristic in memory-based inference: is recognition a non-compensatory cue? *J Behav Decis Making* 2008;**21**:183–210.

39 Dieckmann A, Rieskamp J. The influence of information redundancy on probabilistic inferences. *Mem Cognit* 2007;**35**:1801–13.

40 Elwyn GJ, Edwards A, Eccles M, Rovner D. Decision analysis in patient care. *Lancet* 2001;**358**:571–4.

41 Engel C, Gigerenzer G. Law and heuristics: an interdisciplinary venture. In: Gigerenzer G, Engel C, eds. *Heuristics and the Law.* Cambridge, MA: MIT Press 2006;1–16.

42 McDonald C. Medical heuristics: the silent adjudicators of clinical practice. *Ann Intern Med* 1996;**124**:56–62.

Received 30 October 2008; editorial comments to authors 17 November 2008, 8 January 2009; accepted for publication 5 February 2009

Clinical Simulation in Nursing (2014) 10, e65-e69

Clinical Simulation in Nursing

www.elsevier.com/locate/ecsn

Featured Article

Applying Social Learning Theory to the Observer Role in Simulation

Melody L. Bethards, MSN, RN, CNE, CHSE*

Des Moines Area Community College, 2006 South Ankeny Boulevard, Ankeny, Iowa 50023, USA

KEYWORDS
observational learning;
social learning theory;
observer role;
observation worksheet;
Bandura

Abstract: Students are often assigned to the role of observer during simulation experiences. Educators may struggle with the best way to provide learning experiences for students participating in this role. This article describes how one Midwest community college utilizes the component processes of Bandura's observational learning as a foundation to design simulation experiences around the observer role. Utilizing the component processes of attention, retention, motivation, and motor reproduction to design simulation experiences provides all participants, regardless of the role, the same opportunities to achieve scenario learning objectives. Short videos illustrating these concepts are included and examples of activities for each component of observational learning are provided. Recommendations for future research related to the role of observer are shared.

Cite this article:
Bethards, M. L. (2014, February). Applying social learning theory to the observer role in simulation. *Clinical Simulation in Nursing, 10*(2), e65-e69. http://dx.doi.org/10.1016/j.ecns.2013.08.002.

Students are often assigned to the role of observer during simulation experiences. Simulation design may limit opportunities for learning in this role. This article describes the use of the observational learning construct of social learning theory as the foundation for designing learning experiences for students participating in the observer role.

Social Learning Theory

Social learning theory focuses on learning that occurs within a social context and how people learn from one another. Bandura (1977) focused his early work on the construct of observational learning in which the learner observes a live or symbolic model then duplicates a process, strategy, task, or skill demonstrated by the model. Bandura proposed that observational learning involves four component processes: (1) attention, (2) retention, (3) motor reproduction, and (4) motivation.

Attention Processes

Attention processes determine what features of the modeled behaviors the learner will focus on. ‘‘People cannot learn much by observing unless they attend to, and perceive accurately the significant features of the modeled behavior’’ (Bandura, 1977, p. 24). In other words, the learner must have his or her attention directed toward the modeled behaviors in order to learn from them.

Retention Processes

Retention processes help the observer to imprint the observed behaviors to memory in symbolic form.

* Corresponding author: mlbethards@dmacc.edu (M. L. Bethards).

1876-1399/$ - see front matter © 2014 International Nursing Association for Clinical Simulation and Learning. Published by Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.ecns.2013.08.002

Bandura (1977) proposed that learners use mainly imaginal and verbal systems to remember the modeled behaviors. When using imaginal systems, the learner envisions performing the modeled behavior at a later time or in a different situation. Learners use the verbal system when given the opportunity to discuss what they observed. Verbal discussions also provide opportunities for the observer to compare their judgment with the judgment of others and to distinguish accurate from inaccurate thinking.

Key Points

- The observational learning construct of social learning theory can be used as the foundation for designing learning experiences for students participating in the observer role.
- To promote the application of attention processes to specific modeled behaviors, students in the observer role are provided with a faculty-developed worksheet listing concepts linked to the scenario objectives.
- Regardless of their role, students indicate similar responses related to achievement of scenario objectives and satisfaction with the simulation experience on faculty developed post simulation evaluations.

Motor Reproduction Processes

Bandura (1977) identified four required phases of enactment in order for the modeled behavior to be reproduced: (1) Cognitive organization, (2) initiation, (3) monitoring, and (4) refinement based on feedback. According to Bandura, learners must first cognitively organize constituent elements of the modeled behavior. Once the learner has organized the elements of the modeled behavior, new patterns of behavior can be initiated. Monitoring by other observers and subsequent feedback help to refine and eventually reproduce the desired behavior. Observations cannot be correctly reproduced without providing opportunities for the learner to implement all four phases of enactment.

Motivation

Bandura (1977) noted that learners are more likely to adopt modeled behaviors if they are motivated by intrinsic or extrinsic factors. Intrinsic motivation comes from inside an individual rather than from any external source. Extrinsic motivation refers to factors that are external such as the promise of a reward or the threat of punishment.

The Observer Role in Simulation

Students participating in simulation scenarios are often assigned to 2 types of roles: Process-based roles and response-based roles (Jeffries & Rogers, 2007). Students participating in process-based roles, such as nurse or team leader, have decision-making ability during the scenario and are actively engaged with the simulated patient. Students participating in response-based roles, such as observer, are not actively engaged with the simulated patient. Process-based roles are usually assigned first with remaining learners then assigned to response-based roles. Challenges can exist when students participate in the response-based role of observer. Students may be inactive observers and inattentive to scenario events. Video 1 shows an example of inactive observers viewing from a remote location. Conversely, students may become overactive observers and intervene during the scenario. Video 2 shows an example of a student who becomes an overactive observer during a scenario. In addition to the behavioral challenges that exist when students participate as observers, the perception that response-based roles are less valuable than process-based roles may decrease faculty and student investment in the experience. Harder, Ross, and Paul (2013) conducted an ethnographic study of student perspectives of the roles they were assigned during simulation. Students in the study perceived the role of the observer as passive and most preferred not to be assigned to this role. The authors conclude the article by recommending that instructors should limit the number of students assigned to observer roles.

Challenges aside, there is evidence that participation in the observer role can provide some of the same learning opportunities as participation in process-based roles. Jeffries and Rizzolo (2006) conducted a multisite, multimethod study exploring the use of simulation in nursing education. The authors found that, regardless of the role the student assumed during the simulation, there were no differences among the students in knowledge gained, satisfaction with the experience, or self-confidence. The authors concluded that role assignment does not affect overall student learning outcomes. Ertmer et al. (2010) conducted a cross-case comparison design study comparing critical thinking characteristics of students participating in process-based roles to those of students participating in response-based roles. The researchers discovered that all roles displayed instances of reflection, contextual perspective, and logical reasoning. The authors identified that the response-based role may be more useful in helping the students appreciate the "big picture" view of the scenario. Kaplan, Abraham, and Gary (2012) also compared the learning experience of students participating in the observer role with students participating in the process-based roles. Three weeks after the simulation experience, both groups of students answered 10 test items within a course examination on the topic of the scenario. The researchers found no difference ($p = .97$) in the scores on the 10 test items between students who participated in the process-based role and students who participated as observers.

Applying Social Learning Theory to the Observer Role in Simulation

Traditional simulation experiences are designed around providing opportunities for learners participating in process-based roles to achieve the scenario learning objectives. At a Midwest community college, simulation experiences are designed around the observer role using the four component processes of Bandura's observational learning construct. Designing opportunities for attention, retention, motor reproduction, and motivation processes helps to ensure that all students participating in the simulation experience, regardless of their role, have the same opportunities to achieve the scenario learning objectives (Table).

Attention

To promote the application of attention processes to specific modeled behaviors, students in the observer role are provided with a faculty-developed worksheet listing concepts linked to the scenario objectives. The worksheet emphasizes concepts, not specific tasks, to help students see the big picture of the modeling behaviors and encourage critical thinking. A worksheet template with column headers that emphasize effective implementation and provide an opportunity for observers to indicate questions for discussion during debriefing is utilized (Figure). Faculty determined concepts are included on the worksheet based on the academic level of the learner and the scenario learning objectives. Basic concepts such as assessment, medication administration, procedures, safety, infection control, communication, and teamwork may be included on the worksheet for beginning students. Concepts such as the steps of the nursing process, therapeutic communication, intravenous medication administration, and SBAR (Situation, Background, Assessment, Recommendation) communication may be found on the worksheet for more advanced students. Other concepts that may be utilized on observer worksheets include program objectives, course objectives, test plan categories, and patient safety goals.

Other suggestions for observer worksheets can be found in the literature. Zottmann, Dieckmann, Rall, and Taraszow (2006) conducted a study utilizing collaborative scripts focusing on Crisis Resource Management key points and skills for observers. The study revealed that the observers made more notes, felt more active, and exchanged more information regarding Crisis Resource Management during debriefing than the control group who used blank

Table Suggestions for Applying the Four Components of Bandura's Observational Learning to the Observer Role

Component of Bandura's Observational Learning	Application to the Observer Role
Attention processes	Provide worksheets/guidelines for observers to "attend to" modeling behaviors
	Emphasize concepts not specific tasks
	Assign different concepts to each observer
	Encourage critical thinking
	Link concepts to scenario objectives
	Possible concepts for observer worksheets
	General concepts (i.e. safety, communication, teamwork)
	Nursing process
	Program objectives
	Course objectives
	Test plan categories
	Patient safety goals
	Quality and Safety in Nursing competencies
	Crisis Resource Management key points and skills
Retention	Provide opportunities for observers to symbolically rehearse the modeled behaviors and verify thought processes during debriefing.
	Verbally debrief immediately after the scenario
	Utilize observer guidelines/worksheets to lead discussion
	Facilitate observer involvement in the discussion through learner lead debriefing
Motor reproduction	Provide opportunities for observers to reproduce the modeled behaviors
	Rotate students into process-based roles in subsequent scenarios.
	Ensure that scenarios have the same basic behavioral skills
	Encourage informative feedback during debriefing
Motivation	Emphasize the importance of the observer role
	Provide a clear description of expectations and responsibilities

Observation Worksheet

While observing the simulation, make notes about how the team implemented the following concepts during the scenario. Be prepared to lead the debriefing discussion.

Team Members: ______________________ ______________________

______________________ ______________________

Concept	Examples of Effective Implementation	Suggestions/Question for the Team

Figure Observation worksheet.

pages to document observations. Schaar, Ostendorf, and Kinner (2013) incorporated the 2012 Quality and Safety in Nursing competences of safety, patient-centered care, teamwork and collaboration, informatics, evidence-based practice, and quality improvement into the worksheet used by observers. The worksheet was then used as a guide during debriefing.

Retention

Retention processes are applied by providing students in the observer role the opportunity to symbolically rehearse the modeled behaviors and verify their thought processes during debriefing. Students in the observer role lead debriefing discussion using the concepts on the observer worksheets as a guide. Faculty are present during the debriefing to facilitate discussion and clarify any misconceptions. Video 3 shows an example of observer lead debriefing.

Motor Reproduction

Motor reproduction processes are applied by ensuring that students participating in the observer role have the opportunity to participate in process-based roles during subsequent scenarios. Opportunities for students to replicate modeled behaviors is provided by ensuring all simulation scenarios have the same basic skills, such as focused assessment, therapeutic communication, medication administration, and SBAR report. To provide opportunities for students to refine their behaviors through informative feedback, faculty facilitate discussion related to how observed behavior may have influenced a student's decision making when participating in a process-based role.

Additional benefits of having observers participate in a process-based role can be found in the literature. Ertmer et al. (2010) noted that allowing students to switch roles may provide important opportunities for them to assume different perspectives as well as utilize additional kinds of critical thinking skills. Participants in an ethnographic study of student perspectives of the roles they were assigned noted that they could more easily switch from the observer role to the nursing role when needed (Harder et al., 2013).

Motivation

In an attempt to apply intrinsic motivation, the value and importance of the observer role is emphasized. Students are assigned to the observer role first followed by the process-based roles. The role of observer is always assigned regardless of the size of the group. To apply extrinsic motivation, a clear description of the responsibilities of the observer role, including expectation of leading the discussion during debriefing, is shared with students during orientation to the simulation experience. Students in the observer role are evaluated by faculty on their participation during the debriefing discussion.

Implications for Future Research

By designing simulation experiences around the observer role using the four component processes of Bandura's observational learning construct, common challenges with the observer role have been practically eliminated at the college. Students engage in observing all aspects of the simulation scenario and actively participate in discussions during debriefing. Regardless of the role, students indicate similar responses related to achievement of scenario objectives and satisfaction with the simulation experience on faculty developed post simulation evaluations. More research is needed on the role of the observer in simulation. Opportunities for future research include examining the benefits of different observer worksheets, using Bandura's observational learning construct as a foundation for the observer role, and verifying motor reproduction based on observations during a simulation scenario.

References

Bandura, A. (1977). *Social learning theory.* Upper Saddle, NJ: Prentice-Hall.

Ertmer, P. A., Strobel, J., Cheng, X., Chen, X., Kim, H., Olesova, L., … Tomory, A. (2010). Expressions of critical thinking in role-playing simulation: Comparisons across roles. *Journal of Computers in Higher Education*, *22*, 73-94. http://dx.doi.org/10.10007/s12528-10-9030-7.

Harder, N., Ross, C. J. M., & Paul, P. (2013, September). Student perspective of roles assignment in high-fidelity simulation: An ethnographic study. *Clinical Simulation in Nursing*, *9*(9), e329-e334. http://dx.doi.org/10.1016/j.ecns.2012.09.003.

Jeffries, P. R., & Rizzolo, M. A. (2006). Designing and implementing models for innovative use of simulation to teach nursing care of ill adults and children: A national, multi-site, multi-method study. Retrieved from National League for Nursing website: http://www.nln.org/researchgrants/LaerdalReport.pdf.

Jeffries, P. R., & Rogers, K. J. (2007). Theoretical framework for simulation design. In P. R. Jeffries (Ed.), *Simulation in nursing education* (pp. 21-33). New York: National League for Nursing.

Kaplan, B. G., Abraham, C., & Gary, R. (2012). Effects of participation vs. observation of a simulation experience on testing outcomes: Implications for logistical planning for a school of nursing. *International Journal of Nursing Educational Scholarship*, *9*(1), 1-15. http://dx.doi.org/10.1515/1548-92X.14.

Schaar, G. L., Ostendorf, M. J., & Kinner, T. J. (2013, September). Simulation: Linking quality and safety education for nurses Competencies to the Observer Role. *Clinical Simulation in Nursing*, *9*(9), e401-e404. http://dx.doi.org/10.1016/j.ecns.2012.07.209.

Zottmann, J., Dieckmann, P., Rall, M., & Taraszow, T. (2006). Fostering simulation-based learning in medical education with collaboration scripts [Abstract]. *Simulation in Healthcare*, *1*(3), 193. http://dx.doi.org/10.1097/01266021-200600130-00055.

Glavin *Advances in Simulation* (2016) 1:7
DOI 10.1186/s41077-016-0007-0

Advances in Simulation

COMMENTARY Open Access

Lessons for simulation-based education from social psychology

Ronnie J. Glavin

Abstract

Effective practice is informed by underlying theoretical models. Better awareness and understanding of such models can enhance reflection by practitioners on their current educational activities and so help drive the cycle of continuing improvement. In this article the author reflects on *three ways* in which a better understanding of social psychology gave insights into why some practices appeared to be more effective than others and some ways in which future practice could be altered. Social psychology places great emphasis on the importance of the situation in which people find themselves an how this impacts on their subsequent behaviour. The *three* areas specifically addressed in the article include factors which motivate and drive human activities, especially the importance of self-esteem. Secondly, the relevance of the fundamental attribution error, which looks at our tendency as humans to ascribe personal attributes as the cause of the behaviour of others rather than the influence of external events. The third area to be explored is the role of acquiring scripts or heuristics that can broaden the range of activities than can be performed at a subconscious or intuitive level. *For each concept, the author has included a brief illustration of its application to the practice of a simulation educator.*

Keywords: Social psychology, Educational theory, Reflection

"Observations always involve theory" – Edwin Hubble

"Experience without theory is blind, but theory without experience is mere intellectual play"
– Immanuel Kant
"Nothing is more practical that a good theory"
– Kurt Lewin

Introduction

In this article I would like to explore the ways in which some concepts from social psychology have helped me develop my roles as a teacher in both clinical and simulation-based education. [1]

All of us who practice in simulation-based education of health care professionals utilise theories that guide and inform our behaviour, even if we are not always conscious of their nature or even their existence. The importance of such theories lies in their ability to provide a framework on which we can reflect, especially when our teaching has not gone well and we seek improvement for future practice. Of course, our theoretical models should be in a state of continual development and refinement, especially when we find that they do not adequately explain the phenomena that we observe in our educational practice.

I shall say a little about social psychology as a field of study and then explore the following three concepts: firstly, self esteem; secondly the Fundamental Attribution Error (FAE) and finally scripts and heuristics. However, I shall begin with a brief review of how I came into the world of simulation based education and some of the theories that I have employed.

Background

I began my medical career in 1978 and throughout my anaesthetic training became increasingly interested in medical education. While working as a consultant anaesthetist I graduated as a Master of Philosophy in Educational Studies in 1993. My dissertation looked at the development of educational material that could help promote the values linked to patient safety within the UK anaesthetic training framework. In 1997 I was appointed as an

Correspondence: ronniejglavin@gmail.com
Scottish Centre for Simulation and Clinical Human Factors, Forth Valley Royal Hospital, Stirling Road, Larbert FK5 4WR, UK

Educational Co-Director to the Scottish Clinical Simulation Centre, which became active in early 1998. At this time the centre began a long and successful collaboration with Professor Flin of the Department of Industrial Psychology of the University of Aberdeen. My interest in psychology had been kindled during my M.Phil course and now, with more direct access to the world of industrial psychology I continued to read around psychology but in a relatively unstructured fashion.

A quotation from John Ruskin encapsulates my basic approach to the education of healthcare professionals [1] in general.

> "Education is not about teaching people to know what they do not know:
>
> It is teaching them to behave as they do not behave". I find this quote helpful because it places due emphasis on the role of values, key to the role of professionals in the workplace. My thesis supervisor expressed it in this way "Knowledge and skills give us abilities, but it is our value system that most influences when and how we choose to use those abilities."

As educators we want to help learners choose to change how they behave and so some understanding of how we can encourage people to adopt some values while rejecting others is helpful. I used the methods described in David Krathwohl's account of the Affective Domain of the Taxonomy of Educational Objectives [2]. Krathwohl describes a series of external and internal factors that influence the values which humans can adopt. The most basic factors are the potential impact of external reward or punishment. This is followed by a desire to conform to the group of whose membership we aspire. The third stage is where we accept the value for its intrinsic benefit and the fourth stage relates to how the particular value being promoted fits into the hierarchy of all of the values that any one individual holds. I found that I could make more sense of this scheme by considering the motivators or drivers that have an impact on human behaviour; upon which I shall now elaborate.

Motivators in education

A very simple linear narrative of psychology and motives could begin with Freud thinking about how various subconscious desires influenced our behaviours, and how our brains kept these in some sort of balance to allow humans to function in co-operative society; the relative roles of the id, the ego and the superego. These motives or drives were thought of as internal [3]. The next group to formally study drives were the Behaviourists [3], who wanted to take a more objective, positivistic approach to the response of organisms to stimuli. Luminaries of this group, such as B.F. Skinner, viewed the brain as a 'black box' that could not be examined directly. However, by presenting animals with stimuli, positive or negative, one could study such factors as the strength or duration or frequency of stimuli on the response of the test subjects. That response could be measured in terms of how quickly it was achieved, how quickly it dissipated and the impact of subsequent reinforcement of the initial stimulus. The behaviourists relied on some internal driver, such as hunger, to provide a motive for their subjects: hungry rats would be encouraged to find a route through a maze to locate a piece of food. They did not deny the existence of internal motives, the held the view that proper scientific study of the workings of the 'black box' was not possible at that time.

The next psychologist I wish to consider is Abraham Maslow [3]. Most of us who have undergone formal educational courses are familiar with Maslow's need hierarchy (Fig 1) [3]. Maslow did not conduct the research required to validate the hierarchy and although others, such as Deci [4], have done more work on this field I find that Maslow's hierarchy has provided a model that has helped me make sense of professional development. The top level – self actualisation – surely fits in with the notion that professionals have about themselves. Their sense of who they are, including their sense of worth, is linked to their professional role. I can think of many doctors and nurses who have relinquished meal breaks (bottom level) because of urgent clinical demands. Level 4 – approval and recognition – is consistent with the notion of learners seeking to join a community of professionals. I also believed that professionals use their experience to seek to improve their performance and in this I was influenced by the writings of Jarvis [5], Knowles [6] and Kolb [7]. I also believe that reflection is facilitated when practitioners share a common vocabulary that applies to the area under study. If discussing novels with a friend I may refer to characterisation, plot, dialogue, mood and so on. In 2012 I undertook formal teaching in Social Psychology.

Social psychology – what is it?

A simple definition of psychology is 'the scientific study of behaviour and the mind' the term 'mind' can be substituted by the term 'mental processes' [3]. Social psychology is defined as 'the scientific investigation of how the thoughts, feelings and behaviours of individuals are influenced by the actual, imagined or implied presence of others' [8]. I would like to illustrate this definition by describing a famous experiment – The Good Samaritan Study [9]. In this study students at a New England seminary were allocated into two groups. Group A were asked to give a short talk on life in a seminary, while those in

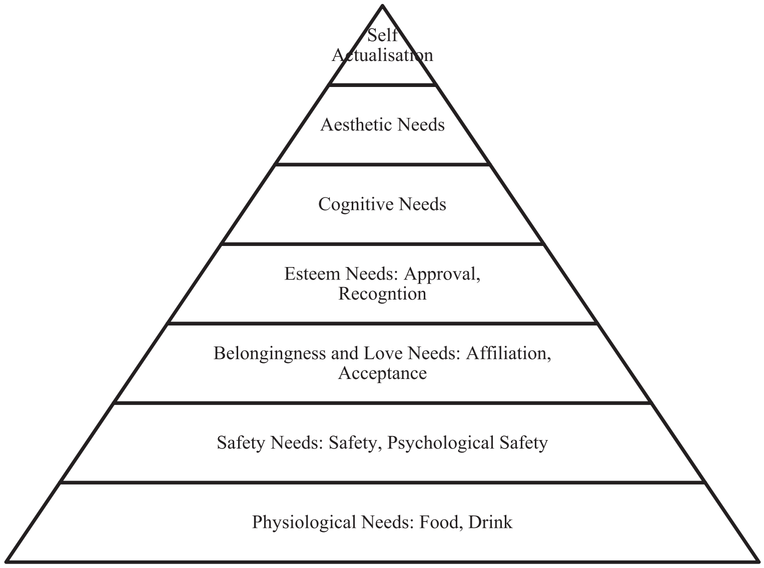

Fig. 1 Maslow's Needs Hierarchy [3]

Group B were asked to give an account of the parable of the Good Samaritan. Half of each group were informed that they were running late and should hurry over to the lecture theatre; the other half was informed that they had some time but should go over early to ensure that everything was prepared. During the walk to the lecture theatre each student encountered a confederate of the investigators simulating a medical emergency. The investigators measured a number of variables for each group but found that the factor that had most impact on the behaviour of the students in terms of whether they would offer assistance or not was the perception of being early or late. Only ten per cent of the 'late' group offered assistance whereas over sixty per cent of the 'early' group offered assistance. This study, and others of a similar nature suggest that the situation a person perceives them self to be in has a much greater impact on their behaviour than other predisposing factors, such as knowledge, personality attributes etc. Social psychology studies how external factors can interact with an individual's internal drivers. I would like to explore three concepts in further detail: self esteem, the fundamental attribution error and scripts and heuristics. *I have chosen these three because they had the biggest impact on changes that I made to my own practice and because they helped me to explain some of my actions to other simulation centre faculty members.* I shall begin with self esteem.

Self-esteem

Self esteem can be thought of as our sense of self worth and in the educational realm can be thought of in terms of a 'need for competence' [4]. One could speculate that the seminary students wanted to be regarded positively; *for those in the 'late' group the thought of being even later for the lecture could clash with that sense of positive regard. Maslow's hierarchy refers to self-esteem in level 4 but I argue that in the context of professionals their identification of self with the professional role is also consistent with self-actualisation. Indeed, it is some of the limitations of my use of Maslow's hierarchy in my practice that encouraged me to adopt other theoretical models. In the early days of simulation based education experiences a recurring scenario played out. Individuals holding important educational posts in Scottish Anaesthesia would ask if they could attend and observe. This was always accompanied by the phrase "you won't make me do a scenario, will you?" I asked why and came to realise that the threat to their sense of professional status was so great that they were not prepared to put it to the test.* Experienced professionals who do undertake scenario based education may change their behaviour to minimise this risk to their need for competence. They may play the game of 'spotting' the scenario, they may blame external factors; "It didn't look real", "It didn't behave the way it should have". We have all heard these comments, especially if things have not worked out so well during the scenario. So this is a very real concept and one of the approaches I found helpful came from reading Carol Dweck's work on positive psychology [10]. Dweck describes a study in which primary school age children were given a problem in mathematics to solve. Some of the group were told that they were very good at mathematics and had above average mathematical ability. Other members of the group were told that they were very hard working and had above average levels of persistence. When the group were presented with further problems those in the 'above average mathematical ability' group were more reluctant to tackle them than those from the 'above average persistence' group. Dweck argued that the 'above average mathematical group' had more to lose because if they didn't solve the problems then their self esteem as better mathematicians would be challenged. The more persistent group had nothing to lose because failure to solve the problem would not negate their self-esteem. Dweck refers to the 'above average at maths' mindset as a fixed mindset in contrast to the 'above average at persistence' mindset as a growth mindset. What Dweck did was to reframe the mindset from a fixed one to a growth one and I found this concept very helpful when dealing with experienced professionals in scenario based simulation. I explored some notions of professionalism with the group during the introduction session and from the discussion made the explicit statement that professionalism includes the desire to improve one's professional performances (consistent with self-actualisation) and this means being able to learn from one's performance. The focus of the course moves from concentrating on individual performance, without ignoring that component, to thinking about strategies that may work in future clinical encounters. This is explored further in the Vignette in Additional file 1.

I am old enough to have experienced teaching by humiliation as a medical student and when I reflect upon the strategies that I and my colleagues adopted to avoid the threats to our self-esteem I can only think that such behaviours (say nothing, make up facts, not turn up) were not ones that would promote a good educational environment. Self-esteem deals with how the individual perceives his or her standing or competence. The next area looks at how others may judge an individual. This takes us onto the Fundamental Attribution Error.

Fundamental Attribution Error

The next area I want to explore is the Fundamental Attribution Error [8] (FAE). I shall illustrate with a fictitious example. Let us imagine that Person A is spending the first day in a new healthcare job. This job is similar to one previously held by that person in a different location. At a break Person A's new colleagues ask the individual to join them for lunch. After a few minutes Person A does join the others. During the meal Person A neither joins readily in conversation nor appears to following those topics of conversation discussed by the others. Person A leaves the lunch table ten minutes before the others without comment. The new colleagues agree that Person A appears to be aloof and unfriendly, almost to the point of being antisocial. However, another colleague who had met Person A previously, expresses surprise and states that such behaviour was not typical from previous encounters. Indeed, Person A was lively, attentive and very popular with colleagues. How might we explain this discrepancy? This colleague talks to Person A and discovers that Person A was up most of the night with a sick child, who required hospital admission but is now in a stable condition. Person A chose to come to work because it was the first day and Person A's spouse could be present in hospital with the child. On the way to work Person A was also involved in a minor road traffic accident, resulting in no personal harm but a future garage repair bill is likely. So which is the real Person A? Is person A the quiet, aloof, retiring individual or the lively, friendly and attentive individual? What is different? Well the circumstances are different and when we learn of Person A's predicament we are much more likely to be understanding of Person A's behaviour at lunch time. So the FAE consists of attributing behaviour to personal predispositions, such as personality factors, rather than attributing the circumstances in which an individual finds them self. As we have seen previously social psychology suggests that the circumstances, the situation, has a much more important bearing on behaviour than the personal characteristics of the individual.

How does this the FAE fit in with my notion of motives? My working model is that we have drivers, such as the need to preserve self-esteem. Social psychologists argue that some aspects of the social situation will activate some of these drivers. However, they operate at a level that is normally inaccessible to our conscious thought processes. By way of contrast we are aware of differences in people and easily (if not always accurately) ascribe personality types to individuals we do not know well, even if we have barely met the person. Evolutionary psychologists [11] hypothesise that when our human ancestors encountered strangers they had to quickly decide whether they were hostile or not and failure to identify hostile individuals could have negative consequences for that individual's ability to contribute to the gene pool.

For part of my professional life I was responsible for the development and running of courses for doctors in Scotland who had to carry out clinical and educational supervision roles. I was impressed by how often the FAE came up and how readily senior clinicians attributed behaviours of their trainees to personal failings - *"that doctor is lazy"; "that doctor is a troublemaker"; "that doctor is not very bright" and so on.* So what can we do about the FAE in simulation based education? The first and most important point is to be aware of it. As simulation centre faculty will be judging the participants on our courses on first acquaintance; that is what we do as humans. What we must not do is ascribe their behaviours during the scenario to personality or cultural factors without exploring the impact of their perceptions of what was happening in the scenario. Behaviour is more likely to be due to the circumstances occurring during the course and the scenario than due to personal or cultural characteristics. In other words, the situation is more likely to elicit a response from deeper drivers than from more superficial influences such as personality characteristics. If we as facilitators think that the behaviour of a candidate was strange or abnormal then rather than label them instantly as having a 'defective personality combination' we should attempt to find out more about how that person perceived the circumstances. This approach is consistent with the Advocacy Inquiry method [12]. This is explored further in the Vignette in the Additional file 1. This instant judgement applies equally to our assessment in the work place of trainees that we do not know well. *The notion of making quick judgements doesn't just apply to the personalities of other people. It applies to many aspects of life, especially professional life and this brings me onto the third and final concept of this review – the use of scripts and heuristics.*

Scripts and Heuristics

The final concept I mentioned was the use of Scripts and Heuristics. This is a very big area in medical education just now and follows on the work of Kahneman and Twersky [13]. Heuristics are rules of thumb that we have developed which allow us make better use of our subconscious mind – described as fast thinking. I think of scripts as a subset of heuristics. The key features of a script are firstly that actors know what they are supposed to do and say and secondly that there are cues letting the actors know when they are expected to respond or react. Social Psychologists often use the restaurant script as an example. A typical example may go like this.

> Customer – "we have a table booked for 7 pm under the name of Smith"
>
> Restaurant staff – having checked bookings list
> "Come this way, here are the menus, the waiter will tell you about the specials"
> Front of House Staff – "Can I get you something to drink"
> Customer – "Can I see the wine list?"
> Etc.

The above script may win no prizes for literary merit but it contains those two concepts of firstly, knowing what to expect from the occasion and secondly, how to respond to the actions of the restaurant staff. Two other driving forces – minimising ambiguity and reducing cognitive work load [14] come into play here. We reduce cognitive load by making the process automatic; that is, the pattern and the specifics of the script are transferred from our conscious working memory to our long term memory and can be recalled when appropriate. We reduce ambiguity by remembering how the sequence is supposed to play out. Of course, there are different kinds of restaurants with different patterns of expected behaviour – buffet, self service etc. and so we build up a repertoire of scripts that we can use for these different circumstances and cues will determine which script we call upon to use. Formica tables, plastic tables and cutlery and several queues at a serving counter will evoke one script, smart furniture, linen napery and the presence of a sommelier will evoke an entirely different script but they are still part of the set of restaurant scripts.

I find this model, in which a person builds up a repertoire of scripts related to professional encounters, very helpful because it expands on the Novice to Expert model described by the Dreyfus Brothers [15]. *The Novice to Expert model describes changes that take place in the cognitive processes as a professional moves from being a novice (relying heavily on rules) to becoming an expert (making extensive use of cognition). The relevance of this model to healthcare was described by Benner* [16]. *Interestingly, Social Psychologists argue that the 'fast thinking' associated with scripts and heuristics is also connected with our willingness as humans to ascribe stereotypes to other people and this may be a contributing factor to the Fundamental Attribution Error.*

We can experience something similar in a clinical setting. Let us imagine a medical student with no personal experience of asthma learning the management of someone suffering an acute asthma attack. The student will probably learn guidelines as a basic script but the more patients the student meets and the greater their involvement in the management then the richer the repertoire of scripts for managing a patient with asthma will become. At the most basic level the student learns an algorithm, which can be thought of as set of rules, and like all sets of rules are helpful to learners by reducing ambiguity. However the guidelines only provide one version of a script and it is only through clinical experience that the scripts become richer and the repertoire of scripts builds up. Some interactions will be common to the majority of these scripts – administer high inspired concentration oxygen, give bronchodilators and so on. Different types of clinicians will have acquired different ranges of scripts for the management of patients with acute asthma – family doctors will acquire a lot of experience of managing patients with asthma and their families and carers but may not see so many severe acute attacks; whereas, intensivists will have a lot of experience of patients with very severe attacks of asthma but much less experience of mild attacks.

This model – the development of scripts – can help us in our design of scenarios in simulation based education. At the level of the novice, where rules are dictating the interactions in a very basic script, strong cues may be helpful. If our wish as educators is to help the learners establish a basic script in long term memory then knowing when to intervene may be helpful. Certain models of simulator have features such as LEDs that are intended to represent the blue of cyanotic peripheries or the red dots of an allergic rash. I am conscious that in my own centre we have often exaggerated physiological values to act as cues to bring out a response from the participants. We have made the heart rate is a bit faster than it probably would be, the blood pressure is a bit lower, SpO2 is a bit lower and so on. I have always held concerns that we may be promoting a behaviourist model of conditioning. I think it is less important if learners are exposed to such experiences infrequently but if we wish to reinforce the place of such algorithms in long term memory and choose to delineate the intervention points, the points at which the learner is expected to initiate an action, we may reinforce an inappropriate pattern.

Another model that may help explain my concern is that of signal to noise ratio. What we are attempting to do in our scenarios is to make the signal so loud so that it stands out above the background 'noise' and so becomes less ambiguous. This may be acceptable for novices who are learning a script that is based on rules. However, when we are delivering scenario based courses for more experienced health care professionals then the scripts that we seek to create in our simulated environment may not be faithful to the repertoire of scripts residing in the long term memories of our participants. Such learners are likely to have acquired the ability to discern more subtle signals from the noise. In some cases I suspect that the cues that would activate a particular script in real life may not be able to be recreated in the simulated environment. In some cases this may be down to limitations of the hardware or *even the simulated actors, simulated patients or confederates in the scenario*. These issues by themselves are not new but maybe we have to add 'script fidelity' to our ever burgeoning dimensions of fidelity as yet another factor to consider when developing courses. As a former obstetric anaesthetist there would be subtle signs but important cues from women undergoing caesarean section under regional anaesthesia that a manikin or even a simulated patient would struggle to replicate. I have no simple solutions for this challenge although I have used the limitations of the manikin and simulated environment as a way of setting an agenda for discussion in courses with experienced clinicians. By asking a group what they would expect to observe, and when they would intervene one can help these clinicians explore their own scripts and so reflect upon them.

Our scripts are unique to us because they are built from our own experiences. I think that one of the ways of learning from others is to make aspects of their scripts more explicit and I think that one of the strengths of scenario based simulation is to use the scenario as a way of bringing scripts from long term memory into the working space of short term memory. I wrote earlier that this also has the advantage of moving the focus away from that of the performance of the individual learner in a scenario and putting the focus on the discussion generated from the performance. This helps with the self-esteem of the learner but the script / heuristic model also helps me reflect on why some discussions went particularly well and other did not. The use of the script / heuristic model may help the facilitator concentrate on some of the more salient components of scripts, such as the way in which clinicians anticipate that the course of an event will follow and how and when they would intervene, update their model and so in. I find this especially interesting because it links this model with the cognitive non-technical skills of situation awareness and decision making. I think that simulation-based education can help with continuing professional development and maintenance of competence by helping healthcare professionals learn aspects of practical management from their peers as well as helping individual practitioners reflect upon their own strengths and weaknesses.

I explore this further in the Vignette in Additional file 1.

Summary

The person and the situation summarises the main thrust of what social psychology is all about. We create situations when we create scenarios in our simulation roles. As health care professionals we have considerable ability and opportunity to influence the behaviours of our learners and to help them learn by facilitated reflection of such behaviours. As humans our behaviours are complex because not only do we each vary in sensitivity to those factors that may provoke a pattern of behaviour but the very patterns themselves will be influenced by factors such as cultural conditioning and personality dispositions. This is not intended to be a comprehensive review of social psychology but I hope that I have shown ways in which my own practice has been influenced by my interpretations of the material I studied. I believe that the greater our understanding of these factors then the more useful our own models and theories will become in helping us develop our role as educators and as health care professionals.

Endnotes

[1]The Editor-in-Chief and Senior Editors commissioned this paper because of his expertise in healthcare simulation education and his recent formal studies in social psychology. As Dr Glavin notes, educational practices are underpinned by theories but these are often not made explicit in courses about simulation education. We believe this combination of simulation expertise and recent exploration of social psychology enables identification of concepts relevant for simulation educators.

Additional file

Additional file 1: Vignette. (DOCX 14 kb)

Abbreviations
ANTS: Anaesthetists' non-technical skills; FAE: Fundamental Attribution Error; SpO2: Peripherally measured oxygen saturation.

Competing interests
The author declares that he has no competing interests.

Funding
The author has received no funding towards the writing of this article.

Received: 3 September 2015 Accepted: 24 January 2016
Published online: 23 February 2016

References
1. Rowntree D. Educational Technology in Curriculum Development. London: Paul Chapman Publishing; 1988.
2. Krathwohl DR, Bloom BS, Masia BB. Taxonomy of Educational Objectives; Handbook II: Affective Domain. London: Longman Group; 1956.
3. Holt N, Bremner A, Sutherland E, Vliek MLW, Passer M, Smith RS. Psychology: The Science of Mind and Behaviour. 2nd ed. Berkshire: McGraw Hill Education; 2012.
4. Deci EL, Flaste R. Why we do what we do. New York: Penguin; 1995.
5. Jarvis P. Professional Education. London: Croom Helm; 1983.
6. Knowles M. The Adult Learner: A Neglected Species. 4th ed. Houston: Gulf Publishing; 1990.
7. Kolb D. Experiential Learning. New Jersey: Englewood Cliffs; 1984.
8. Hogg MA, Vaughan GM. Social Psychology. 6th ed. Pearson: Harlow; 2011.
9. Ross L, Nisbett RE. The Person and the Situation: perspectives of Social Psychology. London: McGraw Hill; 2011.
10. Dweck CS. Mindset: The new psychology of success. New York: Random House; 2006.
11. Workman L, Reader W. Evolutionary Psychology: An Introduction. Cambridge: Cambridge University Press; 2004.
12. Rudolph JW, Simon R, Dufresne RL, Raemer DB. There's No Such Thing as "Nonjudgmental" Debriefing: A Theory and Method for Debriefing with Good Judgment. Simul Healthc. 2006;4:49–55.
13. Kahneman D. Thinking, Fast and Slow. London: Penguin; 2011.
14. St. Pierre M, Hofinger G, Buerschaper C, Simon R. Crisis Management in Acute Care Settings. 2nd ed. Heidelberg: Springer; 2011.
15. Dreyfus HL, Dreyfus SE. Mind over Machine. New York: The Free Press; 1986.
16. Benner P. From Novice to Expert: Excellence and Power in Clinical Nursing Practice. New Jersey: Prentice Hall; 1984.

Nurse Education Today 58 (2017) 32–37

Contents lists available at ScienceDirect

Nurse Education Today

journal homepage: www.elsevier.com/locate/nedt

The effect of an interprofessional simulation-based education program on perceptions and stereotypes of nursing and medical students: A quasi-experimental study☆

Kelly S. Lockeman[a,*], Nital P. Appelbaum[b], Alan W. Dow[c], Shelly Orr[d], Tanya A. Huff[d], Christopher J. Hogan[e], Brenda A. Queen[f]

[a] *Center for Interprofessional Education and Collaborative Care, Virginia Commonwealth University, PO Box 980466, Richmond, VA 23298-0466, United States*
[b] *School of Medicine, Virginia Commonwealth University, PO Box 980466, Richmond, VA 23298-0466, United States*
[c] *Virginia Commonwealth University, PO Box 980071, Richmond, VA 23298-0071, United States*
[d] *School of Nursing, Virginia Commonwealth University, PO Box 980567, Richmond, VA 23298-0567, United States*
[e] *School of Medicine, Virginia Commonwealth University, PO Box 980401, Richmond, VA 23298-0401, United States*
[f] *School of Medicine, Virginia Commonwealth University, P.O. Box 980663, Richmond, VA 23298-0663, United States*

ARTICLE INFO

Keywords:
Interprofessional education
Simulation-based education
Stereotypes
Professional identity

ABSTRACT

Background: Interprofessional education is intended to train practitioners to collaboratively address challenges in healthcare delivery, and interprofessional simulation-based education (IPSE) provides realistic, contextual learning experiences in which roles, responsibilities, and professional identity can be learned, developed, and assessed. Reducing negative stereotypes within interprofessional relationships is a prime target for IPSE.
Objectives: We sought to understand whether perceptions of interprofessional education and provider stereotypes change among nursing and medical students after participating in IPSE. We also sought to determine whether changes differed based on the student's discipline.
Design: This was a quasi-experimental pretest-posttest study.
Setting: The study took place at a large mid-Atlantic public university with a comprehensive health science campus.
Participants: 147 senior Bachelors of Science in Nursing students and 163 fourth-year medical students participated.
Methods: Students were grouped into interprofessional teams for a two-week period and participated in three two-hour simulations focused on collaboration around acutely ill patients. At the beginning of the first session, they completed a pretest survey with demographic items and measures of their perceptions of interprofessional clinical education, stereotypes about doctors, and stereotypes about nurses. They completed a posttest with the same measures after the third session.
Results: 251 students completed both the pretest and posttest surveys. On all three measures, students showed an overall increase in scores after the IPSE experience. In comparing the change by student discipline, medical students showed little change from pretest to posttest on stereotypes of doctors, while nursing students had a significant increase in positive perceptions about doctors. No differences were noted between disciplines on changes in stereotypes of nurses.
Conclusions: This study demonstrated that a short series of IPSE experiences resulted in improved perceptions of interprofessional practice and changes in stereotypical views of each profession even when the experience was not directly designed to address these issues. Differences observed between nursing and medical students should be explored further.

☆ This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
* Corresponding author.
E-mail addresses: kelly.lockeman@vcuhealth.org (K.S. Lockeman), nital.appelbaum@vcuhealth.org (N.P. Appelbaum), alan.dow@vcuhealth.org (A.W. Dow), mlorr@vcu.edu (S. Orr), hufft@vcu.edu (T.A. Huff), christopher.hogan@vcuhealth.org (C.J. Hogan), brenda.queen@vcuhealth.org (B.A. Queen).

http://dx.doi.org/10.1016/j.nedt.2017.07.013
Received 9 December 2016; Received in revised form 25 April 2017; Accepted 21 July 2017
0260-6917/

1. Introduction

Improving collaboration among health professions is vital for safe, high quality care (Greiner and Knebel, 2003). However, as learners become practitioners, they are acculturated into a professional identity that often creates barriers to collaboration (Hall, 2005). Part of an individual's professional identity is defined by how the learner views other professions, and the stereotypes that develop during professional identity formation can affect interprofessional collaboration in clinical settings (Carpenter, 1995b). Professional identity in the form of professional affiliation can conflict with interprofessional collaboration among members of a team (Kvarnström, 2008). For example, the most common professional stereotype—nurses serving doctors in an unequal power dynamic—has been shown to have a detrimental effect on patient safety (Leonard et al., 2004). Improving how professionals perceive other professions is necessary to enhance collaboration and improve healthcare delivery.

Professionals form identities through a process of socialization; as existing personal identities develop through communities of practice, personal and professional identities are shaped (Cruess et al., 2015). Social learning theory (Bandura, 1977) suggests that identity acquisition stems from these learning processes. The process of socialization is influenced by multiple factors, including the learning environment, peer and personal relationships, clinical and non-clinical experiences, role models and mentors, as well as formal teaching with faculty and self-assessment. Symbols and rituals, along with features of the hidden curriculum such as attitudes and treatment by patients, peers, health care professionals, and the public, also socialize professionals in identity formation. While the strength of influences for identity formation may vary among professionals, interactions and experiences can be developed by educators to help shape positive interprofessional relationships (Cruess et al., 2015).

Interprofessional education is a promising approach for achieving this aim (Greiner and Knebel, 2003). In contrast to the traditional model for professional identity formation which relies on role modeling by more experienced practitioners (Bleakley and Bligh, 2008), interprofessional education seeks to create a dual identity. Practitioners develop an interprofessional professional identity as a collaborator that complements each individual's profession-specific professional identity (Khalili et al., 2013). This theoretical goal for interprofessional education is supported by evidence. For example, Crawford et al. (2016) demonstrated that students from other professions perceive the nursing profession differently because of interprofessional education. Studies among practitioners have shown that interprofessional education helps to redefine professional identities consistent with the dual identity model (Ateah et al., 2011; Hood et al., 2014; Langendyk et al., 2015; Meyer et al., 2015). Perhaps, most importantly, a stronger dual identity has been shown to enhance interprofessional practice at the level of the clinical unit (Caricati et al., 2015). However, what is not known is how best to implement interprofessional education to support a dual identity model. More research is also needed to measure how professional stereotypes improve through various learning experiences.

To accomplish this goal, interprofessional education needs sociological fidelity in which educational experiences "reveal and explore real life interprofessional tensions, hierarchies and boundaries" (Sharma et al., 2011, p. 82). Among instructional methods, interprofessional simulation-based education (IPSE) is a promising approach to create interprofessional learning experiences with the sociological fidelity to address barriers to interprofessional collaboration and develop a more interprofessional professional identity. IPSE has been used to educate students for decades (Gough et al., 2012; Zhang et al., 2011) and is well-received by students. However, rigorous study of higher level outcomes for IPSE is limited (Liaw et al., 2014b; Palaganas et al., 2016; Rossler and Kimble, 2016). While IPSE has been shown to promote confidence and knowledge as well as leadership, teamwork, and communication skills among undergraduate students in health professions programs (Gough et al., 2012; Zhang et al., 2011), studies grounded more deeply in professional identity theory and the broader impact on a student's future practice are rare. One brief intervention with a focus on communication strategies provides evidence that IPSE with nursing and medical students can influence stereotypical views of each other's profession (Liaw et al., 2014a), but this activity was not required of all students and may be subject to selection bias. Educators need evidence to support the role of IPSE in developing an interprofessional professional identity.

2. Background

The aim of our study was to explore whether a series of IPSE experiences promoted changes in attitudes and stereotypes among nursing and medical students. We framed this study within the concept of social learning theory (Bandura, 1977) whereby senior students would have developed professional stereotypes from previous experiences in both the curriculum and through their extracurricular activities. We hypothesized that an extended series of IPSE experiences with a longitudinal team that spanned several sessions and focused on collaboration around acutely ill patients would challenge professional stereotypes and create a stronger interprofessional professional identity.

2.1. Research Questions

This study was focused on two primary questions: (1) Overall, do nursing and medical students who participate in a series of interprofessional critical care simulation experiences show change in perceptions of interprofessional education, stereotypes about nurses, and stereotypes about doctors following the educational intervention? (2) Is there any difference between nursing students and medical students on these measures across time?

3. Methods

3.1. Study Design

A quasi-experimental pretest-posttest design was used during a two week simulation course. There were two groups for comparison—nursing students and medical students—but no control group. The study took place at a large mid-Atlantic public university with a comprehensive health science campus, and it was approved by the university's institutional review board.

3.2. Participants

During the 2015–16 academic year, senior Bachelors of Science in Nursing students (n = 147) and fourth-year medical students (n = 163) participated in a series of three two-hour simulation workshops over a two-week period. Students were grouped into 48 interprofessional teams of 6–7 members. Team assignments were made randomly and were primarily based on student availability and clinical rotation schedules. Each team was assigned to a faculty facilitator for the series. Faculty included two female nurses, one male doctor, and one female doctor. The majority of students were female (62%), and 64% were white. Nursing students who participated during the fall semester were enrolled in the accelerated degree program (n = 84), while those who participated in the spring were enrolled in the traditional bachelor's degree program (n = 63). Fewer medical student participated during the fall semester (n = 61) than the spring semester (n = 102).

3.3. Educational Intervention

The workshops were conducted in six two-week blocks over the course of the academic year in order to accommodate the large number of students participating. Three blocks were scheduled during the fall semester, and three blocks occurred during the spring semester. Eight teams participated during each block. Half of the teams were assigned to the simulation center in the School of Nursing and the other half completed their simulation workshops in the School of Medicine's simulation center. Four faculty members (two nurses and two doctors) facilitated the workshops. Faculty were also split, with one facilitator from each profession assigned to each location.

During the first workshop, students were briefed by the faculty about Advanced Cardiac Life Support (ACLS) algorithms, and they worked as a team through six simulated resuscitation events using high-fidelity mannequins. Team communication was emphasized and profession-specific responsibilities were minimized. For example, one scenario involved a 30-year-old who presented to the Emergency Department with supraventricular tachycardia related to a tension pneumothorax. Student teams had to recognize the rhythm, decide on a course of action (i.e., medications or cardioversion), determine the cause of the event based on their assessment, and treat the patient accordingly (i.e., needle decompression) to prevent rhythm reoccurrence.

In the second and third sessions, teams worked to assess and treat simulated patients with an acute change in condition (i.e., hypoglycemia, stroke, opioid overdose, sepsis, myocardial infarction, etc.). Students were required to communicate effectively, think critically to assess the patients, administer the right interventions, and escalate care. Decision-making on whether to escalate care often required that students rely on others in the group for knowledge about what care could be provided at various levels within the hospital (e.g., general vs. critical care). The scenarios required students to perform handoffs utilizing the Situation, Background, Assessment, Recommendation (SBAR) format and use other communication practices like repeat backs and call outs for effective communication among team members. Simulations were developed by faculty with critical care expertise. Their goal was to design scenarios that routinely occur in practice and require extensive team communication. For all three sessions, the faculty facilitators collaborated to create an instructor guide with details about each scenario and the expected course of interventions in order to promote consistency between instructors. The instructor guide included a checklist of clinical behaviors and teamwork behaviors that the facilitators used to assess team performance. After each scenario, the students were debriefed as a team by the faculty facilitator. Debriefing addressed the clinical aspects of the team's performance, with specific attention to whether appropriate interventions and escalation occurred when needed. Additionally, and perhaps more importantly, faculty facilitated a discussion about the teamwork aspect of the group's performance, with a focus on whether the team communicated effectively and worked well together to care for the deteriorating patient. The debrief was conducted using the behavioral checklist questions included in the instructor guide.

3.4. Data Collection

At the beginning of each team's first session, students completed an anonymous paper-based pretest questionnaire, which included demographic items and study measures. The pretest asked each student to create a unique identification code that would be used to match their posttest responses. Faculty waited outside the room while students completed the surveys and asked students to place all questionnaires back into a large envelope. Students were able to turn in blank surveys or skip any items they felt uncomfortable answering without detection. After all students were done, the faculty member reentered the room, sealed the envelope, and labeled it with the date, the location, and the facilitator's name. At the end of the final simulation session, students completed a posttest questionnaire that included the same measures collected on the pretest. These questionnaires were collected using the same procedure as the pretest questionnaires from the same group. A research assistant matched the pretest and posttest surveys at the end of each semester using the unique identification code that each student created and the information on the envelope's label that identified the groups.

3.5. Instruments

3.5.1. Demographic Questions

Demographic information collected on the pretest questionnaire included student discipline (medicine or nursing), sex, race/ethnicity, and age. Since this study was conducted during the period of time that IPE activities were being gradually added to the curriculum, we were curious about the variance in students' previous experience with interprofessional education. A question was included asking about prior experience, with response options of “none”, “some (e.g., one or two short extracurricular experiences)”, or “a lot (e.g., a repeating interprofessional clinic or a course).” We speculated that there would be differences by discipline, which might have some influence on responses to the measures of interest in this study.

3.5.2. Student Perceptions of Interprofessional Clinical Education-Revised Instrument, Version 2 (SPICE-R2)

The ten-item SPICE-R2 survey (Zorek et al., 2016) captures student perceptions about IPE using three subscales: (a) Teamwork and Team-based Practice (4 items), (b) Roles/Responsibilities for Collaborative Practice (3 items), and (c) Patient Outcomes from Collaborative Practice (3 items). Students are asked to rate their level of agreement with each statement on a 5-point Likert scale. Ratings for all ten items are averaged to calculate an overall score, and ratings for the items on each subscale are averaged for subscale scores. Higher scores reflect more positive attitudes about IPE.

3.5.3. Healthcare Stereotypes Scale

This scale measures perceptions by displaying ten descriptive words/phrases—caring, practical, dedicated, arrogant, decisive, do-gooders, detached, hard workers, good communicators, team players—and asking students to rate their level of agreement on a 5-point Likert scale with how well each word describes doctors and nurses (Carpenter, 1995a). For example “Doctors are caring.”; “Nurses are caring.” Both positive and negative stereotypes are reflected in the adjectives. Two adjectives associated with negative stereotypes (“arrogant” and “detached”) were reverse-coded. Ratings for all ten items are averaged for doctors and for nurses to calculate an overall score for perceptions about each profession. Higher scores reflect more positive stereotypes. The instrument was modified slightly from its original version. One adjective, “dithering”, was dropped because we felt that it would not be immediately understood by our sample. In addition, all ten descriptors were used for both doctors and nurses, rather than separating descriptors for traditional stereotypes found to be associated with each profession (Carpenter, 1995a).

3.6. Data Analysis

Descriptive statistics were calculated for the demographic items, and comparisons were made between professions regarding prior experience with interprofessional education (IPE). Scores from each of the measures were compared overall using paired-samples *t*-tests to determine whether, after the course, students gained more positive attitudes towards interprofessional education and whether they attributed more positive perceptions of nurses and doctors. A change score was calculated for each student as the difference between the posttest and pretest score on each measure. Change scores from nursing and medical students were then compared using an independent samples *t*-test to determine whether there were differences between nursing and medical students on the measures of change. Participation for some teams was disrupted by inclement weather during the spring semester, so team membership was less consistent than it was for teams participating in the fall. For that reason, comparisons were also made to determine whether there were differences based on semester of participation. Data were analyzed using SAS 9.4 (SAS Institute, Cary, North Carolina).

4. Results

Of the 310 students enrolled in the educational activity, 309 pretest questionnaires were completed (response rate of nearly 100%), and 274 posttest questionnaires were completed (response rate = 88%). Among all completed surveys ($n = 332$), 251 matched pairs (81% of students who participated in the activity) were identified from the unique identification codes that students provided. Data for the matched pairs were used for further analyses, and the remaining records with inconsistent identification codes were excluded. Among the matched pairs, some students provided incomplete data on some of the measures, including one who did not identify his or her discipline. These records may have been excluded from specific comparisons.

4.1. Demographic Characteristics

Among all completed questionnaires, including those that were unmatched based on the unique identifiers supplied by students, the distribution of nursing students ($n = 156$, 49%) and medical students ($n = 163$, 51%) was almost equivalent. However, among matched pairs, the percentage of nursing students was higher (56% of total sample). Female students accounted for 62% of the sample. Among those who completed the pretest with the demographic questions, Caucasian students were the largest group by race/ethnicity (67%), followed by Asian/Pacific Islander (21%), African-American (6%), Hispanic/Latino (3%), and “Other” (3%). The age of the students ranged from 21 to 52, with a median of 26 years. These characteristics closely matched the demographic characteristics of all students who participated in the simulation series.

The majority of students (73%) reported having some prior experience with IPE (for example, one or two short extracurricular experiences); 15% reported having a lot of experience (e.g., a repeating interprofessional clinic or a course); and 12% reported having no previous experience. Chi-square analysis showed a significant difference in reported experience with IPE by profession, χ^2 (2, $N = 306$) = 9.62, $p = 0.008$, with a greater percentage of nursing students (15%) reporting no prior experience with IPE, compared to 8% of medical students. A smaller percentage of nursing students (9%) reported having a lot of IPE experience, compared to 20% of medical students.

4.2. Perceptions of Interprofessional Education

For all students, the mean overall score on the SPICE-R2 measure on a 5-point scale was 4.23 ($SD = 0.47$) at pretest and 4.56 ($SD = 0.42$) at posttest. Individual mean overall scores ranged from 2.7 to 5 on the pretest and from 3.3 to 5 on the posttest. Internal consistency for the overall scale was high, with Cronbach's alpha values of 0.86 at pretest and 0.89 at posttest. A paired samples t-test showed that the increase from pretest to posttest was significant and the effect size was moderate-to-large; $t(248) = -12.16$, $p < 0.001$, Cohen's $d = 0.745$. A significant increase was seen in each subscale, but the effect was greatest on the Teamwork (Cohen's $d = 0.791$) and Roles/Responsibilities subscales (Cohen's $d = 0.744$) and more modest on the Patient Outcomes subscale (Cohen's $d = 0.428$). Means and standard deviations on each measure at pretest and posttest and the results of the paired samples t-tests are displayed in Table 1.

Change scores for nursing and medical students are displayed in Table 2. The independent samples t-test showed no significant differences in change from pretest to posttest based on student discipline; the increase in scores was similar for nursing and medical students. Additionally, there were no significant differences in this pattern between students who participated in the fall and spring semesters.

4.3. Stereotypes of Nurses and Doctors

For all students, the mean overall score for positive stereotypes of nurses at pretest was 4.11 ($SD = 0.45$), and the mean score at posttest was 4.25 ($SD = 0.44$), a difference that was significant with a small-to-moderate effect size; $t(247) = 5.70$, $p < 0.001$, Cohen's $d = 0.342$. Similarly, for the sample as a whole, positive stereotypes about doctors increased from pretest ($M = 3.82$, $SD = 0.43$) to posttest ($M = 4.05$, $SD = 0.44$), a significant change with a moderate effect size; $t(250) = 8.75$, $p < 0.001$, Cohen's $d = 0.542$. Internal consistency for both scales was high. Cronbach's alpha for stereotypes of nurses was 0.84 at pretest and 0.83 at posttest. For stereotypes of doctors, it was 0.82 at pretest and 0.83 at posttest. No significant differences were detected between students who participated in the fall and spring semester.

There were, however, differences based on student discipline in changes in stereotypes. While medical students had no significant change from pretest to posttest related to stereotypes of doctors, nursing students had a significant increase with a large effect size; $t(242) = -7.39$, $p < 0.001$, Cohen's $d = 0.933$ (see Fig. 1). In contrast, for positive stereotypes of nurses, the t-test showed no significant differences between nursing students and medical students on the change from pretest to posttest. Measures of change from pretest to posttest on each measure for nursing students and medical students are summarized in Table 2.

5. Discussion

As we hypothesized, an increase in SPICE-R2 ratings from pretest to posttest demonstrated that the series of IPSE experiences enhanced interprofessional learning among all students regardless of profession. This change is not surprising given previous research showing that IPSE is well-received and improves attitudinal outcomes towards interprofessional practice (Palaganas et al., 2016). More notable is how the IPSE series appears to have influenced the perception of stereotypes of each profession. Both our study and two other studies (Ateah et al., 2011; Liaw et al., 2014a) demonstrated the capacity of interprofessional education to impact professional stereotypes. In contrast to preceding studies, however, this learning experience was focused on the care of critically ill patients rather than nurse-physician communication and limited selection bias by being required of all students rather than elective. Perhaps, most noteworthy is the heterogeneity of impact of our intervention. When we compared nursing students and medical students on each measure, nursing and medical students showed similar increases in positive stereotypes of nurses, but the same was not true of stereotypes about doctors. Nursing students had a significant increase in positive perceptions of physicians while medical students had little change. These differences by profession have several possible causes worth further investigation.

Social learning theory (Bandura, 1977) posits these stereotypes likely stem from influences in the clinical learning environment. Role models, for example, are one major factor that shapes professional identity (Bleakley and Bligh, 2008). In this regard, the differences between professions may be a result of differences in response to the simulations, differences in preceding learning environments, or a combination of these and other factors. One possibility is these simulation experiences may have inspired both professions to view nursing more positively than prior clinical experiences but only nursing students to view physicians more positively than these students' preceding clinical experiences. Alternatively, medical students may have entered the simulation sessions with a perspective on physicians from preceding learning experiences which was supported but not changed for the better or worse by the activity. If true, these results demonstrate shortcomings of the current clinical learning environment for how nurses view both professions and physicians view nurses. In addition, IPSE appears to address these shortcomings, at least short-term. These findings not only define the impact from this IPSE but also identified

Table 1
Differences in scores at pretest and posttest for each measure on a scale of 1 to 5.

	Pretest		Posttest		*df*	*t*	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*				
Attitudes about interprofessional education								
SPICE-R2 total scale	4.23	0.47	4.56	0.42	248	− 12.16	< 0.001	0.745
Teamwork subscale	4.18	0.52	4.55	0.46	248	− 12.40	< 0.001	0.791
Roles/Responsibilities subscale	4.00	0.58	4.41	0.50	248	− 11.65	< 0.001	0.744
Patient Outcomes subscale	4.52	0.48	4.71	0.41	248	− 6.70	< 0.001	0.428
Healthcare stereotypes								
Stereotypes of doctors	3.81	0.43	4.05	0.44	250	− 8.75	< 0.001	0.553
Stereotypes of nurses	4.10	0.45	4.25	0.44	247	− 5.70	< 0.001	0.360

important issues related to more traditional learning experiences.

Our findings may demonstrate that IPSE has a differential impact on stereotypes that underlie interprofessional collaboration and define an individual student's interprofessional identity, or they may signify a need for interprofessional education that focuses more directly on the roles and responsibilities of each profession in a given setting in order to dispel negative stereotypes. Both nursing students and medical students developed more positive stereotypes of nursing, suggesting that the simulations challenged pre-existing beliefs about nurses held by both group of students. Additionally, these pre-existing beliefs may stem not only from clinical learning experiences but also from clinical learning encounters, interactions with faculty in the classroom, or influences outside the curriculum such as mass media or pre-matriculation experiences. Understanding what stereotypes evolve from traditional education and how interprofessional education can identify these perceptions is worth further study. In contrast, stereotypes of physicians significantly changed for nurses. While this change was positive and is important, the source of preceding stereotypes also deserves further study.

Most important is the long-term impact of this change in stereotypes on practice and health outcomes. As a required course with a relatively high dose of interaction, this learning experience demonstrated beneficial impact. However, as learners return to more traditional educational settings, this benefit may wane. Since IPSE is resource-intensive, identifying the optimal dose, timing, and frequency of IPSE to support long-term change in practice is important. Whether a brief series of IPSE experiences inoculates the students against negative professional stereotypes and leads to lasting change in the interprofessional professional identity is the biggest question raised by this study. Over the long term, students trained to be more interprofessional may become the faculty who develop the desired interprofessional professional identity of their students in not just simulation but also clinical and classroom settings.

6. Limitations

This study is limited by its quasi-experimental design, the short duration of the intervention (three two-hour sessions over a two-week period) and the need for longitudinal follow-up to determine the influence of short-term outcomes on long-term clinical practice. Other limitations revolve around the nature of the IPSE activities and whether reproducibility and/or transferability are dependent on the curriculum or the faculty who are facilitating the simulation and debriefing. Social desirability bias was also a threat considering self-report of attitudes and perceptions of professions.

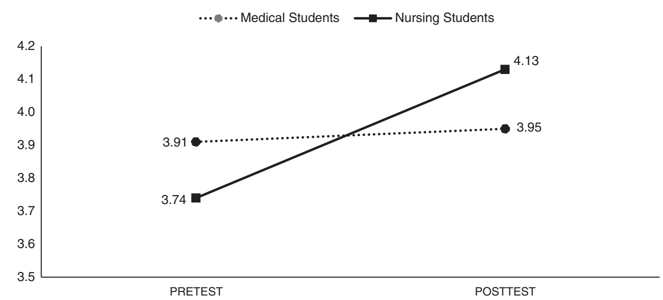

Fig. 1. Change in mean for positive stereotypes of doctors expressed by nursing and medical students from pretest to posttest.

7. Conclusions

Overall, this study demonstrated that a short series of IPSE experiences with small teams of nursing and medical students focusing on care of critically ill patients resulted in improved perceptions of interprofessional practice and changes in stereotypical views of each profession even when the experience was not directly designed to address these issues. Changes related to professional stereotypes should be further explored to see if these differences are the product of the learning experience, preceding experiences in health professions education, or a combination of other factors. Understanding these observed differences can help train the interprofessional practitioners needed to improve health outcomes.

Table 2
Comparison between nursing and medical students of change from pretest to posttest for each measure on a scale of 1 to 5.

	Nursing students		Medical students		*df*	*t*	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*				
Attitudes about interprofessional education								
SPICE-R2 total scale	0.29	0.47	0.36	0.39	210	− 1.32	0.188	0.163
Teamwork subscale	0.32	0.53	0.41	0.42	204	− 1.54	0.125	0.189
Roles/Responsibilities subscale	0.35	0.56	0.44	0.54	246	− 1.30	0.194	0.164
Patient Outcomes subscale	0.18	0.52	0.20	0.40	199	− 0.44	0.662	0.043
Healthcare stereotypes								
Stereotypes of doctors	0.04	0.30	0.39	0.45	242	− 7.39	< 0.001	0.933
Stereotypes of nurses	0.14	0.43	0.15	0.39	245	− 0.33	0.744	0.024

References

Ateah, C.A., Snow, W., Wener, P., MacDonald, L., Metge, C., Davis, P., ... Anderson, J., 2011. Stereotyping as a barrier to collaboration: does interprofessional education make a difference? Nurse Educ. Today 31 (2), 208–213.

Bandura, A., 1977. Social Learning Theory. Prentice Hall, Englewood Cliffs, NJ.

Bleakley, A., Bligh, J., 2008. Students learning from patients: let's get real in medical education. Adv. Health Sci. Educ. 13 (1), 89–107.

Caricati, L., Guberti, M., Borgognoni, P., Prandi, C., Spaggiari, I., Vezzani, E., Iemmi, M., 2015. The role of professional and team commitment in nurse–physician collaboration: a dual identity model perspective. J. Interprof. Care 29 (5), 464–468.

Carpenter, J., 1995a. Doctors and nurses: stereotypes and stereotype change in interprofessional education. J. Interprof. Care 9 (2), 151–161.

Carpenter, J., 1995b. Interprofessional education for medical and nursing students: evaluation of a programme. Med. Educ. 29 (4), 265–272.

Crawford, R.M., Gallagher, P., Harding, T., McKinlay, E.M., Pullon, S.R., 2016. Interprofessional undergraduate students talk about nurses and nursing: a qualitative study. Nurse Educ. Today 39, 7–11.

Cruess, R.L., Cruess, S.R., Boudreau, J.D., Snell, L., Steinert, Y., 2015. A schematic representation of the professional identity formation and socialization of medical students and residents: a guide for medical educators. Acad. Med. 90 (6), 718–725. http://dx.doi.org/10.1097/ACM.0000000000000700.

Gough, S., Hellaby, M., Jones, N., MacKinnon, R., 2012. A review of undergraduate interprofessional simulation-based education (IPSE). Collegian 19 (3), 153–170.

Greiner, A.C., Knebel, E., 2003. Health Professions Education: A Bridge to Quality. National Academies Press, Washington, DC.

Hall, P., 2005. Interprofessional teamwork: professional cultures as barriers. J. Interprof. Care 19 (sup1), 188–196.

Hood, K., Cant, R., Leech, M., Baulch, J., Gilbee, A., 2014. Trying on the professional self: nursing students' perceptions of learning about roles, identity and teamwork in an interprofessional clinical placement. Appl. Nurs. Res. 27 (2), 109–114.

Khalili, H., Orchard, C., Laschinger, H.K.S., Farah, R., 2013. An interprofessional socialization framework for developing an interprofessional identity among health professions students. J. Interprof. Care 27 (6), 448–453.

Kvarnström, S., 2008. Difficulties in collaboration: a critical incident study of interprofessional healthcare teamwork. J. Interprof. Care 22 (2), 191–203.

Langendyk, V., Hegazi, I., Cowin, L., Johnson, M., Wilson, I., 2015. Imagining alternative professional identities: reconfiguring professional boundaries between nursing students and medical students. Acad. Med. 90 (6), 732–737. http://dx.doi.org/10.1097/ACM.0000000000000714.

Leonard, M., Graham, S., Bonacum, D., 2004. The human factor: the critical importance of effective teamwork and communication in providing safe care. Qual. Saf. Health Care 13, 85–90.

Liaw, S.Y., Siau, C., Zhou, W.T., Lau, T.C., 2014a. Interprofessional simulation-based education program: a promising approach for changing stereotypes and improving attitudes toward nurse–physician collaboration. Appl. Nurs. Res. 27 (4), 258–260.

Liaw, S.Y., Zhou, W.T., Lau, T.C., Siau, C., Chan, S.W., 2014b. An interprofessional communication training using simulation to enhance safe care for a deteriorating patient. Nurse Educ. Today 34 (2), 259–264.

Meyer, E.M., Zapatka, S., Brienza, R.S., 2015. The development of professional identity and the formation of teams in the Veterans Affairs Connecticut healthcare system's Center of Excellence in Primary Care Education Program (CoEPCE). Acad. Med. 90 (6), 802–809. http://dx.doi.org/10.1097/ACM.0000000000000594.

Palaganas, J.C., Brunette, V., Winslow, B., 2016. Prelicensure simulation-enhanced interprofessional education: a critical review of the research literature. Simul. Healthc.. http://dx.doi.org/10.1097/SIH.0000000000000175. (Advance online publication).

Rossler, K.L., Kimble, L.P., 2016. Capturing readiness to learn and collaboration as explored with an interprofessional simulation scenario: a mixed-methods research study. Nurse Educ. Today 36, 348–353.

Sharma, S., Boet, S., Kitto, S., Reeves, S., 2011. Interprofessional simulated learning: the need for 'sociological fidelity'. J. Interprof. Care 25 (2), 81–83.

Zhang, C., Thompson, S., Miller, C., 2011. A review of simulation-based interprofessional education. Clin. Simul. Nurs. 7 (4), e117–e126.

Zorek, J.A., Fike, D.S., Eickhoff, J.C., Engle, J.A., MacLaughlin, E.J., Dominguez, D.G., Seibert, C.S., 2016. Refinement and validation of the student perceptions of physician-pharmacist interprofessional clinical education instrument. Am. J. Pharm. Educ. 80 (3), 1–8.