Training multiprofessional trauma teams in Norwegian hospitals using simple and low cost local simulations

Running title: Training multiprofessional trauma teams

Authors:

Torben Wisborg[1,2]

Guttorm Brattebø[1,3]

Johannes Brattebø[1,4]

Åse Brinchmann-Hansen[1,5]

Affiliation:

[1] The BEST Foundation, BEST: Better & Systematic Trauma Care

[2]Department of Anaesthesia and Intensive Care, Hammerfest Hospital, Hammerfest, Norway

[3] Department of Anaesthesia and Intensive Care, Haukeland University Hospital, Bergen, Norway

[4] Department of Surgery, Voss Hospital, Voss, Norway

[5] Department of Medical Education, Norwegian Medical Association, Oslo, Norway

Correspondence:

Torben Wisborg, the BEST Foundation, BEST: Better & Systematic Trauma Care

Department of Anaesthesia and Intensive Care, Hammerfest Hospital, N-9600 Hammerfest, Norway

e-mail: twi@barentsnett.no, phone: +47-41634853 fax: +47-78421205

Keywords

Clinical Education, Continuing Medical Education, Interdisciplinary Medical Education, Graduate Medical Education, Computers and Simulation

Training multiprofessional trauma teams in Norwegian hospitals using simple and low cost local simulations

ABSTRACT

Context & Objective: Norwegian hospitals' trauma teams are seldom exposed to severely injured patients. We developed and implemented a one-day multiprofessional training course for hospital trauma teams in order to improve communication, cooperation and leadership.

Methods: Training courses were held in 28 Norwegian hospitals with learning objectives: improved team work, common understanding of treatment priorities and principles, communication skills, and threats to efficient communication. Two trauma teams in each hospital had two consecutive simulations in their hospital's own emergency room, as part of the course. Simulation was based on real cases, with a low-fidelity mannequin as patient. Participants completed questionnaires before and after the training course.

Results: A total of 2,860 trauma team members participated in the courses, of which 1,237 took part in the simulation. Independent of hospital size, the participants reported leadership and communication to be major obstacles during their last real trauma team participation. Immediately after the training, all participants reported highly fulfilled educational expectations and a high perception of learning, and taking part in the practical simulation improved the evaluation. Nurses scored their outcome significantly higher than physicians. Participants from minor hospitals reported as great a benefit from the training as personnel from major hospitals.

Conclusions: Local team training is a feasible approach and team simulation offers an excellent opportunity to practise demanding and infrequent challenges. The simulation format makes it possible to integrate training on interpersonal skills as well as communication and leadership under stress. Continued requests for such training in Norway support this conclusion.

Training multiprofessional trauma teams in Norwegian hospitals using simple and low cost local simulations

Context & Objective

Severely injured trauma patients are infrequent in most Norwegian hospitals, due to geography and low population density. The opportunity for "learning by doing" rarely occurs, and is not acceptable from a patient safety perspective. The local trauma teams are expected to function efficiently and smoothly when treating these most challenging cases, even though the teams often have scarce or no previous training (Wisborg *et al.,* 2003; Brattebø *et al.,* 2001a). The team members are usually sufficiently trained professionals individually, but with limited team work experience (Sexton *et al.,* 2000).

Several studies indicate that as many as one-fourth of trauma deaths are preventable, and that most treatment errors and protocol deviations occur in the admission phase (Esposito *et al.,* 1995). Improving the systems for treating severely injured patients reduces preventable deaths (Esposito *et al.,* 2003). On a national scale, such improvements have been estimated to potentially save 5-6,000 years of life annually in Norway, as opposed to improvements in treating cardiac arrest, which was estimated to save 2,250 years of life annually[1]. Regarding teamwork, the most difficult tasks to improve seem to be leadership, communication, and cooperation (Fletcher *et al.,* 2002; Sexton *et al.,* 2000).

[1] Official Norwegian Report. "When time is short..." National standards for preparedness in cases of medical emergency. Official Norwegian Report 1998:9. Oslo, Government Administration Services, Section for Government Publications, 1998.

We developed this intervention in response to a need for improving the initial care of multiple injured patients in Norwegian hospitals. As it is the joint efforts of the trauma team members that matters for the patients, efforts were aimed at the team, not the individual. The intervention was not intended to assess individual competence, nor was it to evaluate the hospitals.

The focus of the present study was to describe the intervention and the participants and to assess the feasibility of the intervention. The intervention was evaluated by the participants, and we assessed the influence of profession, hospital type, and personal participation in the practical simulation on the evaluation. Results from 28 hospitals participating in the training program during the years 1997-2003 are reported here.

Methods

The training concept

The intervention was developed to meet the needs for improving trauma care in hospitals based on a team concept. Trauma team members should be trained together in their own familiar environment. Emphasis should be on teamwork and training in communication skills, leadership, and cooperation. Necessary theory should be based on real patient stories so that the participants could identify with the presented cases. The facilitators should preferably come from hospitals of an identical level (peer-to-peer instruction).

The educational intervention

A one-day training course for all members of the trauma team in a given hospital was developed. The main learning objectives were shared knowledge and understanding of treatment

priorities, principles for optimal team work, communication skills and pitfalls, and factors facilitating change in hospitals. The course consists of a three and one-half hour didactic session with theory and discussions, followed by practical training in the hospitals' trauma room involving two trauma teams.

The didactic session: The plenary session is for all employees with a role in the trauma team at each particular hospital, as trauma team composition varies. The didactic session is structured in short parts based on patient cases, including photos from real cases and training. The curriculum includes primary survey with airway management, circulation control and other necessary diagnostic and treatment interventions, damage control surgery, communication, team cooperation, leadership, and finally how to change and improve complex systems as hospitals. Then two trauma teams at the actual hospital are trained through two simulation sessions each, with the objective to demonstrate the agreed upon principles for treatment, communication, and team cooperation.

The practical training: The simulations take place in the hospitals' own trauma rooms, employing a simple resuscitation mannequin. Patient histories are structured, and presented to the team as those of ordinary patients. A briefing is given in the format of a message from the emergency medical dispatch centre, followed by a report from the ambulance en route to the hospital. The team is given a few minutes to prepare for the admittance. Then the mannequin is brought in and the facilitator gives vital signs and information as the team examines the mannequin. The training session lasts 20-30 minutes. Clinical information, X-rays, sonography findings, and biochemical results are provided when the relevant procedures have been performed. The training is recorded on video. A structured debriefing is then performed with the team in a separate room, without observers. The video recordings are used as an adjunct to discussing and evaluating teamwork. Each team member should state one area for improvement before the next simulation. After debriefing, the team proceeds to a second simulation

with a new patient story. This time the patient has more severe injuries, and critical decisions have to be made during the simulation. A second structured debriefing follows.

The educational policies: Emphasis during the training is placed on teamwork: communication, leadership, and cooperation. The training cases are adapted to individual team's performance. If the team deviates from treatment protocols, the facilitator adjusts the case presentation accordingly to maintain treatment challenges without letting the team fail completely (losing the patient).

Facilitators are experienced anaesthesiologists, surgeons and a medical educationalist. Half were from district general hospitals, the other half from university hospitals. Three to four facilitators (out of a group of eight) participated in each course. After the course, all teaching materials were left at the hospital, to enable later training courses arranged locally.

The educational intervention remained practically unchanged during the period.

Participants and hospitals

Participating hospitals were 28 of the 50 Norwegian hospitals with acute care functions. After the three founding hospitals "spread the word", subsequent participating hospitals self-recruited. There were 18 primary hospitals, eight secondary hospitals, and two tertiary university hospitals. The distribution of participating hospitals with respect to levels did not differ significantly from the national distribution as per 1999 ($\chi 2 = 0.372$, d.f.=2, $p=0.83$). Each hospital had at least one training course, followed by rehearsals arranged either locally or by facilitators. During the study period, 75 training courses were arranged with participation of the BEST Foundation, BEST: Better & Systematic Trauma Care, and 15 of the hospitals had more than one course. The proportion of physicians, nurses, and auxiliary personnel varied between hospitals due to local circumstances.

Evaluation

All participants answered an anonymous questionnaire immediately before and after the training. Pre-intervention questions included profession, professional and trauma-related experience, and evaluation of their experience with teamwork in trauma. Respondents indicated on 10 cm visual analogue scales (VAS) the need for improvement in several dimensions at their hospital before the intervention. The VAS was anchored with a few words describing each extreme, but otherwise without tick marks. After the training, a similar questionnaire was distributed.

Statistical data analysis and presentation

Data were analysed using SPSS 11.0. All statistical tests were done with a chosen $\alpha = 0.05$. VAS values were compared with parametric statistics, as Q-Q plots confirmed normal distribution of the data. Comparisons of means between groups were done with t-test and one-way ANOVA with Bonferroni's correction. Chi-square (χ^2) testing was used for nominal data, and Kruskal-Wallis test for non-normally distributed continuous variables (Altmann, 1991). Proportions and means are given with corresponding 95% confidence intervals (95%CI). Analyses were done with all available valid answers for each parameter.

Results

Demographics

2,860 trauma team members participated in the courses. Of these, 1,237 (43%) also took part in the practical simulations in emergency rooms. Limitations in time and emergency room availability excluded practical training for all participants on the day of the course. The participants were physicians (28%), nurses (55%) and others (radiographers, laboratory techni-

cians and clerks - 17%). Participants had rather long professional experience - 53% with more than nine years experience.

Previous experience

Despite the participants' substantial professional experience, they had very limited recent experience in handling multitrauma victims, with a median of 1 (interquartile range 0-2) case the previous 6 months. There was significant variation in experience between hospital levels, as personnel in primary hospitals had a median experience of 0 trauma resuscitations (interquartile range 0-1), secondary hospitals 1 (range 0-2), and tertiary hospitals 2 (range 2-5 - Kruskal-Wallis test χ^2 =325.692, d.f.=2, $p < 0.05$).

Participants were asked to assess their overall evaluation of the performance of the team during their last personal experience with the handling of a multitraumatised patient (see Table 1). Participants in primary and secondary hospitals evaluated team performance lower than their counterparts in tertiary hospitals.

The main problems encountered during the last multitrauma case amongst the participants with recent experience were communication, reported by 868 or 58% (95%CI 56%-61%), leadership by 776 or 52% (95%CI 50%-55%) and prioritising by 337 or 23% (95%CI 21%-25%). More than one alternative was allowed, with the median number of problems reported was 1 (interquartile range 0 to 2).

We asked the participants to state to what extent their hospital needed to improve trauma care in a number of dimensions (see Figure 1). Personnel in primary hospitals reported a significantly higher need for improvement in cooperation, documentation, skills and knowledge, equipment and personnel as compared to the secondary and tertiary hospital levels combined. For leadership and communication, there were no differences.

Evaluation

After the course, the participants evaluated outcomes (see Table 2). Nurses generally scored the outcome of training higher than the other participants, except for the practical training. When testing for differences between primary hospitals vs. the other hospitals, the only significant difference was found in evaluation of the didactic session, which was rated slightly higher by personnel in the primary hospitals (mean difference 0.23, t=3,555, p<0.01).

Respondents who participated in the simulation and debriefing evaluated the learning and fulfilment of expectations higher than those who only took part in the didactic session, while the didactic session was evaluated higher by the respondents not taking part in the practical training. The mean differences were significant, but rather small (0.27, 0.35 and 0.17 respectively in 10 cm VAS).

Of the 1,237 that participated in the practical simulation 1,218 (99%) found the session to be a valuable learning experience. The overwhelming majority, 1,763 of 1,774 valid responses (99%) would recommend the course to a colleague.

Feasibility

In all hospitals requesting the course it was possible for local organisers to arrange the training despite busy schedules. All hospitals had access to training mannequins and video cameras, and were thus able to arrange further training on their own. The hospitals reported that planning of courses required cooperation between several departments, which in itself had positive effects. A survey in 2004 revealed that 19 of the 28 hospitals had arranged training on their own in the previous six months.

Economical aspects

The hospitals had indirect expenses in connection with training courses as "loss of production", and direct cost for travel and facilitator fees. We calculated the difference in expenses for training locally at each hospital as compared to training in Oslo to GBP 5,100 per training course, reducing the costs by 73%. The lack of financial costs of a simulator centre adds significantly to the calculated savings. This comes in addition to the obvious benefits of training with the participants' own equipment in familiar surroundings.

Discussion

This study shows that a one-day multiprofessional simulation course left the participants with highly fulfilled educational expectations, and that it was feasible to arrange team training locally with this approach. The training courses seemed to be equally beneficial to primary compared to major hospitals.

The evaluation of this intervention is based on self-reported assessment of fulfilled educational expectations and perceived learning done on the day of training. It is likely that health personnel, when allowed to train for demanding teamwork to which they are seldom exposed, would rate this training positively. Although teams after training evaluate the experience positively, this does not necessarily imply that survival chances for trauma patients improve. As no trauma registry exists in Norway, it is impossible to assess whether training results in improved treatment results. However, others have found a reduced number of errors as well as improved performance in emergency departments after teamwork training (Morey *et al.,* 2002). Furthermore, self-efficacy, necessary for mastering challenging cases, is improved by "performance mastery experience" (Maibach *et al.,* 1996; Marshall *et al.,* 2001). These studies found both theoretical and practical simulator evidence of improved performance after successful training experiences.

The low exposure of trauma team members to severe trauma underlines the need for alternatives to "learning by doing". Recent surveys indicate that the possibilities in trauma team simulation are utilised less than possible, as only half the Norwegian and Scandinavian hospitals actually train their trauma teams (Wisborg *et al.,* 2003, Wisborg *et al.,* 2005). Most of the hospitals training did so after being introduced to team training by the present programme.

This intervention was feasible in spite of both the lack of tradition for such training in Norwegian hospitals, and significant financial restraints. The demand for courses from other hospitals and the favourable evaluation by the participants indicates that it has its mission. Developed initially for the authors' own hospitals, the concept has attracted national interest, and 44 of the 50 Norwegian hospitals have now trained in this fashion.

Recently, simulation has become more popular in training emergency competency, like handling anaesthetic emergencies and neonatal resuscitation (*Halamek et al.,* 2000). Our project employed a very simple simulator set-up. This training was made as realistic as possible, with the use of full teams, "live" emergency rooms and equipment. This was aimed at facilitating the transition from simulation to real life situations (Mishra & Dornan, 2003). Improved performance in real life situations after trauma team training has been indicated by some (Morey *et al.,* 2002), but it is not yet considered proven. High-fidelity simulators are expensive and difficult to move. They may require several specially trained persons to run scripts defined in advance. Simple training mannequins were available in every hospital, enabling arrangement of new training locally after the initial first training. The training case progression could also immediately be adjusted to each team's actual performance. The disadvantage of such mannequins is the lack of resemblance to live patients. We used real patient stories in the didactic sessions to increase the team members' capacity for clinical problem solving in the team simulation by inviting them to use the critical decision points from the stories. This is in accordance with theory on team decision-making in emergency settings (Klein, 1998, 2003).

The reason that nurses scored their outcome of the course significantly higher than the other participants is in contrast to other investigators from a comparable setting (Sexton *et al.,* 1998). However, the VAS-scores in the two studies were remarkably similar.

The purpose of the present intervention was not to assess individual competency or accreditation of the hospitals. The use of simulation as an assessment tool is difficult (Byrne & Greaves, 2001; Schuwirth & van der Vleuten, 2003). Instead, this was supportive training aimed at improving each hospital's trauma handling from its present level. Two simulations were always run with each team, and teams were never allowed to fail completely. This was a

principle from the very beginning (Maibach *et al.,* 1996), and demands a high degree of flexibility of the training case and the facilitator. As found by others, the post-training debriefing was regarded as the most valuable, but also the most demanding part of the simulation training (Sexton *et al.,* 1998).

A number of details are still uncertain. The use of training mannequins versus live simulated patients has not been evaluated. Markers for optimal teamwork are still lacking.

Conclusion

It was feasible to train trauma teams locally at their workplace hospitals with a simple approach requiring only three or four facilitators. Using a low-fidelity simulated patient was an efficient training tool. Participants evaluated the intervention positively. As a spin-off effect, a network has developed between hospitals in the project, where experiences and improvement ideas are exchanged. New educational initiatives have evolved, like the use of anaesthetised animals for training surgical damage control procedures (Brattebø *et al.,* 2001b) and a systematic evaluation of the impact of using a live simulated patient as opposed to the mannequin.

Acknowledgements:

This study has received financial support from the following sources: The Northern Norway Regional Health Authority, The Finnmark Hospital Trust, The Norwegian Medical Association, The Western Norway Regional Health Authority, VOX – National Centre for Education in the Workplace, and the participating hospitals.

References

ALTMANN, DG. (1991). *Practical statistics for medical research.* London: Chapman & Hall.

BRATTEBØ, G., WISBORG, T. & HØYLO T. (2001a). Organization of trauma admissions at Norwegian hospitals. *Tidsskrift for Den Norske Lægeforening, 121*(20), 2364-2367.

BRATTEBØ, J., BRATTEBØ, G., WISBORG, T., LØNN, R., PILLGRAM-LARSEN, J., BRØNSTAD, A. (2001b). How do surgical teams train emergency surgical interventions? *Tidsskrift for Den Norske Lægeforening, 121*(12), 1513-1515.

BYRNE, A.J. & GREAVES, J.D. (2001). Assessment instruments used during anaesthetic simulation: review of published studies. *British Journal of Anaesthesia, 86*(3), 445-450.

ESPOSITO, T.J., SANDDAL, N.D., HANSEN, J.D. & REYNOLDS, S. (1995). Analysis of preventable trauma deaths and inappropriate trauma care in a rural state. *Journal of Trauma, 39*(5), 955-962.

ESPOSITO, T.J., SANDDAL, T.L., REYNOLDS, S.A. & SANDDAL, N.D. (2003). Effect of a voluntary trauma system on preventable death and inappropriate care in a rural state. *Journal of Trauma 54*(4), 663-670.

FLETCHER, G.C.L., MCGEORGE, P., FLIN, R.H., GLAVIN, R.J. & MARAN, N.J. (2002). The role of non-technical skills in anaesthesia: a review of current literature. *British Journal of Anaesthesia, 88*(3), 418-429.

HALAMEK, L.P., KAEGI, D.M., GABA, D.M., SOWB, Y.A., SMITH, B.C., SMITH, B.E. & HOWARD, S.K. (2000). Time for a new paradigm in pediatric medical education: Teaching neonatal resuscitation in a simulated delivery room environment. *Pediatrics, 106*(4), E45. Available from: URL: http://www.pediatrics.org/cgi/content/full/106/4/e45

KLEIN, G. (1998). *The sources of power. How people make decisions.* (pp. 233-257). Massachusetts: MIT Press.

KLEIN, G. (2003). *Intuition at work.* (pp. 79-84). New York: Doubleday.

MAIBACH, E.W., SCHEIBER, R.A. & CARROLL, M.F.B. (1996). Self-efficacy in pediatric resuscitation: Implications for education and performance. *Pediatrics, 97*(1), 94-99.

MARSHALL, R.L., SMITH, J.S., GORMAN, P.J., KRUMMEL, T.M., HALUCK, R.S. & COONEY, R.N. (2001). Use of a human patient simulator in the development of resident trauma management skills. *Journal of Trauma, 51*(1), 17-21.

MISHRA, B. & DORNAN, T. (2003). Training junior doctors in complex skills. *Medical Education, 37*(8), 672-673.

MOREY, J.C., SIMON, R., JAY, G.D., WEARS, R.L., SALISBURY, M., DUKES, K.A. & BERNS, S.D. (2002). Error reduction and performance improvement in the emergency department through formal teamwork training: evaluation results of the MedTeams project. *Health Services Research, 37*(6), 1553-1581.

SCHUWIRTH, L.W.T. & VAN DER VLEUTEN, C.P.M. (2003). The use of clinical simulations in assessment. *Medical Education, 37*(Suppl. 1), 65-71.

SEXTON, B., MARSCH, S., HELMREICH, R., BETZENDOERFER, D., KOCHER, T., SCHEIDEGGER, D. & TOMS TEAM (1998). Participant evaluation of team oriented medical simulation. In: HENSON, L.C, & LEE, A.C. (Eds.) *Simulators in anesthesiology education* (pp. 109-110). New York: Plenum Press.

SEXTON, J.B., THOMAS, E.J. & HELMREICH, R.L. (2000). Error, stress, and teamwork in medicine and aviation: cross sectional surveys. *British Medical Journal, 320*(7237), 745-749.

WISBORG, T., RØNNING, T.H., BECK, V.B. & BRATTEBØ, G. (2003). Preparing teams for low-frequency emergencies in Norwegian hospitals. *Acta Anaesthesiologica Scandinavica, 47*(10), 1248-1250.

WISBORG, T., CASTRÉN M, LIPPERT A, VALSSON F, WALLIN CJ, ON BEHALF OF THE SCANDINAVIAN WORKING GROUP (WISE) (2005). Training trauma teams in the Nordic countries: An overview and present status. *Acta Anaesthesiologica Scandinavica, 49*(7), 1004-1009.

Table 1

Participants' personal evaluation of team performance during the last multitrauma treatment they participated in before the training course (1,435 valid responses).

Hospital Type	n	mean VAS	SD	95%CI of mean	
Primary	661	5.30	2.02	5.15-5.46	
Secondary	441	5.56	1.93	5.38-5.74	*
Tertiary	333	6.05	1.79	5.86-6.24	

*Significant difference between primary-tertiary and secondary-tertiary hospitals: $F=16.27$, $d.f.=2$, $p<0.005$

Table 2

Participants' evaluations after the one-day training course.*

Dimension	n	mean VAS	SD	95%CI of mean
Learning	1523	7.93	1.33	7.86-8.00
Nurses	794	8.16	1.18	8.07-8.24[1]
Physicians	466	7.73	1.43	7.60-7.86
Others	263	7.61	1.46	7.43-7.79
Fulfilled expectations	1522	8.02	1.27	7.95-8.08
Nurses	793	8.17	1.16	8.09-8.25[1]
Physicians	465	7.92	1.25	7.81-8.04
Others	264	7.72	1.53	7.53-7.90
Didactic session	1520	8.08	1.35	8.01-8.15
Nurses	795	8.36	1.20	8.28-8.44[2]
Physicians	462	7.68	1.46	7.54-7.81
Others	263	7.93	1.37	7.76-8.09
Simulation and debriefing	1229	7.81	1.37	7.73-7.89[3]

[1] Significant difference between nurses and physicians, and nurses and others.

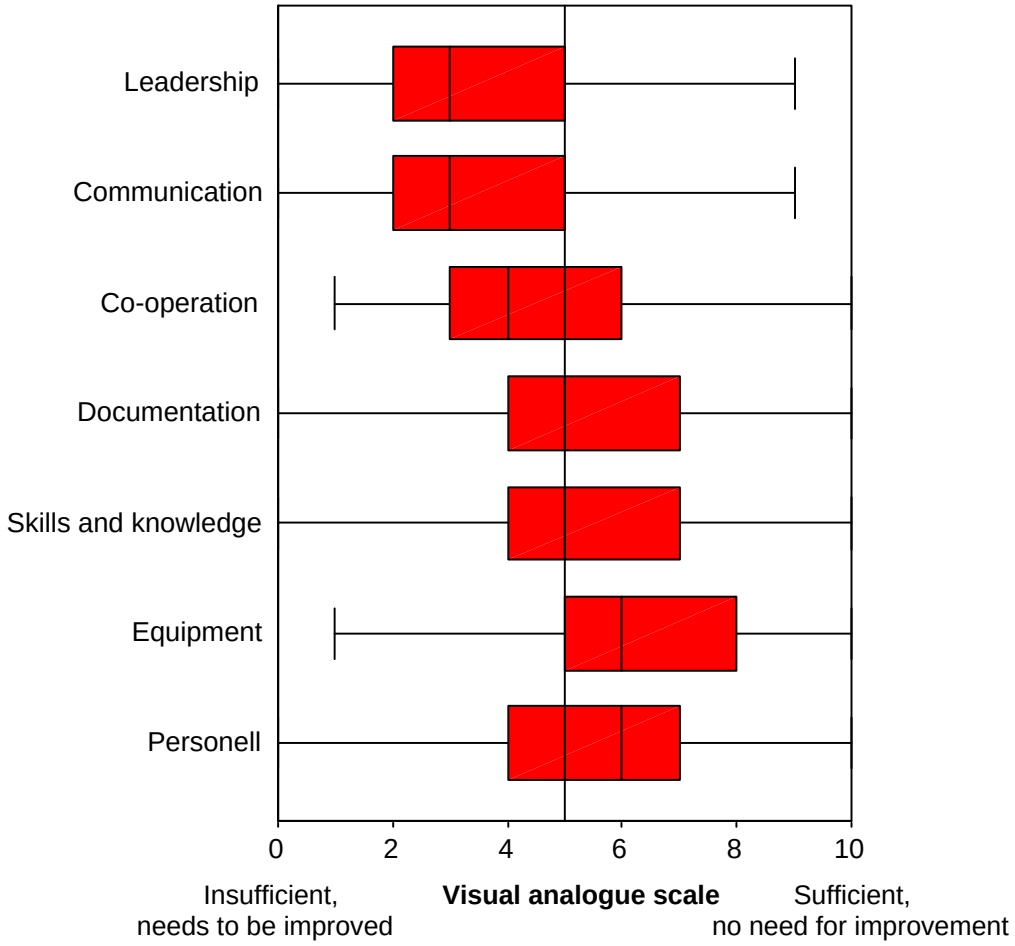
[2] Significant differences between all three groups.

[3] No significant differences between groups.

* Dimensions evaluated were: "To which extent did you learn something during the course?"; "To which extent did the course and training fulfil your expectations?"; "How do you evaluate the didactic session?"; "How do you evaluate the practical training session?". The VAS was anchored with "Little Degree" vs. "High Degree" and "Poor" vs. "Good".

Figure 1

Participants' evaluations of their hospitals' need to improve trauma care in a number of dimensions (n=1,658)*.



*Answers given in visual analogue scales, where zero was anchored with the phrasing "Insufficient, needs to be improved", and ten designated "Sufficient, no need for improvement". Boxes represent median value with quartiles, and vertical lines indicate 10 and 90% percentiles.