Learning the principles and concepts of airway management:
The efficacy of replacing lecture with MicroSim™

Project Team

Carolyn L. Cason, RN, PhD, Professor and Associate Dean for Research, Principal Investigator
Kristine A. Nelson, RN, MN, Lead Teacher, Undergraduate Pediatric Nursing Course, Project Coordinator
Victoria L. Hartman, RN, MSN, CPNP, faculty, Undergraduate Pediatric Nursing Course, Co-Investigator
Jennifer Roye, RN, MSN, CPNP, Undergraduate Pediatric Nursing Course, Co-Investigator
Mary E. Mancini, RN, PhD, FAAN, Professor and Associate Dean Undergraduate Program, Co-investigator
Mary Cazzell, RN, BSN, Graduate Research Assistant

School of Nursing
The University of Texas at Arlington
Arlington, Texas

Report Prepared by
Carolyn L. Cason, RN, PhD
Professor, Associate Dean for Research
School of Nursing
University of Texas at Arlington
411 S. Nedderman
Arlington, Texas 76019-0407
817-272-5781
clcason@uta.edu

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Executive Summary

This project evaluated the effectiveness of knowledge acquisition, knowledge transfer, knowledge retention, and accuracy and timeliness of care decisions when principles and concepts of airway management were taught in either of two pedagogically proper and accepted ways: lecture and computer-based micorsimulation. Undergraduate nursing students enrolled in a required pediatric nursing course in Fall 2007 (n=98) were randomly assigned to instructional approach: Lecture or MicroSim (Acute Asthma MicroSim™ Inhospital Self-directed Learning System). There were no differences in the demographic characteristics or learning styles of students in the two groups (Lecture and MicroSim).

The students performed equally well on measures of knowledge acquisition. Six items on paper and pencil multiple choice examinations provided the measure of knowledge acquisition. Exam scores were available on 76 students: 38 in the Lecture group and 38 in the MicroSim group.

Knowledge transfer was assessed by having all students complete the microsimulation Severe Asthma; MicroSim™ Inhospital Self-directed Learning System. Completion of the microsimulation was a course requirement. Students completed the Severe Asthma microsimulation within three weeks after initial learning. There was no required minimum score on the case and students could repeat the case as many times as they wished. They completed the microsimulation at their convenience with the only restriction that they do so within a three week window. Each student’s performance on this microsimulation was obtained from the CMS system (the debriefing document). From the debriefing documents we extracted, for each student, the number of times the case was attempted, the time spent on each attempt, the score (expressed in percentage points) on each attempt, the total time spent on the case, and the best score achieved.

Students in the MicroSim group had better knowledge transfer scores (first attempt on Severe Asthma microsimulation) than did students in the Lecture Group. Students who learned airway management via the Acute Asthma microsimulation had a better understanding of how to manage a patient with airway dysfunction (Severe Asthma) than did students who learned the content by attending the lecture. Familiarity with microsimulation is unlikely to have resulted in the difference in performance on the first attempt scores on the Severe Asthma microsimulation as all students had prior experience with microsimulation; however, no measure of the extent to which students had prior experience was obtained from them. The absence of a difference in the number of attempts also suggests that familiarity with microsimulation was not a factor in the better performance of the MicroSim group students.

With repetition, differences in knowledge transfer scores (best score on Severe Asthma) disappeared. The number of attempts was comparable for students in each group; however, students in the Lecture group spent more time engaged in the Severe Asthma microsimulation. One hypothesis for the longer engagement time among students in the Lecture group is that they were reviewing/learning airway management content from the...
micorsimulation. Since these data were not collected in this study, the hypothesis cannot be evaluated but deserves study.

At the end of the pediatric course, students completed a receptivity to learning via microsimulation survey. All students were receptive to microsimulation. Students in the Lecture Group reported higher agreement than did students in the MicroSim group with the statement that the microsimulation strengthened their understanding of the concepts and principles of airway management. Both groups of students agreed that engaging the microsimulation challenged their ability to think.

Regardless of how a student initially learned airway management, those with a cognitive learning style had more attempts and were engaged longer in the Severe Asthma microsimulation than were students with an analytical or global learning style. Those with a cognitive learning style performed as well as those with analytical or global learning styles on the Severe Asthma microsimulation but they needed longer engagement times and more attempts.

Of the 78 students in the study during Fall 07, 71 progressed to Senior II during Spring 08 and were eligible to participate in the final component of the study: the objective structured clinical examination (OSCE). Forty students completed the OSCE at the end of Senior II; 22 had attended lecture (Lecture) and 18 had completed the microsimulation (MicroSim). The two groups of students were statistically equivalent on the demographic characteristics of gender, previous degrees, race/ethnicity, learning style, age, and grade point average (GPA) on Senior I courses.

Knowledge retention and the accuracy and timeliness of care decisions data were obtained at the end of the second semester, senior year. Each student completed an OSCE that entailed assessment and care of an infant (SimBaby SW version 1.4.1, Laerdal Medical, Stavanger, Norway) in respiratory distress. To evaluate students’ performances, faculty relied on four sources of data: their observations, the charting forms completed by students, the printed SimBaby event logs, and review of the videotapes obtained during the OSCE. Knowledge retention was defined as action taken that should have been taken (yes/no). The accuracy and timeliness of care decisions data were obtained from the videotapes. A Graduate Research Assistance (GRA), blinded to instructional approach, watched the videotapes to identify the sequence in which each student performed the care steps (accuracy) and timed, using a stop watch, the time it took for the student to complete each decision step (timeliness).

Students in the MicroSim group had better knowledge retention than students in the Lecture group on three key assessment actions: checking respiratory rate, checking oxygen saturation, and noting cyanosis. Although not statistically significant, students in the Lecture group more often than students in the MicroSim group provided care that led to worsening condition of the patient. There were no differences in the timeliness of students’ care actions associated with instructional approach.
In this study, learning principles and concepts of airway management was significantly aided by the use of microsimulation. Even though students were required to complete the Severe Asthma microsimulation only once and their performance scores were not included in course grade determination, many elected to work through it multiple times and reported that doing so helped them learn airway management. Given the opportunity to engage in the Severe Asthma microsimulation as often as desired, students’ average performances were improved for all and were comparable across instructional groups.

One hypothesis for the longer engagement time among students in the Lecture group is that they were reviewing/learning airway management content from the microsimulation. Since these data were not collected in this study, the hypothesis cannot be evaluated but deserves study.

Student receptivity to microsimulation as well as their choice to repeat engagement with the Severe Asthma microsimulation suggests that microsimulation facilitates knowledge acquisition and reinforcement. Unlike the one time presentation of content provided in the lecture, students had unlimited access to the microsimulation. They could and did engage it as often as they wished; it engaged them in active learning and learning was under their control.

Their pattern of engagement suggests that competition, desire to improve their performance and thus achieve higher scores, may have been a factor in repeated engagement; they were trying to ‘beat the house’ and figure out the best way to treat the patient. Perhaps the similarities between microsimulation and electronic gaming played a role in students’ positive receptivity and repeated engagement with the electronic virtual-reality type learning experience. Further study of students’ reasons for attempting the Severe Asthma microsimulation more than once and the ways in which they used additional attempts is needed to understand the ways in which microsimulation facilitates learning.

The concepts and principles of airway management are not linked to age of the patient. The microsimulations (Acute Asthma and Severe Asthma) dealt with adults rather than pediatric patients; but students’ performances were not adversely affected. Their receptivity responses indicate that the use of adult patients in the microsimulation did not detract from their learning nor their assessment of the usefulness of microsimulation to learn airway management. Learning concepts in this way, across patient population groups defined by age, may facilitate knowledge transfer and contribute to improved patient care outcomes; a benefit that needs confirmation through further research.
This project evaluated the effectiveness of knowledge acquisition, knowledge transfer, knowledge retention and accuracy and timeliness of care decisions when principles and concepts of airway management were taught in either of two pedagogically proper and accepted ways: lecture and computer based micorsimulation. The study as originally proposed is detailed in Appendix A.

**Pilot Study**

The University of Texas at Arlington (UTA) institutional review board reviewed and approved the project protocol in December 2006. During Spring 2007, 50 students enrolled in the required undergraduate pediatric nursing course participated in a pilot study. The purpose of the pilot was to evaluate the proposed study processes and measures. At the conclusion of the Spring 2007 pilot study, the project team met to review the processes and outcomes of the pilot study. A summary of the discussion items with recommended changes in the study protocol is provided in Appendix B.

During Summer 2007, the technical logistics associated with using MicroSim™ Inhospital Self-directed Learning System were resolved. Prior to implementation of the study the project team modified the study protocol to exclude the knowledge pre- and post-test (replaced by post-learning examination questions), the group learning activity on a scenario-based simulation exercise (replaced by a simulation training laboratory), and instruction to complete the Airway and Breathing: Introduction module (replaced with specific instructions and directions for each microsimulation). The survey of prior experience with MicroSim™ Inhospital Self-directed Learning System was omitted since all students had used the system in prior coursework. Students completed the Severe Asthma microsimulation as directed; however, they did not collect their debriefing documents for submission to the teaching team. A member of the team retrieved the documents directly from the Competency Management System (CMS). The modified study protocol was reviewed and approved by the UTA institutional review board in June 2007.

**Study Questions**

The study was designed to answer three primary questions:
1. Are there differences in knowledge acquisition and knowledge transfer associated with instructional approach (lecture and computer based microsimulation)?
2. Are there differences in knowledge retention associated with instructional approach?
3. Are there differences in accuracy and timeliness of care decisions associated with instructional approach?

The study also addressed the following secondary questions:
1. Are there differences in learner receptivity to computer based simulation associated with instructional approach used for initial learning?
2. Are there differences in learner receptivity to computer based simulation associated with learner’s age, gender, ethnicity or preferred learning style?
**Design**

The study used a comparison group design with random assignment to instructional approach: lecture or computer based microsimulation. Each approach provided instruction on principles and concepts of airway management. The study design and measures were informed by a pilot conducted in Spring 2007. Students participating in the pilot did not participate in this subsequent study. The study began in August 2007 and ended in May 2008. Students participating in the study were those enrolled in the required undergraduate pediatric course in Fall 2007.

**Instructional approaches**

Learners randomized to Lecture (Lecture) received a 30 minute lecture from the team member who routinely provides the lecture on RSV bronchiolitis, asthma, and airway management. They also received a printed set of lecture notes at the beginning of the lecture. The lecture was delivered to the learners as a group in the same classroom as was all other course lecture content.

Learners randomized to microsimulation (MicroSim) were directed to a computer lab and instructed to complete the Acute Asthma; MicroSim™ Inhospital Self-directed Learning System. They were given written directions (Appendix C) on what to do when they arrived at the lab and completed the microsimulation while learners in the other group listened to the lecture. They did not hear the lecture nor did they receive the printed lecture notes.

**Learners**

Undergraduate nursing students enrolled in a required pediatric nursing course in Fall 2007 (n= 98) were randomly assigned to instructional approach: Lecture or MicroSim. At the beginning of the study, all students were in the first semester of their senior year in nursing school. At the time of the final project evaluation they were second semester seniors preparing to graduate (in May 2008).

**Outcome measures**

**Knowledge acquisition** was assessed using 6 items on paper and pencil multiple choice examinations (Appendix D). Four of these items appeared on an end of unit examination administered to all students two weeks after initial learning and after all had completed the Severe Asthma; MicroSim™ Inhospital Self-directed Learning System simulation. Two questions appeared on the end of course final examination two months later. The three knowledge acquisition scores computed from these data included percent correct score on the end of unit examination questions, percent correct score on the final examination questions, and percent correct score on the six questions combined.

**Knowledge transfer** of learning was assessed by having all students complete the microsimulation Severe Asthma; MicroSim™ Inhospital Self-directed Learning System. Completion of the microsimulation was a course requirement (Appendix E).
They completed this microsimulation within three weeks after initial learning. There was no required minimum score on the case and students could repeat the case as many times as they wished. They completed the microsimulation at their convenience with the only restriction that they do so within a three week window. They received written instructions on what to do to complete the microsimulation (Appendix F). Each student’s performance on this microsimulation was obtained from the CMS system (the debriefing document). From the debriefing documents we extracted, for each student, the number of times the case was attempted, the time spent on each attempt, the score (expressed in percentage points) on each attempt, the total time spent on the case, and the best score achieved.

Knowledge retention and the accuracy and timeliness of care decisions data were obtained at the end of the second semester, senior year. Each student completed an objective structured clinical examination (OSCE) that entailed assessment and care of an infant (SimBaby SW version 1.4.1, Laerdal Medical, Stavanger, Norway) in respiratory distress (Appendix G). The OSCE required the student to assess and care for a five month old infant admitted to Emergency Services for evaluation of coughing and audible wheezing. Each student’s performance was observed by a faculty member stationed in the control room. Faculty members could observe student performance directly by looking through a one-way mirror into the room where the OSCE was situated and indirectly by viewing the live feed captured by the AVS system cameras. The Laerdal® Advanced Video System (AVS) captures the video and audio of students’ performances as they perform the scenario and the SimBaby software captures a log of the time stamped events and the patient monitor. When the scenario is completed the two systems merge the information into a single debriefing file that allows review of the scenario by either playing back the entire video or jumping to a section of the video by clicking on the time stamped event. To evaluate students’ performances, faculty relied on four sources of data: their observations, the charting forms completed by students, the printed SimBaby event logs, and review of the videotapes. They used the assessment guide included as Appendix H to judge performance: action taken that should have been taken (yes/no). These data served as the measure of knowledge retention. The accuracy and timeliness of care decisions data were obtained from the videotapes. A Graduate Research Assistance (GRA), blinded to instructional approach, watched the videotapes to identify the sequence in which each student performed the care steps (accuracy) and timed, using a stop watch, the time it took for the student to complete each decision step (timeliness). The decision steps, highlighted on the form presented as Appendix I, included elevate head of the bed, administer oxygen, obtain orders from primary care provider, give first dose of albuterol, give second dose of albuterol, give prednisolone, and discontinue oxygen. The GRA obtained a time for each decision step by defining start time with the first step in the cluster and ending with the completion of the decision step. For example the time to administer oxygen was obtained by starting the stop watch when the student assessed oxygen saturation and stopping the watch when the student completed the step of administering oxygen at 1 to 2 liters via mask.

Receptivity to learning via microsimulation was assessed with an 11 item survey (Appendix J) administered at the end of the course (December, 2007). For each item, the
response options consisted of a Likert scale that included Strongly Disagree, Disagree, Neither Agree or Disagree, Agree and Strongly Agree. Responses to each item served as the data of interest.

Most students seeking admission to the School of Nursing are required to take as part of their admission application the Admission Assessment™ (A²) published by Health Education Systems, Inc (HESI A²) with a published Kuder-Richardson reliability of 0.58. Students with advanced degrees and those who transferred from other universities are not required to take the HESI A². The HESI A² requires responses to each of 15 questions and identifies each student’s top two learning styles. The learning styles identified include visual, auditory, kinesthetic, cognitive, analytical, and global. Definitions for each as provided by the test publisher (Health Education Systems, Inc.) are

Visual: “Learn best by seeing. Pictures in textbook and skills book are helpful. Will do well in clinical labs after observation. Associate pictures and skills to concepts in your mind. Write and use flashcards to study. Create pictures when studying. Write information down and take notes. Sit in the front of the class. Visualize the information obtained in lab settings and in clinical and related this information to theory. Spend time observing others and plan before taking action. Journalizing stimulates thinking.”


Kinesthetic: “You like to experiment with knowledge you obtain and you learn best by being involved. You will enjoy and do well in skills lab and clinical. Practice tests are helpful to your learning; develop tests for yourself as a practice for exam. Design movements to remember facts. Study for short periods of time, then move around. Set specific goals. You learn best when you are active.”

Cognitive: “You like obtaining information that has personal meaning for you. You need to find ways to make classroom and clinical content meaningful to you. You will enjoy both lecture and clinical and you can identify relevant information well. You need to think concepts through and relate the information into your own words.”

Analytical: “You like things done in an orderly manner, i.e., step-by-step. You pay attention to details and like to be prepared. You also like to know what to expect and you focus your attention on meeting your goals. You value facts over feelings. You like to finish one thing at a time and you are logical, self-motivated, objective, and consistent. You need to know not only the ‘how’ but also the ‘why’ of content. You enjoy learning and like tests because they break information into parts.”

Global: “You are sensitive to others and flexible. You have a tendency to ‘go with the flow’. You learn best by discussing and working with others. However you need reassurance and reinforcement because you work hard to please others. You have a tendency to take criticism personally. You see the big picture and can read between the lines. You have a sense of fairness and avoid competition and
conflict. You like to give and receive praise. You need to relate knowledge to life. You are sometimes threatened by tests and may need to seek help with test-taking skills.”

Students demographic characteristics were extracted from their advising records. Demographic characteristics included gender, age, ethnicity/race, and grade point averages for all course completed during the junior year and for all courses completed in the senior year.

Procedure

Prior to an orientation meeting held at the beginning of the semester, staff verified that all students possessed a log-in to the MicroSim™ Inhospital Self-directed Learning System. At the orientation meeting held just prior to the start of the Fall 2007 semester students learned about the study and signed consent forms (Appendix K). Students were randomized to instructional approach as described in Appendix B.

On 9/21/2007 all students attended a one-hour lecture on cystic fibrosis and related respiratory content presented by a member of the teaching team. At the end of the hour-long lecture and a brief rest break students assigned to the lecture instructional approach returned to the classroom and received a lecture from a member of the teaching team on RSV bronchiolitis, asthma, and airway management. Students assigned to the MicroSim group went as a group to a computer lab where they received instructions on completing the Acute Asthma microsimulation (MicroSim™ Inhospital Self-directed Learning System). They completed the microsimulation and signed out with the proctor in the computer lab. They returned to the classroom at the start of the third hour of class to hear an additional lecture on respiratory system dysfunction in children. A member of the teaching team accessed Laerdal’s Competence Management System (CMS) and obtained printed copies of each student’s MicroSim Debriefing document.

On 9/28/2007 all students participated in a simulation training laboratory using SimBaby and a RSV bronchiolitis scenario. The purpose of the lab was to familiarize students with SimBaby and experience the dynamics of a simulation. Groups of six to eight students worked with a member of the teaching team and a standardized patient who served as parent in the scenario. Each training lab took between 45 and 50 minutes. The lab was intended as a learning experience to build on content addressed in reading assignments and either obtained through class lecture or encountered during microsimulation. Students provided nursing care to the simulated patient and family member without instructor assistance and then received feedback during debriefing with an instructor regarding correct care approaches.

During the subsequent two and a half week period (due date 10/11/07), all students completed the Severe Asthma microsimulation (MicroSim™ Inhospital Self-directed Learning System) using the directions presented in Appendices D and E. Students completed the microsimulations in the computer lab at their convenience. A member of the teaching team accessed the CMS and obtained printed copies of each student’s MicroSim Debriefing document.
The first unit exam was given on 10/5/2007. There were a total of 60 multiple choice questions addressing content from the first five weeks of classes. There were four questions on airway management/respiratory disease in children. The course Final Exam was given on 12/11/07. It consisted of 70 multiple choice questions covering all content areas from the 15 week course. There were two questions on airway management/respiratory disease in children (see Appendix D).

During the last week of the semester, the teaching team requested feedback from students using the receptivity survey. These surveys, posted on the course website, requested students to complete the survey anonymously and to deliver it to the course secretary.

In Spring 2008 as part of the end-of-program capstone course, students completed the final component of the study by participating in an Objective Structured Clinical Evaluation (OSCE) held in the simulation laboratory. Students were given the opportunity to complete the one hour OSCE session between 2/18/08 and 4/21/08.

The scenario dealt with a five month old male brought to emergency services for evaluation of cough and audible wheeze. The OSCE was constructed so that if the student did not act in a timely manner, the patient’s condition deteriorated. For example, in the second section (Appendix H) the student was to note that the patient’s SaO2 dropped to below 92% and that oxygen needed to be administered. If the student failed to do so, the patient’s condition worsened and the situation automatically went to Distress point 1. If the student completed the steps indicated for recovery from Distress Point 1, the situation continued with Post-Intervention actions. If the student did not complete the steps indicated for recovery from Distress point 1, the patient progressed to cardiac arrest.

The OSCE took place in the Team Training room of the The University of Texas at Arlington School of Nursing Smart Hospital™. SimBaby was positioned in a one station patient care unit in an infant warmer with built-in equipment at the head of the bed that included an oxygen flow meter, an EKG and pulse oximeter, and a time clock. The patient’s peripheral body temperature was continuously displayed on the monitor. Supplies and other equipment that were accessible to the students included hand cleansing gel, non-sterile gloves, oxygen mask, suction equipment machine and catheter, resuscitation bag/mask, EKG monitor leads, pulse oximeter probe, a stethoscope with an infant sized bell, infant BP cuff, albuterol MDI with spacer and mask, and an oral syringe with prednisone suspension. SimBaby had an ankle identification bracelet with the patient’s name and age. SimBaby was dressed in a diaper, front tie t-shirt, and socks.

A member of the teaching team used the guide presented as Appendix L to prepare the room by laying out supplies, the charting document (Appendix M), the physician’s standing orders (Appendix N), and the primary care provider’s orders (Appendix O). Immediately before a student began the OSCE, a member of the teaching team briefed the student on the task and then left the room. Students were instructed to chart pertinent findings at intervals but that they were not required to vocalize their findings. The student
began the OSCE by reading a brief statement about the patient (Appendix G) that was presented on the monitor screen.

As students completed the OSCE, their performance was monitored and evaluated. A member of the teaching team, stationed in the control room, observed performance through a one-way mirror and on the AVS System monitors. While observing a student’s performance, a teaching team member used a checklist tool, the Student Performance Evaluation Tool, to document if a student did or did not complete each task (Appendix H). Each student’s performance was also videotaped for later viewing so that the teaching team member could verify her “live” observations. A printed copy of the SimBaby event log produced by the SimBaby computer program was obtained.

In June and July of 2008, a member of the teaching team reviewed each student’s initial Student Performance Evaluation Tool completed during live observation of the student’s performance during the OSCE, the videotape of the student’s performance, the SimBaby event log, and the charting form completed by the student. The faculty member then completed a final version of the Student Performance Evaluation Tool; it is this assessment that served as the data for this study.

The only planned incentive for student completion of the OSCE was credit for clinical practicum time. When few students responded, the incentive was changed to a $50 gift card (after IRB approval) and all students who completed the OSCE received the gift card.

Statistical Analyses

SPSS version 16 was used for all statistical analyses. Descriptive statistics provided information about the demographic characteristics of the students and examination of the distributional characteristics of all outcome measures. Differences in outcome measures associated with instructional approach were assessed with repeated measures analysis of variance for interval level outcomes and chi square for nominal and ordinal outcomes. For each statistical decision alpha was set to .05.

Results

All students (n=98) signed consent forms indicating willingness to participate in the study and half were randomized to each instructional approach. Group assignment was not known to students prior to the class that began the study.

Two students withdrew from the course prior to the class in which the study began; both of these students had been randomized to the Lecture group. Two students, both randomized to the MicroSim group, rescinded consent to participate in the study. Fourteen students did not attend class on the first day of the study: they participated in neither the Lecture (n=6) nor the MicroSim (n=8) and were dropped from the study. Another two students, one in each group, did not attend the Simulation Lab and were dropped from the study.
The demographic characteristics of the remaining 78 students who participated in the study are provided in Tables 1 and 2.

Table 1. Demographic characteristics of students

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</table>

Chi square analyses of data in Table 1 indicate that the groups were equivalent on these demographic characteristics. Multivariate analysis of variance with instructional approach as the independent variable and age and cumulative GPA as the dependent variables indicated that the groups were equivalent on age and cumulative GPA.

Learning style data were available on 71 of the students (Lecture = 35 and MicroSim = 36) as some few had not taken the exam and/or their data files were corrupted. As shown in Table 3, the predominant learning styles among these students were kinesthetic/analytical and kinesthetic/global.

Each student in the study had either a cognitive, analytical or global learning style. Table 4 provides information about their distribution within each instructional approach. Chi square indicates that the groups were equivalent on these learning styles.

Table 2. Students’ age and Cumulative GPA

<table>
<thead>
<tr>
<th>Student Characteristic</th>
<th>Lecture</th>
<th>MicroSim</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>27</td>
<td>26</td>
<td>53</td>
</tr>
<tr>
<td>Cumulative GPA</td>
<td>3.3</td>
<td>3.1</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Table 3. Students’ learning styles

<table>
<thead>
<tr>
<th>Learning styles</th>
<th>Lecture n</th>
<th>%</th>
<th>MicroSim n</th>
<th>%</th>
<th>Total n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual/Analytical</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Visual/Global</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>11</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Auditory/Analytical</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 4. Students’ Learning styles within Instructional Approach

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>Lecture n</th>
<th>%</th>
<th>MicroSim n</th>
<th>%</th>
<th>Total n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>14</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Analytical</td>
<td>11</td>
<td>31</td>
<td>13</td>
<td>36</td>
<td>24</td>
<td>34</td>
</tr>
<tr>
<td>Global</td>
<td>22</td>
<td>63</td>
<td>18</td>
<td>45</td>
<td>40</td>
<td>56</td>
</tr>
</tbody>
</table>

Knowledge acquisition. Exam scores were available on 76 students: 38 in the Lecture group and 38 in the MicroSim group. The unit examination contained four airway management multiple choice questions. The final exam contained two questions. Table 5 shows that students in the lecture group tended to have lower percent correct scores than did MicroSim students; however, this difference was not statistically significant. Students performed equally well on the exam questions regardless of how they initially received instruction on the content.

Table 5. Knowledge Acquisition Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lecture</th>
<th>MicroSim</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>% correct score on unit exam</td>
<td>73.0</td>
<td>23.5</td>
</tr>
<tr>
<td>% correct score on final exam</td>
<td>90.8</td>
<td>19.6</td>
</tr>
<tr>
<td>% correct score on all questions</td>
<td>78.9</td>
<td>17.2</td>
</tr>
</tbody>
</table>

Knowledge Transfer. One MicroSim student did not complete the Severe Asthma microsimulation. As shown in Table 6, 34% of students (n=26) completed the Severe Asthma microsimulation more than once. Two students completed the microsimulation seven times; one in each group. Chi square indicated no differences associated with instructional approach in number of times students completed the microsimulation.

Table 6. Number of times Severe Asthma microsimulation attempted

<table>
<thead>
<tr>
<th>Number of times Severe Asthma microsimulation attempted</th>
<th>Lecture N</th>
<th>%</th>
<th>MicroSim N</th>
<th>%</th>
<th>Total N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24</td>
<td>62</td>
<td>27</td>
<td>71</td>
<td>51</td>
<td>66</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>13</td>
<td>9</td>
<td>24</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>13</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 7 provides information about students’ average first score, average best score, and average time engaged in the Severe Asthma microsimulation. Average first scores for students in the MicroSim instructional approach were higher than for students who attended lecture and this difference approached being significant (F=2.9, df=1,75, p=.09). These differences disappear when students’ best scores serve as the outcome measure.

As shown in Table 7, students in the lecture group had higher average times of engagement with the Severe Asthma microsimulation than did students in the MicroSim group and this difference approached being significant (F=3.4; df=1,75, p=.06).

Table 7. Average First and Best score on Severe Asthma microsimulation achieved by students in each instructional group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lecture M</th>
<th>Lecture SD</th>
<th>MicroSim M</th>
<th>MicroSim SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Score</td>
<td>70.5</td>
<td>14.3</td>
<td>75.6</td>
<td>11.3</td>
</tr>
<tr>
<td>Best Score</td>
<td>79.7</td>
<td>8.8</td>
<td>79.8</td>
<td>8.7</td>
</tr>
<tr>
<td>Time engaged</td>
<td>24.4</td>
<td>26.8</td>
<td>15.3</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Performance differences associated with instructional group and learning style. To evaluate the potential interactive effects of type of instructional approach and learning style, we completed a multivariate analysis of variance in which type of instruction and learning style (cognitive, analytical, global) served as grouping factors and the first Severe Asthma microsimulation score, the best Severe Asthma microsimulation score, the number of times the Severe Asthma microsimulation was completed, the total time engaged with the Severe Asthma microsimulation, and scores on the exam served as the dependent variables. The multivariate F was significant for type of instruction (F=6.9; df=5,60; p=.00; partial eta square = .37), learning style (F=2.7; df=10,122; p=.00; partial eta square = .18), and for the interaction between type of instruction and learning style (F=2.7; df=10, 122; p=.00; partial eta square = .18).

The univariate analyses of variance revealed statistically significant differences associated with type of instruction in the students’ first score on the Severe Asthma microsimulation (F=3.7;df=1,64; p=.05; partial eta square = .05), the total time engaged with the Severe Asthma microsimulation (F=34; df=1,64; p=.00; partial eta square = .35), and the number of attempts (F=12.9; df=1,64; p=.00; partial eta square = .17). Students in the MicroSim group performed significantly better than did students in the lecture group on their first score on the Severe Asthma microsimulation (Mean=76 and SE=2.5 vs. Mean=68 and SE=3.4). Students in the lecture group took significantly more total time with the Severe Asthma microsimulation than did students in the MicroSim group (Mean=48.5 and SE=4.8 vs Mean=13.8 and SE=3.5). Students in the Lecture group attempted the Severe Asthma microsimulation significantly more often than did the students in the MicroSim group (Mean=2.9, SE=0.3 vs Mean=1.3 and SE=0.2).

The univariate analyses of variance revealed statistically significant differences associated with learning style in total time engaged with the Severe Asthma
microsimulation (F=10.6; df=1,66; p=.00; partial eta square = .26) and number of attempts (F=3.1; df=1,64; p=.05). Post-hoc contrasts revealed that there were no significant differences in total time engaged with the microsimulation between students with either analytical or global learning styles but both spent significantly less time than did students with a cognitive learning style. Post-hoc contrasts revealed no significant differences on number of attempts.

The univariate analyses of variance also revealed statistically significant differences associated with the interaction between type of leaning and learning style in total time engaged with the Severe Asthma microsimulation (F=16.5; df=1,64; p=.00; partial eta square = .34) and number of attempts (F=5.6; df=1,64; p=.00; partial eta square = .15). Figure 1 depicts the interaction for total time students engaged the microsimulation. There were two students in the Lecture group who had a cognitive learning style; each was engaged with the module substantially longer than any of the other students. Figure 2 depicts the interaction for number of attempts.

![Estimated Marginal Means of total time on MrRey](image)

Figure 1. Interaction between instructional approach and learning style: time engaged with Severe Asthma microsimulation
Figure 2. Interaction between instructional approach and learning style: number of attempts with Severe Asthma microsimulation

Student receptivity. Receptivity surveys were completed by 26 students in the Lecture group and 23 students in the MicroSim group. Table 8 shows that students in the Lecture group more often agreed than students in the MicroSim group that completing the microsimulation strengthened their understanding of the concept of airway management. There were no differences associated with instructional approach in any of the other survey item. Overall, the responses point to the general receptivity of both groups of learners to the use of microsimulation.

Table 8. Students’ Receptivity to learning by microsimulation (%)

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Completing the module(s) strengthened my understanding of the concepts of airway management. (Chi square=7.3df=3;p=.05)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>56</td>
<td>23</td>
</tr>
<tr>
<td>MicroSim</td>
<td>0</td>
<td>8</td>
<td>28</td>
<td>44</td>
<td>8</td>
</tr>
<tr>
<td>2. The computer module(s) helped me to think through the care requirements of the case.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>58</td>
<td>27</td>
</tr>
<tr>
<td>MicroSim</td>
<td>0</td>
<td>8</td>
<td>20</td>
<td>68</td>
<td>4</td>
</tr>
<tr>
<td>3. Even though the computer module(s) dealt with adults, the content helped me to understand care of pediatric patients.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>0</td>
<td>15</td>
<td>12</td>
<td>54</td>
<td>19</td>
</tr>
<tr>
<td>MicroSim</td>
<td>0</td>
<td>28</td>
<td>20</td>
<td>48</td>
<td>4</td>
</tr>
</tbody>
</table>
4. Going through the computer module(s) was frustrating.
   - Lecture: 8, 31, 15, 12
   - MicroSim: 12, 32, 16, 4

5. The computer module(s) helped to make learning fun.
   - Lecture: 0, 8, 27, 54, 12
   - MicroSim: 0, 12, 48, 36, 4

6. Even though I was required to go through each module only once, I chose to go through a module more than one time.
   - Lecture: 1, 27, 19, 31, 19
   - MicroSim: 0, 54, 17, 29, 0

7. The instructions for completing the computer module(s) were difficult to follow.
   - Lecture: 15, 65, 8, 4, 8
   - MicroSim: 16, 72, 4, 4, 4

8. I would like for more of the course content to be taught in this way.
   - Lecture: 8, 19, 39, 23, 12
   - MicroSim: 8, 48, 24, 20, 0

9. The computer module(s) helped to reinforce key concepts of airway management. (Chi square = 9.8; df=4; p=.06)
   - Lecture: 0, 4, 0, 69, 28
   - MicroSim: 4, 8, 12, 72, 4

10. The computer module(s) helped me plan my care of patients in the clinical setting.
    - Lecture: 0, 15, 31, 35, 19
    - MicroSim: 0, 24, 32, 40, 4

11. The computer module(s) challenged my ability to think.
    - Lecture: 0, 4, 8, 77, 12
    - MicroSim: 0, 0, 32, 64, 4

Knowledge retention, accuracy and timeliness of care decisions. Of the 78 students in the study during Fall 07, 71 progressed to Senior II during Spring 08 and were eligible to participate in the OSCE. Forty students completed the OSCE at the end of Senior II; 22 had attended lecture (Lecture) and 18 had completed the microsimulation (MicroSim). The two groups of students were statistically equivalent on the demographic characteristics of gender, previous degrees, race/ethnicity, learning style, age, and grade point average (GPA) on Senior I courses. Table 10 also provides information about these students average performance on the Severe Asthma microsimulation. Students in the Lecture group spent significantly more time on the Severe Asthma microsimulation than did students in the MicroSim group (t=2.3; df=36; p=.03).

### Table 9. Characteristics of students in each group

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Lecture</th>
<th>MicroSim</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Lecture</th>
<th>MicroSim</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>26.6</td>
<td>26.4</td>
<td></td>
</tr>
<tr>
<td>GPA on Senior I courses</td>
<td>2.9</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Best Score Severe Asthma</td>
<td>78</td>
<td>78</td>
<td>3.4; df=1; p=.06</td>
</tr>
<tr>
<td>microsimulation</td>
<td>8.7</td>
<td>10.4</td>
<td></td>
</tr>
<tr>
<td>Number of Severe Asthma</td>
<td>1.9</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>microsimulation attempts</td>
<td>1.5</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Total time on Severe Asthma</td>
<td>19.3</td>
<td>12.2</td>
<td></td>
</tr>
<tr>
<td>microsimulation</td>
<td>10.4</td>
<td>7.5</td>
<td></td>
</tr>
</tbody>
</table>

Knowledge Retention: Performance on the OCSE. As noted in Table 11, a larger percentage of students in the MicroSim group than in the Lecture group performed the steps associated with the initial state of the OSCE. MicroSim students significantly more often than Lecture students assessed oxygen saturation. The difference approached significance (p=.06) on assess respiratory rate.

Table 11. Percentage of Students who performed each step: Initial State

<table>
<thead>
<tr>
<th>Step in Initial State</th>
<th>Lecture</th>
<th>MicroSim</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess temperature</td>
<td>86</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>Assess blood pressure</td>
<td>86</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Assess respiratory rate</td>
<td>64</td>
<td>89</td>
<td>3.4; df=1; p=.06</td>
</tr>
<tr>
<td>Assess apical heart rate</td>
<td>68</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Assess pulses</td>
<td>14</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Note retractions</td>
<td>73</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Auscultate lungs</td>
<td>96</td>
<td>94</td>
<td></td>
</tr>
</tbody>
</table>
Note bilateral wheezing 73 61
Place on EKC monitor 91 83
Place on pulse oximeter 86 78
Assess oxygen saturation 55 83 3.7; df=1; p=.05
Elevate head of bed 77 94

Table 12 shows that a significantly larger percentage of students in the MicroSim group noted cyanosis in the assessment part of the OCSE. If in the assessment phase, the student did not administer oxygen within five minutes, the scenario took the student to a distress situation. Two students failed to administer oxygen; one from each instructional group. The student in the MicroSim group recovered and moved back to the care protocol while the student in the Lecture group failed to take effective action and SimBaby experienced a cardiac arrest.

Table 12. Percentage of Students who performed each step: Assessment

<table>
<thead>
<tr>
<th>Step</th>
<th>Lecture</th>
<th>MicroSim</th>
<th>Chi square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess oxygen saturation</td>
<td>82</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Note cyanosis</td>
<td>36</td>
<td>67</td>
<td>3.6; df=1; p=.05</td>
</tr>
<tr>
<td>Administer oxygen</td>
<td>91</td>
<td>78</td>
<td></td>
</tr>
</tbody>
</table>

Table 13 indicates that there were no differences in the students’ performances on the post-intervention segment of the OSCE associated with group membership. If the student did not obtain the PCP orders (Table 5), the student was taken to a distress situation. No student was taken to the distress situation.

Table 13. Percentage of Students who performed each step: Post-Intervention

<table>
<thead>
<tr>
<th>Step</th>
<th>Lecture</th>
<th>MicroSim</th>
<th>Chi square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note retractions</td>
<td>9</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Auscultate lungs</td>
<td>36</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Note wheezing bilaterally</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Assess oxygen saturation</td>
<td>32</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Assess respiratory rate</td>
<td>32</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Obtain PCP orders</td>
<td>96</td>
<td>89</td>
<td></td>
</tr>
</tbody>
</table>

If the student did not give Albuterol (Table 14), the student was taken to a distress situation. Only one student went to this distress situation; he/she was in the Lecture group. SimBaby experienced a cardiac arrest.

Table 14. Percentage of students who performed each step: PCP orders

<table>
<thead>
<tr>
<th>Step</th>
<th>Lecture</th>
<th>MicroSim</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check patient ID band with PCP orders</td>
<td>14</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Give Albuterol</td>
<td>100</td>
<td>94</td>
<td></td>
</tr>
</tbody>
</table>

If the student did not give the second dose of albuterol and the oral prednisolone (see Table 15), the student was taken to a distress situation. Five students went to this distress situation.
situation; 3 were in the Lecture group and two in the MicroSim group. For four students care progressed to cardiac arrest. Three of these students were in the Lecture group and one was in the MicroSim group.

Table 15. Percentage of Students who performed each step: Reassessment

<table>
<thead>
<tr>
<th>Step</th>
<th>Lecture</th>
<th>MicroSim</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note retractions</td>
<td>10</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Auscultate lungs</td>
<td>80</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Note wheezing bilaterally</td>
<td>0</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Assess oxygen saturation</td>
<td>35</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Assess respiratory rate</td>
<td>30</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Note tachycardia</td>
<td>40</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Check patient ID band with PCP orders</td>
<td>10</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Give Albuterol</td>
<td>85</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Give oral prednisolone using oral syringe</td>
<td>80</td>
<td>83</td>
<td></td>
</tr>
</tbody>
</table>

Eighteen of the Lecture group students (82%) and 16 of the MicroSim group students (89%) successfully progressed to the final performance step of Reassessment. Table 16 shows no significant differences in their performance on the reassessment steps.

Table 16. Percentage of students who performed each step: Reassess Post Albuterol

<table>
<thead>
<tr>
<th>Step</th>
<th>Lecture</th>
<th>Microsim</th>
<th>Chi square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess respiratory rate</td>
<td>28</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Note retractions gone</td>
<td>11</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Auscultate lungs</td>
<td>78</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Note wheezing gone</td>
<td>39</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Note tachycardia</td>
<td>61</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Assess oxygen saturation</td>
<td>67</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Discontinue oxygen</td>
<td>67</td>
<td>88</td>
<td></td>
</tr>
</tbody>
</table>

For 5 Lecture group students (23%), SimBaby progressed to cardiac arrest. For 1 MicroSim group student (5%), SimBaby progressed to cardiac arrest. The Fisher Exact test did not reach significance.

Accuracy and timeliness of care decisions. More of the students in the MicroSim group (53%) than in the Lecture group (47%) performed the critical care steps in correct order; however, this difference was not statistically significant. For each step, students’ times were included only if they completed the step in order. Means and standard deviations for these steps are provided in Table 17.

Times were not computed for Step 4 (time to read orders to administer the first dose of drug) as both were within reach and did not simulate actual clinical performance. Time for Step 5 (time between drug doses) was not included as the orders stated to wait 15 minutes between doses but the instructor guided students to ‘advance time’; so did and
others didn’t. Time for Step 6 was not included as most students demonstrated uncertainty about when or if to discontinue oxygen even though orders directed them to do so if oxygen saturation stayed about 97%.

Table 17. Average minutes to critical care steps

<table>
<thead>
<tr>
<th>Critical Care Step</th>
<th>Lecture n</th>
<th>Mean</th>
<th>SD</th>
<th>MicroSim n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start of care to elevation of head of the bed</td>
<td>15</td>
<td>1.7</td>
<td>2.2</td>
<td>13</td>
<td>1.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Elevation of head of bed to administer oxygen</td>
<td>10</td>
<td>3.2</td>
<td>1.9</td>
<td>10</td>
<td>4.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Administer oxygen to get orders</td>
<td>11</td>
<td>1.5</td>
<td>1.6</td>
<td>13</td>
<td>1.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Discussion and Conclusions**

The students performed equally well on measures of knowledge acquisition. On paper and pencil examinations, students in the MicroSim group did as well as students in the Lecture group.

Students in the MicroSim group had better knowledge transfer scores (first attempt on Severe Asthma microsimulation) than did students in the Lecture Group. Students who learned airway management via the Acute Asthma microsimulation had a better understanding of how to manage a patient with airway dysfunction (Severe Asthma) than did students who learned the content by attending the lecture. Familiarity with microsimulation is unlikely to have resulted in the difference in performance on the first attempt scores on the Severe Asthma microsimulation as all students had prior experience with microsimulation; however, no measure of the extent to which students had prior experience was obtained from them. The absence of a difference in the number of attempts also suggests that familiarity with microsimulation was not a factor in the better performance of the MicroSim group students.

With repetition, differences in knowledge transfer scores (best score on Severe Asthma) disappeared. The number of attempts was comparable for students in each group; however, students in the Lecture group spent more time engaged in the Severe Asthma microsimulation.

Students in the MicroSim group had better knowledge retention, as demonstrated by performance on the OSCE, than students in the Lecture group on three key assessment actions: checking respiratory rate, checking oxygen saturation, and noting cyanosis. Although not statistically significant, students in the Lecture group more often than students in the MicroSim group provided care that led to worsening condition of the patient. There were no differences in the timeliness of students’ care actions associated with instructional approach.

Regardless of how a student initially learned airway management, those with a cognitive learning style had more attempts and were engaged longer in the Severe Asthma microsimulation than were students with an analytical or global learning style. Those with a cognitive learning style performed as well as those with analytical or global
learning styles on the Severe Asthma microsimulation but they needed longer engagement times and more attempts. Among these students, very few had a cognitive style of learning.

All students were receptive to microsimulation. Students in the Lecture Group reported higher agreement than did students in the MicroSim group with the statement that the microsimulation strengthened their understanding of the concepts and principles of airway management. Both groups of students agreed that engaging the microsimulation challenged their ability to think.

In this study, learning principles and concepts of airway management was significantly aided by the use of microsimulation. Even though students were required to complete the Severe Asthma microsimulation only once and their performance scores were not included in course grade determination, many elected to work through it multiple times and reported that doing so helped them learn airway management. Given the opportunity to engage in the Severe Asthma microsimulation as often as desired, students’ average performances were improved for all and were comparable across instructional groups.

One hypothesis for the longer engagement time among students in the Lecture group is that they were reviewing/learning airway management content from the microsimulation. Since these data were not collected in this study, the hypothesis cannot be evaluated but deserves study.

Student receptivity to microsimulation as well as their choice to repeat engagement with the Severe Asthma microsimulation suggests that microsimulation facilitates knowledge acquisition and reinforcement. Unlike the one time presentation of content provided in the lecture, students had unlimited access to the microsimulation. They could and did engage it as often as they wished; it engaged them in active learning and learning was under their control.

Their pattern of engagement suggests that competition, desire to improve their performance and thus achieve higher scores, may have been a factor in repeated engagement; they were trying to ‘beat the house’ and figure out the best way to treat the patient. Perhaps the similarities between microsimulation and electronic gaming played a role in students’ positive receptivity and repeated engagement with the electronic virtual-reality type learning experience. Further study of students’ reasons for attempting the Severe Asthma microsimulation more than once and the ways in which they used additional attempts is needed to understand the ways in which microsimulation facilitates learning.

The concepts and principles of airway management are not linked to age of the patient. The microsimulations (Acute Asthma and Severe Asthma) dealt with adults rather than pediatric patients; but students’ performances were not adversely affected. Their receptivity responses indicate that the use of adult patients in the microsimulation did not detract from their learning nor their assessment of the usefulness of microsimulation to learn airway management. Learning concepts in this way, across patient population
groups defined by age, may facilitate knowledge transfer and contribute to improved patient care outcomes.

**Dissemination Plan**

In manuscripts submitted for publication, on posters presented, and in presentations made the following acknowledgements will be included

*This study was funded by Laerdal Medical Corporation. Thanks to Tiffany Holmes, D.C., Director, and her staff in the Smart Hospital™ for their support of this project. Thanks to the students who participated in this study.*

The project team plans to submit for publication at least two manuscripts

1. One that focuses on the results from the first semester
2. A second that presents the OSCE results.

At the time of submission of this final report, one abstract had been accepted for presentation at a national conference (Appendix Q). It will be presented at the Contemporary Forums: Mosby’s Faculty Development Institute in Orlando, Florida in January 2009. A second abstract (Appendix R) submitted for the International Meeting of the Society for Simulation in Healthcare (conference scheduled for January 10-14, 2009 in Lake Buena Vista, Florida) was not accepted.
Appendix A: Proposal submitted to Laerdal Medical Corporation

**Phase I: Pilot Study, Spring 2007**

We propose a pilot study in Spring 2007 to insure that all systems are operating as needed to fully evaluate the efficacy of replacing lecture with MicroSim.

**Question:** What are the differences in knowledge acquisition and learning transfer when principles and concepts of airway management are taught in either of two pedagogically proper and accepted ways: lecture and computer based simulation.

**Procedure:** Students enrolled in the Undergraduate Pediatric Nursing course will be randomized to receive content on the principles and concepts of airway management via lecture (the current method of delivery) or to complete the mild asthma MicroSim exercise. Each is expected to take about an hour of student time. In all other respects, students will complete the same course activities including

- participating in a scenario-based simulation (RSV Bronchiolitis with SimBaby)
- completing a second MicroSim (pneumonia)
- participating in pre-class clinical orientation that includes pediatric assessment
- taking all course paper and pencil examinations.

**Subjects.** 50 BSN students enrolled in the Pediatric Nursing course. Half will be assigned to each instructional modality.

**Outcome measures:** We will use student performance on each of the following to evaluate the efficacy of replacing lecture with MicroSim. To assess knowledge acquisition, we will use

- paper and pencil examination items related to airway management (% correct score on these items).
- performance on a scenario-based simulation exercise: RSV bronchiolitis with SimBaby. This is a group learning activity that we will videotape. We will assess student performance using an assessment form developed for this study (% correct score and overall rating)

To assess transfer of learning, we will assess

- performance on the pneumonia MicroSim (performance score provided by MicroSim).

**Timeline:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 11</td>
<td>IRB application submitted</td>
</tr>
<tr>
<td>Week of December 11</td>
<td>Planning meeting with Laerdal representatives to insure that MicorSim is working as desired</td>
</tr>
<tr>
<td>Week of Jan 8</td>
<td>Dry run</td>
</tr>
<tr>
<td>January 26</td>
<td>Students complete lecture or MicroSim to learn principles and concepts of airway management</td>
</tr>
<tr>
<td>February 2</td>
<td>Students complete simulation with SimBaby</td>
</tr>
</tbody>
</table>
Late February    Students complete pneumonia MicroSim
May         Students take final examination in the course
End of May   Analyses completed
June        Report ready for distribution

*Completed

Expected results.
- Methods and procedures for conducting the comprehensive study confirmed and/or modified.
- Comfort level of teaching team is increased along with confidence in learning outcomes associated with MicroSim.
- Data support use of MicroSim to replace lecture.
- Readiness to plan comprehensive study.

Phase II. Plan and conduct a comprehensive evaluation of the efficacy of replacing lecture with MicroSim

Question. What are the differences in knowledge acquisition, learning transfer, and retention when principles and concepts of airway management are taught in either of two pedagogically proper and accepted ways: lecture and computer based simulation learning.

Content area: Airway management

Procedure: The general strategy, subject to the results of the pilot, will involve:
1. All students take a knowledge pre-test.
2. Students will then be randomized to listen to lecture or complete the mild asthma and pneumonia MicroSims.
3. All students take a knowledge post-test.
4. All students participate in a BabySim scenario (group exercise on RSV Bronchiolitis) within the same timeframe.
5. All students debrief with faculty on their performance on the scenario.
6. At the end of the course (end of first senior semester), each student is evaluated on care of a pediatric patient with foreign body obstruction (objective structured clinical examination (OSCE); MicroSim and clinical simulation).
7. At the end of the program (end of second senior semester), each student is evaluated on care of a pediatric patient with respiratory arrest (objective structured clinical examination; MicroSim and clinical simulation).

Subjects: 100 BSN students enrolled in the Undergraduate Pediatric Nursing Course

Outcome Measures:
- Knowledge pre-post test scores
- Performance on BabySim simulation
- Foreign body obstruction
Respiratory arrest

Timeline
June through August  Design the knowledge pre and post tests
                  Develop and test the OSCEs
                  Obtain IRB approval
                  Plan logistics for conducting the study
August  Orient students to the study and begin the study
September through Dec  Conduct the study (steps 1 through 6 above).
Dec to mid Jan  Revise study materials based on results of Fall
                Implementation
January  Start second iteration of the study
April  Conduct the final OSCE for the group who completed the
       Pediatric course in December (step 7 above)
May  Complete data preparation for analyses
June  Conduct all data analyses, prepared reports
July  Disseminate study results
Appendix B

UTASON MicroSim Research Project
Summary of 4/4/07 meeting

Research group members in attendance:  C. Cason, V. Hartman, B. Mancini, K. Nelson, J. Roye

The findings related to the pilot study conducted during Spring 07 with N4431 Sr. 1 nursing students were reviewed. Plans for the actual study to be initiated with N4431 Sr. 1 students during Fall 07 were developed.

The research group members agreed to meet again during the third week of August to prepare for study implementation.

**Proposed New Design for MicroSim Research Study:**

1) Implementation will begin fall semester of 2007 with the Senior 1 students who are registered for N4431, Nursing of Children and Adolescents and will extend through spring semester 2008 for the same students who will then be Senior 2 students registered for N4350 Capstone.

2) The students participating in the study will be referred to as ‘ALL students.’ In order to participate in the study, students must sign the *Informed Consent form* and complete the *Prior MicroSim Experience Survey* to document the work they have already done with the MicroSim Inhospital modules. It is estimated that the number of students beginning the study will be 100.

3) Students will be randomly assigned to one of two groups: M = MicroSim group and L = Lecture group. Randomization will be done as shown below:

<table>
<thead>
<tr>
<th>Student initials</th>
<th>Group</th>
<th>Student initials</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA</td>
<td>M</td>
<td>JA</td>
<td>M</td>
</tr>
<tr>
<td>RB</td>
<td>L</td>
<td>FB</td>
<td>L</td>
</tr>
<tr>
<td>DC</td>
<td>M</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>EC</td>
<td>L</td>
<td>LD</td>
<td>L</td>
</tr>
<tr>
<td>DD</td>
<td>M</td>
<td>SE</td>
<td>M</td>
</tr>
<tr>
<td>FD</td>
<td>L</td>
<td>TF</td>
<td>L</td>
</tr>
</tbody>
</table>

4) On or before Senior 1 orientation on 8/20/07, the LRC staff will verify that all Senior 1 students registered for N4431 have already created a MicroSim Inhospital log-in. Any student who has not created a MicroSim log-in will be instructed to do so by 8/31/07.

5) ALL students will be informed about the study and asked to sign the *Informed Consent form* during the first day of N4431 class on 8/31/07 by Kristine Nelson, Lead Teacher. ALL students will also complete the *Prior MicroSim Experience Survey* that same day.

6) LRC staff will ensure that all student MicroSim Inhospital log-ins have been activated by 8/31/07

7) ALL students will be instructed to complete the *Airway and Breathing: Introduction* module between 8/3107 and 9/14/07 at 9 AM. ALL students will turn in a printed *Debriefing* document that is at the maximum detail end of the spectrum and that includes the student’s performance score to Kristine Nelson by 0900 on 9/14/07. This is a requirement for the N4431 clinical component of the course.
8) On 9/14/07, ALL students will go to the classroom (PKH 104) at 0900 for one hour of lecture on Cystic Fibrosis and other respiratory system content presented by Jennifer Roye, RN, MSN, CPNP. A printed outline of this lecture content will be provided to ALL students via Web CT.

a. ALL students will be given a 5 to 10 question PRE/Post Test at 1000 to 1010.

b. Students will have a 10 minute break from 1010 to 1020. The Lecture group will return to PKH 104. The MicroSim group will go to PKH 216.

c. The Lecture group will have a 30 minute lecture from 1020 to 1050 by Ms. Roye on RSV bronchiolitis, asthma, and airway management. The Lecture group will receive a printed set of lecture notes for this lecture to be distributed at the beginning of the lecture.

d. The MicroSim group will do the Chris Harbour, Acute Asthma MicroSim Inhospital module from 1020 to 1050. The MicroSim group will print the Debriefing document and provide it to the proctor in room 216. The MicroSim group will NOT receive a copy of the lecture notes given to the Lecture group.

e. ALL students will return to room 104 at 1100 for the continuation of class and Ms. Roye’s lecture on respiratory system dysfunction in children. For this portion of lecture content, ALL students will be provided an outline via Web CT.

f. ALL students will take a 5 to 10 question Pre/POST Test from 1150 to 1200. This will be counted for course credit as a quiz.

9) On 9/21/07 from 0830 to 1230, ALL students will participate in Simulation Training Laboratory using SimBaby and the RSV bronchiolitis scenario, as an educational process. These simulation training sessions will NOT be videotaped and the SimBaby Debriefing data will NOT be collected. There will be three simultaneous training sessions occurring at one time with six to eight students per group with one faculty member and one standardized patient. Each training session will last approximately 45-50 minutes.

10) ALL students will complete the MicroSim Michael Reynolds, Severe Asthma module using a LRC computer during the two weeks that follow the simulation training laboratory.

11) ALL students turn in Michael Reynolds module Debriefing document (maximum detail) on 10/5/07 at 0900. This is a requirement for the N4431 clinical component of the course. All students will be required to turn this document in PRIOR to taking Exam #1 on 10/5/07.

12) ALL students will participate in an “end of program” Objective Standardized Clinical Evaluation (OSCE) using SimBaby as the patient and a standardized patient as the parent with a programmed evaluation scenario related to airway management and asthma/bronchiolitis during Spring 08 semester as a part of their N4350 Capstone course work. Students will be given clinical hours credit for Capstone for participating in this OSCE.

13) Each OSCE session will be taped and students will turn in their SimBaby Debriefing Log.

14) Faculty will review each student’s videotape and debriefing log. Using a standardized tool, faculty will “score” the performance of each student during the airway management OSCE.
Several action items related to the initiation of the study during Fall 07 were discussed. The following is a list of these action items and a proposal for who will be responsible for each item and the time frame for accomplishing each item:

<table>
<thead>
<tr>
<th>Completion Date</th>
<th>Responsible Person(s)</th>
<th>Action Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Nelson</td>
<td>Meet or talk with Laerdal representatives (Clint) about ways to streamline the printing function of the MicroSim Debriefing documents (Could these be printed by staff after completion of the modules instead of individually printed by students?)</td>
</tr>
<tr>
<td>2)</td>
<td>Nelson</td>
<td>Create Pre/Post Test 95 to 10 questions)</td>
</tr>
<tr>
<td>3)</td>
<td>Nelson</td>
<td>Develop a list of research group member responsibilities with time frames in order to prepare for initiating the MicroSim Research Study in the Fall 07.</td>
</tr>
<tr>
<td>4)</td>
<td>Hartman</td>
<td>Develop check list and sign off document for LRC staff responsibilities.</td>
</tr>
<tr>
<td>5)</td>
<td>Cason</td>
<td>Revise and submit new IRB proposal (with updated Informed Consent form) to reflect study changes.</td>
</tr>
<tr>
<td>6)</td>
<td>Nelson</td>
<td>Write specific instructions for accessing, transferring the patient at the end, submitting the module for credit, and printing the Debriefing document, etc. for Airway and Breathing: Introduction, the Chris Harbour, Acute Asthma module and the Michael Reynolds, Severe Asthma module. Master print debrief forms for each student.</td>
</tr>
<tr>
<td>7)</td>
<td>Nelson</td>
<td>Verify with LRC staff that the current Jr. 2 and Fall 07 Sr. 1 students all have activated MicroSim log ins.</td>
</tr>
<tr>
<td>8)</td>
<td>Roye</td>
<td>Revise and re-sequence the Respiratory System Dysfunction lecture, create a power point and outline for all lecture content EXCEPT the airway management/ asthma/ bronchiolitis section, and create a power point and outline for airway management/ asthma/bronchiolitis section.</td>
</tr>
<tr>
<td>9)</td>
<td>Rose Smith *</td>
<td>Develop an OSCE using SimBaby and a standardized patient as a parent to evaluate student knowledge and skills related to airway management with bronchiolitis and asthma.</td>
</tr>
<tr>
<td>10)</td>
<td>Rose Smith *</td>
<td>Program SimBaby with an OSCE that will evaluate student knowledge and skills related to airway management with bronchiolitis and asthma.</td>
</tr>
</tbody>
</table>
12) All researchers Run a trial of the MicroSim study design with faculty and graduate students during Summer 07.

13) Rose Smith * Run a trial of the SimBaby OSCE with faculty and graduate students during Fall 07. Videotape these sessions.

14) Nelson Randomized N4431 students into two groups.

15) Nelson Establish student schedule for N4431 that incorporates the MicroSim Study related to dates and required work for clinical and course credit.

16) Hartman Prepare detailed script for standardized patients who will serve as the parent to SimBaby during Respiratory Simulation Lab Training.

17) Hartman Recruit and train at least two additional standardized patients to serve as the parent to SimBaby.

18) Mancini Hire a GTA to support the study and supervise this graduate student’s Completion project.

19) Nelson Meet with LRC staff and submit requests for Simulation Lab use date (9/21/07) and use of 216 computer lab date (9/14/07).

20) Nelson Discuss with Capstone Lead Teacher: Sr. 2 students get 2 to 4 clinical hours credit for Capstone for participation in the OSCE.

* Rose Smith will do this work as part of her completion project for her master degree in nursing. She will also work as a GTA with the N4431 course.

5/10/07/kn
Appendix C. Instruction to students learning via microsimulation

MicroSim Instructions                                Student Name: ______________________
N4431 F 07    9/21/07

1. Log in to LRC computer.

2. Double click on MicroSim InHospital icon.

3. Enter Login and password:

   Login: ____________________   Password: (same as login)___

4. Single click on: OK

5. Single click on Airway & Breathing in the column on the left.

6. Single click on Chris Harbour in the column on the right.

7. Single click on “Go see Chris Harbour” to begin the module.

8. Proceed with the module.

9. You can control time by clicking on the icons in the gray “Time” box near the top right corner of the screen.

   Time: 10:18

   ⏯   ⏯   II   ■

A single click to the ⏯, will advance time by one hour per click. A single click to the II will pause the scenario and a single click to the ⏯ will resume the scenario.

DO NOT click on the square, opaque box ●.

10. When you are ready to end the module – you MUST TRANSFER the patient.
    Single click on box in the bottom, right corner of the screen and then click on the location where you want to send your patient.

11. After the transfer, you will see a screen with a diagram related to your performance. At the bottom of the screen, you will see a statement “Please assess yourself: Was this a correct way to treat the patient?” Single click on the box:

    Yes. it was OK

12. You will then see information displayed that states you “passed this case” or “did not pass”. With either statement, single click on:

    OK

13. Please view the debriefing information. You DO NOT PRINT this debriefing.
14. To end the scenario, single click on the X at the top right corner of the screen.
Appendix D. Exam Questions

Exam #1 given on 10/5/2007

26. Which one of the following medications is usually given FIRST, via the inhalation route in the emergency treatment of an acute, severe asthma episode in a young child?
   a. Corticoidsteroid.
   b. Leukotriene modifier.
   c. $\beta_2$-adrenergic agonist.
   d. Methylxanthine.

30. When planning care for a 4-month-old child admitted with respiratory distress caused by respiratory syncytial virus (RSV) and bronchiolitis, it is essential to include which one of the following?
   a. Give antibiotics.
   b. Ensure hydration status.
   c. Administer cough syrup.
   d. Feed 4 ounces of formula every 4 hours.

46. A child has a chronic cough and diffuse wheezing during the expiratory phase of respiration. This suggests which of the following?
   a. Asthma.
   b. Pneumonia.
   c. Croup.
   d. Foreign body in trachea.

54. Systemic corticosteroids are used to treat acute exacerbations of asthma symptoms in children. Their primary action is to
   a. relax bronchial smooth muscles.
   b. reduce airway inflammation.
   c. liquefy secretions in the bronchioles.
   d. block the allergic cascade.

Final Exam given on 12/11/2007

52. Beta$_2$-adrenergic agonists are often prescribed for children suffering asthma attacks. What is their action?
   A. Liquefy secretions.
   B. Dilate the bronchioles.
   C. Reduce inflammation of the lungs.
   D. Reduce infection.

70. A 3-month-old previously healthy infant is admitted to the hospital for treatment of bronchiolitis. His vital signs are 40.2$^\circ$ C, HR 162, respiratory rate 70. He is irritable, fussy, and coughs frequently. Oxygen is ordered primarily to
   A. reduce fever.
   B. allay anxiety and restlessness.
   C. liquefy secretions.
   D. relieve dyspnea and hypoxemia
Appendix E. MicroSim Module Clinical Requirement

Hi Student,

There is a requirement for All N4431 students to complete one (1) MicroSim Module on asthma. The module is titled “Michael Reynolds” and addresses care of a patient with severe, acute asthma.

Completion of this module counts for one hour of clinical credit. It is not directly related to the MicroSim study. The due date for ALL N4431 students to complete this module is Thursday, October 11, 2007 at 8 PM (2000). You must do this work on a computer in the LRC.

Posted on Web CT are instructions for how to complete this module correctly.

Your login and password are: _________________________ (login and password) are the same. You must use this login to receive credit for N4431.

You do not have to print documentation following completion of the module as your clinical instructor will be able to access the data via the LRC computers.

If you have any questions about this requirement or have any login problems, please email me or your N4431 clinical instructor. Thank you. Kris Nelson
Appendix F. Severe Asthma Directions

N443 Fall 2007 Instructions for "Michael Reynolds" Severe Asthma module
Completion of required assignment = one (1) hour of clinical hours credit
**DUE DATE = THURSDAY, @ 2000**

1. Log in to LRC computer.
2. Double click on MicroSim InHospital icon.
3. Enter your individual login password for N4431 course (login & password are the same):
4. Single click on **OK**
5. Single click on *Airway & Breathing* in the column on the left.
6. Single click on *Michael Reynolds* in the column on the right.
7. Single click on "Go see Michael Reynolds" to begin the module.
8. Proceed with the module.
9. You can control time by clicking on the icons in the gray "Time" box near the top right corner of the screen.

```
Time: 10:18
```


**DO NOT** click on the square, opaque box.

10. When you are ready to end the module - **you MUST TRANSFER the patient**. Single click on box in the bottom, right corner of the screen and then click on the location where you want to send your patient.

11. After the transfer, you will see a screen with a diagram related to your performance. At the bottom of the screen, you will see a statement "Please assess yourself: Was this a correct way to treat the patient?" Single click on **Yes, it was OK**

12. You will then see information displayed that states you "passed this case" or "did not pass". With either statement, single click on: **OK**

13. Please view the debriefing information. You **DO NOT PRINT** this debriefing.

14. To end the scenario, single click on the X at the top right corner of the screen.
Appendix G. Case brief
### UTASON MicroSim Research Project OSCE
Student Performance Evaluation Tool for Pediatric Respiratory

**REVISED 6/5/08**

**INITIAL STATE**

<table>
<thead>
<tr>
<th>Nursing Action</th>
<th>Completed</th>
<th>Not completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON PAUSE, STUDENTS READ INTRO, THEN CLICK ON ARROW TO START</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Assess - temp</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>2. Assess - BP (normal= 94/66)</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>3. Assess - resp. rate (tachypnea=62)</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>4. Assess - apical heart rate (↑164)</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>5. Assess - pulses</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>6. Note retractions</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>7. Assess- auscultate lungs</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>8. Note bilateral wheezing</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>9. Place on EKG monitor</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>10. Place on pulse ox</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>11. Assess - O₂ sat (95-96%)</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>12. Elevate HOB</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

When put on EKG & Pulse Ox monitors, click on NEXT

**ASSESSMENT**  **Event = O₂ sat drops to 88% (trend over 1 min.)**

<table>
<thead>
<tr>
<th>Event = O₂ sat drops to 88% (trend over 1 min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Assess - O₂ sat (87-88%)</td>
</tr>
<tr>
<td>14. Note cyanosis</td>
</tr>
<tr>
<td>15. Administers oxygen @ 1-2L/min- mask</td>
</tr>
</tbody>
</table>

When oxygen administered, click on (1) NEXT

**If O₂ not given after 5 minutes – go to DISTRESS (1)**

**POST INTERVENTION**  **Event = giving oxygen per mask @ 1-2 L/min**

<table>
<thead>
<tr>
<th>Event = giving oxygen per mask @ 1-2 L/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. Note retractions</td>
</tr>
<tr>
<td>17. Assess - auscultate lungs</td>
</tr>
<tr>
<td>18. Note wheezing bilaterally</td>
</tr>
<tr>
<td>19. Assess - O₂ sat(91-92%)</td>
</tr>
<tr>
<td>20. Assess - resp. rate (tachypnea = 60)</td>
</tr>
<tr>
<td>21. Obtain PCP orders/read orders</td>
</tr>
</tbody>
</table>
When student obtains PCP orders (opens envelope), click on (2)NEXT

If no PCP orders obtained after 5 minutes – go to DISTRESS (2)

PCP ORDERS  Event = administers Albuterol #1

22. Check patient ID band with PCP orders  □  □
23. Give Albuterol #1 - inhaler, spacer, mask  □  □

When student completes administering Albuterol #1 via MDI, click on (3)NEXT

If no Albuterol #1 given after 5 minutes – go to DISTRESS (3)

REASSESSMENT  Event = Albuterol #1 given; 15-20 mins later

24. Note retractions continue  □  □
25. Assess - auscultate lungs  □  □
26. Note wheezing bilaterally  □  □
27. Assess - O₂ sat (92%)  □  □
28. Assess - resp. rate (trends down to 52)  □  □
29. Note tachycardia (trends up to 190)  □  □
30. Check patient ID band with PCP orders  □  □
31. Give Albuterol #2 - inhaler, spacer, mask  □  □
32. Give oral prednisolone using oral syringe  □  □

When student completes administering Albuterol #2 via MDI & oral prednisolone, click on (4)NEXT

If no Albuterol #2 & oral pred. given after 15 minutes – go to DISTRESS (4)

REASSESS POST ALBUTEROL #2  Event = Albuterol #2 & Oral Pred. given; 15-20” later

33. Assess - resp. rate (trends down to 34)  □  □
34. Note retractions are gone  □  □
35. Assess - auscultate lungs  □  □
36. Note wheezing is gone – normal  □  □
37. Note tachycardia (192)  □  □
38. Assess – O₂ sat 99% (trends up over 1 min)  □  □
39. Discontinue oxygen by mask  □  □

Total  ___  ___

OSCE ENDS

Print Debrief and write student’s name, date, time on sheet
Save to G Drive as follows: student first initial and last name OSCE date
Example: knelson OSCE 2 11 08

**DISTRESS (1)** Event = DID NOT GIVE \(O_2\)

1. Note retractions
2. Assess - resp. rate (tachypnea = 70)
3. Assess - \(O_2\) sat (85%)
4. Note cyanosis
5. Administers oxygen @ 1-2L/min- mask

After oxygen administered, click on NEXT - Go to POST INTERVENTION

If \(O_2\) NOT given after 3 minutes – go to CARDIAC ARREST FROM RESPIRATORY

**DISTRESS (2)** Event = DID NOT OBTAIN PCP ORDERS

1. Note retractions
2. Assess - auscultate lungs
3. Note wheezing bilaterally
4. Assess - \(O_2\) sat (85%)
5. Assess - resp. rate (tachypnea = 70)
6. Obtain PCP orders/read orders

After obtain/read PCP orders, click on NEXT - Go to PCP ORDERS

If PCP orders NOT obtained after 3 minutes – go to CARDIAC ARREST FROM RESPIRATORY

**DISTRESS (3)** Event = DID NOT GIVE ALBUTEROL #1

1. Note retractions
2. Assess - auscultate lungs
3. Note wheezing bilaterally
4. Assess - \(O_2\) sat (85%)
5. Assess - resp. rate (tachypnea = 70)
6. Check patient ID band with PCP orders
7. Give Albuterol #1 - inhaler, spacer, mask

After Albuterol #1 via MDI given, click on NEXT - Go to REASSESSMENT

If Albuterol #1 NOT given after 3 minutes – go to CARDIAC ARREST FROM
RESPIRATORY

DISTRESS (4)  Event = DID NOT GIVE ALBUTEROL #2 & ORAL PRED
1. Note retractions
2. Assess - auscultate lungs
3. Note wheezing bilaterally
4. Assess - \( O_2 \) sat (85%)
5. Assess - resp. rate (tachypnea = 70)
6. Check patient ID band with PCP orders
7. Give Albuterol #2 - inhaler, spacer, mask
8. Give oral prednisolone using oral syringe

After Albuterol #2 MDI & oral prednisolone given, click on NEXT - Go to REASSESS POST ALBUTEROL #2

If Albuterol #2/oral pred. not given after 3 minutes – go to CARDIAC ARREST FROM RESPIRATORY

CARDIAC ARREST FROM RESPIRATORY  Event = DID NOT COMPLETE STEPS IN DISTRESS (1), (2), (3) OR (4)

Trends to full arrest over 1.5 to 2 mins.
1. Note asystole
2. Note no respirations
3. Note \( O_2 \) sat (0%)
4. Attempt to resuscitate using Ambu Bag
5. Perform CPR

OSCE ENDS
### Nursing Action

**INITIAL STATE**

<table>
<thead>
<tr>
<th>Nursing Action</th>
<th>Completed</th>
<th>Not completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON PAUSE, STUDENTS READ INTRO, THEN CLICK ON ARROW TO START</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40. Assess - temp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41. Assess - BP (normal = 94/66)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42. Assess - resp. rate (tachypnea = 62)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43. Assess - apical heart rate (↑164)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44. Assess - pulses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45. Note retractions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46. Assess - auscultate lungs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47. Note bilateral wheezing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48. Place on EKG monitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49. Place on pulse ox</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50. Assess - O₂ sat (95-96%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>51. Elevate HOB</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When put on EKG & Pulse Ox monitors, click on NEXT

**ASSESSMENT**  
Event = O₂ sat drops to 88% (trend over 1 min.)

<table>
<thead>
<tr>
<th>Nursing Action</th>
<th>Completed</th>
<th>Not completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>52. Assess - O₂ sat (87-88%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53. Note cyanosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>54. Administers oxygen @ 1-2L/min- mask</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When oxygen administered, click on (1) NEXT

**POST INTERVENTION**  
Event = giving oxygen per mask @ 1-2 L/min

<table>
<thead>
<tr>
<th>Nursing Action</th>
<th>Completed</th>
<th>Not completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>55. Note retractions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56. Assess - auscultate lungs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>57. Note wheezing bilaterally</td>
<td></td>
<td></td>
</tr>
<tr>
<td>58. Assess - O₂ sat (91-92%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>59. Assess - resp. rate (tachypnea = 60)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
60. Obtain PCP orders/read orders

When student obtains PCP orders (opens envelope), click on (2) NEXT
If no PCP orders obtained after 5 minutes – go to DISTRESS (2)

PCP ORDERS  Event = administers Albuterol #1

61. Check patient ID band with PCP orders

62. Give Albuterol #1 - inhaler, spacer, mask

When student completes administering Albuterol #1 via MDI, click on (3) NEXT
If no Albuterol #1 given after 5 minutes – go to DISTRESS (3)

REASSESSMENT  Event = Albuterol #1 given; 15-20 mins later

63. Note retractions continue

64. Assess - auscultate lungs

65. Note wheezing bilaterally

66. Assess - O₂ sat (92%)

67. Assess - resp. rate (trends down to 52)

68. Note tachycardia (trends up to 190)

69. Check patient ID band with PCP orders

70. Give Albuterol #2 - inhaler, spacer, mask

71. Give oral prednisolone using oral syringe

When student completes administering Albuterol #2 via MDI & oral prednisolone, click on (4) NEXT

*If no Albuterol #2 & oral pred. given after 15 minutes – go to DISTRESS (4)

REASSESS POST ALBUTEROL #2  Event = Albuterol #2 & Oral Pred. given; 15-20” later

72. Assess - resp. rate (trends down to 34)

73. Note retractions are gone

74. Assess- auscultate lungs

75. Note wheezing is gone – normal

76. Note tachycardia (192)

77. Assess – O₂ sat 99% (trends up over 1 min)

78. Discontinue oxygen by mask

Total
OSCE ENDS
Print Debrief and write student's name, date, time on sheet
Save to G Drive as follows: student first initial and last name OSCE date
Example: knelson OSCE 2 11 08

**DISTRESS (1) Event = DID NOT GIVE O₂**

6. Note retractions □□
7. Assess - resp. rate (tachypnea = 70) □□
8. Assess - O₂ sat (85%) □□
9. Note cyanosis □□
10. Administers oxygen @ 1-2L/min - mask □□

After oxygen administered, click on NEXT - Go to POST INTERVENTION

If O₂ NOT given after 3 minutes – go to CARDIAC ARREST FROM RESPIRATORY

**DISTRESS (2) Event = DID NOT OBTAIN PCP ORDERS**

7. Note retractions □□
8. Assess - auscultate lungs □□
9. Note wheezing bilaterally □□
10. Assess - O₂ sat (85%) □□
11. Assess - resp. rate (tachypnea = 70) □□
12. Obtain PCP orders/read orders □□

After obtain/read PCP orders, click on NEXT - Go to PCP ORDERS

If PCP orders NOT obtained after 3 minutes – go to CARDIAC ARREST FROM RESPIRATORY

**DISTRESS (3) Event = DID NOT GIVE ALBUTEROL #1**

8. Note retractions □□
9. Assess - auscultate lungs □□
10. Note wheezing bilaterally □□
11. Assess - O₂ sat (85%) □□
12. Assess - resp. rate (tachypnea = 70) □□
13. Check patient ID band with PCP orders □□
14. Give Albuterol #1 - inhaler, spacer, mask □□
After Albuterol #1 via MDI given, click on NEXT - Go to REASSESSMENT
If Albuterol #1 NOT given after 3 minutes – go to CARDIAC ARREST FROM RESPIRATORY

DISTRESS (4)  Event = DID NOT GIVE ALBUTEROL #2 & ORAL PRED
9.  Note retractions
10. Assess - auscultate lungs
11. Note wheezing bilaterally
12. Assess - O₂ sat (85%)
13. Assess - resp. rate (tachypnea = 70)
14. Check patient ID band with PCP orders
15. Give Albuterol #2 - inhaler, spacer, mask
16. Give oral prednisolone using oral syringe

After Albuterol #2 MDI & oral prednisolone given, click on NEXT - Go to REASSESS POST ALBUTEROL #2

If Albuterol #2/oral pred. not given after 3 minutes – go to CARDIAC ARREST FROM RESPIRATORY

CARDIAC ARREST FROM RESPIRATORY  Event = DID NOT COMPLETE STEPS IN DISTRESS (1), (2), (3) OR (4)
Trends to full arrest over 1.5 to 2 mins.

6.  Note asystole
7.  Note no respirations
8.  Note O₂ sat (0%)
9.  Attempt to resuscitate using Ambu Bag
10. Perform CPR

OSCE ENDS
Appendix J. Receptivity Survey

UTASON N4431 Nursing of Children and Adolescents  Fall 2007

MicroSim Survey

MicroSim ID: ___________________

Please take a few minutes and tell us what you thought about the MicroSim computer modules you completed as part of this course.

For each statement indicate the extent to which you agree with the statement using the following key:

SA  Strongly Agree
A   Agree
N   Neither Agree or Disagree
D   Disagree
SD  Strongly Disagree

1. ____ Completing the module(s) strengthened my understanding of the concepts of airway management.

2. ____ The computer module(s) helped me to think through the care requirements of the case.

3. ____ Even though the computer module(s) dealt with adult patients, the content helped me to understand care of pediatric patients.

4. ____ Going through the computer module(s) was frustrating.

5. ____ The computer module(s) helped to make learning fun.

6. ____ Even though I was required to go through each module only once, I chose to go through a module more than one time.

7. ____ The instructions for completing the computer module(s) were difficult to follow.

8. ____ I would like for more of the course content to be taught in this way.

9. ____ The computer module(s) helped to reinforce key concepts of airway management.

10. ____ The computer module(s) helped me plan my care of patients in the clinical setting.

11. ____ The computer module(s) challenged my ability to think.

Please add here any other comments that you have about the computer exercises.
INFORMED CONSENT

PRINCIPAL INVESTIGATOR: Carolyn L. Cason and Mary Elizabeth Mancini

TITLE OF PROJECT: A comparison of two instructional methods on learning airway management principles and concepts

You are being asked to serve as a subject in a research study. It is important that you read this document carefully and then decide if you wish to be a volunteer.

PURPOSE: The purpose of this research study is to evaluate whether there are differences in knowledge acquisition and learning transfer when principles and concepts of airway management are taught using lecture or computer-based simulation (MicorSim). Both ways of learning are valid and research studies have been done that show that lecture plus computer-based simulation learning is effective. There have been no studies that show the difference in learning when computer-based simulation learning replaces lecture. In this research study, you will learn principles and concepts of airway management in one of the two ways so that we can evaluate whether there are differences in learning outcomes.

DURATION

If you agree to participate, you will be randomly assigned to listen to the lecture routinely given by the faculty on airway management or to go to Pickard Hall Room 216 and complete the mild asthma MicroSim case study. Each will take about an hour. Half of your class or 50 students will be assigned to each way of learning. This is the only way in which the two groups will differ. Everyone, regardless of group assignment, will complete all of the course activities and requirements specified in the course syllabus.

PROCEDURES

If, after you have read this document and have had all of your questions answered, you agree to participate in the research study, you will sign this form. Immediately after signing the form, you will be told the group to which you are assigned. If lecture, you will remain in the classroom and listen to the lecture. If MicroSim, you will go to Pickard Hall Room 216 and complete the mild asthma MicroSim. By signing this consent form, you agree to

1. be randomly assigned to one of the two groups
2. participate in learning airway management as presented in the assigned group
3. delay reviewing the content presented in the group to which you were not assigned (view the videotaped lecture if you were assigned to MicroSim or do the MicroSim if you were assigned to lecture)
4. have the course faculty provide to the researchers a percent correct score on those test items related to airway management
5. share the computer printouts created by MicroSim when you complete the foreign body case study (part of the course requirements), and
6. permit the researchers to view the videotape made during the case-based simulation with baby manikin that you will complete as part of your Senior II course requirements.

You will not be tested on airway management until after the requested one week delay. Any tests that you will be asked to complete are part of the course; none are specific to this research study. Your choice to participate in the study will in no way affect your grade in the course. Data from the study will not be shared with the course faculty until all grades for the course have been posted.

If you elect not to participate in the study, simply remain in the classroom.

POSSIBLE RISKS/DISCOMFORTS

There are no known risks to your participation in the study.

POSSIBLE BENEFITS

Your participation in the study may not benefit you directly. Should you elect to review the videotaped lecture or the MicroSim case after the case-based simulation, your understanding of the principles and concepts of airway management may be improved.

The primary benefit of the study and its results will go to students who subsequently take the course. The results from this study will be used to plan for course implementation for Spring 2007 and thereafter. To the extent that the results indicate that principles and concepts of airway management can be learned equally well with each instructional modality then students who enroll in the course will have more options to select to learn these principles in ways that better match their learning styles.

ALTERNATIVE PROCEDURES / TREATMENTS

If you elect not to participate in this study, simply remain in the classroom to receive the lecture. None of your performance data will be shared with the researchers.

CONFIDENTIALITY

Every attempt will be made to see that your study results are kept confidential. A copy of the records from this study will be stored in (Pickard Hall Room 508) for at least three (3) years after the end of this research. The results of this study may be published and/or presented at meetings without naming you as a subject. Although your rights and privacy will be maintained, the Secretary of the Department of Health and Human Services, the UTA IRB, and personnel particular to this research (Carolyn Cason and Mary E. Mancini) have access to the study records. Your performance records (data collected for this study) will be kept completely confidential according to current legal requirements. They will not be revealed unless required by law, or as noted above.

FINANCIAL COSTS

There are no financial costs for you to participate in this study.

CONTACT FOR QUESTIONS
If you have any questions, problems or research-related medical problems at any time, you may call (Carolyn Cason) at (817-272-5781), or (Mary E. Mancini) at (241-803-8082). You may call the Chairman of the Institutional Review Board at 817/272-1235 for any questions you may have about your rights as a research subject.

VOLUNTARY PARTICIPATION

Participation in this research study is voluntary. You may refuse to participate or quit at any time. If you quit or refuse to participate, the benefits (or treatment) to which you are otherwise entitled will not be affected. You may quit by calling (Carolyn Cason), whose phone number is (817-272-5781). You will be told immediately if any of the results of the study should reasonably be expected to make you change your mind about staying in the study.

By signing below, you confirm that you have read or had this document read to you. You will be given a signed copy of this informed consent document. You have been and will continue to be given the chance to ask questions and to discuss your participation with the investigator.

You freely and voluntarily choose to be in this research project.

PRINCIPAL INVESTIGATOR: _____________________________________________ DATE

_____________________________________________________________ DATE

SIGNATURE OF VOLUNTEER 
Appendix L. Faculty instructions

**MicroSim Research Study OSCE (revised 2/19 08)**

**Faculty Set-up BEFORE students starts OSCE**

1. Lay out supplies on side table or counter: Orapred, MDI with spacer and mask, Oxygen mask, Ambu Bag, Suction machine with canister and suction tube 10fr., Stethoscope, PCP order in envelope, Previcare

2. Lay out on bedside table: Charting document for student to fill out, Normal VS reference sheet, Standing orders for Oxygen, pencil

3. **BE SURE THE HOB IS FLAT TO START!**

**Faculty Statement to Students**

1. Be sure student is in uniform or in lab coat (loan lab coat if needed)
2. Have student sign attendance sheet
3. Have student write name on charting document
4. Wash your hands prior to starting-show them where Previcare is located.
5. Orient them to where they will find the following equipment at the bedside:
   a. Digital CLOCK above and behind warmer
   b. Monitor/cable
   c. Pulse oximeter/cable
   d. BP cuff/cable
   e. O2 flow meter
   f. Suction
   g. Chart document
   h. Standing orders for oxygen
   i. Normal VS reference sheet
6. Show student how to touch the monitor once the ECG leads and O2 sat probe are connected.
7. Show them how to pinch the O2 sat probe to obtain a continuous reading.
8. Tell them to tap the screen if there is not a reading for respiratory rate.
9. Show student how to take a BP using the monitor.
10. Show them where the Temp (peripheral) is on the monitor
11. Orient them to supplies on the side table/counter:
   a. Ambu bag and mask
   b. O2 mask and tubing
   c. Medications-syringe with Orapred
   d. Medications - Albuterol MDI with aerochamber and mask
   e. Suction machine and catheter
   f. Calculator
   g. Scratch paper
   h. Envelope with PCP order inside
12. Show student how to touch the monitor once the ECG leads and O2 sat probe are connected.
13. **Show student how to elevate and lower the head of the bed.**
14. State, “You may NOT ask any questions during the OSCE.”
15. State, “You may say that time has advanced X number of minutes after a treatment or procedure.”
**CHARTING FOR JOSE HERNANDEZ OSCE**

**ASSESSMENT-Circle what is appropriate**

<table>
<thead>
<tr>
<th>Fontanels</th>
<th>Bulging</th>
<th>Sunken</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucus Membranes</td>
<td>Pale</td>
<td>Cyanotic</td>
<td>Pink</td>
</tr>
<tr>
<td>Lungs</td>
<td>Coarse</td>
<td>Rhonchi</td>
<td>Wheezing</td>
</tr>
<tr>
<td>Breath sounds</td>
<td>Unequal</td>
<td>Equal</td>
<td></td>
</tr>
<tr>
<td>Retractions</td>
<td>Substernal</td>
<td>Intercostal</td>
<td>Supraclavicular</td>
</tr>
<tr>
<td>Heart</td>
<td>Rate</td>
<td>Rate</td>
<td></td>
</tr>
</tbody>
</table>

**TIME OF ASSESSMENT**

**FLOWSHEET FOR OTHER DOCUMENTATION-Document time**

**Vital Sign Documentation**

<table>
<thead>
<tr>
<th>TIME:</th>
<th>Temp</th>
<th>HR</th>
<th>RR</th>
<th>BP</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>TIME:</th>
<th>Temp</th>
<th>HR</th>
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</table>

<table>
<thead>
<tr>
<th>TIME:</th>
<th>Temp</th>
<th>HR</th>
<th>RR</th>
<th>BP</th>
</tr>
</thead>
</table>
Appendix N. Physician’s Orders

DOCTOR’S ORDER SHEET

Patient Name: Jose Hernandez  
Age: 5 months

Standing Orders

1. Administer 1-2 liters of oxygen to maintain oxygen saturation (SpO2) at 92% or greater.
2. Discontinue oxygen when oxygen saturation (SPO2) is greater than 97%.
Appendix O.  PCP Orders

DOCTOR’S ORDER SHEET

**Patient Name:** Jose Hernandez  
**Age:** 5 months

**Primary Care Practitioner (PCP) Orders**

1. Administer FIRST Albuterol, 2-4 puffs with Meter Dose Inhaler (MDI), face mask, and aerochamber.

2. If no improvement in 15 minutes, may repeat ONE TIME Albuterol, 2 puffs with Meter Dose Inhaler (MDI), face mask, and aerochamber and administer 2.5 ml (7.5 mg) of prednisolone (Orapred 15 ml/5mg) orally.
Appendix P. Abstract submitted to Contemporary Forums

Nursing Student Learning Style and Receptivity to Learning with MicroSimulation
Kristine A. Nelson, RN, MN, Instructor; Carolyn L. Cason, RN, PhD, Professor and
Associate Dean for Research; Mary Mancini, RN, PhD, Professor and Associate Dean
Undergraduate Programs; Victoria Hartman, RN, CPNP, MSN, Instructor; & Jennifer
Roye, RN, CPNP, MSN, Instructor
School of Nursing, The University of Texas at Arlington

Intent: This study examined the associations among students’ learning style and their
satisfaction with learning the concepts and principles of airway management using case-
based computer microsimulation (MicroSimTM).  

Description: Upon admission, all students completed the HESI Admission AssessmentTM
(A2). Undergraduate students enrolled in a required pediatric nursing course were
randomly assigned to learn principles and concepts of airway management by attending a
lecture or completing a computer based microsimulation (Acute Asthma; MicroSimTM
Inhospital Self-directed Learning System). Two weeks later to assess knowledge transfer
all students completed a second microsimulation (Severe Asthma; MicroSimTM Inhospital
Self-directed Learning System). At the end of the semester long course, all students were
asked to complete an 11-item survey designed to assess their evaluation of the
effectiveness of microsimulation as a way to learn airway management.

Evaluation: Learning style data were available on 80 of the 100 students. The HESI
Admission AssessmentTM report identifies the two learning styles most preferred by the
examinee and includes visual, auditory, kinesthetic, cognitive, analytical, and global.
Sixty percent (n=55) of students had as one of their two preferred learning styles
kinesthetic learning (likes to experiment with knowledge and learns best by being
involved). Visual and Auditory learning styles were preferred by only a few students (7%
and 8% respectively). All students had as one of their preferred styles either Global
(53%) or Analytical (47%) learning. Those with a global learning style were, on average,
younger than those with an analytical learning style but not significantly so. The
proportion of women and men who preferred global and analytical learning styles was
similar. The proportion of students from different racial backgrounds who preferred
global and analytical learning styles was also similar. There was no difference in
knowledge transfer (performance on the second microsimulation) associated with
students’ preferred learning style. Fifty of the students completed the effectiveness
survey. Those with a global learning style significantly more often than those with an
analytical learning style responded that the microsimulation helped them to think through
the care requirements of the case (66% vs 33%; Chi Square =5.5; df=1; p=0.01). Although
there were no significant differences associated with learning study on the other survey
items, those with a global learning style more often than those with an analytical learning
style thought that completing the microsimulation helped their understanding of the
concepts of airway management (63% vs 37%) and of care for pediatric patients (65% vs
36%), made learning fun (67% vs 33%), and would like for more of the course to be
taught through microsimulation (70% vs 27%). Seventy-six percent of students with a
global learning style and 76% of those with an analytical learning style indicated that the
microsimulations challenge their ability to think. In this study, using microsimulation was
effective irrespective of the student’s learning style. Its use in developing critical thinking skills shows promise but must be evaluated.

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IMPROVING LEARNING AND PERFORMANCE USING CASE-BASED COMPUTER SIMULATIONS (MICROSIM™)

Kristine Nelson, Carolyn Cason, Mary Mancini, Victoria Hartman, Jennifer Roye
School of Nursing, University of Texas at Arlington, Arlington, TX, United States

INTRODUCTION:

This study examined differences in knowledge acquisition and retention when principles and concepts of airway management were taught in either of two pedagogically accepted ways: lecture and computer based simulation (CBS). The CBS used was Laerdal’s MicroSim™ Inhospital Self-directed Learning System.

METHODS:

Undergraduate nursing students enrolled in a required pediatric nursing course were randomly assigned to learn principles and concepts of airway management by attending a lecture or completing a computer based simulation (CBS; Acute Asthma; MicroSim™ Inhospital Self-directed Learning System). One week after initial learning, all students participated in a scenario-based simulation laboratory using a high fidelity pediatric simulator. Knowledge acquisition and retention were evaluated using paper-and-pencil examinations. Knowledge transfer was evaluated using performance on a second CBS (Severe Asthma; MicroSim™ Inhospital Self-directed Learning System) completed 3 weeks after initial learning. Students' learning styles and satisfaction with computer-based simulation were also captured.

RESULTS:

The two groups (attending lecture or completing the CBS) were equivalent on such characteristics as learning style, gender, race/ethnicity, age, and cumulative GPA. Students attending lecture tended to have lower percent correct scores on examinations; but scores were not significantly different from those of students learning via CBS. Knowledge transfer, as assessed by performance on the second CBS (score on first attempt), was significantly better for students who learned airway management by completing the CBS. This difference disappeared when students' best scores on the second CBS were examined. About 40% of students in both groups completed the second CBS more than once (range from 1 to 7 attempts). Although the number of times students in the two groups completed the second CBS was equivalent, those who attended lecture spent significantly more total time going through the second CBS. Students with either cognitive or analytical learning
styles performed best on the second CBS when in the group who learned airway management via CBS.

DISCUSSION:

In this study, learning principles and concepts of airway management was significantly aided by the use of CBS. Both of the CBSs involved adult rather than pediatric cases; however, students' performances were not adversely affected. Even though students were required to complete the second CBS only once and their performance scores were not included in course grade determination, many elected to work through the second CBS multiple times and reported that doing so helped them learn airway management. For these students using CBSs from MicroSim™ Inhospital Self-directed Learning System to learn airway management was both more effective and efficient than was lecture.

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