**Table 1. Characteristics of Included Studies**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID no. | Primary Author | | Population & Country | Sample  size | Subject | Outcomes measured | Intervention | Results | Bias Risk |
| *Patient deterioration/treatment scenarios* | | | | | | | | | |
| 1 | **Blum**  **(2010)** | | Foundation year BSc nursing students  America | 53 | Various patient conditions | Affective/NT | 13-week course  **Low-fidelity group**-7-hours practice on task-trainers.  **High-fidelity group**-7-hours practice on SimMan®.  Both groups received debriefing during practice. | Student skill competence increased in both groups regardless of fidelity-level. No significant difference between groups at mid-term or final assessment points was seen. |  |
| 2 | **Bultas**  **(2014)** | | Qualified staff nurses  America | 60 | Deterioration of the paediatric patient (respiratory and circulatory) | Knowledge  Affective/NT | 1-day course  **Low-fidelity group**-undertook static-mannequin training.  **High-fidelity group**-participated in 2 scenarios on Sim-NewB® mannequin.  Both groups received a pre-brief. | Knowledge was assessed immediately post-training and at 6-months. Knowledge decreased in both groups from test-1 to test-2, but there was no significant difference between the groups.  For affective/NT skills the high-fidelity group significantly out-performed the low-fidelity group at 6-months. |  |
| 3 | **Decelle**  **(2015)** | | Junior level baccalaureate nursing students  America | 52 | Treatment of patient with COPD | Knowledge  Affective/NT | 1-day intervention  **Low-fidelity group**-undertook scenarios on Nursing-Anne mannequin.  **High-fidelity group**-undertook scenarios on iStan® Male patient-simulator.  Both groups attended a pre-brief but de-briefing occurred after all testing was completed. | There were no significant differences in knowledge scores between high and low-fidelity groups after training, (once baseline differences in groups were considered). Gain in knowledge was equivalent.  There was a significant difference in affective/NT skill performance favouring the high-fidelity group. |  |
| ID no. | **Primary Author** | | **Population & Country** | **Sample**  **size** | **Subject** | **Outcomes measured** | **Intervention** | **Results** | **Bias Risk** |
| *Patient deterioration/treatment scenarios* | | | | | | | | | |
| 4 | **Jeffries**  **(2012)** | | Junior level baccalaureate & associate nursing students  America | Not known 403 in 3 study-arms (just 2 arms used) | Care of the post-surgical patient | Knowledge | 1-day intervention  **Low-fidelity group**-assigned 1 of 4 roles and worked in groups of 4 for 20mins on a static-mannequin.  **High-fidelity group**-assigned 1 of 4 roles and worked in groups of 4 for 20mins on a high-fidelity simulator.  Both groups received a 20min debrief. | No significant differences\* were found in knowledge performance between the high and low-fidelity groups.  In addition the student role within the scenario did not affect knowledge scores.  \* Data not presented. |  |
| 5 | **Lapkin**  **(2011)** | | 2nd year under-graduate nursing students  Australia | 38 | Treatment of a patient with hypervolaemia and pulmonary oedema | Affective/NT | 1-day intervention  **Medium-fidelity group**-undertook a 20min scenario using Megacode Kelly™ + Vital-Sim™.  **High-fidelity group**-undertook a 20min scenario using SimMan 3G™.  Pre-brief undertaken. Debrief for both groups occurred after the assessment. | The difference in Affective/NT (clinical reasoning and communication) scores was significantly higher in the high-fidelity group compared to the medium-fidelity group. |  |
| 6 | **Levett-Jones (2011a)** | | 3rd year under-graduate nursing students  Australia | 84 | Treatment of a patient with hypervolaemia and pulmonary oedema | Knowledge | 1-day intervention  **Medium-fidelity group**-undertook a 20min scenario using Megacode Kelly™ + Vital-Sim™.  **High-fidelity group**-undertook a 20min scenario using SimMan 3G™.  Pre-brief undertaken. Debrief for both groups occurred after the knowledge post-test, but before the 2-week follow-up. | Knowledge tests were conducted pre-intervention, immediately post-intervention and at 2-week follow-up. No significant changes in knowledge scores occurred over time. Also medium and high-fidelity groups did not differ significantly in their scores at any time-point. |  |
| ID no. | **Primary Author** | | **Population & Country** | **Sample**  **size** | **Subject** | **Outcomes measured** | **Intervention** | **Results** | **Bias Risk** |
| *Patient deterioration/treatment scenarios* | | | | | | | | | |
| 7 | **Kardong-Edgren**  **(2007)** | | Undergraduate nursing students  America | Not known  14 in 3 study-arms (2 arms used) | Care of the patient with Congestive Heart Failure (CHF) | Knowledge | 1-day intervention  **Low-fidelity group**-participated in a 15min scenario with SimMan® with functions turned off to behave like a static-mannequin.  **High-fidelity group**-participated in a 15min scenario with SimMan®. | There were no significant differences found in knowledge scores between fidelity groups at the post-test 2-weeks later. |  |
| 8 | **Kardong-Edgren**  **(2009)** | | Undergraduate BSc nursing students  America | 100 | Care of the patient with Acute Coronary Syndrome (ACS) | Knowledge | 1-day intervention  **Medium-fidelity group-**assigned 1 of 5 roles and undertook 15mins of practice with a VitalSim® enabled mannequin  **High-fidelity group**-assigned 1 of 5 roles and undertook 15mins of practice with a SimMan® mannequin.  Both groups had a pre-brief and a 15min debrief prior to assessments. | Knowledge tests were conducted at 2-weeks and 6-months post-simulation experience. There was an increase in test scores after the simulator experience and a decrease in scores between 2-weeks and 6-months for both groups. However there was no significant difference between the medium and high-fidelity group’s knowledge scores at any time-point. |  |
| *Advanced Life Support scenarios* | | | | | | | | | |
| 9 | | **Arnold**  **(2013)** | Registered nurses  America | 19 | ACLS | Knowledge  Affective/NT | 1-day Intervention in week 5 of a 9-week critical care programme.  **Low-fidelity group**-40-45mins practice on Resusci-Anne® and a defibrillator monitor.  **High-fidelity group**-40-45mins practice on METI high-fidelity™ mannequin in sim-centre.  Both groups received an orientation to defib and crash-trolley and had a 15min debrief. | The knowledge test occurred 1-week after the intervention and whilst the high-fidelity group scored higher than the low-fidelity group, the results were not statistically significant.  The skills test occurred 3-4 weeks after the intervention. There were no significant differences seen in performance between groups on any assessment items. |  |
| ID no. | **Primary Author** | | **Population & Country** | **Sample**  **size** | **Subject** | **Outcomes measured** | **Intervention** | **Results** | **Bias Risk** |
| *Advanced Life Support scenarios* | | | | | | | | | |
| 10 | | **King**  **(2011)** | Senior BSc nursing students  America | 49 | ACLS | Knowledge  Affective/NT | 1-day intervention on day 1 of 2 day course.  **Low-fidelity group**–underwent training on a static mannequin.  **High-fidelity group**–underwent training on SimMan®.  No debriefing was undertaken. | Knowledge tests occurred at 3 time-points after interventions (day 2 of the course, 2-weeks and 2-months follow-up). There were no significant differences between the groups in knowledge at any point.  For affective/NT the high-fidelity group outperformed the low-fidelity group both at 2-weeks and 2-months. |  |
| 11 | | **Rodgers (2009)** | Senior nursing students (final degree semester)  America | 37 | ACLS | Knowledge  Affective/NT | 1-day intervention on day 1 of 2 day course.  **Low-fidelity group**-used SimMan® mannequins that had all their functions inactivated except for a basic ECG rhythm-generator. (therefore behaving as static-mannequins)  **High-fidelity group**-used SimMan® with all functions activated.  Both groups received debriefing. | Knowledge- although neither group statistically outperformed the other in the post-intervention test, the high fidelity group’s improvement was significantly better than the low-fidelity group, despite a pre-test knowledge advantage of the low-fidelity group.  Affective/NT- the high-fidelity group did significantly better in 9 out of 14 test items than the low-fidelity group, and these items tended to be more complex. |  |
| 12 | | **Lee**  **(2008)** | Qualified Paramedics  Australia | 12 | APLS  (Drug and alcohol overdose and septicaemia scenarios) | Affective/NT | 1-day intervention  **Low-fidelity group**-12min scenario on a static task-trainer with a Heartstart 2000 AED.  **High-fidelity group-**12mins on a SimMan® patient-simulator.  Pre-brief provided to both groups.  Groups crossed over. | The pass rate in the low-fidelity scenario was slightly higher than the high-fidelity scenario but the result was not significant. |  |
| ID no. | **Primary Author** | | **Population & Country** | **Sample**  **size** | **Subject** | **Outcomes measured** | **Intervention** | **Results** | **Bias Risk** |
| *Individual skills (airway)* | | | | | | | | | |
| 13 | | **Harper**  **(2016)** | First year under-graduate ODPs  United Kingdom | 18 | Rapid sequence Induction | Knowledge  Psychomotor | **Low-fidelity group**–undertook 3-hours of practice with a static upper-torso mannequin.  **High-fidelity group**–undertook 3-hours of practice with a METI™ Human Patient-Simulator.  Feedback on performance provided but details lacking. | Knowledge gained from pre to post-test by both fidelity groups was statistically significant. The knowledge gained by the high-fidelity group was significantly greater than the low-fidelity group.  Psychomotor– The high-fidelity group performed significantly better than the low-fidelity group (although marginal). |  |
| 14 | | **Weiss**  **(2016)** | Student and qualified respiratory therapists  America | 30 | Bag-mask ventilation/LMA placement/Endo-tracheal intubation | Knowledge  Psychomotor | 1-day intervention  **Low-fidelity group**–underwent 2-hours of airway training on the Laerdal® Airway Management Trainer.  **High-fidelity group**-underwent 2-hours of airway training on the iStan® Patient-Simulator.  A pre-brief was given to both groups. | There was no significant difference in knowledge scores between the high and low-fidelity groups.  There was no significant difference in psychomotor skill performance between the high and low-fidelity groups. |  |
| *Individual skills (Miscellaneous)* | | | | | | | | | |
| 15 | | **Aqel**  **(2014)** | Second year nursing students  Jordan | 90 | Basic Life Support/CPR skills | Knowledge  Psychomotor | 1-day intervention  **Low-fidelity group**–groups of 3 students had 15mins practice of chest compression, rescue-breathing and defibrillation on a static CPR mannequin.  **High-fidelity group**-groups of 3 students had 15mins practice of chest compression, rescue-breathing and defibrillation on a METI™ emergency-care manikin.  Both groups received a 10min debrief. | Knowledge tests-pre/post sim and at 3-months. The high-fidelity group score was significantly higher than the low-fidelity group post-sim. Knowledge declined in both groups at 3-months, but retention was significantly higher in the high-fidelity group.  The high-fidelity group performed CPR significantly better than the low-fidelity group at both time-points. |  |
| ID no. | **Primary Author** | | **Population & Country** | **Sample**  **size** | **Subject** | **Outcomes measured** | **Intervention** | **Results** | **Bias Risk** |
| *Individual skills (Miscellaneous)* | | | | | | | | | |
| 16 | | **Crofts**  **(2006)** | Qualified  Midwives and Obstetricians  (data adjusted for different staff-groups)  United Kingdom | 95 | Shoulder dystocia management during obstetric delivery | Psychomotor  Affective/NT | 1-day intervention  **Low-fidelity group**-40mins training in groups of 6 on either simple doll-and-pelvis or S500 Childbirth Simulator (both without force-perception)  **Medium-fidelity group**-40mins training in groups of 6 on PROMPT Birthing-Trainer (with force-perception). | The medium-fidelity group performed significantly better than the low-fidelity group for most psychomotor actions especially more complex skills.  There was no significant difference for affective/NT skills, except that the medium-fidelity group was less likely to seek paediatric support. |  |
| 17 | | **Grady**  **(2008)** | First year nursing students  America | 52 | Nasogastric tube and urinary catheter insertion skills | Psychomotor | Interventions occurred at different times (5-weeks into the 14-week course for NG tube training, and 10-weeks into the 14-week course for urinary catheter training).  **Group 1**–received NG tube insertion training using a high-fidelity mannequin (full-sized human patient-simulator), followed by urinary catheter insertion training with a low-fidelity mannequin (lower-torso catheterization model).  **Group 2**–received NG tube insertion training using a low-fidelity mannequin (nonreactive head and chest model), followed by urinary catheter insertion training with a high-fidelity mannequin (full-sized human patient-simulator). | Testing occurred during week 14 of the course.  The high-fidelity mannequin scores were significantly higher than the low-fidelity mannequin scores for both NG tube and urinary catheter insertion.  There was a marginally significant interaction between mannequin fidelity and gender suggesting that male students benefited from high-fidelity simulation more than female students. This was supported by the fact that males achieved higher performance scores than females but only when using high-fidelity mannequins. |  |
| ID no. | **Primary Author** | | **Population & Country** | **Sample**  **size** | **Subject** | **Outcomes measured** | **Intervention** | **Results** | **Bias Risk** |
| *Individual skills (Miscellaneous)* | | | | | | | | | |
| 18 | | **Konieczny (2016)** | Associate degree nursing students (penultimate semester)  America | 126 | Medication calculation, reconstitution and dilution | Knowledge | 1-day intervention  **Low-fidelity group**–students undertook 3 scenarios in groups of 3 (participated in 1, observed other 2) on a low-fidelity mannequin.  **High-fidelity group**-students undertook 3 scenarios in groups of 3 (participated in 1, observed other 2) on a high-fidelity human patient-simulator.  Both groups received a timed-debrief. | Both groups of students increased their knowledge scores from pre to post-test. The high-fidelity group demonstrated a significant increase in score, above that experienced by the low-fidelity group. The difference between the two groups was significant . |  |

**Legend**

=Low Risk-of-Bias

=Moderate Risk-of-Bias

= High Risk-of-Bias