A Pilot Study of Operating Department Practitioners undertaking high-risk learning: A Comparison of Experiential, Part-Task and Hi-Fidelity Simulation Teaching Methods

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Abstract

Health care learners commonly rely on opportunistic experiential learning in clinical placements in order to develop cognitive and psychomotor clinical skills. In recent years there has been an increasing effort to develop effective alternative, non-opportunistic methods of learning, in an attempt to bypass the questionable tradition of relying on patients to practice on.

As part of such efforts, there is an increased utilisation of simulation-based education. However, the effectiveness of simulation in health care education arguably varies between professions (Liaw, Chan, Scherpbier, Rethans, & Pua, 2012; Oberleitner, Broussard, & Bourque, 2011; Ross, 2012). This pilot study compares the effectiveness of three educational (or 'teaching') methods in the development of clinical knowledge and skills during Rapid Sequence Induction (RSI) of anaesthesia, a potentially life-threatening clinical situation. Students of Operating Department Practice (ODP) undertook either a) traditional classroom based and experiential learning, b) part-task training, or c) fully submersive scenario-based simulated learning.

Methods

Twenty-seven (27), first year Operating Department Practitioner students, were assigned to one of three groups: a) a classroom-based teaching group that followed a traditional didactic teaching model with placement experience, b) a part-task using inanimate manikins to develop individual skills such as airway management and c) a simulation group who had access to a simulated operating theatre and hi-fidelity manikin. Each group of participants attended teaching on the theory and practice of rapid sequence induction of anaesthesia. Each intervention group completed pre-test and post-test questionnaires to record their knowledge of the theory of conducting RSI and the indications and contraindications of this intervention as well as their self-perceived confidence in performing their role for an RSI. Standardised criteria from the Difficult Airway Society (DAS) were used to assess participant performance and skills acquisition in supporting rapid sequence induction in a simulated scenario.

Results
The results show that the simulation group performed significantly better in the RSI assessment than the other groups. The adjusted results for small sample numbers are reported as being significant between groups for the RSI OSCE result at the $p<0.5$ level [F (2, 15.249)= 4.5, $p=0.027$].

The paired pre-test, post-test knowledge tests showed that there was a significant change in the Sim group's knowledge scores (M=10.00, SD = 3.16; $p=<0.001$) and in overall confidence (M=-2.22, SD = 0.44; $p=<0.001$). There was a lesser, but still significant effect in the PTT group, pre-post test knowledge score, (M=-3.77, SD =1.30; $p=<0.001$) with confidence reported as (M=-1.44, SD = 0.52; $p=<0.001$). The classroom based group had little effect demonstrating pre-test, post-test results of M=-0.22, SD = 0.66; $p=0.34$, for knowledge and for confidence, results of M=-0.33, SD = 0.50; $p=0.08$.

Discussion
Compared to the other two groups the simulation group demonstrated greater ability to assist in the communication, preparation and procedural intervention for an RSI. The simulation group also demonstrated increased knowledge in other key areas, and reported self-perceived increased confidence. In conclusion, functional knowledge, skill, confidence and ability can be increased when this type of learners are taught in a submersive scenario-based simulated environment for this clinical subject.

Introduction
The provision of high quality medical and surgical care is predicated by high quality education and training, and relies on understanding the needs of learners as well as the way in which they learn. This is no less pertinent in the perioperative environment, where high impact interventions are performed by Operating Department Practitioners (ODPs), and where patient safety and the quality of care must be paramount. This is due to the complex and potentially life-threating nature of surgical and anaesthetic interventions on elective, unscheduled or critically ill patients.

In such clinical settings medical training requires a balance between patients' care and safety and the exposure to situations that facilitate student learning whereby students perform tasks on real patients (Gregory, Guse, Dick, & Russell, 2007; National Reporting and Learning Service, 2011). Hands-on learning is becoming increasingly challenging because of a number of factors including the reduction of clinical hours worked following the coming into force of the European Working Time Directive (EWTD) (British Broadcasting Corporation, 2009; Department of Health, 2009; NHS East of England, 2009), the requirement to obtain patients' consent for learners to treat them, and the impact of increases in day surgery and reductions in inpatient stays Maran and Glavin (2003).

One historical method of gaining experiential learning for complex clinical competencies is to allow learners to practice on deeply sedated patients (or on the recently deceased should clinical placement allow) while following the senior physician and emulating her/his practice. However, such practices are deemed unethical unless there is no alternative route to obtain the appropriate level of competency or in the case that the patient's family specifically consents to such practice (Ardagh, 1997; Ginifer & Kelly, 1996; Hudson, 2000; Lowe, Kerridge, McPhee, & Hart, 2008; Stewart, Paris, Peltan, & Garretson, 1984).

Learning in anaesthesia and surgery often relies on opportunistic placement activities; skills or case based learning elsewhere. There are two clear limitations to an opportunistic placement learning approach. The first is that there is a potential risk to the patient's physical or mental welfare where the learner is practicing a skill or technique because care of the patient becomes secondary to learning (Lowe et al., 2008; Reynolds & Kong, 2011).

Secondly, such placement learning is not always available to students that may result in non-standardised training of new practitioners. Experiential learning in placement is not guaranteed and therefore, the developing '*expert*' is trained in mastering a series of skills and techniques or schema forging an inventory of experience that could be used to treat a patient (Domuracki, Moule, Owen, Kostandoff, & Plummer, 2009; Owen & Plummer, 2002; Robertson & Bandali, 2008).

Failures in the United Kingdom care system such as the illegal retention of children's organs for learning at Alder Hey Hospital and the subsequent Bristol enquiry (Department of Health, 2001), as well as 'never events' like fixation syndrome (Donaldson, 2009; Harmer, 2005) where clinicians become blinded to the situation that they are facing and perform inadequately are inexcusable. In an attempt to mitigate such failures, it has been recommended that medical and healthcare education moves away from an apprenticeship approach (often with the consequences of trial and error) and concentrate on other methods of developing future competent medical and healthcare professionals (Maran & Glavin, 2003) whilst maintaining patient-centered care (Baker et al., 2004; Clark, 2011; Department of Health, 2013; Ker, 2003; Levinson, 2010; Sharek & Classen, 2006; Ziv et al., 2006).

One response has been to expand the way by which medical education is delivered through the introduction of simulation-based education and training, to complement practice-based experiential learning (Agazio, Pavlides, Lasome, Flaherty, & Torrance, 2002; D. Gaba, Howard, Fish, Smith, & Sowb, 2001; D. M. Gaba & DeAnda, 1988). One catalyst for the use of simulation is the increasing need for students to acquire skills and gain professional experience in a *'safe'* environment (Aggarwal, Undre, Moorthy, Vincent, & Darzi, 2004; Harper, Eales-Reynolds, & Markham, 2013).

The use of simulation in clinical education and training in the UK has increased since the 1960s (Donaldson, 2009; Harper et al., 2013). Indeed, some form of simulated learning prior to clinical placement is currently advocated for all medical, health and social care students (Department of Health, 2011a, 2011b). However, despite a wealth of literature describing the use of simulation in clinical teaching and training, evidence that it facilitates higher order learning such as the memory of learning event, enhancement of clinical performance and transference from the simulated environment into the clinical one is inconclusive (Baker *et al*., 2004; Billings & Reynard, 1984). This may be because simulation education is not standardised and many facilities operate as 'silos' or employ individualistic approaches (Bradley & Postlethwaite, 2003; Weller, 2004).

The aim of this study was to investigate the effectiveness of simulation-based learning of rapid sequence induction of anaesthesia (RSI). RSI is a time critical clinical intervention whereby an ODP and the anaesthetist work closely together to anaesthetise a patient and gain secure airway control and ventilation of the patient who may otherwise vomit during anaesthesia.

This study compares the effectiveness of three types of learning, on undergraduate ODP students with no clinical learning experience of the RSI but who were exposed to the same theoretical teaching of this subject. The three types of learning are:

- 'traditional learning' where a student receives subject-specific lectures complemented by a month-long period of learning in clinical placement in order to reinforce theoretical knowledge as part of practice and develop abilities in specific skills, if opportunity facilitates;
- 'traditional learning' augmented with 'part-task training' which facilitates theoretical practice using an inanimate object such as a cannulation arm, an upper airway torso or a resuscitation manikin;
- 'traditional learning supported with simulation' in a contextually similar environment, using hi-fidelity manikins and simulated staff who involve the learner in a scenario.

Each participant was then assessed by an examiner who was blinded to the participant group, using a standardised checklist adapted from the Difficult Airway Society (DAS) to assess performance and skills acquisition in supporting rapid sequence induction in a simulated scenario. This method would identify if there were any differences in attained knowledge, ability, skills and confidence of participants.

Methods

This was an equivalence, controlled, pilot study, limited to a single cohort and a single site. Participants were allocated into either a traditional teaching and learning group [TTL], a part task training group [PTT] or a simulation group [Sim] using a simple random sampling frame (Procter & Allan, 2009). Assessment was undertaken by a clinical examiner, external to the project that was blinded to the groups that participants had been taught in.

Participants

Recruitment was based on opportunistic and convenience sampling of a generic population of undergraduate ODPs. This sample was normally distributed in terms of gender and age and at the very beginning of their first year of study.

Study settings
Data was collected in classrooms, part-task training laboratories, hi-fidelity simulated ward and operating theatre. Data collection was in two stages; for the Sim and PTT groups data was sought immediately before and after the intervention. For the TTL group data was collected before the lecture and after a clinical placement that lasted for one month.

Allocation to groups
Participants were allocated a number from 1-27. Nine participant numbers were chosen and allocated to each group. There was no age or gender stratification.

Intervention
Participants undertook the routine teaching for RSI including the delivery of one didactic lecture of two hours duration that was delivered by the same lecture to afford as much consistency as possible.

For the TTL group which served as the control group, this was the only formal teaching arranged as this group would rely on clinical placement activity of one months duration to develop further their knowledge and skills.

The PTT group had an additional three hours classroom-based workshop that included psychomotor or skills practice on inanimate upper torso manikins' combined with rehearsal of the theoretical principles for assisting in an RSI. All participants were involved in practicing and applying taught theory on the PTT manikins.

The Simulation group attended one three-hour workshop where simulated scenarios of a patient requiring an RSI ran repeatedly. The scenario took place in a simulated operating theatre which had an anaesthetic machine, a lecturer imitating an anaesthetist, an operating table and a hi-fidelity manikin METI-HPS™ that is equipped with the ability to 'respond' to drugs, oxygen delivery and defibrillation. All participants were involved in practicing and applying taught theory on the PTT in a scenario based hi-fidelity teaching event with feedback on performance.

Outcomes
The primary outcome was to analyse participants' ability and skill when performing an RSI with an anaesthetist in a simulation on a hi-fidelity manikin. Participants undertook assessment using an Objective Structured Clinical Examinations (OSCE) format, which is a pre-validated rubric used to measure the effectiveness and appropriateness of participant intervention and follows DAS guidelines. An external examiner used a standardised checklist and rated 'intervention' and 'skill' for each participant. Assessment outcomes were scored using safe / unsafe criteria where the actions and interventions of the candidate were sequentially recorded against the standardised OSCE assessment and were ratified by an independent, experienced clinician.

The secondary outcome was the pre-test / post-test cognitive knowledge and self-confidence scores, comparing any changes in relation to the intervention arm that the participants were allocated to.

Statistical analysis
Following the cleaning and checking of the data to ensure it satisfied the assumptions of parametric tests three separate parametric tests were conducted. The first was analysis of variance (ANOVA) between the groups to establish if there were any important differences in overall results across the groups. The second was independent *t* tests to compare specific trends and results when comparing each group, and the third was paired samples *t* tests, which measured the pre-test questionnaire results to the post-test questionnaire results. The data collected from the questionnaires consisted of multiple choice and right / wrong answers converted to a rating scale for analysis (Field, 2006). Data included the participants' age, gender, allocation to intervention arm, OSCE scores (including: outcome, algorithm use, safety, communication scores, and equipment use), pre- and post-intervention confidence scales and pre- and post-intervention cognitive levels. Data was analysed using statistical analysis software (SPSS inc., Chicago, IL, USA).

Results

Sample

Thirty students were initially approached to take part in this study. Of the thirty students that were approached, twenty-seven (n=27) students agreed to participate and informed written consent was obtained from all participants (Ferguson, Myrick, & Yonge, 2006; Horner, 1999; McHaffie, 2000).

ANOVA

The first level of analysis sought to establish if there were any statistically significant variances between the means across the groups' psychomotor / skill performance when undertaking post-intervention OSCEs for the RSI being tested.

The one-way analysis of variance (table 1) shows that there was a significant difference across the groups for the RSI OSCE results F (2, 15.249)=4.9, p=0.027 with a Confidence Interval (CI) of 95%.

Table 1: ANOVA showing significance across groups for RSI

Robust Tests of Equality of Means

		Statistic[a]	df1	df2	Sig.
OSCE Result RSI	Welch	4.594	2	15.249	.027
	Brown-Forsythe	3.652	2	21.482	.043

The significance of the results warranted further investigation using independent *t* tests to further compare performance and outcome (between group analysis).

Between group analysis RSI OSCE

The independent *t* tests show further variation between the groups. Comparisons between the simulation group and the part-task training group for the RSI OSCE show that the simulation group results are statistically significant (M=1.11, SD 0.33) than that of the PTT group (M=1.55, SD 0.52; p=0.048. Similar results are found when comparing the RSI OSCE results between the simulation group (M=1.11, SD 0.33) and traditional teaching group (M=1.66, SD 0.50; p=0.014. The PTT group (M=1.55, SD 0.52) and the TTL group (M=1.66, SD 0.50) results in the RSI OSCE do not show significant differences in performance (p=0.65).

Overall the simulation group produced significantly better results than the other two groups in the RSI OSCE assessments. The PTT group performed better in the RSI OSCE compared to the TTL group assessment demonstrating significant results. This concurs with the results from the ANOVA analysis across the groups but presents greater detail into direct comparisons of assessment results between the groups.

Analysis of secondary outcome measure: Paired t tests

It was desirable to investigate if the interventions led to any developments in cognitive knowledge and self-assessed confidence of the participants, therefore demonstrating deeper learning. The paired pre-, post-, tests showed that there was a significant change in the Sim group scores (M=10.00, SD 3.16; p=<0.001) and in overall confidence (M=-2.22, SD 0.44; p=<0.001). There was a lesser, but still significant effect in the PTT group, pre-post test, M=-3.77, SD 1.30; p=<0.001) and confidence M=-1.44, SD 0.52; p=<0.001). The TTL group with reliance on placement learning following a theoretical lecture demonstrate pre-post test results of M=-0.22, SD 0.66; p=0.34, and for confidence results of, M=-0.33, SD 0.50; p=0.08 neither of which are significant.

These results infer that for the Sim and PTT demonstrated a significant increase in knowledge of the indications and contraindications or performing an RSI. Furthermore, an increase in participant confidence in self-perceived ability in performance of RSI was reported. The TTL group data reported a non-significant increase in pre-, post- test scores and confidence and this is cognisant with learners often waiting for, or receiving limited exposure to a learning event whilst on clinical placement.

Discussion
Compared with the other two study groups, the simulation group demonstrated a greater ability to assist in the communication, preparation (equipment and patient), and procedural intervention in RSI. This may be due, in part, to the simulated learning environment, which presented students with a more realistic environment through the use of a simulated patient that responded to interventions (Druckman & Bjorck, 1991; D. M. Gaba & DeAnda, 1988; Laurillard, 1979).

The results of this study infer that simulated learning for RSI can be advantageous for this professional group and supports learning in simulation without sole reliance on gaining experience in clinical placement (Department of Health, 2011a, 2011b). The results of this pilot study are similar to previous studies (Brindley, Simmonds, Needham, & Simmonds, 2010; Kromann, Jensen, & Ringsted, 2009) that were conducted with anaesthetists. However, those studies evaluated skill acquisition alone, our study has also reported on participants' development of cognition and confidence and the differences between the three participant groups.

Indeed, the participants undertook learning of RSI at an early stage of the course, implying that a well-constructed simulated learning strategy can accelerate learning and confidence in this clinical subject. It could potentially help remedy the challenges involved with the teaching of health professionals by supporting educational modalities such as placement learning with simulated learning blocks.

Where learners' knowledge, skill and confidence can be developed in simulation and scenarios or emergencies effectively rehearsed by the students, the reliance of opportunistic practice on patients can be mitigated (Domuracki *et al*., 2009). That said, It is acknowledged that there shall always be a need for skill and knowledge development under realistic clinical conditions, however, adopting simulation into curricula could mitigate risks of patient harm and potentially unethical 'trial and error' methods of learning (Department of Health, 2011a; Domuracki *et al*., 2009; Garratt, 2009).

Evaluation of methods
There are two limitations to this study. First, it is possible that some of the participants obtained previous clinical knowledge prior to the testing having been worked previously in a clinical support role. These participants may have observed the test conditions and acquired knowledge through social learning or 'osmosis of knowledge', simply being in the environment where an RSI was performed. This was not elicited from participants' during the selection process. Second, it is recognised that the single site, single cohort design means the representativeness of the findings, is limited and therefore, the wholesale use of simulation or the generalisability of using simulated learning activities cannot be advocated.

Conclusion
This study sought to explore differences in the teaching methods of Operating Department Practice students. It addresses several important issues in areas of teaching, learning and assessment in part-task training, simulated learning and traditional teaching and learning. The results from this study demonstrate that a simulated approach to teaching RSI was successful, and that this approach enhanced students' skills requisition, cognition and confidence in performing this clinical task. The results offer a level of confidence that satisfied the main study questions and offers a baseline for further investigation. For those who design teaching and learning strategies it may provide an area for further thought in developing specific simulated learning opportunities at strategic points along the timeline of a course of study.

References
Agazio, J.B., Pavlides, C.C., Lasome, C.E., Flaherty, N.J., & Torrance, R.J. (2002). Evaluation of a virtual reality simulator in sustainment training. *Military Medicine, 167*(11), 893-897.

Aggarwal, R., Undre, S., Moorthy, K., Vincent, C., & Darzi, A. (2004). The simulated operating theatre: comprehensive training for surgical teams. *Quality Safe Health Care, 13*, 27-32.

Ardagh, M. (1997). May we practise endotracheal intubation on the newly dead? *J Med Ethics, 23*, 289-294.

Baker, G.R., Norton, P.G., Flintoft, V., Blais, R., Brown, A., & Cox, J. (2004). The Canadian adverse events study: The incidence of adverse events among hospital patients in Canada. *Canadian Medical Association Journal, 170*, 1678-1686.

Billings, C.E., & Reynard, W.D. (1984). Human factors in aircraft incidents|: Results of a 7 year study. *Aviation, space and environmental medicine, 55*(10), 960-965.

Bradley, P., & Postlethwaite, K. (2003). Setting up a clinical skills learning facility. *Medical Education, 37*(s1), 6-13.

Brindley, P. G., Simmonds, M. R., Needham, C. J., & Simmonds, K. A. (2010). Teaching airway management to novices: a simulator manikin study comparing the 'sniffing position' and 'win with the chin' analogies. *British Journal of Anaesthesia, 104*(4), 496-500. doi: 10.1093/bja/aeq020

British Broadcasting Corporation. (2009). Better Care 'if Doctors Rest'. Retrieved 9th March, 2009, from http://news.bbc.co.uk/go/pr/fr/-/1/hi/health/75858921.stm

Clark, K. (2011). The Collaborative Continuum Associated with Adverse Medical Events. *International Journal of Collaborative Practices, 2*(1), 1-11.

Department of Health. (2001). *Bristol Royal Infirmary Final Report*. London: Department of Health.

Department of Health. (2009). *European Working Time Directive: UK notification of Derogation for doctors in training London: Department of Health of the Senior House Officer grade*. London: Department of Health.

Department of Health. (2011a). *A Framework for Technology Enhanced Learning*. London.

Department of Health. (2011b). *Innovation, Health and Wealth: Accelerating Adoption and Diffusion in the NHS*. London.

Department of Health. (2013). *Independent Inquiry into care provided by Mid Staffordshire NHS Foundation Trust January 2005 – March 2009: Volume II*. London: HMSO.

Domuracki, K. J., Moule, C. J., Owen, H., Kostandoff, G., & Plummer, J. L. (2009). Learning on a simulator does transfer to clinical practice. *Resuscitation, 80*(3), 346-349. doi: 10.1016/j.resuscitation.2008.10.036

Donaldson, L. (2009). *Chief Medical Officers Annual Report*. London: DH.

Druckman, D., & Bjorck, R.A. (1991). *Optimising long term retention and transfer. in the mind's eye: Enhancing human performance*. Washington: National Academy Press.

Ferguson, L., Myrick, F., & Yonge, O. (2006). Ethically involving students in faculty research. *Nurse Education in Practice*(6), 397-403.

Field, A. (2006). *Discovering statistics using SPSS*. London: Sage.

Gaba, D., Howard, S.K., Fish, K.J., Smith, B.E., & Sowb, Y.A. (2001). Simulation based training in anaesthesia crisi management (ACRM): A decade of experience. *Simulation & Gaming, 32*(2), 175-193.

Gaba, D.M., & DeAnda, A. (1988). A comprehensive anaesthesia simulation environment: Re-creating the operating room for research and training. *Anaesthesiology, 69*(3), 387-394.

Garratt, M. (2009). Bringing the Ambulance into the Classroom. *Journal of Paramedic Practice, 1*(10), 411-412.

Ginifer, C., & Kelly, A.M. (1996). Teaching resuscitation skills using the newly deceased. *Med J Australia, 165*, 445-447.

Gregory, D.M., Guse, L., Dick, D.D., & Russell, C. (2007). Patient safety: Where is nursing education? *Journal of Nursing Education, 46*, 79-82.

Harmer, M. (2005). Report into the Death of Elaine Bromiley. Retrieved 1st May 2013, from http://www.chfg.org/blog/patient-safety-the-importance-of-learning-from-failure

Harper, M., Eales-Reynolds, L.J., & Markham, C. (2013). Transforming simulation in clinical education: is pre-placement hybrid learning valuable to healthcare students? *J Contemp Med Edu, 1*(1), -. doi: http://dx.doi.org/10.5455/jcme.20121129051301

Horner, J.S. (1999). Retreat from Nurenburg: Can we prevent unethical medical research? *Public Health, 113*, 205-210.

Hudson, T.S. (2000). Is it ethical to practice intubations on the deceased? *JONA's Healtcare Law, Ethics registration, 2*, 22-28.

Ker, J. (2003). Developing professional clinical skills for practice-the results of a feasibility study using a reflective approach to intimate examination. *Medical Education*(37), 34-41.

Kromann, C.B., Jensen, M.L., & Ringsted, C. (2009). The effect of testing on skills learning. *Medical Education*(43), 21-27.

Laurillard, D. (1979). The process of student learning. *Higher Education, 8*(4), 395-409.

Levinson, D.R. (2010). Adverse Events in Hospitals: National Incidence Among Medicare Beneficiaries (O. o. I. General, Trans.).

Liaw, Sok Ying, Chan, Sally Wai-chi, Scherpbier, Albert, Rethans, Jan-Joost, & Pua, Gim Gim. (2012). Recognizing, responding to and reporting patient deterioration: Transferring simulation learning to patient care settings. *Resuscitation, 83*(3), 395-398. doi: http://dx.doi.org/10.1016/j.resuscitation.2011.08.021

Lowe, M., Kerridge, I., McPhee, J., & Hart, C. (2008). Do patients have an obligation to participate in student teaching? *Medical Education, 42*(3), 237-241.

Maran, N.F., & Glavin, R.F. (2003). Low to hi fidelity simulation-a continuum of medical education? *Medical Education, 37*, 22-28.

McHaffie, H. (2000). Ethical issues in research. In D. Cormack (Ed.), *The Research Process in Nursing*. Oxford: Blackwell Science.

National Reporting and Learning Service. (2011). Organisation Patient Safety Incident Reports Workbook. In NRLS-1034 (Ed.). London: DoH.

NHS East of England. (2009). *Achieving WTD 2009 Compliance The Contribution of new roles: Showcasing Anaesthetics and Theatres Manchester*: Skills for Health – Workforce Projects Team.

Oberleitner, M.G., Broussard, A.B., & Bourque, J. (2011). An Unintended Consequence of Simulation: A Case Report. *Clinical Simulation in Nursing, 7*(2), e35-e40. doi: http://dx.doi.org/10.1016/j.ecns.2010.03.074

Owen, H., & Plummer, J.L. (2002). Improving learning of a clinical skill: the first years experience of teaching endotracheal intubation in a clinical simulation facility. *Medical Education, 36*, 635-642.

Procter, S., & Allan, T. (2009). Sampling. In K. Gerrish & A. Lacey (Eds.), *The Research Process in Nursing* (pp. 173-191). London: Blackwell Science.

Reynolds, T., & Kong, M.L. (2011). Learning without patients. *BMJ, 342*, 83-84.

Robertson, J., & Bandali, K. (2008). Bridging the gap: enhancing interprofessional education using simulation. *Journal of Interprofessional Care, 22*(5), 499-508.

Ross, J.G. (2012). Simulation and Psychomotor Skill Acquisition: A Review of the Literature. *Clinical Simulation in Nursing, 8*(9), e429-e435. doi: http://dx.doi.org/10.1016/j.ecns.2011.04.004

Sharek, P.J., & Classen, D. (2006). The Incidence of Adverse Events and Medical Errors in Paediatrics. *Pediatr Clin N Am, 53*, 1067-1077.

Stewart, R.D., Paris, P.M., Peltan, G.H., & Garretson, D. (1984). Effect of varied training techniques on field endotracheal intubation success rates. *Ann emerg med, 13*, 1032-1036.

Weller, J.M. (2004). Simulation in undergraduate medical education: bridging the gap between theory and practice. *Medical Education, 38*(1), 32-38.

Ziv, Amitai, Erez, David, Munz, Yaron, Vardi, Amir, Barsuk, Daphna, Levine, Inbal, . . . Berkenstadt, Haim. (2006). The Israel Center for Medical Simulation: A Paradigm for Cultural Change in Medical Education. *Academic Medicine, 81*(12), 1091-1097 1010.1097/1001.ACM.0000246756.0000255626.0000246751b.