

# THE CENTER FOR ADVANCED MEDICAL SIMULATION

*Reducing errors in high technological health care*

*- one step forward*

## Annual Report 2003

[www.simulatorcentrum.se](http://www.simulatorcentrum.se)

### **Collaborating departments at Huddinge University Hospital**

Department of Anesthesia and Intensive Care

Department of Biomedical Engineering


Department of Gastroenterology and Surgery

Minimal invasive surgical unit

Department of Emergency Medicine

Department of Orthopedics

 HUDDINGE  
UNIVERSITY HOSPITAL

 Center for Advanced<sup>TM</sup>  
Medical Simulation  
- for good patient safety

## THE CENTER FOR ADVANCED MEDICAL SIMULATION

The Center for Advanced Medical Simulation is an investment for improved patient safety and error reduction in health care. It was established 1998 by the profession to meet the demands of systematic and evidence based training in high technological health care with special focus on image guided surgery and endoscopy. Human patient simulation has since then been incorporated in order to train skills, procedures and teamwork.

Our role is to promote the development of a safety culture providing values and systematic training opportunities for improved patient safety in complex health care.

The Center for Advanced Medical Simulation has a leading position in systematic education, evaluation and research in the field of advanced medical simulation. From the start of 2004 the Center will be integrated as a permanent part of high technological skills, abilities and team training in our hospital.

### Our mission

- **To implement a new safety culture in today's healthcare**
- **Validation and research in the field of advanced medical simulators and human factors in high technological healthcare**
- **Development of a modern curriculum embedding the use of advanced medical simulators for image guided surgery and endoscopy, procedural training and team work in surgery and critical care management**
- **Basic accreditation in image guided surgery and endoscopy**

**A Network of Excellence has been established with the Karolinska Hospital**



## NEW TECHNOLOGY AND HUMAN FACTORS IN IMAGE GUIDED SURGERY AND ENDOSCOPY

The minimally invasive surgical revolution has changed the way surgery is practiced. Image guided intervention in many medical fields e.g. laparoscopic surgery, arthroscopic surgery, natural orifice endoscopy and percutaneous intravascular stenting is rapidly growing. These interventions are becoming commonplace. The technique is associated with new demands on perceptual, visual-spatial and psychomotoric skills. Image guided intervention has introduced a new and unique set of psychomotor skills for a physician to acquire and master. Although minimally invasive surgery in many cases provides considerable advantages to the patient, it has imposed significant difficulties on the surgeon and susceptibility on outcomes. The difficulties are primarily human factors in nature and have previously not been sufficiently addressed and understood by key groups such as device designers and manufacturers and surgery educators and trainers.

## TEAM WORK AND PROCEDURAL TRAINING IN ANESTHESIA AND CRITICAL CARE

System failure and poor team performance are significant components of adverse outcome in complex health care. Medical knowledge is seldom lacking in a team of well-educated, dedicated professionals. Failure to reach set goals rather suggest that it is the lack of training in manual skills, coordination, or the under-utilization of team member resources (medical knowledge) that account for most of the errors. Team performance and manual skills are essential to mission success in a domain such as aviation. Crews perform in an environment that is characterized as stressful, life-critical, and with high workload replete with human error. This also holds true for areas of medicine such as invasive procedures, emergency medicine, intensive care, anaesthesia, obstetrics and neonatal intensive care. Although teamwork is necessary, successful team performance does not just happen. For teams to become truly effective, they must receive training in teamwork behaviours as well as task work behaviours. Training of aviation crews in skills, procedures and teamwork using simulators has been extremely successful in order to implement a safety culture and reduce errors. Medical simulators have rapidly evolved from primitive mannequins to machines with inherent technology and computer power capable of creating realistic physiological and patient scenarios as well as metrics. Several procedural or part-task trainers with high-fidelity computer graphics of appropriate anatomy, including also deformable tissues and appropriate physiological reactions, are now available. Features of these technologies include an increase in computer processing capacity; improvement in computer graphics that allow sophisticated graphics of human anatomy and physiology; advances in psychology and education that can affect the selection, training and testing of medical personnel; and advances in haptic engineering that enable the virtual environment to relate to the touch and feel of the human hand.

Availability of advanced medical simulators now allows us to augment the safety culture in medicine and to further reduce medical errors by the rational use of medical knowledge.

## CURRENTLY AVAILABLE SIMULATORS

### Image guided intervention

Procedicus MIST

Procedicus VA

Procedicus KSA

Procedicus Dry Lab

Simbionix GI Mentor

Simbionix Uro Mentor



GI-mentor



Procedicus - Dry Lab

### Advanced patient simulation

Human Patient Simulator (METI)



Human patient simulator



Procedicus-KSA



Procedicus-MIST

## STAFF 2003

### Steering group

Cecilia Schelin Seidegård	CEO	Huddinge University Hospital
Jörgen Larsson, professor	Director of Education	Huddinge University Hospital

### Management

			Weeks of service in the Center
Li Felländer-Tsai	Director	Orthopaedic surgery	13
Ann Kjellin	Project director	General surgery	13
Carl-Johan Wallin	Project director	Anaesth & IC	39
Torsten Wredmark	Professor	Orthopaedic surgery	5

### Administration

Ann-Charlott Nordström	Administrator
Monica Dovrin	Secretary

### Biomedical Engineers

Kai Mäkinen	26
Lars Särnå	26

### Scientific evaluation

Leif Hedman	Psychologist	Scientific collaborator	
Pär Ström	Physician	PhD candidate	16
Martin Hjälml	Medical student	PhD candidate	16

### Instructors Image Guided Intervention

Lars Enochsson	Physician	General surgery
Bo Westman	Physician	General surgery

### Instructors Human Patient Simulation

Sinikka Isoaho	Nurse	Emergency medicine	10
Lars Bremberg	Nurse	Anaesthesia	10
Brith Fägerhall	Nurse	Anaesthesia	10
Jan Löfgren	Nurse	Anaesth & IC	13
Madelaine Ciesluk	Nurse	Anaesthesia	3
Katarina Fridén	Nurse	Anaesthesia	3
Lisbeth Meurling	Physician	Anaesth & IC	6
Johan Creutzfeldt	Physician	Anaesth & IC	5
Per Lange	Physician	Emergency Medicine	3
Su-San Oh	Physician	Anaesth & IC	10

The Center was open for human patient simulation during 20 weeks with a mean of 4.15 instructors in service each day.

Su-San Oh and Torsten Wredmark were granted by the Karolinska Institutet. The Center had collaboration with the Department of Medicine (Eva Zetterberg M.D., and Loghman Henareh M.D.), and Department of Gastroenterology (Johan Apelman M.D.) during fall 2003.

## TRAINING OF SIMULATOR INSTRUCTORS

No professional medical simulator instructors were available in Sweden at the start of the Center. Professional instructors are a prerequisite for good qualitative training and evaluation of the teaching process. The Center has thus a continuous education program for instructors. This year the curriculum has included items such as situational leadership, offensive behaviour (sexism, professional conflicts, racism), conflict resolution, order giving, structure of courses, advanced medical programming of simulator, debriefing techniques.

### FORMAL EDUCATION OF STAFF

2003-01-09 –2003-01-12 International Meeting on Medical Simulation (IMMS), San Diego, CA, USA *C-J Wallin*

2003-02-24 – 2003-03-01 Human Patient Simulation Network (2003), Sarasota, FL, USA  
*Kai Mäkinen, Lars Särnä*

2003-02 Pedagogic leadership (Pedagogiskt ledarskap 2 p), CUL LIME, Karolinska Institutet  
*C-J Wallin*

2003-04 Basic course in pedagogy (Pedagogik för högskolelärare 3 p), LIME, Karolinska Institutet  
*Lars Bremberg*

2003-06 Basic Course in pedagogy (Pedagogik för högskolelärare 3 p), LIME, Karolinska Institutet  
*Lars Särnä*

2003-08-25 - 2003-08-27 Summer University Course: "Advanced Medical Simulation - Evidence Based Education for improved Patient Safety". Center for Advanced Medical Simulation, Huddinge University Hospital, Stockholm  
*Johan Creutzfeldt, Jan Löfgren, Sinikka Isoaho, Pär Ström and Martin Hjälml*

2003-09-24 - 2003-09-26 SIMSEM, Nordisk Förening för Träningsimulatorer, Trondheim, Norge  
*C-J Wallin*

## COURSES- GENERAL

The Center has provided courses in image guided intervention and advanced patient simulation with the human patient simulator. A broad range of fields ranging from procedural training (e.g. induction of anesthesia and basic accreditation in image guided intervention) to full-scale multidisciplinary trauma team training. Trainees range from medical and nursing students to clinical specialists and nurses. Course details are listed on page 8 and 11.

### Graduate Course

An international postgraduate course, “Advanced Medical Simulation - Evidence Based Education for improved Patient Safety” was organized by the center in collaboration with The Summer University of Southern Stockholm. In all, ten participants and teachers were from Australia, Germany, Denmark and USA as well as Sweden.



Prof David Gaba, Stanford and Dr Marcus Rall, Tübingen, at the International Postgraduate Course in August 2003.



Dr Tony Gallagher, Emory University, Atlanta, giving a lecture at the International Postgraduate Course in August 2003.



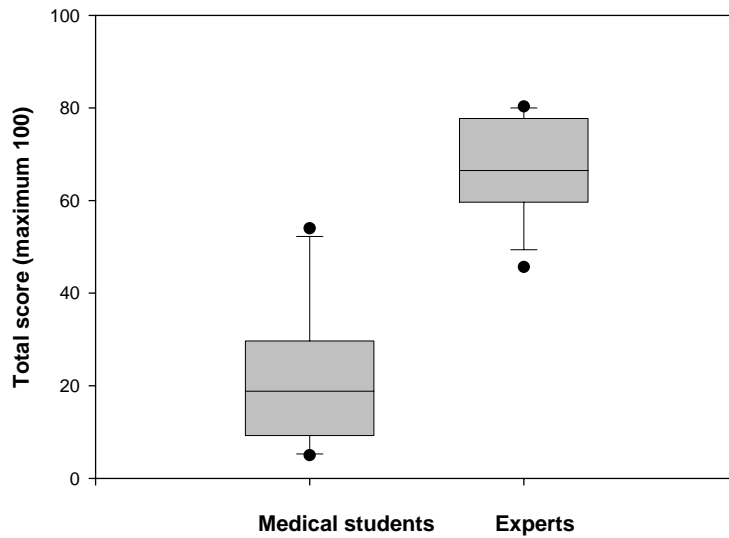
Anders Borgvall, Creative manager, simulation design, The Swedish Defence research agency, in a seminar at the Center for Advanced Medical Simulation.

## IMAGE GUIDED INTERVENTION AND BASIC ACCREDITATION IN IMAGE GUIDED INTERVENTION

In image guided surgery there have been courses for medical students, residents and specialists. In 2003 the basic accreditation program in image guided surgery was established and 8 doctors completed the program with both tutoring in biomedical engineering and performance up to predefined criterion level in the simulators for image guided surgery. The primary goal during 2003 was to develop the course in basic accreditation in image guided surgery. The course is a combination of different aspects on medical technical safety and skills training in image guided simulators. It is now running on a regular basis and attracts residents from all image guided specialities, within and outside the hospital.

<u><i>Courses</i></u>	<u><i>Time</i></u>	<u><i>Participants</i></u>
Basic accreditation Image guided interventions	400 hours	40
Medical technical safety	6 days	40
Medical students, Basic course in surgery	8 days	60
Orthopaedic residents (SK-kurs artroskopi)	2 days	24
Surgical residents, Laparoscopic surgery (SK-kurs laparoscopi)	4 days	16
Surgical residents, Emergency medicine (SK-kurs akut buk)	2 days	30
Sports-traumatology (elective course)	2 days	12
Endoscopy simulation, Paediatric gastroenterology	1 day	4
Endoscopy simulation, Gastroenterologists & surgeons	3 days	15
<b>Total</b>	<b>78 days</b>	<b>241</b>

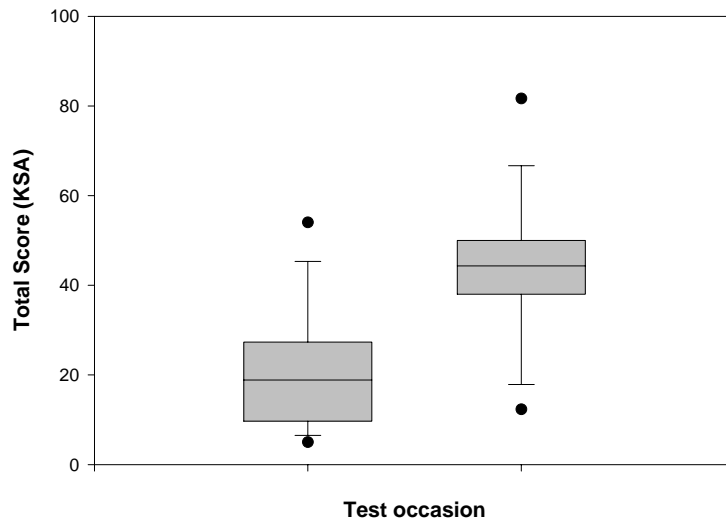




**Medical students vs Experts in the Procedicus KSA (Total Score), t-test  $p < 0,001$**

**Graph 1**

This graph shows the results from the KSA simulator of a reference group of experienced specialists in image guided intervention (general surgeons, orthopedic surgeons, gastroenterologists and gynecologists) compared to medical students (construct validity).



**The Procedicus KSA (Total Score). Medical students before and after training. Paired t-test  $p < 0,001$**

**Graph 2**

This graph shows the effect of training in the KSA simulator in a group of medical students.

## Human Patient Simulation Courses

Half-day courses (four hours) were created for three to six trainees and led by one to three instructors and an engineer:

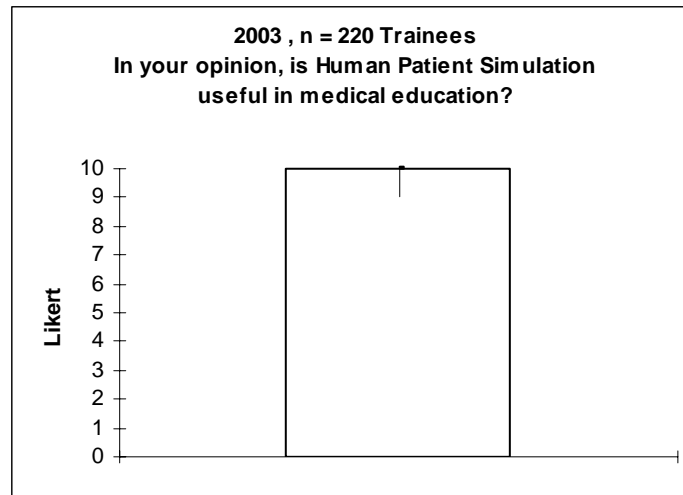
- A. Basic Life Support for Third Year Medical Students (Team resource management adapted to a ward).
- B. Introduction to General Anaesthesia for Fourth Year Medical Students (Decision making and application of checklist).
- C. Emergency team training for fourth year medical students (Team resource management adapted to emergency room).
- F. General Anaesthesia for Novices (Procedural training of anaesthesia drill)
- H. Applied pharmacology in anaesthesia for Fourth Year Medical Students (Elective, experience enhanced learning in circulatory physiology and pharmacology)
- J. Primary Patient Survey in Intensive Care (Team resource management adapted to intensive care for graduated).
- K. Emergency Medicine for Fifth Year Medical Students (Team resource management adapted to the emergency department).

Full-day courses were created for six trainees and led by four instructors and an engineer:

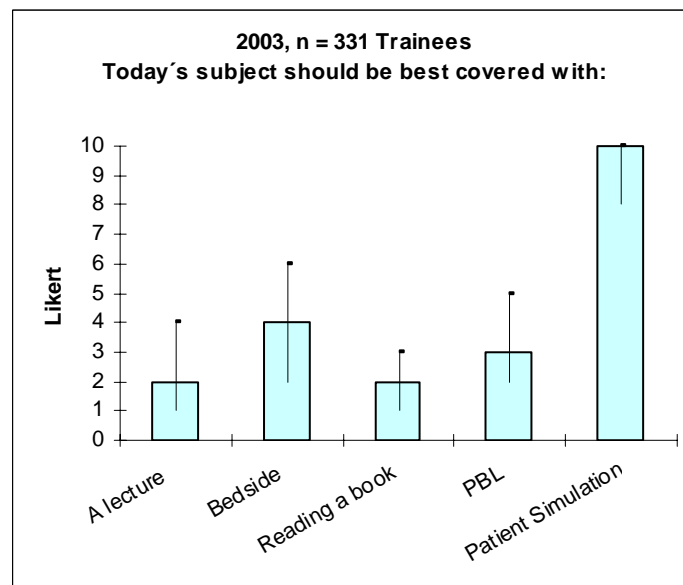
- D. Basic Life Support for Interns and Trainee Nurses (Team resource management adapted to a ward).
- E. Trauma team training (Team resource management adapted to the multi-professional, multi-disciplinary trauma team).
- G. Critical Care Team Training (Team resource management adapted to multiprofessional, multi-disciplinary intensive care team).
- I. Difficult airway management (Team resource management adapted to ENT and anaesthesia staff).

HPS Course	No of Courses	No of Trainees
A	3	17
B	16	54
C	14	48
D	12	69
E	12	63
F	6	6
G	6	28
H	1	6
I	1	6
J	2	16
K	3	18
<b>Total</b>	<b>76</b>	<b>331</b>

## TRAINEES' REACTION TO HUMAN PATIENT SIMULATOR TRAINING



Trainees were asked whether they regarded patient simulation as a useful tool in medical education. The mean for all answers was 9.4 (1.0) on a ten-graded Likert scale, a very convincing result.



Trainees were asked whether they believed that the subject they learned at the center, independent of course could have been taught with another method, less costly method. The answers showed that they regarded patient simulation as a unique method. Our interpretation is that we have succeeded in using the patient simulator for teaching behaviour and attitudes that are hard to teach with any other method but full-scale patient simulation.

## TRAINEES' CHANGE IN ATTITUDE IN RESPONSE TO HUMAN PATIENT SIMULATOR TRAINING

In a study we have shown that medical students gain in maturity and are more prone to shoulder responsibilities for the patient under anaesthesia in response to simulator training.

## RESEARCH

Two PhD candidates are registered at the Center, Martin Hjälms and Pär Ström.

### **Scientific Collaboration**

#### **National collaboration**

To further explore the learning psychology of procedures and teamwork competencies we are building a research group including PhD Leif Hedman (Umeå University), professor Kirsti Lonka and PhD Klas Karlgren (LIME/CUL Karolinska Institutet), Kai Hakkarainen and Sanna Järvinen (Finland).

Studies in the field of technology and social change are carried through together with MS Ericka Johnson at Linköping University.

Scientific collaboration is also performed with Professor Hans von Holst at Centrum för teknik i vården (CTV)

#### **International collaboration**

The SimTech project is a co-venture with SUMMIT, Stanford University, and supported by Wallenberg Global Learning Network.

The traditional method for teaching Crew Resource Management (CRM) is by full-scale simulation. This method is though costly; an alternative could be by using distributed three-dimensional virtual e learning. SUMMIT at Stanford University creates a 3D VR software enabling mimicking of the full-scale patient simulation scenarios for trauma team training. In this project the two methods for learning of teamwork will be compared.

Together with Dr Anthony Gallagher, Dr Dan Smith and Dr Matt Ritter at Emory University in Atlanta a Multi-institutional Advanced Surgical Training and Education Research program (the MASTER study) is also performed.

## EXTERNAL COMMUNICATION 2003

### **2003-01-13 SUMMIT, Stanford University, CA, USA**

Invited lecture: "A Method for Behaviour Training using a Patient Simulator"

*Carl-Johan Wallin*

### **2003-01-23 Medicine Meets Virtual Reality, CA, USA**

"Visuospatial skills and performance in endoscopic simulators"

*Li Tsai*

"Validation of simulators in endoscopic surgical training"

*Torsten Wredmark*

### **2003-03-24 Swedish Learning Lab, Wallenberg Global Learning Network, KTH, Stockholm**

Oral presentation: "Simulation Technologies for Team Learning, SimTech - Virtual training environment for teams in critical care" *Li Tsai, Carl-Johan Wallin*

### **2003-03-25 Karolinska Institutet's 6th Educational Congress, Stockholm**

Oral presentation: "Enhancement of medical students self-confidence using a full-scale patient simulator" *Carl-Johan Wallin*

### **2003-04-03 - 2003-04-05 The SESAM Annual Scientific Meeting, St Bartholomew's Hospital, London**

Panel: "Training the Trainers" *Chair: Ronnie Glavin. Participant: Carl-Johan Wallin*

Oral presentation: "Medical Simulator Training Based on Goal Orientation and Learning Psychology Principles" *Carl-Johan Wallin, Jan Hedegård*

Lecture: "Training of tasks with different visual-spatial components does not improve virtual arthroscopy performance" *Pär Ström*

Workshop: Goal Orientated Medical Simulator Training as Applied for the Emergency Team  
*C-J Wallin, Kai Mäkinen, Jan Löfgren, Sinikka Isoaho, Brith Fägerhall, Hans Hjelmqvist, Li Tsai, Ann Kjellin, Torsten Wredmark, Pär Ström, Lars-Gunnar Andersson*

### **2003-04-09 Study visit at Simulatorcentrum**

Visitors: The Educational Board of Karolinska Institutet, chair Vivi-Anne Sundqvist

*Hosts: Jörgen Larsson, Li Tsai, Torsten Wredmark, Carl-Johan Wallin*

### **2003-04-25 Working Group on Simulation in Medicine (WISE), Copenhagen**

Oral presentation: "Medical Simulator Training Based on Goal Orientation and Learning Psychology Principles" *Carl-Johan Wallin*

### **2003-05-28 Study visit at Simulatorcentrum**

Visitors: LIME, Karolinska Institutet, Kirsti Lonka, Sanna Järvilä, Kai Hakkarainen.

*Host: Carl-Johan Wallin*

### **2003-08-19 The Swedish Surgical Society, Annual meeting Karlstad**

Simulation Technology

"Basic accreditation in image guided surgery"

*Lecture: Li Tsai and Gunnar Ahlberg*

**2003-08-21 - 2003-08-23 Swedish Society for Anaesthesiology and Intensive Care Annual Meeting, Huddinge University Hospital, Stockholm**

Session: "Patient Safety" *Chair: Carl-Johan Wallin. Participant: Terri Monk*

Session: "Patient simulation" *Chair: Carl-Johan Wallin. Participants: Boel Berner, Jan Hedegård*

Workshop: "Team Training using Simulators. Philosophy, Teckniques and Out-come"  
*Chair: Carl-Johan Wallin. Panel: David M.Gaba, Jan Hedegård, Anders Borgvall, Eric Wahren.*

**2003-09-19 Study visit at Simulatorcentrum**

Visitors: The Pedagogic Committee at Huddinge University Hospital, chair Björn Eriksson.

*Host: Carl-Johan Wallin*

**2003-11-04 - 2003-11-06 Emergency & Public Safety (EPS) 2003**

Session: "Patientsimulering" *Chair: Anders Johansson. Participant: Carl-Johan Wallin.*

**2003-11-21 IVAN, Älvsjö, 2003**

Oral presentation: "Patientsimulering" *Lars Bremberg, Jan Löfgren*

**2003-11-26-28 The Annual Meeting of the Swedish Society for Medicine (Svenska Läkaresällskapets riksstämman)**

Together with collaborators from the Karolinska Hospital site (Gunnar Ahlberg, Ulf Jensen and others)

**2003-12-02 Study visit at Simulatorcentrum**

Visitors: Dept for Anaesthesia - & Intensive Care, Malmö University Hospital, Malmö  
Jonas Ingimarsson, Paul Rosenlöf, Ing-Britt Blomstrand, Cecilia Holm.

*Host: Carl-Johan Wallin*

**2003-12-03 Study visit at Simulatorcentrum**

Visitors: Trauma Comittee at Huddinge University Hospital, chair Folke Hammarqvist.

*Host: Carl-Johan Wallin*

**2003-12-04 Study visit at Simulatorcentrum**

Visitors: Dept for Obstetrics and Pediatrics, Huddinge University Hospital,

*Host: Carl-Johan Wallin*