**SDC 3 - Characteristics of Mixed-Distance Simulation Studies**

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| **Study** | **Country** | **Study**  **Design** | **Sample**  **Size / Participants** | **Study Aims** | **Clinical Topic** | **Sim modality** | **Pictogram\*** | **Configuration \*\*** | **Purpose \*\*\*** | **Results/**  **Outcomes** | **Challenges** | **ROB**  **\*\*\*\*** |
| Altieri et al.  (2020) | USA & Canada | RCT | N=65  Surgical residents | To evaluate if bench-top simulation Fundamental Use of Surgical Energy (FUSE) curriculum through telementoring is as effective as a live-in house proctor for electrosurgical training | Procedural training | Task trainer | No | Conf. A | On | - Total score on the pre- post-exam improved from 47% to 78% amongst all participants, -similarly in the post-curriculum scores in the (77% vs 80%)  At 6 months,  performance declined significantly for both groups,  Participants in both groups reported feeling greater comfort and competence post-curriculum. | The  proctors were different among study sites, which may have  an effect on learning | (-) |
| Autry et al.  (2013) | USA & Uganda | RCT | N=18  First year residents on an OBGYN rotation | To study the feasibility and acceptability of using video Internet communication to teach and evaluate surgical skills in a low-resource setting (knot tying) | Procedural training | Task trainer-  knot tying board | No | Conf. A | On | Scores increased by 50% or  more in six of eight (75%) interns in the intervention  group compared with one of seven (14%) in the control group (P=.04).  Remote teaching in low-resource settings, is feasible, effective, and accepted. | Dropped calls due to internet issues; time zone differences and lack of time | (+) |
| Auerbach et al. (2021) | USA | Quasi Experimental | N=147  pediatric EM  Physicians, nurses, nurse graduates, respiratory therapist, ED medical technician | To describe the  implementation experiences and participant feedback of a 1-year remotely facilitated pediatric emergency  telesimulation program in three critical-access hospitals. | Pediatric Emergency Medicine Scenarios | Mannequin | Yes | Conf. A | Using | 90% of the participants reported that pediatric simulations should be conducted regularly.  Forty-seven of 48 simulations were completed on the first attempt. | Some technical issues reported. | (-) |
| Baron et al.  (2021) | USA & Russia | Case-control | 54 Oncology residents | To study the efficacy of remote training program in oncology | Communication skills training | Not stated | No | Conf. A | Using | Median score for simulated communication skills assessment were significantly higher in the trainees participating in the remote training program (Scenario 1 71 (IQR, 58-84) and 15 (IQR, 10-30), respectively, P , .0001. and Scenario 2 – 78 (IQR, 71-85) versus 22 (IQR, 4-58), P = .005 | Technical difficulties – internet speed.  Time zone 7-8 hour time difference  Seminars frequently delivered over the weekend | (-) |
| Boedeker et al.  (2011) | USA | Quasi Experimental | 12 National Air Guard Personnel | The study analyzed the feasibility of distance mentoring of basic mannequin intubation. | Casualty Training  Video laryngoscopy | Mannequin intubation | Yes | Conf. A |  | From a score of 10  Training session scored:  9.2 - found video laryngoscopy valuable for training  9.5 - found remote training valuable  91% could see the view of the laryngoscope clearly on the monitor | Not mentioned | (-) |
| Boggs et al.  (2021) | USA | Quasi Experimental | N=18 (n=9 virtual and n=9 in person) EM residents | To assess the effectiveness of disaster medicine  education virtual session for residents. | Mass casualty in the ED | Table-top simulation | No | Conf. B | Using | There was an improvement (P < 0.05) in confidence  scores for both patient care (3.0 to 5.8) and triage (3.6 to 5.7), with no statistical difference between the virtual and in-person subset.  66.7% virtual participants felt their learning was hindered by remote interactions and technical limitations. 88.9% in-person participants regarded their experience positively. | Technical limitations and limitations with interacting in the simulation. | (+) |
| Brei et al.  (2020) | USA | Pre and Post test design | N=33  Physicians mostly attendants | To assess the feasibility of conducting a large group telesimulation to teach physicians how to use telehealth software, and to assess provider comfort it | Paediatric emergencies requiring procedural intervention | Procedural skill | Yes | Conf. C | On | Participants reported increased comfort with using advanced features of the telehealth software such as taking pictures and sharing with the patient (p < 0.01), drawing on the shared image (p < 0.05), and sharing images from my computer/device using image grabber (p = 0.06)  Participants had 3 concerns using telemedicine – discomfort with troubleshooting while on a call, personal discomfort with technology, and an unclear documentation plan. | Not mentioned | (-) |
| Burckett et al.  (2016) | Canada | Pre and post test design | 19 staff anaethetists | The objective of this study was to examine if telesimulation was a feasible method to teach ultrasound guided regional anaesthesia remotely to anesthetises across different hospitals in Ontario, Canada. | U/S guided supraclavicular brachial plexus block | Procedural skill training Central line task trainers with ultrasound | Yes | Conf. A | On | Following the training, post-training scores were significantly higher across 9 Global Rating Scale (GRS) and checklist assessments P < 0.001 for virtual and onsite assessors Inter Rater reliability between them was good for checklist and excellent for GRS | Reduced Internet bandwidth, - call would disconnect and freezing of computer images  -Familiarity with equipment in setting up the video and ultrasound machine and video | (-) |
| Carmen et al.  (2017) | USA | Quasi experimental | 23 nurses in Acute care in nursing program | To study the use of a virtual learning platform for distance-based simulation in the training of nurses in the acute care management of patients | Medical emergencies  Management of a critically ill patient | Simulated Participant | No | Conf. C | On | More than 80% of students performed the key expected behaviors.  The evaluation tools followed a set format of 8 areas of performance 2 outside assessors viewed recorded videos.  Agreement between both between remote and independent assessors ranged between 75% - 87% | 4 of 18 recordings had technical issues that rendered them unusable. | (+) |
| Christensen et al.  (2015) | Australia | Quasi Experimental | 155 physicin and nurse participants completed Pre&Post scenario appraisals and 297 returned Pre and Post MCQ | To compare newly graduated health professionals’ perceptions of quality of interaction and knowledge outcomes after exposure to Remote facilitation (RF) and local facilitation (LF) of SBT | DETECT course to help healthcare staff identify and manage deteriorating patients | mannequin based | Yes | Conf. A | On | A small but significantly higher score was seen for LF-SBT versus RF-SBT (p=0.01). In addition to a significantly higher scores for LF-SBT for a better learners’ experience (p< 0.01).  There was no difference in knowledge measured through post course and pre-course MCQ | Not mentioned | (-) |
| Danesh et al.  (2019) | USA | Quasi-experimental | Nurse practitioners and, 36 undergrad nurses and social workers | To train psychiatry and mental health nurse practitioners in the use of remote telepresence robots in telehealth and undergrad students in acquiring telehealth competencies | Management of a patient with alcohol withdrawal syndrome | Standardized Participant | No | Conf. D | On | Undergrad students provided moderate (9 of 36 students) to strong (25 of 36 students) value of adding telemedicine within the simulation.  Postgrad nurses provided written reflections | Not mentioned | (+) |
| Drake et al.  (2021) | USA | RCT | 56 medical students | To evaluate the non-inferiority of tele-ultrasound to in-person training of medical students | Students were trained to perform ultrasound on abdomen (FAST), lower extremity for DVT and guided vascular access | Procedural skill | No | Conf. A | On | Using a Fisher’s exact test, there was no inferiority seen between the Traditional and Tele-ultrasound groups (p< 0.05). | Not mentioned | (-) |
| Duch Christensen et al.  (2018) | Denmark & Australia | Qualitative | 21 physician and nurse course participants | To study the view of participants that participated in simulation training with local and remote facilitation in order.  (1) to understand the factors that contributed to negative attitudes toward RF-SBT  (2) identify theory that explains its potentially negative impact | DETECT course to help healthcare staff identify and manage deteriorating patients | Manikin based | Yes | Conf. A | On | All participants appraised both formats as acceptable and beneficial to their learning.  Three broad themes, were identified and categorized into perceptions, enablers, and precursors.  Precursors, representing factors present before the simulation and enabling factors, relating to how the simulation was delivered, seemed to impact on perceptions. | Not mentioned | (-) |
| Guzic et al.  (2012) | USA | Pre and Post-test design | 7 senior nursing students | To evaluate the feasibility and perceived value of a simulation from a distance | Management of cardiac arrest, hypoglycemia | mannequin | Yes | Conf.A | On | Experience rated high or very high.by 86% of participants evaluated the activity favorably (p < 0.05),  Being observed was a distraction by faculty and could affect the outcome of the simulations.  Some students felt threatened by their instructors who they viewed as superior | Not reported | (+) |
| Ikeyama et al.  (2012) | Japan | Quasi Experimental | 16 Paed Anaesthesia residents | To examine the technical feasibility of remote-facilitated (RF) simulation compared with locally facilitated (LF) simulation | 1)Ventricular fibrillation.  2)Desaturation in an intubated patient (both paediatrics) | Mannequin Based | Yes | Conf. A | On | In three sessions:  93.8% rated RF simulation to be effective and  87.5% rated it to be as effective as or more effective than the LF simulation | not mentioned | (-) |
| Lin et al.  (2021) | China | RCT | 118 Medical students | To compare the effect of synchronous online and face-to-face cardiopulmonary resuscitation (CPR) training on chest compressions quality in a manikin model. | CPR training | Mannequin Based | No | Conf. A | On | No statistically significant difference in quality of chest compressions (CC) between two groups. However, the FF group had a significantly higher percentage of appropriate CC than the remote group (p = 0.045) with device feedback | Not reported | (-) |
| Mikrogianakis et al.  (2011) | Canada & Botswana | Pre and Post test design | 22 physicians | To determine if telesimulation could be used by pediatricians in Toronto, Ontario, Canada, to teach a relatively new intraosseous (IO) insertion technique to physicians in Africa | Management of a 2-year-old child with moderate to severe dehydration | Task trainer | Yes | Config A | On | Physician scores on the post telesimulation written test improved by a mean of +5 (95% CI for the mean difference = 3.92 to 6.34) compared to their scores on the pre telesimulation test. After telesimulation, all 22 physicians rated the telesimulation as a worthwhile experience, and 95% (21 of 22) felt more prepared to manage a pediatric resuscitation | The connection dropped resulting in an invalid timing  assessment.  Connections dropped during training sessions | (-) |
| Molloy et al.  (2016) | USA | Retrospective | 48 nurses | To assess the feasibility and acceptability of a telepresence robot as a tool to introduce telehealth and to engage distance-based students in clinical simulations | Paediatric scenarios | Unclear | No | Conf. A | Using Simulation | Use of telepresence robot was feasible and both groups of students reported high mean scores on its acceptability. | Not mentioned | (+) |
| Moote et al.  (2019) | USA | Quasi-experimental | 46 nursing and pharmacy students | To provide a forum to improve communication and interprofessional relationships. | Management of supratherapeutic INR, and complicated UTI with resistant organisms | Case discussion through telephone | No | Conf. B | Using | Success of the IPE activity - Comments indicated the activity helped develop perspective on others’ contributions and mutual respect for what each profession can offer.  The final scores on the ap-appropriateness of the individual care plans and concordance were low (46% average). The plans were incomplete, and many provided inappropriate recommendations based on the patient case | Not reported | (-) |
| Mulcare et al.  (2020) | USA | Quasi-Experimental | 98 Medical students | To develop, implement, and assess a training module designed to teach medical providers techniques to deliver a telemedicine encounter | The  four cases:  (1) intake of a new patient to clinic with a history of hypertension  (2) subacute presentation of new congestive heart failure  (3) complicated  urinary tract infection  (4) self-diagnosed anxiety who was actually in alcohol withdrawal | SP | Yes | Conf. E | On | 97% found the  course to be useful and 100% felt simulation was an effective  teaching strategy.  Almost all learners found that the sessions provided insight into their communication, history taking, and physical exam skills | A limitation was the required level of training of different faculty members in simulation, education,  and clinical telemedicine to successfully implement this course | (+) |
| Ohta et al.  (2006) | Japan | RCT | 14 Medical Students | To determine if a laser pointing system operated remotely to improve the accuracy of performing thoracentesis. | A training mannequin was used as a mock patient for students to practice thoracocentesis of the 2nd intercostal space | Task Trainer | Yes | Conf. A | On | Operators in both groups completed the task correctly. The laser pointer correctly identified the centesis space and performed the task on the first trial. When the laserpointer was not used, four operators (57%) made a mistake in selecting the centesis space at the first trial. . | Not reported | (+) |
| Okrainec et al.  (2010) | Canada & Botswana | Case Control | 16 Physician trainees | To determine the effectiveness telesimulation for teaching laparoscopic skills | Skills such as Peg Transfer, Pattern Cutting, Ligating Loop and Extracorporeal Suturing | Laparoscopic simulator | Yes | Conf. A | On | Surgeons in the TS group scored significantly higher (440±56 vs.272±95, p=0.001) than those in a self-practice group except for one task. | Internet and power challenges | (-) |
| Packard et al.  (2019) | USA | Quasi Experimental | 168 Interprofessional 168 nurses and pharmacy, physical therapy and pre-hospital care | To evaluate a synchronous inter-professional patient safety simulation to train students on inter-professional teamwork and communication through recognition of patient safety hazards and medical hazards | A patient with primary cardiovascular illness  Professions integrate basic safety hazards to more complex medical errors | Manikin-based | No | Conf.  B | Using | 84% agreed or strongly agreed the activity was a valuable learning experience, 88% agreed or strongly agreed that interacting with other professions was a valuable learning experience,  Larger interprofessional teams were are able to identify more medical errors and safety hazards. | Not reported | (-) |
| Padhya et al.  (2021) | USA, Canada, China, Congo, Croatia, India, & Turkey | Pre and Post-test design | 18 Physicians and Nurses | To determine the feasibility  and effectiveness of remote training of international  critical care providers | 3 Scenarios  emergency situations requiring admission in PICU: (1) urosepsis; (2) community acquired pneumonia; (3) Status epilepticus | Manikin based | No | Config A | Using | Participants improved from pre to post test on number of critical actions.  Percent of compliance to standards of care guidelines improved from (45% to 95% (P < .01)  Critical task completion for admission scenarios improved from 8.2 ± 2.6, to 11.2 ± 1.8, P = .01. | Internet and audiovisual recordings | (-) |
| Pennington et al.  (2017) | USA, Brazil, Bosnia, Saudi Arabia, India, Ireland, Serbia & Mexico | Pre/post test design | 11 Interprofessional teams of 3-5 individuals | To determine if team dynamics can be improved via remote simulation in resource-limited areas | Not reported | SP and Manikin Based | No | Config A | Using | Most teams demonstrated an overall improvement following remote simulation (six out of nine teams), and all teams demonstrated improvement in at least one area.  The greatest average area of improvement was in the team‚ ability to complete tasks in a timely manner, and in the team leader‚ communication to the team with an average improvement from 2.1to2.7(28.5%, p=0.05) and 2.3 to 3.0 (30.4%,p=0.03) respectively. | Language was a limitation | (-) |
| Rudolph et al.  (2017) | USA | Quasi-Experimental | 48 BSc students  5 Nurse Practitioners | To study the feasibility of combining telepresence and simulation technologies for training nurse practitioners and undergraduate nurses. | Two simulation scenarios 1-A 4-year-old with acute onset meningitis 2- A5-month-old with bronchiolitis | Simulated Participant; Other: telepresence robot | No | Conf. B | Using | Simulation experience was reported as favorable by both sets of students. Design Scale and Self-Confidence in Learning Scale were used.  Fidelity/realism scores were low. | Volume on the robot  was low -telepresence robot difficult to manoever | (+) |
| Sampsel et al.  (2014) | USA | Qualitative | 70 Graduate Nurses | To evaluate the effectiveness of a remote telepresence robot (RPR) | -Caring for an older adult living at home with a family member.  - impact of age-on the initial assessment,  - the home environment,  -interaction with the family member | Simulated Participant | Yes | Conf. A | Using | 3 major themes of usefulness, acceptability, and impact – 75% students, and 56% faculty found RPR was useful.  Acceptability was met with negative comments  The RPR helped enhance evaluation of student skills | Not reported | (+) |
| Seibert et al.  (2004) | USA | RCT | 12 clinical nurse specialists | To increase student engagement and improve outcomes by redesigning a distance learning using simulation. | Head, ENT assessment | SP | Yes | Conf. D | Using | Knowledge outcomes, were significantly higher (p< 0.01) in the simulation group when compared to control group | Not reported | (-) |
| Taekman et al.  (2017) | USA & Uganda | Pre and Post test design | Physicans, Nurses in Obstetrics and anaesthesia | To study the effectiveness of a multiplayer screen-based simulation in the training of Postpartum Hemorrhage. | Postpartum Haemorrhage | Screen based | No | Conf. A | On | Self-reported confidence scores increased significantly (pre = 7.83 ± 1.55, post =  8.95 ±  1.42, p <  0.001).  All showed improvement in the 3 domains of cognition, affect and psychomotor skills.  100% of learners felt screen-based simulation led to effective learning | Not reported | (+) |
| Thelen et al.  (2021) | USA | Pre and Post test design | 34 Nursing students | To examine the effects of online immersive simulation on nursing students  self-efficacy and perceived knowledge acquisition of pharmacology. | 1-post- operative patient requiring morphine, 2-malignant hyperthermia, 3-alcohol withdrawal 4- asthma, 5-hyperglycemia, 6-hypoglycemia, 7-heparin drip 8- patient requiring antibiotics | Mannequin based | No | Conf. C | On | The pre-test score-Motivated Strategies for Learning Questionnaire Self-Efficacy Subscale (MSLQ-SE)  (M = 31.21) and post-test scores (M = 32.85) significantly increased after the intervention (p = .02)  Specific academic exam self-efficacy (SAE-SE) – post test scores increased significantly (p=0.003)  Specific academic learning self-efficacy (SAL-SE)- showed no significant improvement | Not reported | (+) |
| Tilton et al.  (2015) | USA | Quasi -experimental | 79 Graduate nurses | To study the feasibility of virtual simulation to address the gap in chronic care management in nursing education. | Four patient avatars – of different ages and ethnicities with chronic physical and mental conditions. | Screen based | No | Conf. E | Using | -Mean scores for clinical ability items ranged from 2.46 to 5.22 (max is 6)  - mean scores for perceptions of the learning environment ranged from 3.1 to 5.0 (max points is 6) | Not reported | (+) |
| Treloar et al.  (2001) | USA & Puerto Rico | Pre and Post test design | 18 – 10 physicians and 8 emergency medical technicians | To assess the feasibility of training on a Human Patient Simulator at a remote location from a distant site. | Five scenarios, near drowning, ventricular fibrillation, blunt trauma with pneumothorax, rapid-sequence intubation and shock. | Mannequin based | No | Conf. A | On Simulation | Improvement in post test scores for preparedness and self-efficacy  Participants felt that training with a remote instructor will be useful during periods of prolonged deployment | Not reported | (+) |
| Von Lubitz et al.  (2004) | USA, France, & Italy | Quasi - experimental | 86 Physicians, senior academics, armed forces and Industry | To test responses of civilian, military, and medical personnel to a suddenly occurring bioterrorism event, | Clinical signs of either sarin exposure or chicken pox | Mannequin based | Yes | Conf. D | Using | Military medical personnel had no difficulties in recognizing and managing sarin poisoning.  Chicken pox was misdiagnosed by all lay participants and 20% of medical personnel.  Distance simulation was found useful to train large numbers of people 7.6 (all participants) and 7.3 (medics) from a score of 10 | Not reported | (-) |
| Von Lubitz et al.  (2003) | USA, France, & Italy | Quasi -experimental | 20 medical students and physicians and paramedics | To describe the first stage of simulation-based transatlantic training of physicians, medical students, and paramedics | Three scenarios airway emergency, ventricular fibrillation and drug intoxication | Mannequin based | Yes | Conf. D | Using | Remote access to human patient simulator resulted in a statistically significant (p<0.03 to 0.05) improvement of performance in all assessed categories | Not reported | (+) |

\***Pictogram**: Diagrammatic or photographic representation of the simulation configuration, depicting the location of the different participants in relation to each other

**\*\*Configuration: A** depiction of the location of the different participants of the simulation in relation to each other

\*\*\* **Purpose of Study**: Studies “on” studying simulation as a methodology, or “using” simulation is used as a tool to study a non-simulation topic

\*\*\*\* **Risk of Bias – (+)** High Risk, (-) Low Risk