

Abstracts Presented at the 12th Annual Meeting of the Society in Europe for Simulation Applied to Medicine

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Theme Session Presentation # 1

What is real about simulation? Different modes of thinking about the 'as-if'.

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During simulation real people interact with real devices and a real simulator. Some actions and consequences of these actions are said to be real, others simulated. A basic difference concerns the 'as-if' of simulation. Participants interact with the simulator manikin as if it were a patient, they engage in diagnostic reasoning like they would with a patient and experience the situation in many respects as if they would experience a similar situation in the clinical setting. Their physical actions do not have physical consequences in many cases, but these consequences are represented as if they would occur.

During a simulation scenario a reality is constructed based on 'human agreement'. Instructors need competence to construct meaningful scenarios and participants need competence to interpret scenarios in order to reach this agreement. Different physical set ups (a manikin is not a patient) allow for meaningful interpretation as well as adequate involvement. The three modes of thinking about reality by Uwe Laucken allow for ordering reality and realism of scenarios into physical, semantical and phenomenal aspects.

This order helps in analysing what happens during scenarios as well as designing and running scenarios goal oriented. Implications of these modes of thinking for tailoring simulation fidelity to training goals will be pointed out.

Theme Session Presentation # 2

Bridging the gaps in simulation.

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Medical simulators faces one major problem: They are not true to nature. A medical simulator should ideally look and behave like a real patient, or at least that part of a patient being in focus of the simulator in question. However, the lack of "true to nature" may be of less importance than first presumed. Actually, the simulation process takes place in the head or the mind of the trainee, "the internal simulation". The simulators are props suitable for the learning process. Actually, this process also takes place in the head or the mind of the trainee.

In the world of magic, there is one single goal: to let the impossible happen. Every trick or illusion is designed to «break the laws of nature». One important principle is our own ability to imagine. We may call this «filling in the blanks» or «bridging the gap». If a simulation is like an illusion, we then may use the principles of illusion to make the simulation of a patient to happen. For example, it may be wise to make sure that all the functions and conditions are as good as possible (the easy ones). This will add realism to the simulator and then increase the tolerance to the gaps in the simulator as a «forgiving» effect for the «impossible» features. Another principle is trying to direct the attention of the trainee under the simulation. But for the educational impact, you have to know when to stop the simulation.

Theme Session Presentation # 3

How was it for you? Aiming for realism in simulation.

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In order to maximise the educational capital achievable from simulation the learner should be exposed to as realistic an experience as possible. Different groups of learners find it easier to suspend disbelief than others. Clinical staff who work in a variety of different areas and settings, eg Anaesthetists, Emergency Physicians, Hospital at Night Nurse Practitioners, rather than in one unchanging clinical area eg ward nurses appear to take to simulation more readily.

As simulation teachers and course developers we can approach this issue from a number of directions. We should

- place the simulation experience in a training programme or curriculum such that it follows on from previous teaching, training and study
- work on appropriate scenario and course design including realistic supporting clinical materials
- provide adequate orientation and a solid 'scene setting' for individual scenarios
- allow individuals to adopt their own clinical position and level of seniority
- have inter-professional groups 'working' together
- ensure a believable predicted clinical course and response to interventions
- concentrate on good verbal interplay between participants and the 'patient': make the dialogue work. Having clinically active individuals involved in the scenario as the voice of the patient can add to the accuracy and brightness achieved
- provide hardware compatible with the learners usual clinical setting
- run simulation in the learner's own clinical environment

These points will be highlighted in relation to courses for Medical Emergencies (medical undergraduates, medical and nursing post-graduates, dentists), Intensive Care Medicine (ICM): Paediatric Extra-Corporeal Membrane Oxygenation training, adult ICM training and Identifying Sepsis Early training.

Theme Session Presentation # 4

Pitfalls and problems concerning implementation of VR simulators as endoscopic training and assessment tool: one step beyond?

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The use of virtual reality (VR) surgical simulators as training tools in endoscopic surgery has increased rapidly over the last five years. There has been a concomitant growth in the number of companies involved in developing such systems, focussing on VR software, VR haptic interface, or both. Attention has shifted from basic 'psychomotor' training systems, to systems that can simulate full surgical (endoscopic) procedures. VR companies' core business is not focused particularly on the development of the scoring systems underpinning their simulation. Nevertheless, most systems do supply users with an 'assessment' or 'evaluation' option.

Such assessment is usually based on what is easy to measure according to VR software developers, instead of what *should* be used: parameters and actions considered to be of clinical relevance concerning the simulated surgical procedure.

Before surgical simulators can be implemented validly in a training curriculum, consensus must be established within the surgical educational community about parameters of significance, pivotal moments in the simulation that are likely to determine clinical outcome, sequential actions and their respective 'weight' in the simulation referring to the clinical procedures. Only then, with a proper score as foundation for performance outcome, a meaningful validation process can help simulators to become implemented in the standard training curriculum. This presentation outlines process and pitfalls of building founded scoring systems, and presents an overview of the current state in validation of various endoscopic surgical simulation systems.

Theme Session Presentation # 5

Development of a hands-on training for undergraduates on cadavers and artificial bones in trauma surgery.

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BACKGROUND: Education of students in trauma surgery is problematic with respect to a number of factors, e.g. work flow in the operating theater or patient safety. As a result, surgical education for students takes place mainly in the lecture hall favouring theory and neglecting procedural skills.

AIMS: To better close the gap between watching operations and performing them on patients we established a hands-on training in trauma surgery. To achieve this, we developed a seminar for students to practice procedural skills as simulations on artificial bones and cryo-fixed corpses outside the operation theater.

DESIGN: The first seminar was held five years ago with a group of 12 students, trained from one trauma surgeon employing one formaldehyde-fixed cadaver. Due to increasing experience and feedback from students, the curriculum was adapted in every consecutive course to better meet the students' expectations and knowledge in psychology of learning. The final curriculum included a training seminar in osteosynthesis techniques on artificial bones using different implants. Additionally, students were allowed to perform a variety of surgical approaches and osteosynthesis using cryo-fixed corpses.

CONCLUSION: Taken together, we developed a trauma surgery curriculum including simulations ranging from basic skills (suturing wound) to complex procedures (planning and performing orthopedic operations). Artificial bone training followed by a simulation employing cryo-fixed corpses seems to represent adequate and logical substitutes to obtain advanced surgical skills. Using this trauma surgery curriculum, we are able to offer students intensive hands-on training in trauma surgery in a very cost-efficient.

Theme Session Presentation # 6

Virtual reality training for endoscopic surgery; voluntary or obligatory?

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Shortened working hours and evolution in surgical techniques are of significant influence on the educational programs of surgical residents. Training in the operating room is under pressure, due to planning issues and the changes in ethical perspectives. Virtual reality simulators are currently developed to train basic endoscopic surgical skills outside of the O.R.. Several training programs have been evaluated adequately and transfer of skills to the OR has been demonstrated. Discussion raises how to implement these simulation based training opportunities in the surgical training curriculum. Residents claim that access to the simulators is insufficient and that readily available access would be an incentive for independent training.

PURPOSE: This study was commenced to investigate voluntary skills training by surgical residents on a readily accessible VR simulator training and to evaluate the influence of stimulation on the intensity of the training.

METHODS: 21 residents in surgery had 24 hours access to a V.R. simulator for a period of four months. The next four months a competition was started with scores of the residents made public every second week to the complete department of surgery. The winner was awarded with a prize.

RESULTS: In the first period of four months only two out of 21 residents (9.5%) have been training on the simulator for a total of 163 minutes. Intensive stimulation in a comparative period of time has led to the use of the simulator by 7 out of 21 residents (33.3 %). Together they have been training for 738 minutes, of which 424 minutes (57.6%) during a nightshift.

DISCUSSION: Free access to a VR simulator without obligation or assessment resulted in our setting in a minimal and unsatisfactory effect on the motivation of the surgical residents to improve their skills level. Stimulation by adding a competitive element had a marginal effect only on the intensity of training. The acquisition of expensive devices for training basic skills for endoscopic surgery is probably only of use when the training method is an elementary component of an obligatory curriculum with assessment as the basis for progression in the individual training program.

Theme Session Presentation # 7

Face validity of the GI Mentor II for training in colonoscopy skills.

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BACKGROUND: Colonoscopy is a common procedure for patients with bowel complaints, which is very stressful however. Teaching novice endoscopists the fundamentals of the skill outside the clinical setting is important to minimise discomfort for the patient. The aim of this study was to verify the validity of the Simbionix GI Mentor II Virtual Reality simulator in providing a suitable non-clinical setting for training in and assessment of fundamental colonoscopy skills.

METHODS: Profound knowledge of validation studies with medical simulators within the Catharina Hospital. A questionnaire was used to assign participants to an expert group (>200 colonoscopies previously performed, N= 27) or referent group (no colonoscopy experience, N=19). Participants were familiarised with the simulator, performed a colonoscopy case in full screen mode, and filled out a questionnaire to assess the value of the simulator.

RESULTS: The majority of the participants (93.5%) agree that the GI Mentor II is valuable to provide trainees with an appropriate training tool, while minimising complications and discomfort for patients in the first stage of the learning fundamental colonoscopy skills. While 88.9% of the expert group has the opinion that the simulator should be implemented in the training programmes of endoscopists, only 37% of the experts regard the GI Mentor II to be a valuable component for accreditation.

CONCLUSIONS: With this study, we have established the GI Mentor II as useful tool for colonoscopy training. In future studies we will further investigate the additional value of this VR simulator for colonoscopy tasks.

Theme Session Presentation # 8

Face validity study of the ProMIS Augmented Reality laparoscopic suturing simulator.

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BACKGROUND: Laparoscopic surgery has become one of the most used techniques for a lot of procedures. To prevent unnecessary mistakes and complications, there has to be proper training. A safe way to train surgeons for laparoscopic procedures is simulation. In this study we want to validate the probability of usefulness of ProMIS, an Augmented Reality laparoscopic simulator, as a tool for training suturing skills in laparoscopic surgery.

METHODS: A two-paged, 12-item structured questionnaire, using a global 1–5 rating scale (1: negative, 3: neutral, 5: positive), was presented to 50 surgeons/ surgical interns in a non-academic hospital. The participants were divided in two groups based upon their laparoscopic experience, which resulted in an 'expert' group (>50 procedures; N=23) and a 'referent' group (<50 procedures; N=27). Non-parametric statistics were used to determine statistical differences between these groups.

RESULTS: There was general consensus in both 'expert' and 'referent' groups, delineating ProMIS as a useful tool in teaching suturing skills surgeons/ surgical interns (mean \pm st dev, resp. score 4.91 ± 0.42 and 4.93 ± 0.38 , $P < 0.001$) with regard to realism, tactile feedback and suturing techniques. Significant differences in opinion about the ergonomics and design of ProMIS between the 'expert' and 'referent' groups were found.

CONCLUSIONS: The ProMIS Augmented Reality laparoscopic simulator is regarded as a useful tool in laparoscopic training in both 'expert' and 'referent' groups. Although, significant differences in opinion, with regards to ergonomics and design of ProMIS, were found between experts and novices.

Theme Session Presentation # 9

Twin to Twin Transfusion Syndrome Modeling and Simulations of Therapy.

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The twin to twin transfusion syndrome (TTTS) is notorious for high rates of mortality and morbidity in monozygotic monochorionic twins. TTTS is caused by an unbalanced chronic transfusion of blood from one twin to the other along vascular anastomoses during pregnancy. Onset and development of TTTS is characterized by the development of a donor twin which is stuck in its membranes and a polyhydramniotic recipient twin. Subsequently more severe stages develop including donor anuria, abnormal umbilical artery flows in either twin, recipient hydrops and finally intrauterine death.

To date, several therapeutic interventions have been developed of which reducing the recipient polyhydramnios or fetoscopic laser coagulation of placental anastomoses are the preferred options. Following a coincidental encounter of a case of TTTS in obstetrics, Martin van Gemert initiated the development of a computational model of TTTS at the laser center in 1994. To date several models have been developed covering all stages of TTTS. The latest models include one which describes essential fetal parameters of donor and recipient twin, and a second representing the pulsatile fetal arterial tree, both will be presented briefly.

The main achievements of these models include the investigation of optimal therapy for TTTS, investigation of TTTS pathophysiology and the opportunity to perform experiments which are unethical in a human pregnancy and virtually impossible in an animal model.

Theme Session Presentation # 10

“Stan Vintage”: A baseline patient for the Human Patient Simulator™ with hemodynamic parameters from the scientific literature.

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INTRODUCTION: Baseline patient Stan V1.3 on the Human Patient Simulator™ (HPS) has a number of hemodynamic shortcomings, including unrealistic blood pressures and blood volume, cardiac tamponade on start-up, and difficulties in simulating septic shock. The cardiovascular model of this patient was inspired by the model presented in (1), referred to as the Beneken model, but has several structural differences, also making comparison of parameter values between the two models difficult. We hypothesized that the original model would not have these hemodynamic shortcomings. The purpose of this study was to provide and test a parameter set in HPS format with explicit references to this model.

METHODS: Access to (1) is not straightforward and simulation results were obtained in conditions that could not be totally reproduced. Therefore, we refer to the model and adult parameter set as presented in (2) and implemented it in Matlab. By carefully describing structural differences and parameter transformations, we derived a parameter set for the HPS which is equivalent to the Beneken model.

RESULTS: After adaptation of a single parameter, vital signs simulated with the derived parameter set match those of the original model and its Matlab implementation. Preliminary results indicate that they are more realistic than those of Stan V1.3 and that cardiac output values corresponding to septic shock can be obtained.

CONCLUSION: We provided a baseline patient for the HPS with hemodynamic parameters that can be traced back to the scientific literature.

REFERENCES: (1) Beneken, PhD thesis, 1965. (2) Goodwin, et al., *Anesth Analg*, 2004.

Theme Session Presentation # 11

Modelling desflurane in the human patient simulator.

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In the Bristol Medical Simulation Centre (BMSC) we have developed specific courses for the teaching of low flow anaesthesia and the pharmacology of volatile anaesthetic agents. With the re-launch of desflurane in the UK it has become apparent that there is still reticence among some British anaesthesiologists to use low fresh gas flows with this agent (less than 1000 ml min⁻¹). As desflurane is expensive, economy must be achieved by the use of rebreathing techniques, and these methods can be taught using the Human patient simulator in the BMSC.

The HPS can currently model halothane, enflurane, isoflurane and sevoflurane, but not desflurane. To obtain reasonably realistic expired gas concentrations, the simulator uses real anaesthetic liquid agents injected into the model lung via a copper vaporiser. One of the problems in obtaining a realistic simulation of desflurane is the handling of a very volatile liquid which is almost boiling at the ambient temperature of the simulator (desflurane boils at 23.5 degrees C).

The aim of this work was to model desflurane in the HPS so that it could be used in a teaching scenario. The work used, in a novel manner, the existing anaesthetic liquid injection and pharmacodynamic system concepts.

It can be concluded that desflurane may be successfully modelled on the HPS. The kinetics are modelled using an external computer, analyser, and syringe pump housed in a domestic fridge. The dynamics are modelled using the existing HPS hardware, with the enflurane channel reprogrammed to be considered as desflurane.

Theme Session Presentation # 12

Simplified, validated empirical model for thermodilution cardiac output.

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INTRODUCTION: The model for simulation of thermodilution cardiac output (TCO) curves in the Human Patient Simulator was derived on a semi-physiological basis and is difficult to interpret and adapt to different patients and clinical situations.

METHODS: We present a fully empirical model of the same order and dynamic behavior, but with a simplified notation and separate parameter sets for the clinical situation and patient dependent system dynamics. Thermodilution curves for the adult and six-month-old infant were obtained from the scientific literature (1, 2).

RESULTS: Parameters of the new model are easily adapted to match simulated curves to these data.

DISCUSSION: Ongoing research targets validation of the curves at different cardiac output values and an educational needs analysis of TCO in infants.

REFERENCES: (1) Jansen JR et al., *Anesthesiology*. 1996 Sep;85(3):481–90. (2) Freed MD et al., *J Pediatr*. 1978 Jan;92(1):39–42.

Theme Session Presentation # 13

Pregnancy – a challenge for physiological modelling.

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BACKGROUND: Available simulators with models of physiology lack a convincing patient model of pregnancy. Numerous groups therefore developed their own patient models. They sometimes sacrifice physiological correctness to the achievement of quick results. We think that the use of imprecise models of physiology may be harmful. The aim of this project was to create a model of pregnancy on an existing simulator using a newly developed tool.

METHODS: The underlying physiological models and equations of the hardware and software of METI (Sarasota, Florida) simulators were used. An extensive literature research was conducted to identify the physiological changes in pregnancy, which should be applied to the HPS. We used a tool we recently developed (HPS interface, AQAI, Mainz, Germany) for the prototyping and control of the pregnancy model. In a later phase we conducted experiments of physiology to test the pregnancy model.

RESULTS: We were able to elaborate on a list of physiological changes that occur during pregnancy. We identified several phases with different physiological implications: Baseline (pre-pregnancy) first, second and third trimester / at term and the postpartum period plus contractions and eclampsia that could be superimposed. The HPS interface allowed to create complex relationships (taken from literature) between input variables (e.g. trimester) and output variables (e.g. oxygen consumption). The resulting different versions of pregnant patients were subsequently and successfully tested: Reactions to blood loss, apnoea, and contractions were successfully compared with literature data and favourably evaluated by clinical experts.

DISCUSSION: Physiological modelling, the HPS interface in combination with literature research allow the creation of complex clinical situations successfully with acceptable effort.

Theme Session Presentation # 14

Simulation and Perinatal Safety.

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Improvements in Perinatal Safety has been recognised as one of the key future themes by the NHS: in particular reducing the rate of cerebral palsy by 25%. Failure to recognise or act on CTG abnormalities, communication and poor teamworking were recurrent problems identified in national enquiries into poor perinatal outcomes. Simulation and multi-professional training have been proposed to address these problems, but there is little evidence available about the best methods of training, or direct benefits for perinatal safety.

The current evidence base for perinatal education/simulation will be reviewed including a randomised trial of low technology and high technology training – the SaFe study, as well as recent evidence of improvements in perinatal outcome (shoulder dystocia and hypoxic ischaemic encephalopathy) after training.

The experiences of the SaFe study group after 450 consecutive simulated Shoulder Dystocia drills and 93 Eclampsia drills will also be presented.

Theme Session Presentation # 15

Training obstetric emergencies on a birthing simulator combined with fetal CTG/FECG simulation (STAN S31).

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BACKGROUND: Training obstetric emergencies in simulation scenarios improves patient safety. To motivate obstetricians to follow the trainings the simulation needs to be as realistic as possible.

AIM OF THE STUDY: To improve reality by simulating fetal condition in birthing simulation scenarios.

MATERIAL AND METHOD: x obstetric teams (consisting of a nurse, a midwife and an obstetrician) were trained in two consecutive obstetric scenarios on a female birthing simulation model (Noëlle, Gaumard). In the first scenario the fetal condition was described orally by the coach. In the second scenario the fetal condition was simulated by displaying on a bedside computer the fetal cardiocogram and electrocardiogram (registered on a STAN S31 monitor). The effect was measured on evaluation forms.

RESULTS: The scenarios supported by the STAN-registration scored higher on “realistic design” and “tension/distress” compared to the scenario without CTG/EKG.

CONCLUSION: Simulating the fetal condition by displaying the cardio- en electrocardiogram improves the realistic impression of the scenario and should be integrated into computerized birthing simulators.

Theme Session Presentation # 16

The role of the pelvic trainer and OSATS tool in assessing junior doctor competency at instrumental delivery.

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HYPOTHESIS: The pelvic trainer can be used for assessing junior doctor competency in instrumental delivery using the Objective Structured Assessment of Technical Skills (OSATS) tool.

INTRODUCTION: Instrumental delivery is a core skill required in Obstetric practice. The inability to perform this safely has important consequences. Models can provide a safe environment in which to master difficult practical skills and may enable selection of those trainees who are suitably proficient to proceed to deliver patients using the RCOG developed OSATS tool. OSATS may provide reproducible assessments using video linkage.

METHODS: A pilot study of 6 junior doctors was performed. A delivery room was set up with a model pelvis and actress as the patient in the second stage of labour with a direct occipito-anterior position and a fetal bradycardia. Each doctor was asked to assess and proceed to delivery. Two assessors were present in the room during the simulation, which was recorded to analyze whether assessment could also be made by video linkage at a future stage. Competency was assessed by means of the OSATS tool from the RCOG. Individuals were asked to assess their own competency on completion of the study.

RESULTS: The OSATS tool was successfully completed for 100% of participants by both assessors in the room with less than 3% discrepancy between scores allocated.

CONCLUSIONS: The RCOG OSATS tool has been developed for use in “live” situations. This pilot has demonstrated its transferability to the use of models providing a safe environment in which to learn difficult skills.

Theme Session Presentation # 17

Knowledge reinforcement and learner satisfaction of delivery simulator classes in undergraduate medical training.

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The aim of this study was to evaluate knowledge reinforcement and learner satisfaction of adding a delivery simulation based training module to the existing undergraduate medical curriculum at the Porto Medical School. A total of 119 fifth-year medical students participated in the study.

After a 2-hour "labour and delivery" theoretical class, the students were randomly assigned to two groups. The first group (n=59) participated in a 30-minute supervised self-study session, while the second (n=60) was divided in pairs attending a delivery simulator session (Noelle, Gaumard Inc., USA). Tests consisting of 10 multiple choice questions were taken before the theoretical class (pretest), after the self-study or simulation session (1st posttest) and 12–15 days later (2nd posttest). Six questions about session satisfaction using a five-point Likert scale were added to the 1st posttest for 53 students. ANOVA tests were used, setting significance at $p < 0.05$. The simulator group pretest, 1st posttest and 2nd posttest means were 2.1, 5.8 and 6.2, respectively. For the control group they were 2.4, 5.0 and 5.9. The pretest means were not significantly different in both groups ($p = 0.35$). The 1st-posttest mean was significantly higher in the simulator group ($p = 0.001$) but the 2nd-posttest means were again not significantly different ($p = 0.41$). Reported satisfaction was significantly higher in the simulator group (means: 4.1 versus 3.1; $p = 0$).

Simulator based reinforcement of the "labour and delivery" undergraduate theoretical class led to a significant increase in short term knowledge and higher learner satisfaction than textbook based reinforcement.

Theme Session Presentation # 18

Does training reduce the incidence of fetal injury in cases of shoulder dystocia?

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BACKGROUND: Shoulder dystocia (SD) remains largely unpredictable. Inadequate management can result in neonatal morbidity and mortality. In the UK, annual SD training for all staff is now a mandatory requirement for CNST level 2, despite absence of evidence that such training improves neonatal outcomes. We investigate whether annual SD simulation training of all staff in our maternity unit (introduced in June 2000) has led to any decrease in rates of neonatal injuries.

METHODS: All live term (≥ 37 weeks) singleton, in-hospital vaginal deliveries with 'difficulty with shoulders', spanning 1996 to 2004 were studied. Antenatal and delivery details, management of SD, as well as relevant neonatal injuries (e.g decreased arm movement, fractured humerus/clavicle) were reviewed. The prevalence of SD, and rates of injuries related to SD were studied. The 4 year period prior to training (1996–99), was compared with the 4 years post initiation of training (2001–04).

RESULTS: 587 cases of SD were found and reviewed. Rates of SD were similar before and after training: 274/15919 (1.72%) and 224/13160 (1.70%) respectively. There was an almost four-fold reduction in the rates of neonatal injuries in babies with SD, from 35/274 (12.8%) prior to training, to 8/224 (3.6%) post training (RR = 0.27, p -value < 0.0001 (Chi-squared test)).

CONCLUSION: A significant reduction in neonatal injuries occurred following the introduction of SD training. This is the first time that SD training has been shown to be associated with an improvement in neonatal outcomes, justifying recommendations for annual simulation training of all staff in SD management.

Theme Session Presentation # 19

A visual model of coronary circulation.

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Teaching medical trainees about the coronary circulation is important. One in every five deaths in the US is attributed to coronary heart disease. We have developed mathematical models describing the coronary blood flow and pressure, heart muscle tissue oxygen demand, and oxygen supply.

The pressure/flow model is driven by the existing Human Patient Simulator (HPS™) cardiovascular models, because the blood flow into the coronary circulation is determined by the pressure difference between the aorta and the right atrium. Three heart muscle tissue compartments were defined: a right ventricle compartment and two left ventricle compartments (epicardial and endocardial).

In order to form a mental model that our students can easily fall back to, we developed a simple graphical display, consisting of two circles of muscle tissue, driven by the cardiovascular and coronary models. The stylized heart beats in real-time, and the inside volume and muscle wall thickness are realistic representations and are calculated by our models. The muscle tissue is colored between red and blue, depending on the partial pressure of oxygen in that tissue. When oxygen demand exceeds supply, the tissue will turn bluer. Currently, three model parameters can be easily changed via sliders: flow resistance to the endo- and epicardial LV compartments, and heart rate. This allows for the scenario where some coronary vessel blockage exists, but is not apparent at normal heart rates.

Slowly increasing the heart rate will lower the tissue oxygen partial pressures in real-time. Visual mathematical models of physiology are a powerful tool for teaching complex physiology.

Theme Session Presentation # 20

An interactive, web-disseminated, clinical simulation of perioperative coagulation.

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BACKGROUND AND GOALS OF STUDY: An updated conceptual model of hemostasis, the cell-based model, has begun to supplant the classical cascade model because it elucidates *in vivo* observations, especially in the perioperative setting where multiple complicated processes affect the hemostatic outcome. Although other simulations exist, none seems to illustrate the whole perioperative setting or to allow users to observe how their interventions affect hemostasis.

MATERIALS AND METHODS: We are implementing an interactive, web-disseminated simulation of perioperative coagulation that will be available free of charge to all involved in the perioperative care of patients. Within the goal of simulating perioperative hemostasis, we focus on clinical aspects grounded in basic science. To facilitate understanding, we apply transparent reality simulation techniques that allow users to interact with the cell-based model of hemostasis and visualize the essential and usually invisible effects of their interventions on hemostasis within a surgical setting.

RESULTS AND DISCUSSION: As of this writing, the various concepts that have been explored for interactively simulating hemostasis can be viewed at <http://vam.anest.ufl.edu/hemostasis>. We will demonstrate our evolving work at the SESAM 2006. The clinical environment presented will include scenarios of liver failure and transplantation, cardiopulmonary bypass, massive transfusion and coagulopathy, among others. In each case, the user may select laboratories, treatments and other interventions to allow self-guided learning.

CONCLUSION: The free, web-based, perioperative hemostasis simulation should increase clinical understanding of the cell-based coagulation model, coagulation tests and management of perioperative coagulopathy by facilitating exploration, "learning by doing" and visualization.

Theme Session Presentation # 21

More Mental Models Mandated.

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We explain and explore complex relationships in medicine by peeling away features not needed when focusing on specific aspects of dynamic systems. We describe such relationships with two- or three-dimensional renditions or mathematical expressions. These models show features, proportions, or dynamic relationships that— to make the models **mental** and useful— should be easy to comprehend, use, and remember.

In clinical practice some models, such as the ECG, are difficult to comprehend and remember. Cognoscenti with 'deep knowledge', to use Gaba's phrase, will form mental models of a beating healthy or diseased heart when monitoring the ECG. Mathematical analyses of the ECG are available; therefore, visual mental models of cardiac electrophysiology or pathology could offer clinicians information more user friendly than an ECG tracing.

While such cardiac models have not yet been introduced into anesthesia practice, we are well served by a visual model of uptake and distribution that reveals what lies behind the lines tracing the concentration of inspired and expired gases on physiologic monitors. The interactive GasMan® mental model brilliantly shows how gases flood imaginary compartments. Part of this mental model's success lies in its simplification that hides complexities, which still other models can explain. While GasMan® does not strive to evoke images reflecting physical reality, other accomplished models, such as the Virtual Anesthesia Machine meld representation of physical reality with iconic elements.

Mathematical models underlying the human patient simulator make possible the development of visual mental models offering clinicians user-friendly shorthand explanations of complex, dynamic relationships.

Theme Session Presentation # 22

Mental Models and the Cardiovascular System.

Tammy Y. Euliano Department of Anesthesiology, College of Medicine, University of Florida, USA

Full-scale simulation offers opportunity to learn in the same setting in which the information must be retrieved, enhancing recall in the clinical environment. However, full-scale simulation provides only an external view of physiologic events. Unrelated pathologic conditions can have identical vital signs challenging the clinicians to analyze the background of the disturbance. This background could be rendered visible if there were a "transparency" to the simulator's physiologic models. A firm grasp of cardiovascular and respiratory physiology is essential to the optimal management of critically ill patients. The complexity of these fields begs for well-designed mental models of the integrated system.

In collaboration with Digital Worlds Institute, an interdisciplinary research organization focusing on engineering and fine arts, we developed a rudimentary version of a cardiovascular mental model. This model demonstrates many of the physiologic concepts of the cardiovascular system such as systemic vascular resistance, venous capacity, and pulmonary perfusion. A future version will include communication with the simulator models, animation, demonstration of reflex responses and transesophageal echocardiography. During a simulator session, the animation will demonstrate the ongoing physiologic derangements, and the response to pharmacologic interventions.

We believe combining the obvious value of full-scale simulation with review of the underlying physiologic concepts in such a visual manner, will enhance education. Meanwhile, the opportunity to interact with physiology in this way should interest the trainee in developing their own mental model of the system.

Theme Session Presentation # 23

A research strategy integrating simulator and field data on teamwork: Implications for the development of theory, methods and curricula.

Tanja Manser ETH Zurich, Switzerland

Although it is widely accepted that teamwork is a crucial aspect of performance in complex work environments such as health care, little empirical evidence exists on team behaviour that supports successful performance of medical teams. Most studies follow a single-setting, single-method approach. From a methodological point of view this is premature because our understanding of team behaviour is still rather fragmented. In this presentation a research strategy integrating field and simulator data will be outlined.

A careful comparison of behavioural data from both research settings would allow for a better understanding of the possibilities and limits of simulator-based research. However, the question if and under what circumstances data collected in these two settings can be regarded as "comparable" is still a point of debate. Data from an interview and observation study on coordination processes in anesthesia will be used to illustrate how results from field research can help in the development of simulator based studies and curricula. Data collected with the same observation method using simulations will be discussed as another important "window" to a more complete understanding of teamwork in the operating room.

Theme Session Presentation # 24

A qualitative analysis of team skills needed in the delivery room and the operation theatre.

Doris Østergaard, Kurt Nielsen, Marlene Mohr, Morten Lebech, Nini Vallebo Danish Institute for Medical Simulation, Herlev University Hospital, Denmark

AIM OF PRESENTATION: To present a method for task analysis of the emergency situation in the delivery room and the operation theatre looking specifically at team skills.

SUMMARY OF RESULTS: Based on observational studies in the delivery room we developed scenarios illustrating different emergency situations in the delivery room addressing both the adult and the neonatal patient. A combination of a simulated patient and a manikin was used in the full scale simulations. The midwife was supposed to call for help as the situation worsened and introduce the new team members to the situation. The scenarios were video recorded and later analysed for specific categories and relationship between decision making (diagnose and treatment of the patient) and team skills such as communication, collaboration and leadership. Immediately after the simulation scenario the team was interviewed about the situation, their ability to function as a team, their experiences and their thoughts regarding the situation. Aspect with relevance for patient safety was addressed.

CONCLUSION: The method used was well accepted by the participants in the scenarios and interviews. By combining simulation and interview it was possible to initiate reflection in - and on action.

Theme Session Presentation # 25

Leadership behavior, but not attitude, changes in response to short term team training using a patient simulator.

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INTRODUCTION: Our hypothesis was that trainees' leadership performance improves and attitude change in response to trauma team training using five scenarios in a patient simulator environment.

METHODS: Fifteen medical students without earlier experience of trauma or team training were recruited to the study. After introduction lectures in trauma, A-B-C-D-E, and team work participants were familiarized to the patient simulator environment, and answered a questionnaire on attitudes (OTRMS) (1). In a pre-test trauma scenario students acted as team leader. During the training period the following day each student was active observer in two scenarios, acted as team member in two scenarios and as team leader in one scenario. Feedback was given during a debriefing session using video recording after each of the five training scenarios. The last day all subjects experienced a post-test scenario as team leader and were presented the OTRMS. Pre-test and post-test scenarios were all video recorded and behavioral performance analyzed using the Emergency Medicine Crisis Resource Management Scale (2) by three raters.

RESULTS: Only one of the 18 items in OTRMS changed significantly. Nine of ten behavioural components of leadership were significantly higher in the post-test scenario.

DISCUSSION: Findings that almost all behavioural components of leadership were significantly higher after scenario-based training indicate that the course was able to improve behaviour, but not attitudes.

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Theme Session Presentation # 26

Assessing the Burden of Error Recognition in Cardiac Surgical Teams: Implications for simulation training.

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INTRODUCTION: The fear of committing clinical errors in peri-operative care has a negative impact on the psychological well-being of surgical teams and ultimately on the safety of patient care.

METHODS: Pediatric Cardiac Surgery teams (PCS) in three major urban academic health centers participated in this study. 61 of 89 respondents completed the questionnaire (69%) We used 29 validated questions, sorted by multi-factorial analysis to assess the attitudes and perceptions of PCS members. The domain Impact of Error, relates to the organizational and personal burdens that are direct consequences of making and anticipation of committing clinical errors. Confirmatory factor analysis using SAS was computed.

RESULTS: We found that 31% feel that levels of staffing are sufficient; 47% report that equipment is adequate for safe care, and fewer than 60% feel that errors due to lack of skill or knowledge are rare; 91% of the respondents stating they have seen errors; 83% reporting that they have made a mistake that had the potential to harm a patient; and 75% reporting being ashamed of making an error in front of the PCS staff. 97% of respondents agreed that errors are important to identify and analyze regardless of patient outcome (near misses). 41% reported that medical errors happen every day in PCS care and 39% acknowledged that PCS personnel often disregard rules and policies. 36/57 respondents indicated that they sometimes had problems sleeping due to clinical decisions.

DISCUSSION: Surgical teams are well aware and influenced by the error burden of clinical care. This data supports observational data of over 102 PCS cases of the pervasive error opportunities in PCS. Over one-third of the respondents admitted that errors occur daily and repeatedly, and that staff frequently disregard rules and procedures. The responses of this validated survey about the impact of working in an error-prone and high-risk environment suggest many intervention opportunities. Coupled with more than one-third admitting feeling not safe in their own OR, this study points to many training and simulation opportunities.

Theme Session Presentation # 27

Design of a screen based simulator for neonatal cerebral function monitoring.

C.M.L. Lommen¹, W.L. van Meurs², S. Bambang Oetomo¹ ¹Máxima Medical Centre Veldhoven, the Netherlands, ²INEB - Instituto de Engenharia Biomédica, Laboratório de Sinal e Imagem, Porto, Portugal

The cerebral function monitor (CFM) enables long-term monitoring of cerebral electrical activity of newborns at the neonatal intensive care unit (NICU). Using only 3 electrodes, a one-channel biparietal EEG is measured, which is processed into a signal that reflects brain function and is relatively easy to interpret. CFM measurements are performed and interpreted by neonatologists and nurses. This relatively new device is on its way to become an important additional feature in monitoring patients at the NICU. With the introduction of a CFM on the ward, thorough training for nurses and doctors is mandatory for the optimal benefit of this technique.

The goal of this project is to develop a screen-based educational simulator for CFM. The training needs analysis (TNA) for this simulator concluded that training is needed in both the performance of the measurement and interpretation of the CFM signals. This can be divided into several items, namely the preparation of the skin, positioning of the electrodes, classification of typical patterns in the CFM signal and the detection of artefacts. Most of these items are equal for nurses and neonatologists. However, the understanding of the source of the CFM signal and the classification of its typical patterns needs to be basic for nurses and advanced for neonatologists.

From the TNA we conclude that regular training is needed for a good performance and interpretation of the CFM. Through this CFM trainer we aim to make an improvement in the use and understanding of this relatively new monitoring method.

Theme Session Presentation # 28

Educational simulation of hemodynamic transitions during and shortly after birth.

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After a brief discussion of clinical educational needs related to normal and abnormal hemodynamic transitions at birth, we present an adaptation of an existing model of the fetal cardiovascular system (1). This model, with relatively simple and intuitive modifications, allows for educational simulation of hemodynamic transitions during and immediately after birth: removal of placental circulation and closure of foramen ovale, ductus arteriosus and ductus venosus. In this study we consider normal hemodynamic transitions up to 48h after birth.

After expansion of the cardiovascular model with a model for oxygen transport, we intend to use it to simulate the differences between a neonate with persistent pulmonary hypertension and a neonate with cyanotic heart disease.

Preliminary simulation results of the normal hemodynamic transition are under progress and will be presented at the conference. The developed models can form the basis for screen-based or full-body educational simulators.

(1) Huikeshoven F, et al. Am J Physiol 1980; 239: R317-R325.

Theme Session Presentation # 29

Undergraduate medical training of neonatal resuscitation: scenario development and educational impact study.

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A simulator-based teaching scenario in neonatal resuscitation is being developed in the Biomedical Simulation Centre, Faculty of Medicine, University of Porto, for undergraduate students training in Pediatrics. The main objective of these simulation classes is to provide a bridge between theoretical classes and real life situations. A study to evaluate the impact on knowledge transfer and trainee satisfaction is being conducted.

The neonatal resuscitation training scenario can be divided into 4 categories of action: rapid assessment and initial steps of action - airway evaluation (A); breathing and ventilation, including bag-mask or bag-tube ventilation (B); circulation and chest compressions (C) and fluids or drugs administration (D). At the end of the training, each student should be able to adopt the correct steps of action.

To assess the transfer of knowledge, the students are randomly assigned to two groups to compare two learning experiences: (a) supervised self-study and (b) simulation based training class using the scenario described above. Tests to evaluate concepts on neonatal resuscitation are taken before the assistance to theoretical classes (pre-test), after the self-study or simulation based training class (1st post-test) and 12–15 days later (2nd post-test). Questions about the trainee satisfaction are added to the 2nd post-test. At the conference we expect to present preliminary results.

Theme Session Presentation # 30

Training program design of a screen based simulator for neonatal cerebral function monitoring.

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The cerebral function monitor (CFM) is a device to monitor the cerebral function of newborns at the neonatal intensive care unit (NICU). This relatively new device is used by nurses, residents and doctors of the neonatology department. Their experience in these types of signals is limited and training is needed for an optimal use of the monitor in performance and interpretation of the signals.

In the training program design of this screen based simulator, we address subsequently a theoretical introduction, placement of the electrodes, the quality of the signal, recognition of artefacts and interpretation of signals of specific pathologies. In each section the trainee will be tested by his/her actions and by multiple choice questions. Positive feedback and explanations of answers will be given by the program. The scenarios included in the program are birth asphyxia and movements that could be seizures. In addition, attention will be paid to differences in clinical course of disease and effects of medication, with respect to the occurrence of seizures and change in background pattern. Different types of artefacts are included as well.

The program features different levels of skills for doctors and nurses as well as a review mode where the theoretical introduction, placement of electrodes and the questions will be left out. Using this program, we aim to improve the adequate use of the CFM and hence increase the quality of care in the NICU.

Theme Session Presentation # 31

What shall we do with our Simulation Centre?

Alasdair Strachan Montague Clinical Simulation Centre, UK

Simulation Centres have varied beginnings. Many have been established in the United Kingdom by individual enthusiasts. Others followed educational needs surveys. Some Centres are purpose built high fidelity simulation centres. Others are part of clinical skills centres or are housed in educational centres. All should have formulated a mission statement, written a business plan, identified where funding would come from and recruited relevant staff. The Centre is opened with a fanfare of congratulation and media coverage and then the real work begins. Within a year or two the picture often changes. Political changes in education change the funding streams. Courses designed to increase funding begin. The staff are overworked but at least the Centre survives. Within a few short years the ethos of the centre seems to have changed, the motivation of the staff has reduced and the centre no longer seems to be doing what it set out to do. Questions about why we are doing what we are doing seem to be more frequent. How can this be avoided?

Many pitfalls can be avoided in the initial setup. Aiming for the achievable and not the highest technology avoids many problems. Clarity of initial aims will also help. Sticking to these aims may not make life easy but will maintain motivation. Regular review of aims with necessary amendments will maintain staff ownership. Major changes need to be made with staff enthusiasm or possibly indicate staff changes are needed.

Maintaining direction for a Simulation "Centre" is a major challenge for all centres and this presentation should help with this.

Theme Session Presentation # 32

Running simulation centres: the academic and the private (commercial) approach.

Wolfgang Heinrichs Clinic for Anaesthesiology, Johannes Gutenberg University, Medical School, Mainz, Germany

The Costs of simulation centres consist of investment and running costs for personal, rooms, material maintenance. This is the same for academic and commercial centres. Academic centres: Academic centres are linked to a kind of university institution. By this money for investment has to be retrieved from grants. In Germany those grants are either the HBBG-procedure (a procedure where investment costs are taken half by the institution and half by the government) or from private organisations who support science in general.

When we started our centre in 1997 we applied for HBBG-grants and this was the financial basis of our centre. The personnel were recruited from the university department of anaesthesiology and the rooms could be recruited from an old OR that was no longer in use for patient care. We found additional sponsors like pharmaceutical industry and even the German Lufthansa who supported us substantially. But: the running personnel cost came from the university hospital, at least in part.

Private centres: By now all the money has to come from the private investor. Therefore the investment costs have to be looked at as investment and also renewal within 4–5 years and the personnel has to be paid for being facilitators. If we assume that the investment for a simulation room would mean about 500 T€ and that we would need at least 2 people being full time employed at the centre then it becomes obvious that a private centre would have to be very busy in order to pay for this amount of costs. We jumped into this risk and still we swim on the surface of the water. The figures will be given in detail during the presentation.

Theme Session Presentation # 33

Setting Up a Clinical Simulation Centre – Financial Considerations.
Neil Pease Clinical Simulation Centre, Montagu Hospital, Doncaster and Bassetlaw Hospitals NHS Foundation Trust, UK

Both set-up costs and mounting monetary demands can be one of the biggest threats to the operational stability of a clinical simulation centre. In addition to devising a robust portfolio of courses, mechanisms for reducing costs and capitalising on income generation opportunities need to be grasped.

Within this workshop opportunities for reducing the cost of consumables, obtaining medical equipment at a cost neutral basis and lowering the tax duty burden will all be discussed.

Theme Session Presentation # 34

Robotic and Virtual Simulation in the Training of Health Care Professionals from Andalusia.

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The Ministry of Health of the Regional Government of Andalusia (Spain) creates the IAVANTE Foundation in the year 2004, for the training in the care of most common pathologies for its nearly 80.000 health care professionals working in its network of Hospitals, Primary Care Settings and Emergency Services. To fulfill this mission IAVANTE Foundation designed a virtual campus for eLearning with access from all the Hospitals and Primary Care settings in Andalusia plus a multifunctional and intelligent building with an area of 6800 m², which can simulate realistic scenarios like streets, apartments, outpatient clinics, plaster rooms, operating rooms, ICU's and recovering rooms, or tele-medicine. Interactive Robotic Human Simulators and Virtual

Reality are used in the different scenarios and to teach more specialized procedures like bronchoscopies, digestive endoscopies, urologic catheterizations or laparoscopic surgery. The teaching methodology emphasizes team work, which is complemented with the feedback provided thanks to video camera recording system in each practice, debriefing sessions, and final evaluations. The tutors of the courses are all health care professionals working in the Andalusian healthcare system.

In 2005 a total of 87 different courses were designed, of which 60% used some kind of robotic or virtual simulation. The number of students was above the 5000. Our funding is mixed with part of our budget coming from the government and our aim is to obtain as much autonomy as possible.

Theme Session Presentation # 35

Premises, staff and tools – experiences from building a medical simulation center.

Cecilia Holm, Christer Carlsson Malmö Center for Medical Simulation, Department of Anesthesiology, Malmö University Hospital, Malmö, Sweden

Many medical simulation centers start out with enthusiasm and personal commitment as initial capital. Center for Medical Simulation at Malmö University Hospital in southern Sweden, active since 2003, is no exception. Defying the fact that simulation is far from being an undisputable part of medical education in Sweden and that the health care system during the past 15 years has been object of extensive cuts, we bought a full-scale patient simulator without having suitable premises or designated staff. A challenge!

Now, three years later, we have established an obvious position in the educational system of the hospital. Courses have contributed in setting standards, improving procedures and in some contexts begun to change work culture. This is – perhaps - why:

- We focused on premises, staff, realism, tools and props and the needs of the trainees.
- We have been seeking support from other simulation centers and major departments and administrators in our organisation.
- We created a trustful and respectful atmosphere for the trainees.
- We let politicians and hospital managers work hands-on at the center, knowing that it is not until you've experienced an encounter with "Simon the patient" that you fully understand the potential of full scale simulation.

But our most important advice is this; pay great attention when you name your patient simulator(s). She, he or they will soon be on everybody's lips!

The presentation will with a down-to-earth non-scientific approach illustrate experiences that might be useful to new centers or centers-to-be. It refers to full scale simulation, but is probably applicable also to other fields.

Theme Session Presentation # 36

Simulated Patient Pathways.

Kevin Russell, Francis Maietta, Mervyn Maze Chelsea and Westminster Simulation Centre, Simulation Learning Consultant, London, UK

Simulation and modelling is a well-known business management discipline from management science and system operations research. In healthcare, simulation and modelling of processes has started to be more widely adopted, but generally focuses to manage, plan and forecast resource utilization. In the Information Technology industry, this category of systems is called Enterprise Resource Planning (ERP).

However, greater efficiency for 'the system', does not necessarily translate into quality care for the patient. In a 'patient service' focused healthcare system, the primacy of an appropriate patient care pathway, through the healthcare system of services, would seem to be the first logical step towards a rational framework. A framework where available resources were applied to patient and best practice needs as a starting point, rather the often-neglected end. Such a framework would support a host of integrated systems and applications, to empower the staff's collaborative design of patient pathways to best balance resources and quality. Clarifying an opaque historic legacy of ad hoc, unordered, mostly inaccessible information shared between various work groups would be the first benefit. Modelling patient care pathways, linked to resource allocation systems can provide staff (and patients) with a new insight into understanding labyrinth of care services.

With an initial letter of interest of support from the NHS Innovation Service, we've proposed a innovative learning solution addressing modelling patients' care pathways to improve communication between clinicians and patients.

Theme Session Presentation # 37

Organizational effects of high penetrance immersive team simulation.

Stephen D. Small Department of Anesthesia and Critical Care, University of Chicago, USA

Medical simulation approaches have been increasingly adopted as training solutions in the past 10 – 15 years worldwide. Quite recently, the move to organization-wide simulation programs for capturing economies of scale and achieving new synergies of performance has suggested that powerful institutional – level effects of scaling up simulation interventions may occur independent of skills training.

These effects may be described as creating new awareness about existing hazards, dynamic organizational memory for serious past events and hazards, aligning beliefs about why failures happen to correspond more closely to scientific theories, and raising the profile of safety related issues among clinicians, managers and executive leadership. It is important to consider these organizational effects not just on their own merit, but also because these effects become conflated with the efficacy of transfer of training. It is suggested that structural characteristics of health care delivery and regulation as opposed to aviation, power generation and other high consequence industries may by default place simulation approaches – especially immersive team training with video feedback – in a unique position to effect positive changes in culture, policy, and resource allocation.

We have endeavoured to better understand and describe these possible effects and their causes through executive level interviews with experts in high consequence industries as well as health care, in addition to a systematic review of cross disciplinary literatures. Given the known difficulties of reliably linking costs of advanced simulation approaches to return on investment, it may become increasingly important to convincingly articulate positive indirect, organizational and societal effects.

Theme Session Presentation # 38

How simulation can contribute to make health care an High Reliability Organisation undertaking.

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Patient Safety and its systems perspective have become one of the top issues in health care in the last years. No diagnosis has ever been so much neglected as the diagnosis “error in healthcare”. Systematic approaches to patient safety and the introduction of simulators went parallel, at least in anesthesia, were the concept of CRM-oriented, video-assisted team training started.

In the beginning the assumption was, that simulation would increase the performance of individuals and teams. Now there are possibilities where simulation could have a much wider influence on the health care system and contribute to transform the health care industry into a High Reliability Organisation. There are 7 levels, where simulation can and should have an influence on patient safety: 1) Simulation and the Personal perspective 2) Simulation and the Team perspective 3) Simulation and the Department perspective 4) Simulation and the Organisational perspective 5) Simulation and the Safety Culture perspective 6) Simulation and the Ergonomics and Equipment perspective 7) Simulation and the Research and Development perspective.

A special focus could be a) simulation and its bilateral connection with modern incident reporting systems, b) the use of the debriefing/facilitation techniques for learning from everyday cases in the real world (every case is a learning case) and c) the use of simulation for retrospective and prospective error analysis and counter measure development.

Theme Session Presentation # 39

Safety Culture by CRM Training: Experiences from 2 Trainings in German Hospitals.

Wolfgang Heinrichs, Stefan Mönk, Jochen Vollmer, Dirk Schädler Simulation Center Mainz, Department of Anaesthesiology, Johannes Gutenberg-University Mainz, Germany

Anaesthesia CRM training is in most cases performed at special simulation centres. This has the disadvantage that the participants act in an unknown environment with often unknown equipment. Our group – the simulation centre Mainz – has been invited by two German hospitals to perform a one week training of all team members (physicians and nurses) onsite. We used the METI HPS for training. The simulator was setup in an OR that was reserved for the training. Additional rooms included a seminar room and a debriefing room. The anaesthesia members were divided into groups of two physicians and two nurses and underwent a total of five scenarios with immediate video debriefing (Duration 1 hour). Theoretical aspects of human factors were added as lectures. Two groups of participants per day were trained alternatively. The scenarios consisted of relevant anaesthesia complications.

RESULTS: During the week including the Saturday we trained a total of 60 persons from each of the clinics. That is about 25 % in the first clinic (a university clinic) and about 40% of the total staff in the second (community hospital). After the training more than 95 % of the participants were very well satisfied with the training day and stated that this should be repeated regularly, e.g. in two year intervals. The university clinic invited us to do the training although they own an ECS simulator themselves. They decided to do this, because an external evaluation of the staff was considered more objective than if they had been using their own simulation group. Although it is difficult to prove the effects of such CRM training there was face validity that the training resulted in immediate behaviour changes, e.g. in terms of communication culture or that participants called for help more early. Concrete results included the decision of the team in modifying certain procedures to be more safe and / or more efficient.