REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
April 2010		

4. TITLE AND SUBTITLE

Use of Advanced Technologies and New Procedures in Medical Field Operations (Utilisation de technologies avancées et de procédures nouvelles dans les opérations sanitaires

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Research and Technology Organisation (NATO)
BP 25, F-92201 Neuilly-sur-Seine Cedex, France

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Research and Technology Organisation (NATO)
BP 25, F-92201 Neuilly-sur-Seine Cedex, France

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

RTO-MP-HFM-182

12. DISTRIBUTION / AVAILABILITY STATEMENT

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Supporting documents are attached to the report as separate files (MS Word, PDF, HTM).

14. ABSTRACT

NATO faces several challenges if Combat Casualty Care is to be improved further, especially if a smaller "foot print" is one future planning factor. In 45 papers and 29 posters the RTO-HFM 182 symposium on "Use of Advanced Technology and New Procedures in Medical Field Operations" has presented valuable and promising possibilities. Further, this symposium has presented lessons learned especially from Operation Enduring Freedom and Operation Iraqi Freedom. The volcanic eruption on Iceland served as a pertinent reminder of our own vulnerability in addition to the need to identify all limiting factors. To fully evaluate all possibilities and weaknesses more emphasis must be put on robust and relevant indicators. A NATO Trauma Registry would be key.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER** *(include area code)*
U	U	U	SAR	39	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

AC/323(HFM-182)TP/361

www.rto.nato.int

RTO MEETING PROCEEDINGS **MP-HFM-182**

Use of Advanced Technologies and New Procedures in Medical Field Operations

(Utilisation de technologies avancées et de procédures nouvelles dans les opérations sanitaires)

Papers presented at the RTO Human Factors and Medicine Panel (HFM) Symposium held in Essen, Germany on 19 to 21 April 2010.

Published April 2010

The Research and Technology Organisation (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective co-ordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also co-ordinates RTO's co-operation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of co-operation.

The total spectrum of R&T activities is covered by the following 7 bodies:

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS System Analysis and Studies Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier co-operation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

Published April 2010

ISBN 978-92-837-0130-9

Use of Advanced Technologies and New Procedures in Medical Field Operations

(RTO-MP-HFM-182)

Executive Summary

The RTO-HFM 182 symposium on "Use of Advanced Technology and new Procedures in Medical Field Operations" has presented valuable and promising possibilities. Comprehensive presentations of the vast number of opportunities ahead, taking full advantage of the rapid and sophisticated technical development during the last decades, have been laid out. The willingness of especially USA to invest in technical research and development is impressive. Further, this symposium has presented lessons learned especially from Operation Enduring Freedom and Operation Iraqi Freedom. The change of blood transfusion concepts with consequences also for civilian life is but one, but currently the most visible and accepted. Other outputs are haemostatic procedures and products, but here proper evaluation is still needed to identify the ultimate procedure/outcome.

However, NATO faces several challenges if Combat Casualty Care is to be improved further, especially if a smaller "foot print" is one future planning factor. Some of these challenges can be met by (1) modification of treatment; (2) new equipment/technology, (3) by operational development, both tactically and strategically and (4) with a combination of the three. Lack of manpower may, at many levels, be compensated for by telecommunicated systems and robotics, provided the tests of such systems prove their feasibility.

Concomitantly one must not fall into the "mythical trap", assuming so strongly that one direction is correct, that proper control mechanisms become unavailable for redirection of a course. If a problem is addressed one way only, it is impossible to prove that that solution is wrong. This underlines the need for a NATO Trauma Registry. Since different allies may have different approaches to the same problems, a NATO Trauma Registry will have a greater potential than the Joint Theatre Trauma Registry alone, as we will have more groups to compare. Thereby evaluation and research may confirm some hypothesises, discard others and prevent ill-conceived paradigms from developing into myths.

All new technology presented and demonstrated seem, to different extents, feasible for asymmetric war fare. They may also prove even more beneficial and feasible for civilian peace time challenges like in disaster scenarios or search and rescue operations. But what about limiting factors, especially for Combat Casualty Care? Is the human factor a limiting one? Further, most of these new concepts demand complete control of air space, cyber space, radio waves etc. So, what about *asymmetric* warfare? Are we developing concepts that will invalidate us in an asymmetric combat situation? Who will be in control of the needed satellites? Are there actually "Killing Factors"[1]? It remains to be seen if all obstacles can be identified and overcome and where such systems have their best potential.

And last but not least, unexpectedly, the Icelandic volcanoes have taught us another lesson:

- When mother-nature opens her mouth we have to shut ours!
- We are vulnerable!
- We will never be in complete control!

And this must be included as a Planning Factor for future prospects and their evaluation and research.

[1] A "Killing Factor" is a critical condition that must be met or guaranteed. If not, the proposed project will not be viable as designed (See "Logical Framework Approach" 4th edition).

Utilisation de technologies avancées et de procédures nouvelles dans les opérations sanitaires

(RTO-MP-HFM-182)

Synthèse

Le symposium RTO-HFM 182 sur « L'utilisation de technologies avancées et de nouvelles procédures dans les opérations sanitaires » a ouvert des perspectives de grande valeur et des plus prometteuses. Des présentations exhaustives d'un grand nombre d'opportunités à venir, qui tirent tout l'avantage possible du développement technique rapide et sophistiqué de ces dernières décennies, ont été exposées. Le désir des Etats-Unis en particulier d'investir dans la recherche et le développement techniques est impressionnant. Ce symposium a également tiré les leçons en particulier des opérations « Enduring Freedom » et « Iraqi Freedom ». Le changement des concepts de transfusion sanguine avec des conséquences également pour le secteur privé n'en est qu'un exemple, mais qui reste actuellement le plus visible et le mieux accepté. Les procédures et les produits hémostatiques sont d'autres résultats, mais ici une évaluation particulière est encore nécessaire pour identifier les dernières procédures, les derniers résultats.

Cependant, l'OTAN se trouve face à plusieurs défis si les soins des blessés au combat sont encore à améliorer, en particulier si réduire l'empreinte est un des éléments d'un programme à venir. Certains de ces défis peuvent être résolus (1) par une modification du traitement ; (2) par de nouveaux équipements / une nouvelle technologie, (3) par un développement opérationnel, à la fois tactique et stratégique et (4) en combinant les trois. Le manque de main d'œuvre peut être compensé à différents niveaux par des systèmes commandés à distance et de la robotique, sous réverve que les tests de tels systèmes aient démontré leur faisabilité.

En même temps, il ne faut pas tomber dans le « piège du mythe » en supposant de façon tellement péremptoire que telle direction est la bonne, que les mécanismes de contrôle appropriés deviennent incapables de réorienter la direction prise. Si un problème n'est abordé que sous un seul angle, il est impossible de prouver que la solution est mauvaise. Ceci souligne la nécessité d'avoir un Registre Traumatologique de l'OTAN. Tant que différents alliés pourront avoir une approche différente des mêmes problèmes, un Registre Traumatologique de l'OTAN aura un plus grand potentiel qu'un seul Registre Traumatologique par Théâtre Interarmées, car nous aurons toujours plus de groupes à comparer. Ainsi, l'évaluation et la recherche peuvent confirmer certaines hypothèses, en rejeter d'autres et empêcher des paradigmes mal-conçus de se transformer en mythes.

Toutes les nouvelles technologies présentées et démontrées semblent, jusqu'à un certain point, utilisables dans le cadre d'une guerre asymétrique. Elles peuvent aussi être encore plus utilisables et bénéfiques pour les défis civils du temps de paix comme les cataclysmes et les opérations de recherche et sauvetage. Mais qu'en est-il des facteurs limitatifs, en particulier pour les soins des blessés au combat ? Le facteur humain est-il un facteur limitatif ? De plus, la plupart de ces nouveaux concepts requièrent un contrôle complet de l'espace aérien, du cyber espace, des ondes radio etc. Qu'en est-il également de la guerre *asymétrique* ? Sommes-nous en train de développer des concepts qui deviennent dépassés en situationde combat asymétrique ? Qui aura la maîtrise des satellites nécessaires ? Y a-t-il réellement des « facteurs létaux »[2] ? Cela reste à voir si tous les obstacles peuvent être identifiés et surmontés et quand de tels systèmes sont potentiellement au plus haut niveau.

Et, dernier élément, mais non le moindre, de façon inattendue les volcans islandais nous ont appris une autre leçon :

- Quand notre mère nature ouvre la bouche, nous devons la fermer !
- Nous sommes vulnérables !
- Nous ne maîtriserons jamais tout !

Et ceci doit être intégré en tant qu'élément de programme des perspectives futures de recherche et d'évaluation.

[2] Un « facteur létal » désigne une condition critique qui doit être soit constatée, soit assurée. Dans le cas contraire, le projet proposé ne sera pas viable tel quel (Voir l'« approche d'un cadre logique » 4° édition).

Technical Evaluation Report

Knut Ole Sundnes MD, Colonel
Norwegian Defence Forces
NORWAY

PREAMBLE

This report deviates to some extent from previous reports as the Technical Evaluator (TE) to address this needs to be addressed in a larger context. Nothing works in isolation and cause-effect relationships may emerge outside what was the original scope of a procedure or technical solution implemented to solve a problem. This report therefore elaborates on general issues and research concepts where challenges are similar to those identified, e.g. disaster research.

Evaluation of this symposium could be done based on the sessions. There are, however, considerable overlaps between sessions. Further, tele-network and wireless connection seem to be common denominators with advanced technology being "the overarching trademark" for many papers and posters.

Also, several papers in themselves address a host of ideas and new techniques partly in detail, partly as rough summaries. Short comments on each paper are presented inn Annex 1, but extensive evaluation and elaboration on each topic seem not feasible or productive due the wide scope of this symposium.

Unfortunately the volcanic fallouts from Island forced a significant modification of the symposium as a majority of the presenters were unable to attend. Clarifying discussions and questions could therefore to a large extent not be held and this report is based mostly on the written documentation.

ACKNOWLEDGEMENT

The TE wants to thank the organisers for a very good event. Venue, organisation and social arrangements were all excellent and, in spite of the Islandic event grounding all planes in Europe, the participants able to attend left Essen with nothing but good memories.

RESPONSIBILITY

The Prussian General Karl von Clausewitz stated more than 200 years ago that "War is politics added other means". When politicians are using their ultimate political instrument, the military forces, thereby placing soldiers in harm's way, there should be an inherent obligation to provide optimal protection and medical treatment to their troops, all the way from the point of injury to final treatment and rehabilitation.

MANDATE

Quote: "The NATO leadership has mandated, and our populaces expect, that to the maximum extent possible, the medical care provided to our deployed military personnel will be of the same standard as they could receive in their home countries.

The new NATO expeditionary strategic concept, with its emphasis on multinational shared responsibility for medical care, reduced deployed medical footprints and early evacuation, cannot be implemented from a

medical point of view without effective use of all available advanced medical technologies in the multinational setting.

This activity will bring together international experts in the development and fielding of advanced medical technologies, with the goal of gaining a greater understanding of soon-to-be fielded technologies, and to determine how they can best be applied within the multinational NATO environment." *Unquote.*

PLANNING FACTORS

During the last decades the development of medical technologies has forced a rethinking for all levels of medical treatment and medical operations.

We have acquired a better insight in trauma care and the pathophysiology of trauma. However, the last decades have also witnessed a narrowing of the medical specialities that have been split further into sub-specialities. The consequence has been that the former "omnipotent" physician is next to extinct (e.g. specialist of general surgery). Further, technical procedures very well functioning for elective surgery (like laparascopy) provide little basic training for doing procedures such as emergency laparotomies. This, together with other rationales, has forced the need for trauma treatment systems, with health care professionals concentrating on trauma care. The number of such health care personnel is however limited. Consequently, the number of western physicians, especially surgeons, with the required level of field proficiency, has been reduced compared to just one or two decades ago.

Can such diminished field proficiency be compensated by new technology? Can new technology also open for new ways of treatment?

The way how wars are waged has also changed during the last decades shifting from dominating symmetric to asymmetric warfare. Protective gear has improved and has modified the bodily distribution of battlefield injuries, but at the same time influenced the mobility of the soldiers. However, the causing mechanisms (high velocity bullets/fragments and explosions), are mostly the same, with blasts and explosions dominating. The battlefield injuries therefore have changed little. (The new DIME weapon is not yet largely distributed between warring factions.)

In concert with other changes, the strategic and operational concepts for medical support have also changed and are still undergoing transformation processes.

On this background we must address the current challenges of 86% of the battlefield casualties dying within the first 30 minutes. The majority die from haemorrhage with head trauma as the second largest cause of death. Further, 85% of preventable deaths are caused by haemorrhage, non-compressible and compressible comprising 31% and 69% respectively. (Kelly & al. 2008)

BACKGROUND

War wounds differ from most civilian trauma. Therefore an in depth understanding of the challenges associated with Combat Casualty Care, personal insight in the nature of war wounds and their causing mechanisms and the treatment principles is crucial. Some examples are given in figures 1-6.[1]

[1] All photos by the TE.

CIVILIAN CASUALTIES

As pictured in figure 1, 2 and 4-6, and also referred to frequently in other papers in and outside NATO, the majority of persons wounded from warfare are now civilians, either coming in harm's way at random (collateral damage) but also more and more directly targeted as part of asymmetric warfare. As we are all obliged to adhere to the Geneva Convention, we will still have responsibilities for all civilian casualties resulting from warfare and this obligation must also be inherent in new concepts.

Figure 1: Dying victim from an artillery shell. Kabul 1992.

Figure 2: Insufficient first debridement resulting in a chronic lethal infection. Kabul 1990.

Figure 3: Cambodian guerrilla soldier with haemostatic attempt: Insufficient tourniquet after mine injury resulting in increased venous bleeding. Khao I Dang 1985.

Figure 4: Land mine victim. Maimed children today comprise a 2 digit percentage of all war wounded. Kabul 1990.

Figure 5: "Exarticulation" by large artillery shell. Exsanguinated after one hour. Today he might have survived with wound packing and compression dressing. Kabul 1990.

Figure 6A and 6B: Penetrating brain injury from shrapnel (A) (Lebanon 1979) and ricochet (cal. 7.62) (B) (Kabul 1990). Both patients recovered.

SCIENTIFIC APPROACH/CHALLENGES

General approach to expand and refine Combat Casualty Care (technical and procedural) comprises many elements of the scientific algorithm like:

1) Ideas/hypothesises on technology and/or new methods or concepts for treatment

2) Brainstorming
3) Technical developments (Gadgets)/Refining methods
4) Testing in vitro/table top exercise
5) Testing in vivo/live exercise
6) Clinical pilot testing
7) Full research protocol.

If standard prospective design studies are not within reach, case control studies of different cohorts may provide answers. In that context differences in treatment concepts between allies are of utmost importance. The scope of research fathoms all aspects of the Combat Casualty Care continuum:

1) Prevention/protection
2) Point of Injury
3) Extraction
4) En-route care in theatre
5) Damage Control surgery/resuscitation
6) Strategic evacuation
7) Definitive care
8) Rehabilitation

Any change of any method at any level will probably have consequences at more than one level and sector, hopefully positively on the outcome, but also requiring more and different training and teaching programs.

A key part of today's technology depends on telenetwork. This applies for data gathering, distance learning, distance diagnosis and surveillance, remote control and distance treatment. Much of this still futuristic possibilities have proven promising in a laboratory setting but need to be field tested and proven; others, like remote imaging diagnostics, are well implemented.

TERRA INCOGNITA

In the wake of the technological development come many key questions: To what extent do we need a human back up system? Are these high tech concepts only feasible when one has the upper hand both on air space, fighting power and the cyber space? Are we developing war fare concepts for the asymmetric war fare only, invalidating ourselves for any symmetric conflict? Could natural events (like a volcanic eruption or sun explosions turn out to be "Killing factors"? Could underestimation of a yet not identified future enemy be a "Killing Factor"?

In order to improve diagnostics, treatment and logistics this symposium has been characterized by:

- Visionary thinking
- Innovative Capacity
- High level expertise

- Willingness to tear down old barriers:
  - Finding new operational concepts
  - Developing new high tech Solutions
  - Identify new possibilities inherent in "old" technologies
- Modify/improve existing concepts.

Nevertheless, the title of one paper, "Terra Incognito" (Pacificio A. Paper 28), captures very well the inherent properties of this symposium. We are entering a new world of applicable science and technology. Never before have so many human functions been subject to replacement by technical devices and systems. Do we want to go there? Do we have to go there? Is there a return possibility? Are we burning bridges? Which are the benefits? Which are the Spin offs? Which are the Trade offs? Are humans still significant players to achieve success?

The possibilities are huge, but also the risk to go astray. To pose the right question and find the right answer demands an open mind and a wide horizon. Investment and/or actions on one sector may directly or indirectly influence functions in other sectors not necessary envisioned. With all these options within reach, the role of RTO-HFM becomes crucial. They must serve as the ultimate guardian and see that all aspects of new techniques and methods are scrutinized, evaluated and substantiated. This not necessarily implies a "p-value research". Since Double Blind Randomised Controlled Trials are not possible in the combat zone and values may be tangible and intangible, evaluation and research must use both quantitative and qualitative scientific methods: "If you can't count it, it may still count." (Modified from Dr. J. Øvretveit.)

THE RTO HFM-182 SYMPOSIUM

General

The papers in this symposium picture the wide scope of science. Within the medical community science is closely related to clinical trials. Double blind randomized control trials represent the "golden standard" for producing evidence. Randomized open studies and retrospective cohort studies representing are also acceptable but less robust approaches.

Other papers like # 1 addresses dilemmas in modern medical technology. The increasing use of high tech equipment has diminished the clinical field proficiency especially on diagnostics. To compensate for this "deadlock" situation, efforts are started to produce smaller technology devices that are applicable to limited space and transport situations, like on a naval ship or in a forward expeditionary medical support and may compensate for diminishing clinical skills.

From the technical side the symposium presents several sound examples of elaborate utilisation of current physical and technical knowledge, breaking new boundaries and expanding the science of hardware and software to new heights. Evidence for their applicability is given through technical tests and measurements. Their relevance for the medical and combat casualty support still has to await the evaluation on the ground, - the medical outcome representing the last "proof of the pudding".

Scopes/Themes

This symposium has presented promising projects and concepts on:

- Battlefield extraction and in theatre evacuation

- Distance Diagnostics
  - Imaging
  - Photoscopy
- Distance treatment (assisting and robotics)
  - Point of injury
    - E.g. Deep Bleeder Acoustic Coagulation
  - Level II and Level III
- Damage Control
  - Surgery
  - Resuscitation
- Strategic Evacuation

Of equal importance is that it has shed light on:

- Increased insight and potential of old methods
  - Like early prediction of haemorrhage based on e.g. ECG analysis and evaluation
- Refinement of traditional therapies
  - Transfusion concepts
    - FWB, leucocytes, and infection control (B12 and UV-light)
  - Modification of Hypotensive resuscitation.
  - Global network of donors and info of them.
- Training and Teaching devices
  - Mannequins
    - Full size
    - Part task trainers
      - E.g. wet suite like device for realistic training
  - Virtual reality

Sessions

The symposium covered several sessions, most of them with wide and overlapping scopes. These were:

1) Advanced Technologies in Medical Field - Current Research efforts
2) Medical Training and Information Technologies
3) In Field Critical Care Technologies
4) Haemorrhage Control. Blood Products and Resuscitation Technologies
5) Imaging and Laboratory Technologies
6) Evacuation Support Technologies
7) Monitoring and Treatment Technologies
8) Poster Session (mirroring all the above sessions)

The Symposium has presented 45 oral papers, 29 posters and 15 demonstrations. (The demonstrations will not be evaluated.)

Table 1: Distribution of oral presentations and posters by country.

Submitted from	Papers	Posters
USA	32	19
DEU	6	6
FRA	2	2
CAN	1	1
GBR	1	
NOR	1	
TUR	1	

Papers from USA outnumber the rest of NATO by far. Also, more than any other ally, USA has conceptionalised research and established relevant institutions with sufficient funding and also joint venture systems between the military and the private sector. What about the others of the 28 member countries? What about partners' contribution (e.g. PfP and MDC nations)?

Science and Research

The number of papers and posters to be categorised as scientific papers is less than expected.

Roughly evaluated 25 of the presentations may be classified at scientific level 1 or 2. The rest are narratives focusing on technical development and/or operational development based on identification of different needs and shortcomings based on assumptions and hypothesis not necessarily confirmed. There are statements of achieved results and improvements but their justifications are not properly substantiated.

Papers and posters can be categorised according to scientific properties:

- Scientific levels 1 and 2
  - Randomized
    - Blinded
    - Non-blinded
  - Case Control studies
- Narratives
  - Overviews
  - Technological
  - Operational
  - Experimental

Medical Footprint

How can NATO reduce the medical "footprint" and prevent people from being placed in harm's way, at the same time improving the entire Combat Casualty Care (from the point of injury during tactical and strategic

evacuation through all medical treatment facilities until final treatment is done)? Tele-medicine serves as a key word. However, telemedicine is nothing new. The first technical development allowing for telemedicine came in 1876 with the telephone, and has been practiced widely since. For more than 100 years the telephone constituted the only tele-medical gadget. Today, driven by many processes during the last decades, current tele-technology offers a host of new possibilities if properly implemented. Just to mention some like:

- Distant Data collection – Information dissemination
- Operational communication
- Distant Imaging
- Distant Monitoring
- Wireless sensors
- Remote advising
- Remote control
- In field monitoring and Close-loop treatment

To take full advantage of all possibilities inherent in new technology, technical research programs are necessary, both with regard to functionality and feasibility, but also with regard to the overall benefit of the populations, military and civilian alike. No doubt there is much truth in the statement that "the technological revolution of the past three decades is catalyzing a paradigm shift in the care of the battlefield casualties". (Paper 3) We must, however, be sure that shifts of paradigms are to the better as a whole. This means that also side-effects (negative) must be included in the evaluation, first and foremost the tangible, but to some degree also the intangible.

This will require proper data, correctly collected. The US, and to some extent UK and Canada, is here ahead of the allies. They have, since long, implemented and improved their Joint Theatre Trauma Registry (JTTR). Properly used this may give answers to a lot of questions posed, and also confirm or discard hypotheses on cause-effect relationship that are tested. However, there exist different paradigms of treatment between different allies (e.g. Packed Red Blood Cells, paper 22 by McFaul & al,)[2]. Therefore, implementation of the NATO Trauma Registry will be an even stronger and necessary tool in the process to identify most probable cause-effect relationships.

Unmanned Systems – Robotics

The future opens for some "impossible" scenarios from robotic extraction till final treatment. In between we have the possibility for temporary treatment and closed loop surveillance and treatment, without human intervention. ("This capability should include Electrocardiogram, invasive pressure monitoring, non-invasive blood pressure monitoring, temperature, pulse rate, blood oxygen saturation, heart rate, infusion pump, fluid warmer, ventilator and oxygen." (Paper 4 by Mr. Beebe & al.))

The Battlefield Extraction Assist Robot (BEAR) is one system that seems feasible and sensible. It may replace a human Combat Medic and reduce the number of troops being put in harm's way. Combining such a robot

[2] This paper tests how leucocytes containing supernates from PRBC facilitate coagulopathy. In Europe one rationale for PRBC is to get rid of also leucocytes since they otherwise may result in future immunological problems (microchimerism); i.e. supernates is an American problem.

with detective devices for chemical, nuclear, bacteriological and explosive detection makes the system even more palatable. Reliability and field proficiency still remain keywords.

Telemedicine and remote control treatment seem also to be within reach, technically. This encompasses "Deep Bleeder Acoustic Coagulation" (DBAC) based on High Intensity Focused Ultrasound (HIFU), Robotic Laser Tissue Welding (RLTW), Autonomous Airway Management (AAAM), and Target Controlled Infusion Anaesthesia (TCIA) based on electrochemical biosensors that measure the intravenous anaesthetic (paper 5). Telerobotic and Automated Robotic Surgery has already been tested at Phase 1, amalgamating Scrub Nurse System (SNS), a Tool Rack System (TRS), Supervisory Controller System (SCS), a Patient Imaging System and a User Interface to provide link and assistance between a remote surgeon and a robot treating the patient.

The important questions are, if such remote telemedical systems prove reliable for Combat Casualty Care and thereafter, how far forward are they feasible. However fascinating this is, their applicability for a combat situation must be scrutinised. All downsides and obstacles must be clearly identified, and certainly any "Killing Factor" must actively be looked for. Operational communicating problems like limited bandwidth, latency, and loss of signals are all such challenges. Both tangible and intangible outcomes should be addressed, mortality and morbidity being the priority indicators.

The above makes the approach by Paper 6 from LtCol Martindale and Dr. Folds rather pertinent, addressing Human System Integration in Expeditionary Medical Treatment Facilities. They deal with following domains: Human factors Engineering, Manpower, Personnel, Training, Safety and Occupational Health, Survivability, Habitability and Environment. Associated to these domains they list topics of relevance comprising a total number of 120 relevant questions to be addressed.

Teaching and Training

Simulation based training systems have come a long way since the first Resusci Anne mannequin was presented in 1960 by Laerdal industries. Further attempts to replace live teaching on real patients and also animal models by mannequins and virtual reality are underway. For some procedures Virtual Reality seems very promising but for more difficult procedures it is still hard to fathom how they will work.

High tech contribution for training and education can hardly go wrong, except on the budgetary side. Gains on mannequins and virtual reality should include advanced treatment, especially for groups that often are "starved" with regard to treating real cases. This goes for physicians, nurses and medics. Great care, however, must be given that simulation only replaces what can be replaced. The large variations seen in the animal live model (anaesthetised) is hard to be replaced by a mannequin or a virtual reality program.

Medical Outcome / New Paradigms

The bottom line is: what serves the wounded soldiers and, from an operational view, what serves the military mission and maintains the fighting ability?

Paper 32 (Ritchie & al) serves as an example of critical feed back. Comparing the mortality for two cohorts of similar trauma cases (both with Injury Severity Score of 18) they found significant better outcome at the Level II Medical treatment facility compared to the Level III. Causative factors are listed but final conclusion will have to await further analyses as this may change our medical treatment and evacuation concepts.

Another paper with direct implication on primary casualty care is the paper on Hypertonic Saline Dextrane in pigs, clearly demonstrating higher mortality of hypertonic saline in blasts/high pressure injury, due to

pulmonary failure. In penetrating injuries alone no advantage could be demonstrated. (Paper 28) Pigs are more fragile than humans, but this could be applicable also to humans.

Modification of the Hypotensive Resuscitation is also important. It is logical and also documented that hypotensive resuscitation saves lives from haemorrhage, but if extended too long, organ failure from poor perfusion will manifest itself and influence the outcome negatively.

Haemorhage/Transfusion

OEF and OIF have resulted in a shift of paradigm for blood transfusions. The ratio 1:1:1 concept for Packed Red Blood Cells, Plasma and Platelets has become widely accepted. If logistics prevent this, the old concept of a "Walking Blood Bank" has re-emerged successfully with regard to immediate life saving results. The trade offs have been microchimerism and late immuno-system problems and the potential viral infection. Goodrich & al. have addressed this problem in an interesting paper on Pathogen Reduction and Leucocyte inactivation based on riboflavin (B12) and Ultraviolet light. This device is currently under clinical evaluation. (Paper 24)

Diagnosis/Treatment/Evacuation

There is a trend to design and test high tech equipment for forward operational units, all the way up to the point of injury. In expeditionary settings with extended lines between mother-unit and forward unit this often poses an extra challenge and may justify both new diagnostic and treatment possibilities.

It is crucial that such projects and processes are addressed properly with regard to field exposure and robustness but also its function and applicability from a medical point of view.

Diagnostic procedures should only be implemented if they have therapeutic consequences. The introduction of high tech diagnostics is futile unless the findings will have consequences, either for a decision to evacuate or to treat.

Discussion

This symposium mirrors a strong faith in forward high tech diagnostics and treatment potentials. No doubt that several projects presented here will bring modern medicine and traumatology forward. However, several products are not yet field tested; still yet statements in the papers indicate that their benefit is taken for granted. For all high tech initiatives there is a need for a sober scientific evaluation and research before final conclusions are made. Only few papers did demonstrate that this was part of the process or had been done properly.

As documented through this symposium, the in-hospital mortality rate has been reduced to 4.1% (Eastridge & al., Paper 7). For comparison, the International Committee of Red Cross (ICRC) has figures varying between 4.9 and 6.4%, 6.4% representing the hospital in Kabul with 300 surgical beds. The admissions for this hospital ranged from 10-400 per day (4-2 surgical teams), was exclusively for war wounded and with very limited natural triage as most injuries took place in Kabul city. The resources available to ICRC were very limited, but to a large extent compensated for by clinical skills and field proficiency by the teams.

The costs associated with a reduction from 6.4% to 4.1% are assumed to be enormous.[3]

[3] The ICRC hospitals comprised first and final treatment and pre-hospital treatment hardly existed. For a NATO soldier the primary MTF is mostly not the same as the final referral hospital.

Some of the technological futures presented here may also be applicable to the civilian health care. Indeed, such advanced technology will probably get a more dominant place in a well controlled civilian setting than in a battlefield mayhem scenario.

There is, however, no such thing as a "free lunch". Costs, opportunity costs and side-effects must be included when the balance sheet is presented. Consequently, we must provoke colleagues to "think out of the box". If the US congress orders the US military to have all medical rescue and combat care to be executed by robotics in 30% of the situations, we must develop instruments to prove what consequences that may have, positively and negatively. Scientists and health care personnel carry a significant responsibility. Most medical "truths" are actually medical paradigms (fig. 7, 8 and table 2). Real medical truths are few and far between. As in disasters, myths are easily established in a Combat Casualty Care Situation, and equally hard to eradicate. It is our obligation to prevent this from happening and that can only be achieved with an honest, open-minded and unbiased approach to the topic addressed. We must have robust procedures that prevent myths from establishing themselves as they then may slowly be regarded as axioms.

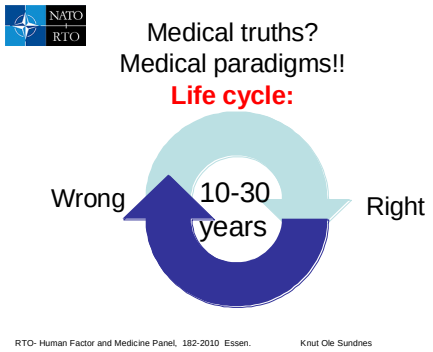

Figure 7: Most medical treatment concepts can be categorised as paradigms.

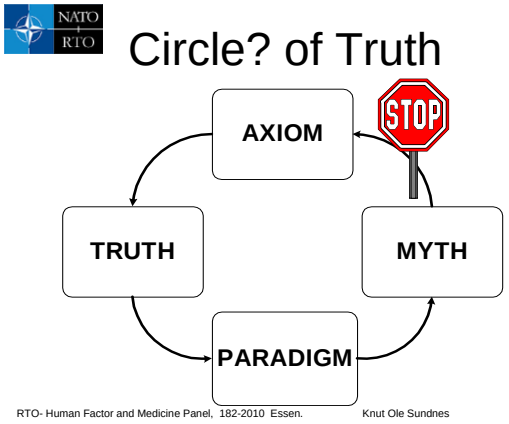

Figure 8: Myths and axioms have one thing in common. They cannot be proven.

Table 2: Basic properties of Axioms, Truths, Paradigms and Myths.

AXIOM:	**TRUTH:**
Self-evident truth which cannot, but also need not to be proven.	A condition or cause-effect relationship that will not change and which can be proven/ is based on evidence.
PARADIGM:	**MYTH:**
A ”truth” dependant on time and place, the temporary ”golden standard”, an example.	A general perception or commonly-held belief which is untrue and for which there is no foundation.

Further, a procedure that may prove beneficial for some aspects may prove negative for other sectors, partly directly, partly through the concept of opportunity costs. For all processes trying to improve Combat Casualty Care, indicators for effectiveness, efficiency and benefit must be identified, and, furthermore, they must be identified prior to the start of the project. Such indicators must be chosen in order also to reveal unexpected effects in sectors where influence was not expected, both positive (spin-offs) or negative side-effects.

Having read through all manuscripts, this constitutes my main concern. In spite of some papers stating that “metrics” must be identified to evaluate the program, such metrics obviously are not yet identified. For even the most elaborate new technology, there was little mentioned as to how these new devices were to be evaluated. This is a serious shortcoming.

I find it pertinent to draw the attention to the diagram as published in the “Health Disaster Management. Evaluation and Research in the Utstein Style”. (Figure 9.)

For any need identified, there may be more than one solution to cover that specific need. Each of these solutions must therefore be executed to its maximum efficiency and, thereafter, that procedure which proves more cost-efficient will be chosen. Both cost-efficiency and cost-effectiveness must be compared using identical indicators. However, it still remains to be seen if the activity chosen really benefited the population. Therefore the indicator for cost-benefit must be different. This latter indicator must serve as an overall quality control both for needs assessment and for the total impact of the process or procedure implemented. An example: A refugee camp may have a high Crude Mortality Rate (CMR) and there has been assumed that lack of potable water is the reason. That water can be provided by water trucks, ground water cleansing systems or ground water drilling. All procedures are measured as to their capability to provide water in litre/capita/day. The benefit to the population must, however, be measured as to what extent the CMR was reduced. Other indicators may also be chosen as CMR is the ultimate hard endpoint indicator. Qualitative indicator like being thirsty is one option. Another example was mentioned during the symposium. New Combat Rations that provide enough nourishment were so unpalatable that those who had tried them for a week came up with the hypothesis that they would lower combat moral. But how do you “measure” moral?

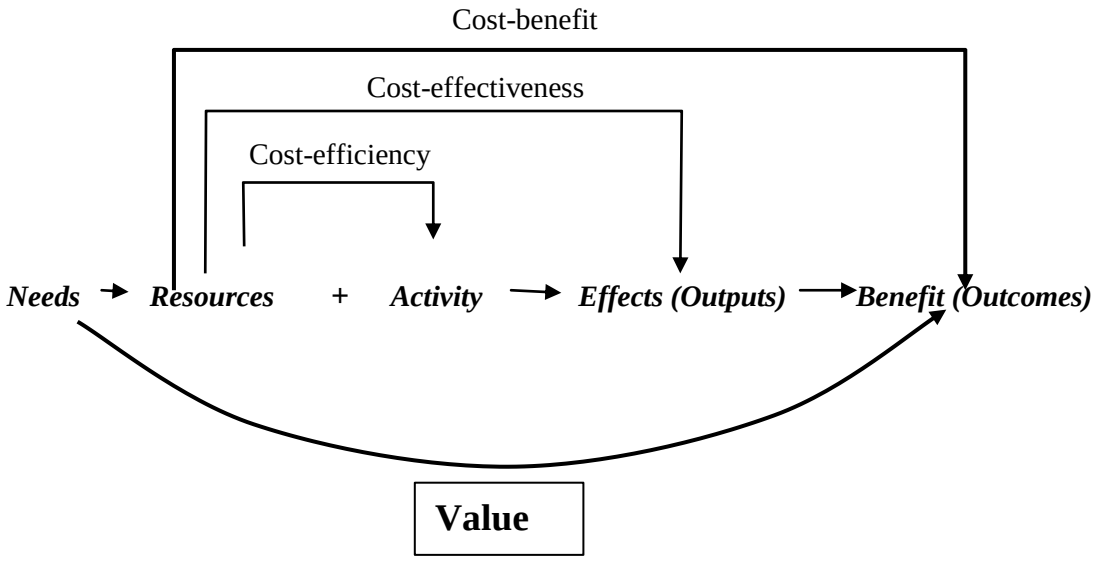

Figure 9: Diagrammatic representation of cost-efficiency, cost-effectiveness, and cost-benefit. Each intervention must be carried out as efficiently as is possible. That intervention that proves more effective to deliver the wanted output (effect) is chosen. Still it remains to be evaluated to what extent the intervention really benefited the population (produced a positive outcome).

It is not automatically given that introducing high-tech combat casualty treatment will have the expected positive outcome. Therefore indicators must be identified on beforehand.

This is partly mirrored in the curves. In a static situation we have postulated that within certain limits lack of equipment and resources can be compensated for by a higher clinical competence and field proficiency, as pictured in figure 10. What if this is also a dynamic situation? Will introduction of new high tech gadgets result in a decrease of clinical competence? (Figure 11.) And, what if such a relationship has a threshold relationship under which you have a significant diminishing return? (Figure 12.)

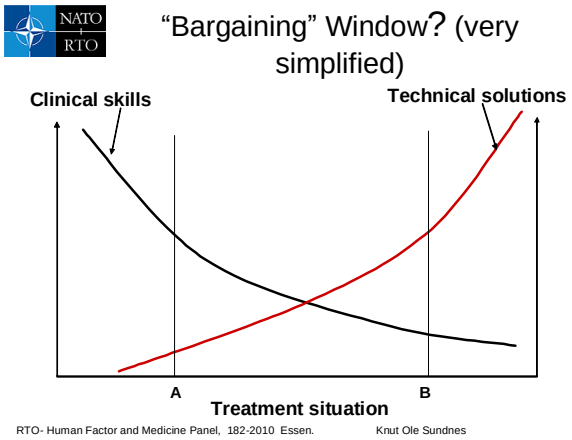

Figure 10: Static picture. To the left of A clinical skills cannot compensate for lack of equipment and vice versa to the right of B.

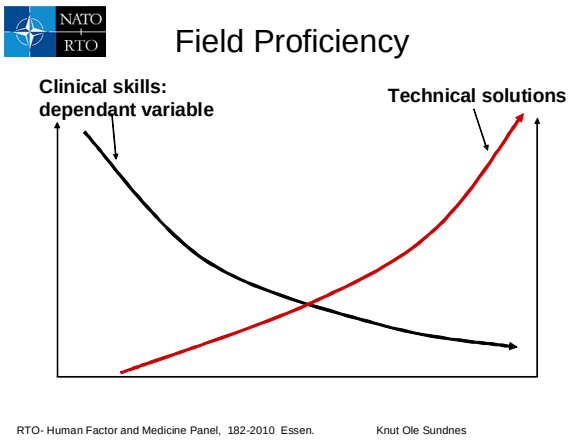

Figure 11: Dynamic picture. Will introduction of high tech equipment result in reduced clinical skills?

It is our duty to identify such relationships. This can only be achieved when research and evaluation is conceptualised and institutionalised. Therefore, to overcome this shortcoming a NATO Trauma Registry is long overdue.

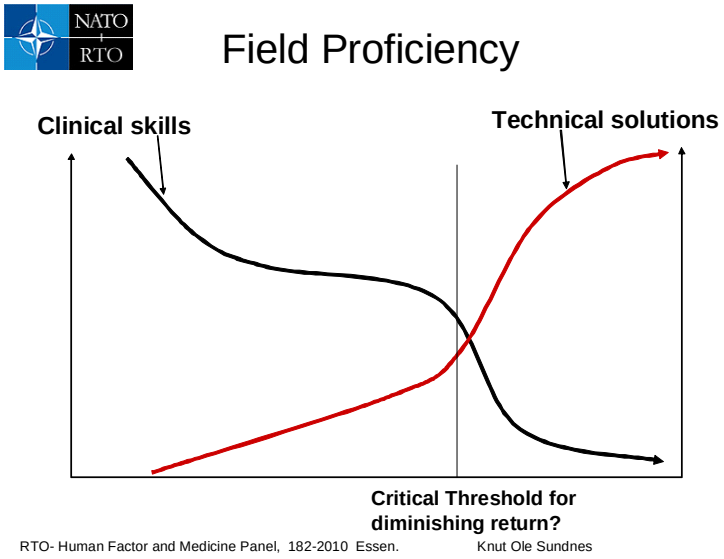

Figure 12: One aim of future research could be to find the ultimate relationship between clinical skills/field proficiency and advanced technical equipment. This is but an anticipated relationship/hypothesis.

When will we again find ourselves in the situation "A little knowledge is a dangerous thing" (Alexander Pope, An Essay on Criticism, 1709). Combining "too little knowledge" (clinical) with "too much knowledge" (technical) opens for interesting outcomes, not necessarily positive.

We already have well functioning telemedical diagnostic systems utilising experts at home and tele-imaging. Taken further as demonstrated at this symposium, the ultimate result of distance monitoring and treatment could comprise:

1) Robotic extraction
    a) Robotic treatment (e.g. deep hemostasis by ultrasound and airway management (paper 5).
2) Unmanned air evacuation
    a) including en route monitoring and closed loop treatment (e.g. anaesthesia)
        i) invasive wireless monitoring
3) Admission to a level 2 hospital being operated by a remote surgeon situated in USA (paper 5)

Pertinent questions would be:

- Feasible? May be
- Safe? Probably not 100%, as of yet
- Comforting? Hardly
- How to deal with postoperative complications?
- Other obstacles still to overcome? Yes
- Will increasing high tech result in diminishing clinical skills? Likely (TE's hypothesis)

Are unmanned systems the "road to heaven"? What about empathy, communications, "Love and Tender Care"? Where is the threshold for diminishing returns when the "best becomes the enemy of the good"?

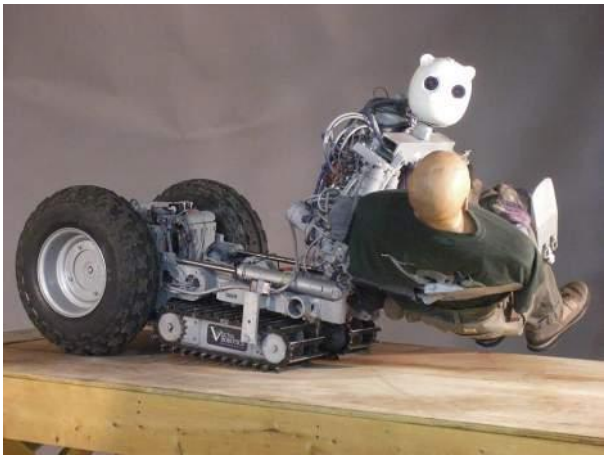

Figure 13: "Buddy aid". Robotic extraction of casualty.

Figure 14: Unmanned Air Evacuation Vehicle.

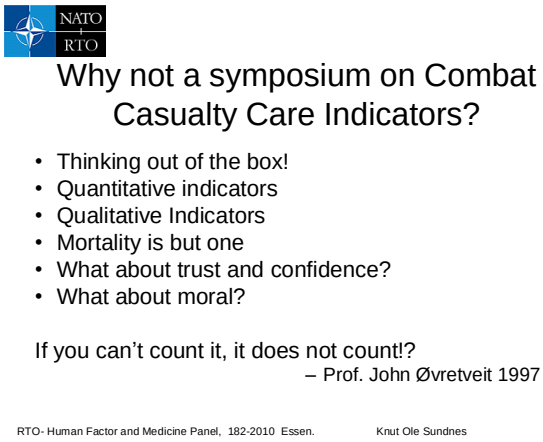

Figure 15: Identifying correct indicators is crucial for all research. This topic deserves an institutionalised approach.

Appendix 1 – Papers, each with brief summaries and comments from the Technical Evaluator

Keynote KN1 – Meeting the Challenges of Medical Support on Current NATO Operations
BGen. R. Cordell, Medical Advisor, SHAPE (GBR)

Keynote KN2 – Medical Challenges in the CENTCOM AOR: From Trauma to Influenza
Col. R. Erickson, Command Surgeon, US Central Command, CENTCOM (USA)

SESSION 1

Paper 1 – Point-of-Injury Care in Expeditionary Medicine
Cdr. J. Patrey, Mr. W. Sobotka, Dr. J. Lytle, et al, Office of Naval Research (USA)

This paper addresses the prime challenge of critical care at the point of injury when the line between forward care and preliminary surgery is extended beyond comfort, on land or sea. Confined in space and time a naval ship represents special challenges and limitations, also when part of a battleship group or an aircraft carrier group. They identify a gap between what can be trained in civil settings and what will be asked/demanded at a point of injury in an austere setting. They further underline that current diagnostic equipment is not "fieldable" in an expeditionary setting and that the ONR is developing light weight equipment.

TE's comment: A key issue is that diagnostic possibilities and procedures should not be implemented if they result in unnecessary delays before evacuation and necessary treatment.

Paper 2 – Advanced Product Development for Combat Casualty Care at the US Army Institute of Surgical Research
Dr. D. Baer, Dr. M. Dubick, Dr. J. Wenke, et al, US Army Institute of Surgical Research, ISR (USA)

This paper establishes an overview of what Institute of Surgical Research focuses on both on prevention (protective gear) and treatment at all levels from point of injury till final treatment (haemorhage, dressings, tourniquets, blood products, pain control burns, etc.)

Paper 3 – US Department of Defense Research in Robotic Unmanned Systems for Combat Casualty Care
Dr. G. Gilbert, Telemedicine and Advanced Technology Research Center, TATRC (USA)

This paper deals with a futuristic scenario, which may not be so far away. They present the current state of several projects that have produced prototypes or even field tested equipment like Battelfield Extraction Assist Robot (BEAR), Unmanned Aerial Systems, smart stretchers, sewn in tourniquets, Combat Medic UAS, etc.

In this paper nothing is impossible. The need to evaluate and differentiate between output and outcome is crucial for all these projects. Further, they will surely be applicable in many settings. The key questions is, is a battlefield scenario one of them?

Paper 4 – Robotics and Unmanned Systems - "Game Changers" for Combat Medical Missions
Mr. M. Beebe, Dr. G. Gilbert, TATRC (USA)

This paper continues the robotic issue and all unmanned concepts. It also underlines the SBIR commercial aspect of these projects. The congressional directed goal is that 1/3 of ground combat vehicles should be unmanned by

2015. DARPA (Defense Advanced Research Project Agency) and TATRC (Telemedicine and Advanced Technology Research Center) are key players in this development. Three systems comprising ECG, monitoring BP (invasive and non-invasive), pulse, O2 saturation, heart rate, infusion pumps, fluid warmer, ventilator and oxygen plus closed-loop capability, and transmit and communication system for remote adjustments.

Key issue: Requires absolute control of cyberspace, radio waves, transmitter stations, satellites etc.

Paper 5 – Distributed Automated Medical Robotics to Improve Medical Field Operations
Dr. T. Broderick, Dr. C. Carignan, TATRC (USA)

Sophisticated medical and surgical expertise-on-demand through non-medical teleoperated robots are proven military force multipliers. This paper addresses how these advantages are now entering the field of medical treatment and combat casualty care. In concert with the other parts, it opens the door to a futuristic unmanned scenario with regard to medical treatment and evacuation. The vision is to provide expert surgical assistance in the first 30 minutes through remote control to capture the preventable deaths that occur within that time period. Deep Bleeder Acoustic Coagulation and Robotic Laser Tissue Welding are two of many products/programs. Autonomous Airway Management and Target Control Infusion Anaesthesia based on closed loop from electrochemical biosensors are others.

The authors state realistically that limited bandwidth, latency, and loss of signal in the deployed combat environment represent real challenges.

Paper 6 – Human Systems Integration in Expeditionary Medical Treatment Facilities
LtCol. V. Martindale, AF Human Systems Integration Office, Dr. D. Folds, Georgia Tech. Research Institute (USA)

This balanced paper can be read as a pro and con paper addressing benefits and challenges related to growing sophistication of equipment and robotics. Fewer personnel, lower initial qualification (cause and result) is parallel, preceding or caused by this development. Extended familiarization should reduce human errors based on incompetence, mishaps and fatigue and exhaustion. On the other hand ill-conceived design or concepts may become counterproductive. Hand held brain diagnostics may replace a CT in the forward setting and other robotics may prove advantages in the end (see above). Important are the domains of Human Systems Integration: Human factors Engineering, Manpower, Personnel, Training, Safety and Occupational Health, Survivability, Habitability, and Environment, each encompassing relevant pro and con issues.

Paper 7 – Implementation and Dissemination of a Military Trauma System: Utilizing Medical Lessons Learned from the Battlefield
Col. B. Eastridge, Col. G. Costanzo, Mrs. Mary Ann Spott, Col. L. Blackbourne, ISR (USA)

This paper informs how JTTR has demonstrated the true purpose of a trauma registry: Through proper registration of trauma and care given, new concepts have been identified which has lead to institutionalized improvement of casualty care and protective gear leading to a lower in-hospital mortality of 4.1% (TE's comment: This should be lower than the figure from the National Trauma Data Bank.)

SESSION 2

Paper 8 – The Integration of the Medical Service into the Principle of Network Enabled Operations (NEO)
Col. S. Kowitz, Bundeswehr Medical Office (DEU)

This paper elaborates and underlines the overall function of network enabled operations and how this is crucial also for expedient medical support systems as well as Patient tracking Systems. It will also be the backbone for greater mobility and operational support. Sensors, effectors, data collection and data inference into information are all key elements for medical support and for quality assurance and control.

Paper 9 – Medical Regulation Concept for Forward Field Casualty Management Based on an Information System
Dr. A. Puidupin, Mr. W. Guessard, Mr. R. Besses, et al, Service de Santé des Armées (FRA)

Paper 10 – The Best Path for Blood Management Software: From Idea to Prototype to a Deployable Solution
Dr. M. Trujillo, CAMRIS International, Maj. I. Hauge, USAF Human Effectiveness Directorate (USA)

Blue Evaluation Software (BEST) is a US Global Profile Database for Blood Donor's Identity, Health and Travel History. The paper details how a SBIR project is governed and run, and how it in this case results in an innovative solution to trace and keep electronic access to necessary information of blood donors in order to reduce infection rates, discarding of blood and transport time. This will now enter Phase III for commercialisation/sale before implementation.

Paper 11 – A New Era in Medical Training Through Simulation-Based Training Systems
Mr. J. Magee, TATRC (USA)

Simulation training is expected to reduce human errors in health care, both in civilian and military settings. (98000 Americans are estimated to die from human errors annually.) Fatal outcome from human errors must also be expected in a combat casualty setting. Investments and innovations to reduce this is priority both for civilian and military health care authorities.

This paper elaborates various innovations for simulation based training systems. High-Fidelity Computer Modeling of Epithelial Tissues and Ultra-High Resolution Display for Army medicine represent some important enabling technologies for new development of e.g. light head-mount display powered by only 2 watts. PC based programs have existed, but been expanded as have mannequins that are now digitally enhanced and also part-task trainers (attrappe).

Paper 12 – Using Advanced Prosthetics for Stress Inoculation Training and to Teach Life Saving Skills
Dr. M. Wiederhold, Dr. B. Wiederhold, Ms. A. Salva, The Virtual Reality Medical Center (USA)

Virtual Reality Medical Center (VRMC) has developed a part task-trainer comprising a wearable injury simulator (like a diving wetsuit). The target group is combat medics. It is comprised of a synthetic skin system and can simulate amputations, eviscerations, blast injuries, punctures and burns. It now also includes Pneumothorax, haemoperitoneum, and gunshot wounds to an artery. How this enables treatment in addition to diagnostic training must vary. Also, all features are not necessarily revolutionary (like bleeding wound that is stopped by a tourniquet.

But all in all, this paper adds to the picture of the possibilities already available and for future development for training technologies.

Paper 13 – PAPER WITHDRAWN

SESSION 3

Paper 14 – Pain Management in Trauma Care
LtCol. Dr. M. Helm, Prof. L. Lampl, Federal Armed Forces Hospital (DEU)

Paper 15 – Virtual Reality: An Emerging Tool to Treat Pain
Dr. J-L. Belard, TATRC, Dr. H. Hoffman, University of Washington, Col. K. Gaylord, ISR, et al (USA)

A randomized trial confirms previous reports that virtual reality will reduce pain, occupying the mind of the patient. In those who need it most, starting at VAS 7 or higher at a Likert scale from 0-10, it has proven to have the best effect. Previous trials have demonstrated that the correct program is crucial (e.g. SnowWorld). To be applicable to the field, smaller and less heavy helmets are necessary.

Paper 16 – Preventing Hypothermia: A Comparison of Current Devices Used by the US Army with an In Vitro Warmed Saline Model
Capt. P. Allen, S. Salyer, Brooke Army Medical Center (BAMC), Dr. M. Dubick, ISR, et al (USA)

Hypothermia is one of the crucial elements in the lethal triad. Temperature <33 ˚C is associated with 100% mortality. Different devices were tested in a structured in vitro trial using blankets, space blankets, chemical heating devices, active heating by air, body bags and a combination of some of them. Only the Bair Hugger is purpose built for surgical procedures. The rest are meant for transport. Interestingly the "Bair Hugger" did not score as well as could be expected. The test was an in vitro test and a similar real life test is possibly very cumbersome. It may also be considered unethical.

Paper 17 – Modern Initial Management of Severe Limbs Trauma in War Surgery: Orthopedic Damage Control
BGen I. Ausset, Prof. M. Levadoux, LCdr. Dr. M.K. Nguyen, Lt. Dr. Y. Baudouin, et al, HIA St Anne (FRA)

The authors introduce a principal of Orthopaedic Damage Control presenting a concept of minimum treatment called the "Just seven procedure": just bridge the fracture, just align the limb, just stiff enough to allow evacuation, just a few pins, just associated with a surgical debridement, just after the injury if possible.

Paper 18 – US Army Oxygen Generation System Development
Mr. M. Arnold, US Army Medical Materiel Agency, USAMMA (USA)

Compared to a civilian setting, oxygen represents a logistical problem. The author gives an overview of different ways to address this need and how local production in the field can be achieved, both low pressure and high pressure. Three principles are available: Filtration through zeolite filters (oxygen concentrators), portable and large scale options (need electricity), chemical, electrochemical, cryogenic- separating nitrogen-oxygen and argon; which is effective and efficient also for storage (liquid oxygen) but complex Ceramic Oxygen Cylinders and high pressure cylinders. The need to economize with oxygen, as it is an expensive and dangerous medical commodity, is rightly emphasized.

TE's comment: All options have their pros and cons. Practical and feasible at forward surgical units seem to be oxygen cylinders and portable oxygen concentrators. At Role III, large oxygen concentrators capable of filling cylinders may be the better choice. All systems require energy, some more than others. Oxygen economizing systems like on-demand valves should be compulsory for spontaneous ventilation. Pulseoximeters help economize oxygen utilization.

SESSION 4

Paper 19 – Combat Damage Control Resuscitation: Today and Tomorrow
Col. L. Blackbourne, Commander, ISR (USA)

The author introduces the concept "Damage Control Resuscitation". He underlines the importance of avoiding the lethal triad and preventing the vicious circle: hypothermia – acidosis – coagulopathy. Permissive hypotension until haemostatic surgery, and then blood components RBC: plasma: platelets in ratio 1:1:1 has been demonstrated during OEF and OIF as the optimal blood component therapy. If this is not available FWB is the option. Unless retrospective Case Control studies are accepted, the author asks for randomised control studies. If that is currently acceptable from an ethical point of view, is not clear.

Paper 20 – Hemorrhage Control in the German Army – Lessons Learned
Dr. Madei, Federal Armed Forces Medical Academy (DEU)

This paper puts more emphasis on the factor VIIa and fibrinogen as key components for transfusion strategies when massive bleeding and coagulopathy seems inevitable. They now follow the 1:1:1 ratio principle and have also accepted the use of FWB, if needed.

Paper 21 – New Technologies for Treating Severe Bleeding in Far-Forward Combat Areas
Dr. M. Dubick, Dr. B. Kheirabadi, ISR (USA)

These authors address the haemorrhage control and looks at new types of dressing, powder/granulates plus tourniquets. The best hemostatic proved questionable due to epithelial damage. The "winner" then became Combat Gauze in a clinical test on pigs. (TE's comment: Testing during the last winter exercise also on pigs, we found no difference between the Combat Gauze and a standard dressing. Method may have been wrong though.) The Tourniquets seems to established themselves. For those who recognise the cons of tourniquets it is critical that proper use of them is understood. It is also to be noticed that one well conceived study on tourniquets from the first Gulf war is not listed. (Pillgram-Larsen & al.) The tourniquet has killing power if used wrongly (TE's statement).

Paper 22 – Inhibition of Platelet Aggregation by Supernates from Stored Packed Red Blood Cells
Dr. S. McFaul, Walter Reed Army Institute of Research, Lt. F. Mattheu, Navy Regional Blood Center Great Lakes (USA)

This paper adds to the basic understanding of physiology and pathophysiology of the coagulation process and its dependency on the blood products transfused. Lack of coagulation may not necessary originate only from absence of coagulation factors or age diminished properties, but result directly from biproducts developed during storage (supernates from PRBC solutions). The difference between leucocyte-reduced and non-leucocyte-reduced blood was striking.

From a European point of view this is utterly interesting since one of the rationales for producing PRBC is to remove the leucocytes which are considered an important pathogen for delayed immunoproblems. Non LR blood therefore does not exist in most European countries.

Paper 23 – Use of Advanced Machine-Learning Techniques for Non-Invasive Monitoring of Hemorrhage
Dr. V. Convertino, ISR, Dr. S. Moulton, Dr. G. Grudic, University of Colorado, et al (USA)

The authors underline the limited average insight in physiology and pathophysiology of hypovolaemia. They demonstrate that vital parameters like increased heart rate and hypotension mark the beginning of decompensation and is not an early sign of blood loss.

Applying Lower Body Negative Pressure they were able to scale the central hypovolaemia and a produce a structured study. Using non-invasive measures like Heart Rate, RR interval, Systolic BP, MAP, Pulse Pressure, Stroke Volume, Cardiac Output, total Peripheral Vascular Resistance they were, with 96.5% accuracy, able to predict the amount of central blood volume reduction.

Paper 24 – Pathogen Reduction of Fresh Whole Blood for Military and Civilian Use
Dr. R. Goodrich, Dr H. Reddy, S. Doane, et al, CaridianBCT Biotechnologies, LLC (USA)

With the increasing use of FWB and the relatively clear evidence that this saves lives in combat casualty care, any effort to reduce the long term pathology resulting from microchimerism and virus infection must be welcomed. This paper demonstrates how a Pathogen Reduction Technology based on riboflavin (vitamin B12) and UV light (Mirasol System for Whole Blood) was able to significantly reduce pathogens like different viruses, bacteria and leucocytes. Parasites are not yet tested (like malaria). Recommended energy was 80 J/ml. Trade offs were some reduction of certain functions like Prothrombin time, activated partial thromboplastin time and some clinical chemistry. TEG seemed not to suffer from these trade-offs.

The device is currently under final testing for approval.

Paper 25 – Comparison of Hemostatic Efficacy of ChitoGauze and Combat Gauze in a Lethal Femoral Arterial Injury in Swine Model
Dr. K. Real, Dr. L. Buckley, HemCon Med. Tech. Inc., Dr. J. Teach, Dr.H. Xie, Oregon Medical Laser Center, et al(USA)

Comparison between ChitoGauze dressing (chitosan) and Quick Clot Combat Gauze was significantly in the favour of ChitoGauze with less bleeding, shorter time before haemostasis, better survival and fewer applications.

Paper 26 – Hypertonic Saline Dextran (HSD) in a Complex Military Injury – A Preclinical Study
Dr S. Watts, Maj. J. Granville-Chapman,Dstl Porton Down, Surg.Capt. M. Midwinter, et al, Royal Centre for Defence Medicine (GBR)

This paper provides two important messages. Hypotensive resuscitation prevents some unnecessary deaths due to haemorrhage but causes substantial physiological deterioration if prolonged.

The authors have demonstrated how a hybrid strategy of 60 minutes hypotensive resuscitation followed by normotensive resuscitation offered significant physiological benefit after haemorrhage alone and significant better survival after combined haemorrhage and blasts injury.

They also demonstrate how hypertonic saline offers no advantage for a haemorrhage patient and actually significantly increases mortality when combined with a blast injury (pulmonary pathophysiology).

SESSION 6

Paper 27 – Portable 3d/4d Ultrasound Diagnostic Imaging System (PUDIS)
Dr. S. Stergiopoulos, Dr. P. Shek, Defence Research and Development (CAN)

An extremely complicated physical and mathematical model made this paper not easily accessible for a normal physician like the TE.

From what can be understood, however, they have brought 3D/4D ultra sound imaging into new heights regarding image resolution combined with possibility for light weight field equipment. This device should be able to facilitate detection of non-visible internal injuries based on volumetric imaging outputs.

Its clinical field proficiency is still awaiting and also the decision of using it for general screening or symptom orientated targeting. If easy to handle the potentials may be good. Sensitivity and specificity will be essential.

Paper 28 – Terra Incognita: Current and Potential Uses of Optical Spectroscopy for Combat Casualty Care
Dr. A. Pacifico, TATRC (USA)

Another step forward based on advanced technologies and their new applications. Using photon metods with wavelengths between 200 and 16,000 nanometers gives advantages to detect and diagnose morbidities of the battlefield. The greatest advantage is at surface imaging applicable to burns and infectious. Optical spectroscopy/optical imaging has potentials to assist medical operations in the battle field. There are also a host of other applications possible.

Functional near infrared spectroscopy (fNIRS) is discussed.

Paper 29 – Cell Biosensors: Rapid Detection and Identification of Pathogens Using FTIR Microspectroscopic Spectra
Dr. J. Ward, Dr. J. Hilliard, Georgia State University, et al (USA)

This paper presents essential information and may provide important improvements for virus diagnostics, not only in the battlefield, bur for medical diagnostics as a whole, including civilian hospitals. A new hypothesis has been tested that the cells themselves serve as biosensors which can be probed using FTIR microspectrometry to identify specific viruses to which a cell is exposed, and that much earlier than using PCR techniques. Spectral bands discriminate between viruses. In addition they identified specific intracellular pathways in cells at different points of time for the different viruses.

Herpes simplex, coxsackie B3 and human adenovirus 5 were selected. (Vero cells were used.)

Paper 30 – Molecular Strategies Against Sulfur Mustard Toxicity
LtCol. Dr. A. Korkmaz, Cdr. Dr. H. Yaren, Capt. Dr. Z. Kunak, Gulhane Military Medical Academy, et al (TUR)

The authors provide a thorough overview of the latest knowledge of SM pathology especially at a molecular level. There are new insights as to the biomolecular damage done and the epigenetic damage or traces left. This may open for new therapeutic windows through epigenetic drugs.

SESSION 7

Paper 31 – Multinational AirMedEvac-Crew Concept in NATO
LtCol. Dr. C. Vogl, Maj. Dr. C. Strobl, German Air Force (DEU)

NATO missions today more and more become multinational. This also takes place within more confound operations where cross-border regulations, operational procedures and equipment are different. This paper addresses the challenges, how they were solved, and the training period necessary to integrate a Dutch crew into the German AirMedEvac system.

Paper 32 – Utilization of Level II Military Treatment Facilities Associated with Decreased Mortality
Capt. J. Ritchie, Capt. M. Hardin, LtCol. C. White, et al, ISR (USA)

A very important presentation informing of the statistically better outcome from surgical/hospital treatment at Role 2 facilities compared to Role 3 facilities. Same injury severity score (18 vs. 18). The cause-effect relationships are not clear but the extended use of FWB may be one factor, evacuation time another. The authors conclud that more studies are needed.

Paper 33 – Joint Medical Distance Support and Evacuation - Joint Combat Casualty Care System Concept of Employment
Dr. G. Gilbert, Mr. C. Manemeit, TATRC (USA)

This paper presents another high tech futuristic (partly imminent?) system of Joint Medical Distance Support and Evacuation and Joint Precision Airdrop, to provide and augment diagnostic and treatment facilities in the combat zone. This is of course combined with transmittal systems of the monitored vital data. Operational demonstrations will provide further answers as to applicability.

Killing Factors?

Paper 34 – The Bundeswehr STRATAIRMEDEVAC System
Col. Dr. F. Grell, German Air Transport Command (DEU)

The author presents the conceptualization of the comprehensive German StratAirMedEvac system that has already proven itself on various occasions.

Paper 35 – Development of a Dual-Mode, Noise-Immune Stethoscope for Combat Environments
Mr. S. Brady, US Army Medical Materiel Agency, Maj. S. Gaydos, US Army Aeromedical Research Laboratory (USA)

An interesting contribution to medical diagnostics. It has the potential to bridge the gap between diagnostic needs and possibilities during medical treatment in a noisy environment. Using electromechanical acoustic (passive) and ultra sound Doppler it may enable us to use a stethoscope also when noise reaches 90 dB and may be even up to 110 dB. Its ruggedness has been tested (humidity, temperature, vibration) but it still failed the drop test. It needs training to learn new sound principles, but otherwise new use of previously known technology.

SESSION 8

Paper 36 – Operational Use of US Army Telemedicine Information Systems in Iraq and Afghanistan– Considerations for NATO Operations
Col. R. Poropatich, TATRC, LtCol. R. Lappan, Great Plains Regional Medical Command, Dr. D. Lam, TATRC, et al (USA)

The US telemedicine consulting/diagnostic system has been expanded beyond teledermatology and includes now 19 medical and 7 dental specialty services. 6642 consultations resulting in 85 avoided repatriations and activation of 265 repatriation it has been considered a success.

In order to offer the same services to allies in the OEF and OIF legal and technical issues were addressed and February 2009 it was implemented for NATO.

Multinationally the start was OK but died completely after 5 months. The Human Factor as seen explicitly during HOTO is to blame as the concept was not part of the information conveyed to the successors.

Paper 37 – Integrated Diagnostic and Treatment Devices for Enroute Critical Care of Patients Within Theater
Mr. E. Abbot, Mr. R. Palmer, USAMMA (USA)

En-route diagnostic and treatment devices have been given ample attention, especially by US military authorities. The key issue is that the 40% reduction in case fatality rate during 2001 and 2005 is attributed partly to the Forward Surgical Teams. This again results in DCS treated intensive care needing patients which are up for in theatre transport under tough conditions. Also en-route surveillance and monitoring is difficulty. Currently three devices are under evaluation and testing, namely a new LSTAT version (LS-1 or MEDEX 1000), LTM and the MOVES.

Paper 38 – PAPER WITHDRAWN

Paper 39 – Assessment of the need to Perform Life-Saving Interventions Using Comprehensive Analysis of the Electrocardiogram and Artificial Neural Networks
Dr. A. Batchinsky, Dr. J. Salinas, ISR, et al (USA)

To improve risk stratification and prognostics various efforts using Artificial Neural Networks (ANN) derived from traditional vital signs. E.g. decrease in Heart Rate Complexity occurs early during blood loss.

Out of 24 variables calculated from and ECG, ANN chose 14 as independent predictors of the need for Life Saving Interventions.

Paper 40 – Automated Decision-Support Technologies for Prehospital Care of Trauma Casualties
Dr. J. Reifman, Dr. L. Chen, Dr. A. Reisner, Bioinformatics Cell, Telemedicine and Advanced Technology Research Center, U.S. Army Medical Research and Materiel Command, Fort Detrick (USA)

This is another paper focusing on more comprehensive analysis of easy to get vital signs in order to come up with early warning signals of emerging problems. A Propaq monitor combined with a new hardware/software (APPRAISE) concluded that standard vital signs are reasonable predictors of major haemorrhage.

Paper 41 – Lightweight Noninvasive Trauma Monitor for Early Indication of Central Hypovolemia and Tissue Acidosis
Dr. B. Soller, Reflectance Medical Inc., Dr. K. Ryan, Dr. V. Convertino, ISR (USA)

During trauma and also intensive care, tissue acidosis has been an increasingly important indicator of poor oxygenation, independent of cause. Blood lactate tells us what has happened and indicates when surgery should be performed. This paper presents the results of muscular oxygen saturation (SmO2) measured by spectroscopic devices and also Stroke volume as a new non-invasive parameters to determine impending cardiovascular collapse. In this trial using LBNP, SmO2 and SV were better indicators than HR, MAP and SpO2.

Paper 42 – On Ultra Wideband Wireless Body Area Network for Medical Applications
Dr. J. Bergsland, Dr. I. Balasingham, dr. E. Fosse et al, Oslo University Hospital (NOR)

Another wireless sensor networks development using both on and in-body sensors. As such transmissions are vulnerable to interference from Wireless Local Area Networks or Bluetooth an Ultra wideband (UWB) has proven promising and can measure heart beat and respiration and track objects both on and in-body. This may facilitate patient monitoring especially during transport (both in and out of Hospital).

Paper 43 – Telemicrobiology for Mission Support in the Field of Infectious Diseases
LtCol. Dr. P. Scheid, Central Institute of the Bundeswehr Medical Service (DEU)

This paper refers to several double blind tests on telemicrobiology and telemicroparasitology, which has proven reliable and the system has been implemented in four German military theatres and is now part of the standard telemedicine "family". (Slogan: Exportation of expertise, not experts.)

Paper 44 – Regenerative Medicine at Early Echelons: Changing Medical Care & Outcomes
Dr. E. Lai, TATRC (USA)

The paper takes us through the tissue repair process presenting the conceptual platform of regeneration and its further development. One result, like the SkinGun seems to give exciting possibilities to replace skin-grafting. Other objectives like adding regenerative tissue to the injury already at the point of injury will require a lot of debates. Such tissue hardly reaches to the fresh salvable tissue. However, later, at Level 3, this is less controversial. TE's comment: Other methods as part of organogenesis could lead to a shift of paradigm, but currently not yet ready for the field. Well designed studies are necessary.

Paper 45 – Medical Equipment Tele -and Condition- Based Maintenance With Enhanced Remote Diagnostic Access (RDA) and Computer Vision
Mr. D. Van, Concepteers, LLC (USA)

RDA would reduce the need for transporting extra people into the battlefield. Currently such maintenance requires skilled engineers at least as forward as Role 2. Also, different equipment mostly needs different systems for technical testing and diagnosis. WHO also has stated that one out of 10 patients are subject to Health Care errors. Some of these may be due to non-maintained equipment. Another problem seems to be that both the High tech private provider and the High tech user (the military) have their classified worlds prohibiting exchange of insight and maintenance skills.

Previous attempts of RDA have been unsuccessful also due to technical shortcoming.

Now the group has developed a new device, a teleconsole, multifunctional with ample options that seems promising to take on telemaintenance.

Paper 46 – The Prospect of Tele-Medicine and Tele-Assistance in Bringing the Neurosurgeon Expertise to Medical Field Operations Worldwide
Cdr. Dr. C. Schulz, Maj. R. Mathieu, LtCol. Dr. U-M. Mauer, et al, Military Hospital Ulm (DEU)

Previous experience concluded that the neurosurgeon was very seldom needed in theatre. Consequently a system with essential training before deployment, combined with telemedicine assistance (orally?!) has been implemented in the German army. This provides a link between the orthopaedic surgeon in theatre and an neurosurgical expert at the home base.

POSTER SESSION

This session was seriously hampered by the volcanic eruption as most presenters could not arrive and the comments are based exclusively on the abstracts without any possibility to pose clarifying questions.

Poster P-1 – Sound Spatialization for Medicine on the Battlefield: Applications and Constraints 15:50
Dr. G. Andéol, Mr. D. Sarafian, Mr. L. Pellieux, Institut de Recherche Biomédicale des Armées (FRA)

This presentation on 3D ultrasound converted into auditory functions enabling the investigators to interpret the acoustic sounds through a headset. Further results are needed to decide if this can replace or augment the visual presentation of ultra sound in the field (TEs' comment).

Poster P-2 – Current Constructs in Regenerative Medicine for the Craniomaxillofacial Injured Patient
Maj. T. Austin, Dr. P. Brown-Baer, Col. R. Hale, ISR (USA)

A very interesting poster on how degradable scaffolds impregnated with bioactive factors to promote osteogenesis for maxillofacial repair has been used successfully in an animal model.

Poster P-3 – Veno-Venous Extracorporeal CO2 Removal: Can We Reduce Dependence on Mechanical Ventilation During En-route Care?
Dr. A. Batchinsky, Mr. Bryan Jordan, Dr. D. Regn, et al, ISR (USA)

An interesting device which probably originates from the other extra-corporeal lung devices developed for critically ill intensive care patients. It partially decouples CO2 ventilation from Oxygenation. Its rationale is said to be treatment of Acute Lung Injuries (ALI) combined with reduced oxygen expenditure. Since CO2 diffuses 20 times quicker than O2 through the alveolar wall, the future use needs to be properly conceived. If it can reduce FiO2 during ventilation because of prolonged end-inspiratory time and therefore diffusion time, this device may be another armamentarium for ICU patients. Since the introduction of room air transport ventilators, it remains to be seen to what extent this will add anything to the combat casualty care. Basic rules currently demand potential ALI or multi-organ failure patients (incl. burns) to be transported in the 48 hour window between injury and potential MOF.

Poster P-4 – Development of Portable Exoskeleton Devices for Rehabilitation/Assistance in the Field
Dr. T. Broderick, Dr. C. Carignan, Dr. S. Cardin, Ms. A. Fisher, TATRC (USA)

In addition to informing that shoulder dislocation is 20 times higher in the military than in the civilian population, this poster describes how an external "skeleton" can help the patient during the recovery phase, limit the work of the physiotherapist and actually bring the patient faster back to duty.

Poster P-5 – Treatment of Refractory Fever in the Burn Intensive Care Unit With an Intravascular Temperature Management Catheter
Dr. J. Hansen, Dr. P. DeSocio, Dr. C. Maani, Ms. M. Morrow, et al, ISR (USA)

This paper is first and foremost addressing the problem of unwanted hyperthermia and how too cool down a patient. The poster elaborates on internal central venous devices to function more like "thermostat+ cooling device". The device can simultaneously be used for i.v. fluid.

Poster P-6 – Prospects for Continuous Care: The Medex 1000™ "Suitcase Intensive Care Unit"
Mr. D. Janney, Dr. M. Hanson, Integrated Medical Systems Inc. (USA)

Presents MedEx1000 system which is an integrated system soon to be fielded *medical relevant technology* to meet current shortfalls in NATO military medical operations. Emphasis is on interoperability with all future projects like close loop, and unmanned vehicles. Supposedly the only CE-cleared fully integrated medical suite available on the market today.

TE's comment: CE-clearance is basically a guarantee for quality. In a field setting it also introduces obstacles as it can reduce flexibility, adaptability and ruggedness.

Poster P-7 – COMBINED with DEMO 3: "Back to the Future" – The Digital Pen and Paper (DPP)
Col. Dr. M. Helm, LtCol. J. Hauke, Federal Armed Forces Medical Centre Ulm (DEU)

No compatible document.

Poster P-8 – The Bundeswehr STRATAIRMEDEVAC System
Col. Dr. F. Grell, LtCol. Dr. Körner, Maj. Dr. Strobl, German Air Transport Command (DEU)

A full manuscript has been delivered for oral presentation.

Poster P-9 – The Multidrug-resistant Organism Repository and Surveillance Network (MRSN): the Army's Response to the Antibiotic Resistance Crisis
Dr. E. Lesho, Walter Reed Army Institute of Research (USA)

The poster addresses the problem of increasing infections. This new surveillance and monitoring network functions also as a repository and is expected to reduce infections. (For war surgery this must be coupled to the trauma registry as the surgical performance has previously proven key to wound infections. International Committee of Red Cross. (TE's comment).)

Poster P-10 – Advanced Airway Management in Combat Casualties by Medics at The Point of Injury: A Sub-Group Analysis of the Reach Study
Maj. R. Mabry, AMEDDC&S, Capt. P. Cuniowski, BAMC, Dr. Alan Frankfurt, et al (USA)

Lists how airways of 20 patients, dead on arrival or dying, were managed. Twelve had oesophagotracheal devices, four had endotracheal tube, three had cricothyreotomy and one had a laryngeal mask. At least 18 patients had GCS of 3. One had GCS of 5. All 17 who died before transfer had GCS of 3. Only one patient survived (neck haemathoma). This patients GCS is not given. Two evacuees were lost to follow up.

Poster P-11 – Automatic Monitoring of Gut Function & Inflow Control for Safer Enteral Nutrition After Trauma
Dr. G. Moss, Rensselaer Polytechnic Institute (USA)

This poster addresses more controlled but "aggressive "feeding of patients after trauma. They have previous good clinical experience with this and now also based this on an animal randomized model, where the GI fed dogs had shorter recovery and doubled wound bursting strength compared to the controls. (This is in concert with the practice at the Burn Unit at Rambam University Hospital, Haifa in Israel in the 1970's. TE's comment.)

Poster P-12 – Infection-Associated Clinical Outcomes in Hospitalized Medical Evacuees following Traumatic Injury- Trauma Infectious Disease Outcome Study (TIDOS)
LtCol. C. Murray, San Antonio Military Medical Center; LtCol. N. Conger, Landstuhl Regional Medical Center; Col. S. Fraser, Walter Reed Army Medical Center, et al, (USA)

This appears to be a narrative description of how Infectious Diseases and especially Trauma Infectious Diseases will be studied and evaluated/analyzed based on the existing figures and data from the JTTR. One key question is why the ID increases as the wounded patients move from lower to higher echelons.

Poster P-13 – Current Practice of Thermoregulation during the Transport of Combat Wounded
Capt. M. Nesbitt, Capt. P. Allen, BAMC, LtCol. A. Beekley, Uniformed Services University of the Health Sciences (USU), et al (USA)

This paper states how Clinical Practical Guidelines (CPG) has reduced the incidence of hypothermia. (Other statements in this poster seem not to be in full concert with paper 16 in the oral session. TE's comment.)

Poster P-14 – New Stereoscopic Technologies for Practice and Formation to Chirurgical Gesture: Usage Limits
Asp. P. Neveu, Dr. A-E. Priot, Capt. M. Philippe, et al, Institut de Recherche Biomédicale des Armées (FRA)

This abstract suffers from the absence of the poster and the possibility to ask clarifying questions.

Poster P-15 – Surgical Management of Open Fracture of the Limbs by External Fixation and Minimal Internal Fixation
Maj. Dr. Y. Baudouin, LCdr. Dr. M. Nguyen, Prof. M. Levadoux, , et al, HIA St Anne (FRA)

Results of combining external plus minimal internal fixation of fractures in 17 patients are presented. Mechanism of injury is not presented. Two deep and five superficial infections.

Poster P-16 – Flexible Strain Sensing Surface Based on Fiber Optic Sensors for Application in Orthopedic Biomechanics and Rehabilitation
Dr. G. Papaioannou, Dr. G.Kanellos, Dr. N. Pleros, et al, Wisconsin Institute for Biomedical Health Technologies (USA)

This paper demonstrates how new technology is applied to already well established treatment. Based on measurements of the strain and load on the prostethic device through biosensors, monitoring will assist in adjusting and improving the prosthesis for the patients concerned.

Poster P-17 – Towards a Novel "SMARTsocket" Design for Lower Extremity Amputees
Dr. G. Papaioannou, Mr. C. Mitrogiannis, Mr. George Nianios, et al, Wisconsin Institute for Biomedical Health Technologies (USA)

This Smart socket provides a three dimensional stereogram enabling better prosthesis production.

Poster P-18 – Advantages of Telemedicine & Endoscopy in Military Operations
Mr. D. Pickles, Karl Storz Endoscopy GmbH (DEU)

Subtitle is "To save Lives, Time and Money". TE's comments: The subtitle tells me that the outcome is taken for granted. Better information is needed how the practice of telemedicine through endoscopy will assist in difficult treatment and intubation. The tele-connection of nearly every part of the world is not yet the same as timely assistance in difficult patients.

Poster P-19 – Device and Method for Internal Tamponade of Noncompressible Hemorrhage Due to Penetrating Trauma: Device Description and Live Tissue Ballistic Testing
Dr. M. Ramsey, Cardio Command, Inc. (USA)

The presenter describes a device that, inserted into the shoulder/axilla or the pelvis/groin area, can be insufflated and stop non-compressible bleeding. (TE's comment: What about standard internal deep wound packing and what about the nomenclature? A bleeding that actually stops on compression, is that a non-compressible bleeding?)

Poster P-20 – FINSS: A Field-Deployable, Integrated Neuropsychiatric Support System
Prof. P. Rapp, USU; Dr. J. Kimura, Sensorium Inc, Dr. C. Cellucci, Aquinas LLC, et al (USA)

This device represents significant improvements, both with regard to integrated systems and to portable systems for neuro- and electroencephalography, amalgamating several functions into one device with the size of a shoebox. It may be relevant for normal neuropsychiatry examination, but will also address the latest theories of PTSD and monitor encephalographic development. To what extent this will improve diagnostics and treatment remains to be seen. The devise is certainly intriguing.

Poster P-21 – Continuous Doppler Ultrasound-Monitoring in Infrainguinal Bypass Procedures of Combat Vascular Injuries
LtCol. C. Richter, T. Böckenfeld, M. Vogelpohle, et al, Federal Armed Forces Hospital Ulm (DEU)

This group presents a system for continuous Doppler ultrasound monitoring which supposedly functions also in the hands of inexperienced surgeon. Narrative only.

Poster P-22 – Computerized Decision Support System for Burn Resuscitation Improves Outcomes in Burn Patients
Dr. J. Salinas, ISR, Dr. G. Kramer, University of Texas Medical Branch, Maj. K. Chung, et al, ISR (USA)

A very educating paper and very important if confirmed in more studies. Computerized fluid treatment proved to result in lower mortality during the first 48 hours and also reduced the fluid given. (TE's comment:

Assuming they aim at 0.5 ml/kg/hour urinary output (not stated) this informs us how correct this indicator is for renal physiology. It also tells us how fragile human body is to unbalanced fluid therapy during the pathophysiological process that a burn constitutes when TBSA>20%. Does the same apply to trauma after haemorrhage control?)

Poster P-23 – Machine Learning Techniques Effectively Predict Need for Life Saving Interventions in Trauma Patients
Dr. J. Salinas, M. Doderer, Col. L. Cancio, et al, ISR (USA)

This abstract would have benefited from more detailed explanation by the authors. However, it seems that it underlines the benefit of combined clinical inputs **and** electronic inputs from monitoring into an artificial neural network (ANN) thereby producing better predictability of the need for life support interventions.

Poster P-24 – New Advances to Improve Haemorrhage Control in Role3 and Role2 Settings
Dr. A. Schubert, Pentapharm GmbH (DEU)

Thromboelastograms have reemerged as important monitors for haemorrhagic coagulopathy. This abstracts inform about a ruggedised unit capable of functioning under harsh conditions also in Role 2 settings.

Poster P-25 – High Strength BioCompatible, Hemostatic Tissue Adhesive
Dr. L. Shecterle, Dr. J.A. St.Cyr, LCTA, Inc. (USA)

The authors advocate for a new haemostatic tissue adhesive, which does not need to be removed. Unfortunately it is only compared to BioGlue and not to traditional liver packing or abdominal packing. However, the results presented are very promising. A better description of the HSBC and how to apply it is needed.

Poster P-26 – Use of Mirror and Virtual Realty Therapy for Amputee Rehabilitation
Cdr. J. Tsao, US Navy Bureau of Medicine and Surgery,Mrs. S. Weeks, Col. P. Pasquina, WRAMC (USA)

This poster had an interesting message. The use of a mirror, combined with an active approach to move both the intact extremity and attempting to move the Phantom extremity, reduced the phantom pain substantially compared to other therapies. P<0,002 and 0.04 compared to two respective control groups. Further details must be presented at the next cross road.

Poster P-27 – Current U.S. Military Operations and Implications for Military Surgical Training
Dr. J. Tyler, Dr. K. Clive, Dr. C. Whit, ISR, et al (USA)

This poster can be regarded more like an audit comparing the surgical interventions from the Combat Support Hospital in Baghdad, Iraq (OIF) with the surgical interventions and procedures that the residents had logged during their training period. Some crucial shortcomings were discovered and these were recommended overcome by cadaver studies and training on animal models.

Poster P-28 – POSTER WITHDRAWN

Poster P-29 – The Apache II Score for Lethality Prognosis Can Explain why 4 Severe Wounded Soldiers in Afghanistan Are Not Dead Regarding to the Need of Highly Trained Personnel and Sophisticated Medical Equipment During Strategic Aeromedical Evacuation
Maj. M. Vahid Dastgerthi, German Armed Forces Central Hospital (DEU)

The TE's final conclusion on this poster, which was demonstrated during the symposium, is that there is a discrepancy between the severity scores and the final outcome. It was difficult to decide if this was related to wrong scoring, insufficiency of the scoring system, exceptionally competent treatment or just random variation.

Poster P-30 – POSTER WITHDRAWN

Poster P-31 – A Portable 3D Ultrasound Telemedicine System
Dr. G. Sakas, Fraunhofer IGD (DEU), Dr. S. Stergiopoulos, Dr. P.Shek, Defence Research & Development (CAN)

A 2D and 3D ultrasound machine, compact and portable with all possibilities for direct external communication is presented. It may prove beneficial in several scenarios like on ships, in isolated environments or otherwise devastated areas.