Preparation for MedEvac
INTERNATIONAL CONFERENCE ON DISASTER AND MILITARY MEDICINE 2015
Challenges, Innovations and scientific developments in disaster and military medicine

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<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
<th>Title</th>
<th>Authors/Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>68</td>
<td>Reports</td>
<td>43rd COMEDS Plenary Session in Berlin</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Editorial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>Business Mirror</td>
<td></td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>Upcoming Events</td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>Imprint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>NATO Centre of Excellence for Military Medicine (MILMED COE)</td>
<td>NATO Centre of Excellence for Military Medicine (MILMED COE)</td>
<td>K. A. Ferland</td>
</tr>
<tr>
<td>22</td>
<td>Challenges in Military Medicine – Lessons Learned, Training, Exercises</td>
<td>Clinical and Epidemiological Assessment</td>
<td>A. Panariti, L. Nikollari, M. Duli</td>
</tr>
<tr>
<td>58</td>
<td>Challenges in Military Medicine – Lessons Learned, Training, Exercises</td>
<td>Amputations in Patients Admitted</td>
<td>H.M. H. Tayseir, M. el M. Osman, A.A.M. Hassan</td>
</tr>
<tr>
<td>64</td>
<td>Challenges in Military Medicine – Lessons Learned, Training, Exercises</td>
<td>Epidemiological Profile of Trauma at the University Hospital</td>
<td>L. Nikollari, E. Nikollari</td>
</tr>
<tr>
<td>28</td>
<td>Challenges in Military Medicine – New Developments</td>
<td>Serving the Services for more than 100 Years</td>
<td>Ch. Büttner</td>
</tr>
<tr>
<td>42</td>
<td>Challenges in Military Medicine – New Developments</td>
<td>Effects of a New Piezoelectric Device on Local Microcirculation</td>
<td>M. Stoetzer</td>
</tr>
<tr>
<td>32</td>
<td>Urology Special</td>
<td>Management of Urethral Injuries in Foreign Assignments</td>
<td>D. Liebchen</td>
</tr>
<tr>
<td>35</td>
<td>Urology Special</td>
<td>Management of Genital Injuries – from Trauma to Reconstruction</td>
<td>A. Martinschek, M. Höppner, C. Sparwasser</td>
</tr>
<tr>
<td>4</td>
<td>Organisation of Medical Support and Experiences in Operational Medicine</td>
<td>Long-Distance Mass Body Repatriation from an Ebola-Risk Area</td>
<td>T.J. Lighthelm, J. Louw, J.T. Claassen</td>
</tr>
<tr>
<td>10</td>
<td>Organisation of Medical Support and Experiences in Operational Medicine</td>
<td>Mass Casualty Aero-Medical Evacuation</td>
<td>T.J. Lighthelm, L.A. Wallis, S. Martin, P.J. van Aswegen</td>
</tr>
<tr>
<td>18</td>
<td>Organisation of Medical Support and Experiences in Operational Medicine</td>
<td>Military Medical Support in the Humanitarian Arena (MMSHA)</td>
<td>J. Meyer, J. Koch, O. Krieter</td>
</tr>
<tr>
<td>40</td>
<td>Organisation of Medical Support and Experiences in Operational Medicine</td>
<td>Canadian Armed Forces Medical Risk Matrix</td>
<td>C.H.T. Cross</td>
</tr>
<tr>
<td>48</td>
<td>Organisation of Medical Support and Experiences in Operational Medicine</td>
<td>Quality Increase of Emergency Health Care to the Injured</td>
<td>S. Goncharov, O. Garmash</td>
</tr>
<tr>
<td>50</td>
<td>Organisation of Medical Support and Experiences in Operational Medicine</td>
<td>11 Years of Air Quality Monitoring in Afghanistan</td>
<td>J. D. Lalonde, M. Bradley</td>
</tr>
<tr>
<td>45</td>
<td>Index of Advertising</td>
<td>Atmos</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Index of Advertising</td>
<td>Dräger</td>
<td>3rd Cover</td>
</tr>
<tr>
<td>13</td>
<td>Index of Advertising</td>
<td>Karl Storz</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Index of Advertising</td>
<td>Maquet</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Index of Advertising</td>
<td>MediHelp</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Index of Advertising</td>
<td>Philips</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>Index of Advertising</td>
<td>Schiller</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Index of Advertising</td>
<td>Schülke &amp; Mayr</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Index of Advertising</td>
<td>Siemens</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Index of Advertising</td>
<td>Takeda</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Index of Advertising</td>
<td>Water-Jel</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Index of Advertising</td>
<td>Zeppelin</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Index of Advertising</td>
<td>ZOLL</td>
<td>4th Cover</td>
</tr>
</tbody>
</table>

Dear Reader

Your tremendous feedback demonstrates that, as well as organisational issues, articles covering deployment-specific issues, are of particular interest.

This exchange of knowledge and experience ultimately benefits the patients we look after. So we are very much looking forward to continuing to publish your very varied and interesting experiences.

Military missions involving the medical services are currently on the rise. The emerging global refugee problem is one of grave concern. It presents a major challenge to the medical services and aid organisations.

As Editor in Chief, I feel particular satisfaction in reporting on the medical and humanitarian achievements of the teams going abroad.

So I would like to specifically invite you to write about your experiences in this field.

Finally, let me remind you about the Conference on Disaster and Military Medicine, which is being held at MEDICA on the 17th to the 18th of November 2015 in Düsseldorf, Germany.

I am sure that the presentations and workshops we have prepared will be of great interest to all attendees.

I would be delighted to welcome many loyal readers of our magazine to the event.

Chers lecteurs,

Votre formidable feedback démontre que nous avons bien plus de problèmes organisationnels que des articles couvrant des questions liées aux opérations en zone déployées. C’est un échange de connaissances et d’expérience qui profite finalement aux patients que nous soignons.

Les missions militaires impliquant les forces sanitaires sont actuellement en augmentation. Le problème global de réfugiés qui se pose est d’une grande importance. Il représente un défi majeur pour les services médicaux et les organisations d’aide.

En tant que rédacteur en chef, je ressens une grande satisfaction à publier les réalisations médicales et humanitaires des équipes qui partent à l’étranger.

C’est pourquoi je vous invite à écrire à propos de vos expériences dans ce domaine.

Enfin, je vous rappelle qu’il y a lieu de se rendre à la Conference on Disaster and Military Medicine qui se tiendra du 17 au 18 novembre 2015 à Düsseldorf, en Allemagne.

Je suis sûr que les présentations et les ateliers que nous avons préparés seront d’un grand intérêt pour tous les participants.

Je serais ravi de vous accueillir parmi de nombreux lecteurs fidèles de notre magazine à cet événement.

Estimados lectores:

Su numerosos comentarios indican que además de los temas organizacionales, también resultan particularmente interesantes artículos sobre temas especializados específicos de la práctica.

Este intercambio de experiencias se realiza también la problemática mundial de los refugiados que se perfilan. Ello es especialmente importante y es una oportunidad para hacer público el conocimiento adquirido así como para el desarrollo de nuevas técnicas de cooperación internacional.

Así lo demuestran nuestros numerosos comentarios recibidos en los últimos años. Por lo tanto, me gustaría invitarlos a escribir sobre sus experiencias en este campo.

Finalmente, recuerde que la Conferencia de Desastres y Medicina Militar que se celebrará en MEDICA el 17-18 de noviembre de 2015 en Düsseldorf, Alemania.

Estoy seguro de que las conferencias y los talleres seleccionados serán de gran interés para nuestros participantes.

Me alegraría poder saludar personalmente a muchos fieles lectores de nuestra revista.
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Answers for life.
Long-Distance Mass Body Repatriation from an Ebola-Risk Area

This paper discusses the organisation approach to a mass body repatriation from Nigeria to South Africa during the Ebola outbreak in Nigeria. A complete different approach was followed by flying in refrigeration mass body repatriation trucks and support vehicles by cargo plane to collect the bodies from various locations within the city. These trucks, with the bodies were then driven back into the plane and flown back. During the operation, all precautions for possible Ebola Virus Disease were implemented.

Introduction

A case of Ebola Virus Disease was introduced into Nigeria on 20 July 2014 when an infected Liberian man arrived by aeroplane to Lagos, Africa’s most populous city. The man, who died in hospital 5 days later, set off a chain of transmission that infected a total of 19 people, of whom 7 died(1). Nigeria was only declared Ebola-free on 20 October 2014(2).

On Friday, 12 September 2014 at approximately 12:44 local time (3) a guesthouse, located within the Synagogue Church of All Nations (SCOAN) premises in Lagos, Nigeria collapsed. This resulted in the largest number of South African citizens and 4 persons traveling with South African travel documents were killed in this event(4).

The average age of the deceased was 43, with 36 males and 48 females (84). The deceased could also have been suffering from South African travel documents were South African citizens and 4 persons traveling with South African travel documents were killed in this event(4).

Post mortem examinations were conducted by the Nigerian authorities, with causes of death indicated as shown in Table 1.

<table>
<thead>
<tr>
<th>Causes of Death</th>
<th>Number (n=84)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphyxia</td>
<td>23</td>
</tr>
<tr>
<td>Multiple Injuries</td>
<td>36</td>
</tr>
<tr>
<td>Exsanguinations</td>
<td>14</td>
</tr>
<tr>
<td>Head Injury</td>
<td>4</td>
</tr>
<tr>
<td>Chest Injury</td>
<td>5</td>
</tr>
<tr>
<td>No record available</td>
<td>2</td>
</tr>
</tbody>
</table>

Tab. 1: Causes of Death

Problem Statement

To repatriate up to 115 bodies in non-ideal condition, possibly contaminated with body fluids from Ebola Virus patients, from a highly populated and congested city, with very limited infrastructure and political turmoil back to South Africa, over a distance of 4500 km.

Discussion

Ebola Risk

Believers from all over Africa travel to this SCOAN church, due to the claims and rituals of alleged healing which are widely publicized (3). Numerous allegations and non-substantiated statements were made at the time that the pastor of this church, T.B. Joshua, had claimed to be able to cure Ebola Virus Disease and able to “wash off Ebola” from people exposed to the disease. As the nationality of the non-South African victims were unknown at the time, it was possible that Ebola patients from Sierra Leone, Guinea or Liberia, where the Ebola outbreak occurred or from Nigeria itself, may have taken a pilgrimage to the church. These allegations, which could neither be substantiated nor proven false, was holding the risk that some of the victims killed in the event, may have been suffering from Ebola Virus Disease. As bodies were transported and stored in close proximity with other bodies from the city where an outbreak occurred, the risk was that the decomposing South African bodies were contaminated with body fluid from Ebola Virus Disease patients. The deceased could also have been suffering from other communicable diseases such as extreme-drug resistant Tuberculosis, as many

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desperate patients undertook a pilgrimage to the church for healing. Ebola Virus Disease is caused by a virus from the family Filoviridae. Human-to-human transmission occurs through contact with the body fluid from an infected patient. This transmission is well described, with an incubation period of 21 days (1). However, the duration of the virus’s life cycle in a decomposing body is not well researched, especially in high and humid environmental temperatures and non-ideal storage conditions.

The mortuary infrastructure of Lagos is very limited, with very limited body transport capabilities, limited space in dilapidated mortuary buildings, chaotic travel conditions and an unreliable power grid. This resulted in a challenge to the South African military and civilian health authorities to identify and then repatriate a minimum of 85 decomposing bodies, possibly contaminated with body fluids from Ebola Virus Disease victims, over a distance of nearly 4500 km to South Africa.

Due to the risk involved, the principle decision was taken to manage all bodies as possibly Ebola contaminated and to protect all staff members through high risk bio-safety precautions (5).

Transport Challenges

The number of bodies, condition of the bodies and the bio-safety risk ruled out the use of commercial repatriation and a decision was taken to launch a joint military-civilian operation to repatriate the bodies to South Africa. Although considered, the possibility of cremation was ruled out due to very limited facilities in Lagos and that the practice would not be accepted by the families due to cultural practices in South Africa.

No mass body transport capabilities were available in Lagos. Bodies are normally transported wrapped in a shroud by private undertakers in small sedan vehicles. Limited numbers of these vehicles were available. Limited space was available at the mortuaries to prepare bodies for repatriation while taking the bio-safety procedures into account. Due to the limited transport capabilities, deteriorating conditions of the bodies and bio-safety risks, a decision was taken to deploy a fully self-sustained capability team able to receive, prepare, decontaminate, cool, transport and repatriate the bodies back to South Africa in a respectful manner.

Planned Solution

In order to address the unique challenges, a combined civil-military plan was compiled to repatriate up to 115 bodies to South Africa in a combined transport and repatriation operation (the number was unconfirmed at this stage but minimum 85 South Africans was reported missing, assumed dead, with the possibility that more of the unidentified bodies may have been South Africans or citizens of the neighbouring countries).

A Reconnaissance Team was deployed to Lagos from 7-10 October 2014 to assess all facilities, assess the condition of the bodies and obtain principle approval from the Nigerian Authorities. All facilities were visited and all roads travelled at the proposed times, to determine travel times. It was concluded that the full repatriation process will need to be self-sustained with own capabilities and limited local support capabilities. This reconnaissance resulted in a planned Mass Body Repatriation Operation. Due to transport challenges in Lagos a plan was compiled to deploy mass body repatriation trucks with cooling capabilities by cargo plane to Lagos. Support vehicles, also transported with the cargo plane, would then aid these trucks. Each support vehicle contained air-conditioned inflatable tents, trestles, personal protective equipment (PPE), decontamination equipment and body bags in order to establish a body preparation station at each mortuary. Teams of civilian and military expert personnel would be deployed to each mortuary consisting of a command element, forensic pathology officers; military emergency care personnel trained in decontamination; environmental health officers; psychologists to initiate debriefing of staff; technical personnel and a medico-legal consultant.

A detailed flow-chart, linked to timelines, was compiled for the entire plan and specific report lines were identified. This assisted in planning the inter-relationships with contractors and suppliers to coordinate actions. Bagging channels were planned and the size of the team and number of channels were planned based on the number of bodies at each mortuary facility.

Special authority was obtained through a Note Verbale to the Nigerian Government to drive South African vehicles in the country. All drivers obtained International Driving Permits prior to the deployment. Authority was obtained to import and export vehicles and equipment through the customs authorities. Management of valuables and personal possessions of the deceased were planned for.

Command and Control

A military commander with a civilian co-commander was appointed and approved by all staff contributing institutions. These commanders were given mission command flexibility during the operation. Functional control was executed by each specialist grouping, be it military or civilian, over the specialist function answering to the joint command structure. This command affiliation was described in the pre-deployment formal plan and approved by the Director-General of the Department of Health and the Surgeon General.

A command network utilising the local cellular phone network was planned.

Body Identification

A Body Identification Team consisting of identification experts from the South African Police Service and initially also Forensic Pathology and Forensic Dentistry experts were deployed to Lagos. The team envisaged to obtain fingerprints from the deceased for comparison to South Africa’s national fingerprint data bank, obtain dental records for dental identification where fingerprints failed, and to collect DNA samples. Due to Nigerian authorities’ decisions, this team was only allowed to participate partially in identification processes. The local authorities decided to only utilise DNA identification and to outsource the DNA matching function to a private

Fig. 1: Mass Body Repatriation Truck’s internal outlay
laboratory. (This process delayed the repatriation to a 6-month operation and forced a second wave repatriation operation).

**Execution**

As soon as the Nigerian authorities agreed to the DNA identification of the majority of bodies a Mass Body Repatriation Capability, with staff, was deployed to Lagos. An Antonov 124 was chartered, transporting 4 Mass Body Repatriation Trucks with a combined capacity to transport 85 bodies and 4 Light Delivery Trucks each with an inflatable air-conditioned tent, generators, flood lights, decontamination and hand-washing facilities, protective clothing and body bags. As water and electricity supplies in Lagos are frequently disrupted, generators were taken along. Water tanks were taken along and filled by a pre-arranged contractor on arrival at Lagos airport. As the standard of diesel was questionable, fuel for the trucks and generators was also taken along.

The plane was accompanied by a second Airbus A320 passenger plane with 81 staff members, including:
- Command Element of 13 members including a medicos legal consultant;
- 32 Forensic Pathology Officers;
- 16 Military Emergency Care staff trained in decontamination;
- 8 Environmental Health Officers to enforce and supervise decontamination;
- 2 Military Psychologist to manage continuous debriefing of staff; and
- 2 Technical staff to sustain vehicles and generators.

A Chaplain accompanied the team for religious observance, as well as representatives from the Department of International Relations and Cooperation. A South African Police Service team to manage personal possessions and valuables were deployed in advance.

The team arrived on 14 November 2014 at 01:30 Nigerian time after a flight of 6 hours at the Military Section of Lagos International Airport. Following custom procedures, the team was issued with their PPE equipment. Sizes of PPE were already determined in South Africa during one of the briefing sessions, which made it easy to distribute PPE correctly in terms of size. Snack packs and bottled water were also issued before departure to the mortuary facilities. The team divided into three teams each consisting of mass body repatriation trucks and a support vehicle. Staff transport was arranged by the South African Consulate in Lagos. Each convoy was escorted by a military security element from the Nigerian Defence Force, coordinated by the South African Military Attaché. It took 2 hours to offload vehicles and equipment, which included refuelling of the vehicles with diesel and distribution of PPE and equipment. The internal 50 litre water tanks of the disaster vehicles were also filled by the contractor for use at the mortuary facilities. The convoys departed from the airport at 04:20 Nigerian time and arrived at the mortuaries at 05:34. Each of the three teams’ disaster vehicle drivers received a personal satellite-tracking device through which the movements and locations of the teams could be monitored from within Nigeria and South Africa by command structures. To the benefit of the repatriation team, the 7 bodies at Ikeja mortuary were transferred the day before to Yaba mortuary and the team members allocated to Ikeja mortuary could be moved to Yaba where the majority of bodies (63) were located to increase the manpower and capacity.

According to the flow-chart plan, reporting took place at specific pre-determined reporting timelines to ensure coordination. At each mortuary a Preparation Station was set up and these tents were cooled down with mobile air-condition units and generators to an average temperature of 22°C. The tents had an entrance that was positioned in proximity to the exit of the mortuary and an exit where the mass body repatriation truck was positioned. The trucks were pre-cooled en route to the mortuaries and maintained an average temperature of 10°C for the full day. After all of the bodies were successfully transferred to the truck and the load box doors closed, the temperatures dropped to 2.5°C.

All Preparation Stations were set up in a three-area designated concept(5):
- Green rest area for staff;
- Yellow decontamination area; and
- Red high risk area where the bodies were managed.

Although by the time the repatriation was completed (63 days after the incident), the risk for Ebola and other communicable diseases had ceased due to the time-lapse since death, the condition of the bodies remained an area for concern. Therefore, the decision was taken to maintain the planned approach of full protection against Ebola to test the system and to protect staff against all possible risks. All staff therefore wore full protective

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**Fig. 2: Forensic Pathology Mass Body Transport Trucks and support vehicles positioned in Cargo Aircraft**

**Fig. 3: Body Preparation Station at one of the Mortuaries**
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With our breadth of expertise and our collective wisdom and experience, Takeda will always be committed to improving the future of healthcare.
equipment (PPE) which was donned and doffed under direct supervision from the Environmental Health Officer:

- All staff changed from standard uniform to theatre scrubs and waterproofed boots. This attire was worn throughout in the green area.

- When entering the yellow area, staff donned a second layer of protective equipment consisting of a water repellent (but breathable) paper cover-all with cap, a N-95 respirator mask and first pair of cuffed gloves, with cuffs worn under the sleeves of the coverall.

- Before entering the red area they donned a third layer of protective clothing consisting of a water repellent long sleeve gown, second pair of gloves and a full face visor. When advanced decomposing bodies were transferred, red aprons were used which were ripped-off immediately and replaced when contaminated.

Goggles were found not suitable due to high humidity and ambient temperature in Lagos. Gas masks with filters were taken along for offensive odours from decomposed bodies, but staff preferred not to wear it due to heat and humidity.

At each mortuary, the identified bodies were pointed out to the team by the Nigerian staff and identification detail was confirmed by the SA Police Service. Identification tags were attached to each body. Traumatic amputated body parts were placed with the body in the same bag and identified.

The body was then manually moved in a mortuary tray to the tented body preparation station. The body was manually transferred to a prepared mortuary tray with a pre-positioned body bag (all bodies were naked due to post mortem investigations conducted by the Nigerian authorities). Bodies were then:-

- Bagged in a transparent body bag and sealed.
- This bag was decontaminated by spraying the bag with a chlorine solution (4000 ppm) and then wiping it down all around.

- The bag was then placed in a second white bag and 15 ml formaldehyde solution was squirted between the layers of bags. This second bag was then also sealed. The vaporising formaldehyde created a formaldehyde gas-layer between the bags.

- The sealed second bag was similarly decontaminated using a chlorine solution and placed inside a third opaque metal lined body bag.

- Formaldehyde was again squirted between the layers and the outer bag sealed.

- The outer bag was decontaminated again using a chlorine solution.

- The outer body bag was then identified, using a waterproof tag. This identification was double-checked. A colour code system was used for all identification tags (bodies and body bags) to indicate Provincial destinations within South Africa.

On completion of this preparation process the bagged body was placed in a Stokes basket stretcher and moved to the pre-cooled mass-body repatriation truck. These basket stretchers fitted into numbered racks in the truck. To assist with recordkeeping, the names and body numbers of bodies were also recorded on the white board within each truck. On average it took 15 minutes to prepare a body for repatriation.

Anecdotal, it was confirmed that no unpleasant odours from the decomposed bodies were detected after the triple sealing process. Protection from formaldehyde vapours was achieved by utilising N-95 respirator masks and airflow in the tents from the air conditioners.

Staff rotated every 40-60 minutes. Due to PPE and ambient temperature staff was forced to rotate within 60 minutes from donning red area protective clothing.

Staff decontaminated at each rotation through a structured supervised process; removing the first layer of PPE at the exit of the red-area and washing their hands over inner gloves, walking through a foot-bath to the yellow area where they removed the second layer of PPE and decontaminated hands again. They then remained in the green area for 80-120 minutes where they were instructed and supervised to re-hydrate before dressing up to enter the red area again(5). A psychologist was positioned in the green area throughout to debrief staff informally and establish rapport with staff for formal debriefing at a later stage. Although clinical temperature monitoring equipment was taken along to monitor staff’s body temperature, it was not utilised due to the effective cooling of the tents by the air-conditioners.

Snack packs with cool drinks and water were issued to all staff on arrival in Nigeria and meals were delivered at the Green Area by the South African Consulate.

Only 74 bodies were released by the Nigerian authorities, due to their insistence on DNS identification as the sole identification method. On completion of the preparation and loading process, all teams and equipment were decontaminated. All support vehicles were
The standard 5-step military debriefing was planned for staff exposed to the decomposed bodies. Although showering in Lagos for all staff prior to the return flight was planned, it could not take place due to a water supply failure at the air force base. A full meal was served to all staff members on arrival in South Africa and all personnel participated in the memorial service. Personnel then attended formal debriefing sessions. Although the bodies were seriously decomposed and the conditions were unpleasant, no acute post-traumatic stress reactions have been reported to date.

Feedback from staff indicated that they felt safe and protected within the three-area system with three layers of PPE and the controlled decontamination. In the initial Ebola risk planning a decision was taken not to allow the opening of the inner transparent bags and not to allow night vigils with the bodies. A procedure was complied to only open the outer opaque bag in a controlled environment and allow viewing through the transparent inner bags if families insist. A directive to this regard was issued by the Director General of Health to undertakers collecting bodies for burial. Due to the time delay, the Ebola risk however ceased, but families were still discouraged to view the remains due to the appearance and subsequent emotional trauma. Only one family insisted to opening the bags.

**Lessons Learned and Conclusions**

A mass body repatriation of high-risk bodies over a long distance is a complex operation requiring detailed planning. A detailed task flow chart coupled with estimated times assist in ensuring a seamless operation. Self-sufficiency (down to micro-level) remains a critical requirement to ensure execution. The use of mobile mass body repatriation trucks in a cargo plane is a possible solution, even if no cooling can take place in flight, but on condition that trucks are kept closed and is appropriately isolated, for a period of up to 12 hours.

A three-layer bag system used in a three-area preparation area (green, yellow and red) with three layers of protected clothing is suitable for a high bio-safety risk operation.

The principles used in high security bio-safety isolation can be applied in the handling of high-risk mortal remains. Cooling areas are essential for non-acclimated personnel who are suddenly expected to execute manual labour in high ambient temperature areas. Enforcing re-hydration is a critical precaution.

Civil-military cooperation is possible in complex operations through proper planning, role-identification and appropriate command and control.

Post-traumatic stress can be prevented/limited by using a planned debriefing process which should include and integrate psychologists with the team and then cleaning, rest and feeding, ceremonial honours and then debriefing. Informal psychologist interaction throughout the operation enhances rapport between staff and psychologist. Cremation is not a generally cultural acceptable procedure, but triple sealed bodies can be viewed within restrictions to address cultural practices.

**References:** ref@mci-forum.com

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The article discusses the use of military aircraft for a mass casualty aero-medical evacuation of civilian casualties over a long distance. Structured approaches of a pre-determined team with pre-planned equipment are explained. The positioning of patients in the plane is planned according to a loading plan with specific triage priorities placed at specific levels. The lessons learned during the evacuation of 25 civilian patients after the Nigerian building collapse over a distance of 4500 km back to South Africa are highlighted.

Introduction
During September 2014 at least four organised groups totalling more than 100 people, travelled from South Africa to attend services at the Synagogue Church of All Nations (SCOAN) under the charismatic leadership of its pastor, T.B. Joshua, in Lagos, Nigeria. On Friday, 12 September 2014 at approximately 12:44 local time (1) a guesthouse on its Pastor, T.B. Joshua, in Lagos, Nigeria. On Friday, 12 September 2014 at approximately 12:44 local time (1) a guesthouse on its Pastor, T.B. Joshua, in Lagos, Nigeria. On Friday, 12 September 2014 at approximately 12:44 local time (1) a guesthouse on its Pastor, T.B. Joshua, in Lagos, Nigeria. On Friday, 12 September 2014 at approximately 12:44 local time (1) a guesthouse was formed of the National Department of the army, in Nigeria. As more information became available, the South African Government by 16 September, appointed an Inter-Ministerial Committee to manage the event under the chairpersonship of the Ministry in the Presidency and activated its joint planning structure. This structure consisting of all applicable government departments, the South African National Defence Force and the South African Police Service, is a well-established coordinating capability and was tasked to manage the response. Within this coordinating structure, a Health Cluster was formed of the National Department of Health and the Military Health Service.

Response
This Health Cluster adopted the classic command algorithm of CSCATT approach (5) (6) to address the medical needs of the situation, namely:
- C: Command.
- S: Safety.
- A: Communication.
- T: Triage.
- T: Treatment.
- T: Transport.

Command
A joint co-command was established, consisting of military and civilian personnel, working together as a team. This included a command element from the South African Military Health Service and a co-commander from the National Department of Health. This grouping immediately started compiling a mass evacuation plan for possibly transporting a large grouping of casualties back to South Africa.

Safety
Both the intelligence community and the Police Service assessed the safety of victims as well as possible relief teams, in view of the political and security turmoil in Nigeria. This included an assessment of the possibility of terror threats from the Boko Haram group in Nigeria. It was concluded that the situation in the Lagos region is stable and that a relief operation could be launched. Simultaneously, the health cluster assessed the health risks for such an operation. A case of Ebola virus disease was introduced into Nigeria on 20 July 2014 when an infected Liberian man arrived by air from Liberia into Lagos. The man, who died in hospital 5 days later, set off a chain of transmission which infected a total of 19 people, of whom 7 died (7). Nigeria was only declared Ebola-free on 20 October 2014 (8).

Numerous allegations and unsubstantiated statements were made at the time that pastor Joshua had claimed to be able to cure Ebola and was able to “wash off...
Ebola” from people exposed to the disease. As the grouping in the building at the time of the collapse were unknown, it was possible that Ebola patients from Sierra Leone, Guinea or Liberia, where the Ebola outbreak occurred or from Nigeria itself, may have taken a pilgrimage to the church for healing. As the outbreak in Lagos was also not yet under control, the risk was that casualties may also have been exposed to Ebola in the hospitals in Lagos after the event. These allegations, which could be neither substantiated nor proven false, held the risk that some of the casualties may have been exposed to Ebola Virus Disease.

As many patients with other serious health conditions were on a pilgrimage to the church to seek healing, the risk for other communicable diseases such as extreme drug resistant tuberculosis, needed to be considered. As no information was available on the health conditions of the South Africans who travelled to the church, or the infection control measures in the hospitals they were admitted to, communicable diseases were identified as a serious health safety risk and the need for precautionary measures planning was identified.

Communication
To enable proper planning; communication was established with frequent combined planning meetings. These meetings included a health cluster meeting, followed by a meeting of the joint planning structure with role-players from all the government departments and agencies involved. The first planning meeting took place on 16 September 2014 at 15:00. In the initial stages of the response these meetings occurred three times per day. 14 meetings were held over a period of 10 days prior to the operation.

The South African Consul General in Lagos was activated and a communication link between the Consulate and the joint planning group was established. After the assessment team arrived in Lagos, an Operational Room was established in a hotel in Lagos with telephone communication lines back to South Africa.

Within South Africa, a communication centre with a 24-hour telephone line was established at the Department of International Affairs and Cooperation (DIRCO) where family members could enquire about their next-of-kin. This was later expanded to a social service response line.

Assessment
As information was very limited on the number and condition of casualties it was decided to deploy an assessment team to Lagos to join-up with the South African High Commissioner’s staff, in order to execute an accurate evaluation of the impact of the event. It was clear from the onset that the medical condition of the injured will need to be assessed specifically to determine possible requirements and to determine the need for evacuation of the injured back to South Africa.

On Thursday, 18 September 2014, Prof Lee Wallis, Head of Emergency Medicine at the Universities of Cape Town and Stellenbosch, was deployed by commercial airline to Lagos to assess the medical condition of the injured and to advise on evacuation. He arrived in Lagos on Friday 19 September 2014 and joined-up with the rest of the assessment team consisting of various government departments and the SA Police Service.

As it was unclear at that stage how many South Africans were injured or where they were treated, he had to work systematically through all applicable hospitals in Lagos tracing possible South African patients. By Saturday morning 20 September 2014, Prof Wallis gave the feedback that he had identified 26 South African patients from the incident in 5 hospitals.

Additionally one uninjured orphaned child would need to be evacuated along with an injured sibling and a spouse who needs to travel with a patient. It was clear from the assessment that the patients were seriously injured, some with serious co-morbid health problems, which required urgent medical interventions. The best-practice interventions required were not necessarily readily available within Nigeria. Based on the feedback from the assessment team, the South African Government opted to evacuate the injured back to South Africa through a mass aero-medical evacuation. Various options were appreciated and the most feasible option was identified to utilise a rigged C-130 aircraft from the South African Air Force and staffed with a Mass-Casualty Aero-Medical Evacuation Team from the South African Military Health Service (SAMHS).

Triage
The assessment team assessed each patient clinically and a triage priority was allocated utilizing the military Priority 1, 2 and 3 approach. This information was captured in a database and each patient allocated a patient number. This database with basic clinical information was sent back to South Africa where the Health Cluster received the first accurate data on 20 September 2014 at 00:34h–8 days after the incident. These patients were listed and evaluated as:

- Priority 1: 6
- Priority 2: 16
- Priorit 3: 4

Based on the triage categories and clinical information a mass casualty aero-medical evacuation team was then placed on a six hour stand-by, whilst the planning for over-flight clearances for a military aeroplane over at least three countries, was conducted by the South African Air Force and DIRCO.

The assessment team also evaluated each patient for the possibility of exposure to Ebola Virus Disease as well as co-morbid conditions, which may influence air-evacuation. The assessment team warned that Ebola precaution measures were only in place in one of the hospitals visited. Although all patients were within the 21-day incubation period for Ebola, since their arrival in Nigeria, none of them had any increased temperature. This risk was continuously assessed by a specialist advisory team from the National Centre for Communicable Diseases (NICD) in South Africa. As none of the patients met the case definition for Ebola, the decision was taken to only take adequate personal protective equipment along, but not to transport any patient in an isolator (three negative pressure transport isolators were brought into readiness as a contingency). The co-morbid communicable diseases were also assessed and the assessment team found that none of the patients had a known high-risk communicable disease. The triage assessment was therefore limited only to clinical injuries and co-morbid non-communicable diseases.

Treatment
In preparation for the aero-medical evacuation, limited treatment was initiated in Lagos by the assessment team. This was limited to treatment advice to the local clinicians, as the assessment team was not registered for practice in the country. This situation necessitated the aero-medical evacuation team to prepare to initiate treatment at the airport prior to evacuation.

Due to the nature of the injuries, especially the serious orthopaedic injuries, a military orthopaedic surgeon was included in the team to initiate treatment. Additionally the hospitalisation needs were assessed and communicated to South Africa in order to enable the receiving hospital to adequately prepare.

The Aero-Medical team was informed of the need to establish a temporary Resuscitation Post at the airport in Lagos to stabilise patients for evacuation.

Transport
An evacuation plan was compiled and the team was briefed on the plan.

Doctrinal Approach
A mass casualty aero-medical evacuation was planned according to the military health service doctrine (9). Theoretically, a Hercules C-130 can carry 72 stretchers but in this full-configuration, extremely limited movement space is available with limited seating for
<table>
<thead>
<tr>
<th>Case No</th>
<th>Gender</th>
<th>Primary Injury</th>
<th>Comments</th>
<th>Other Concerns</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>Left Below Knee Amputation</td>
<td>Healthy wound; mobilising slowly</td>
<td>None</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>Left Above Knee Amputation</td>
<td>IV antibiotics; ready to mobilise</td>
<td>Left arm soft tissue injury</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>Right Below Knee Amputation</td>
<td>IV antibiotics; ready to mobilise</td>
<td>Urine catheter</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>Right pneumothorax; ICD in situ</td>
<td>IV antibiotics</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>Right upper arm wound</td>
<td>Infected wound; IV antibiotics</td>
<td>Non-Insulin Diabetes</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>Le Fort III fracture</td>
<td>Moderate facial swelling; taking oral fluids; mouth laceration sutured; ready for surgery; IV antibiotics</td>
<td>3 units blood transfused; HCT 33%</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>Pelvic injury – no fracture</td>
<td>Ready for discharge</td>
<td>Soft tissues injuries</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>Left orbital blow out fracture</td>
<td>IV antibiotics</td>
<td>Left hand injury – soft tissue</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>Right pelvic injury (? Fracture?)</td>
<td>Hematemesis Thursday two episodes; rib fractures suspected but no pneumothorax; IV antibiotics</td>
<td>Right knee ligament injury for PoP backslab; catheterised</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>Right bi-malleolar ankle fracture with taler shift</td>
<td>Below knee PoP backslab; apparently minor abrasion over fracture; IV antibiotics</td>
<td>Hypertensive on medication</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>Crush injury</td>
<td>Acute kidney injury on haemodialysis; needs dialysis Sunday morning</td>
<td>Spinal injury neurological fall out both legs; catheterised; right shoulder fracture</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>F</td>
<td>Soft tissue injuries both legs</td>
<td>IV antibiotics; Enoxaparin</td>
<td>Hypertensive on medication</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>F</td>
<td>Soft tissue injuries</td>
<td>Recovered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>F</td>
<td>Chest wall injury</td>
<td>Rod through right breast exit right back; IV antibiotics; infected wounds</td>
<td>Insulin dependent; Hypertensive on medication</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
<td>Right bi-malleolar ankle fracture</td>
<td>Below knee PoP backslab; needs surgery</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>F</td>
<td>Left arm injury</td>
<td>Elevation for swelling</td>
<td>Parotia laceration – missed injury; closing by secondary intention; honey dressing</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>F</td>
<td>Back injury no fracture or neurology</td>
<td>Ready for mobilisation</td>
<td>Non-Insulin Diabetes</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>F</td>
<td>Fracture right tibia</td>
<td>Above knee PoP backslab; IV antibiotics; Enoxaparin</td>
<td>Deteriorated later in day; confused; febrile</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>F</td>
<td>Leg and back pain</td>
<td>No fractures or neurology; mobilising</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>F</td>
<td>Back pain</td>
<td>No fractures or neurology; bed rest; catheterised; Enoxaparin</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>21</td>
<td>F</td>
<td>Back pain</td>
<td>No fractures or neurology; bed rest; Enoxaparin</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>22</td>
<td>F</td>
<td>Left medical malleolus fracture</td>
<td>Below knee PoP backslab; Enoxaparin; being mobilised</td>
<td>Pelvic pain no fracture</td>
<td>2</td>
</tr>
<tr>
<td>23</td>
<td>F</td>
<td>Leg and back pain</td>
<td>No fractures or neurology; bed rest; Enoxaparin</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>24</td>
<td>F</td>
<td>Right scaphoid fracture</td>
<td>PoP front slab; may convert to split full PoP; IV antibiotics for hand wounds</td>
<td>Hypertensive on medication</td>
<td>2</td>
</tr>
<tr>
<td>25</td>
<td>F</td>
<td>Left arm and both legs injury</td>
<td>Soft tissues; lacerations</td>
<td>Hypertensive on medication</td>
<td>3</td>
</tr>
<tr>
<td>26</td>
<td>M</td>
<td>Gangrene left 4 toes</td>
<td>Spreading infection; dry dressings; IV antibiotics; needs amputation</td>
<td>Multiple abrasions and bruises</td>
<td>1</td>
</tr>
</tbody>
</table>

* Priority for aero-medical evacuation

Tab. 1: Patient List
To be MISSION READY
Through KARL STORZ S.E.T.I.
crew and little space for equipment. Due to these limitations, the SAMHS utilises only the central rigging of stretchers and not the stretcher positions on the outer sides of the plane. This space is reserved for team members and equipment. The aft stretcher rigging positions are also not used to allow space for high-care platforms.

According to the SAMHS doctrine the rigged C-130 is divided in port and starboard sides. Each side is structured in columns identified by alphabetical letters from the front and then rows identified by numerical numbers from top to bottom. Staff is allocated according to this layout with:
- an emergency care practitioner per row of maximum five stretchers,
- a nursing officer is then allocated for every two rows; and
- a medical officer per side of the plane.

A Priority 1+ area is established in the back of the plane with up-to four high care platforms. Each high-care platform is allocated a nursing officer and a medical officer is allocated per two high-care platforms.

Each side of the plane is also staffed with a warrant officer who co-ordinates and controls loading and off-loading as well as a technical officer who maintains oxygen supply and electronic equipment.

An overall Military Health commander is appointed for the plane with a warrant officer to support him/her. The commander is specifically not a clinician to ensure that command and control is maintained without being side-tracked by clinical needs of patients in evacuation. In total, a Mass Casualty Aero-Medical Evacuation Team consists of 23 members (9).

This team is supported by a minimum of two loadmasters from the Air Force. This doctrine was practiced and tested by the SAMHS 2 months prior to the event, which enabled the team to apply the doctrine, and the lessons learned during this operation.

Aero-Medical Evacuation Team

Although the triage assessment only indicated 26 patients for evacuation, the risk existed that more patients may be found in the chaos following the incident or that neighbouring countries may have found some of their citizens and requests South Africa to evacuate these citizens back to Southern Africa as well. For this reason the decision was made to prepare the plane for the full load of 40 stretchers in the rigging and 2 high-care platforms.

The team was therefore constituted to address the full planeload of patients and not necessarily only the patients on the triage list. The Mass Casualty Aero Medical Evacuation Team mobilised for this operation was adapted to reflect the expected patient’s profile. Only one technical officer was available. The team for this operation consisted of:
- Commander
- 5 X Medical Officers (Incl. Orthopaedic Surgeon)
- 6 X Nursing officers
- 8 X Emergency Care Practitioners
- 1 X Technical Support Officers
- 2 X Warrant Officers

Initially a Paediatrician was also included but after reviewing the information of the injured child it was found not necessary. The team reported to the Air Force base on 21 September 2014 at 02:00 to be ready for deployment. The plane took-off at 03:56B— 9 days after the event.

Food parcels were provided for the team for three meals in flight and adequate drinking water was made available.

Equipment

The doctrinal approach for equipment was adhered to (9). In this approach standard resuscitation equipment, monitors, suction and oxygen are packed per column of five stretchers. Additional support equipment to replenish this first line of equipment is added per side of the plane. These include mass infusion packs with additional fluid as well as drugs.

Each high-care platform carries its own oxygen, suction and resuscitation equipment. Four high-care platforms were available, but based on the assessment teams’ findings only two were loaded.

A central emergency blood bank with fresh frozen plasma and packed cells in portable refrigerators was taken along. No platelets were taken along due to a logistical challenge.

Comfort equipment such as bedpans, urinal bags and a chemical toilet was also packed per side of the plane. Due to the nature of the injuries, six scoop stretchers were included to transfer patients from ambulance stretchers to the aeroplane stretchers and four vacuum mattresses were taken for spinal injuries.

Standard NATO-design canvas stretchers were used throughout the plane for all the columns. These stretchers were equipped with a linen pack with pillow, sheets and a blanket. An aluminium space blanket was used underneath the patient for isolation and additional blankets were available to keep patients warm. (The patient compartment of the C-130 plane’s temperature can be adjusted to ensure patient and staff comfort. This system however often overheats the forward part of the cabin, to ensure a comfortable temperature in the aft.) It was decided that due for the duration of the flight, all patients and the uninjured child will be transported as stretcher cases, as adequate space was available.

Two small orphaned children, aged 2 and 6 were amongst the patients. A donation of a teddy bear and a gift pack per child was received from a private hospital group prior to the flight and taken along. A nursing officer was appointed to take care of these children in-flight.
To adhere to custom regulations, all equipment had to be declared to the custom authorities prior to the operation. This was a very time consuming process.

**Road Transport Plan and Pre-Flight Treatment in Lagos**

The Assessment Team compiled a meticulous transport plan to transport all the patients from the 5 hospitals to the airport, based on clinical condition. All hospitals were within an 8 km radius from the airport. Each patient was allocated a number and these numbers were attached by identification bracelet to the patient. The very limited number of six ambulances (3 from the church, 2 private and one hospital ambulance) and one minibus were planned optimally to move the less serious patients to the aircraft first and then return to transport the more serious patients last. The purpose of this plan was to limit the out-of-hospital time of the critical patients to the minimum.

On confirmation of the landing time of the plane in Lagos this plan was activated. One patient decided not to return on the flight and to return to the church, resulting in 25 patients and 2 uninjured passengers evacuated.

The C-130 landed on 21 September 2015 at 14:43B on the military apron of the Lagos International Airport. An aircraft hangar space was made available to the team by the Nigerian Air Force to establish a re-triage and resuscitation post. On arrival the team commenced with the final rigging of the plane and preparing all stretchers for receiving patients. All equipment was moved to in-flight positions and checked. The resuscitation area was prepared to receive patients. Within 2 hours after landing, the patients started arriving. Patients were transferred from the ambulances to the pre-determined triage and resuscitation area. Prof Wallis re-triaged the patients and briefed the clinicians on the patient’s condition.

In the triage area, the patients were assessed for:
- Severity of injuries.
- Type of transport support required such as vacuum mattresses or standard stretchers.
- Requirements for pre-flight treatment.

During the assessment patients who had spinal injuries were placed on vacuum mattresses to assist with in-flight stabilisation, comfort and safety during loading; four (4) patients were immobilised on vacuum mattresses.

Numerous patients also required anti-emetics and analgesics pre-flight. Where applicable intravenous lines were established and the administration of blood products commenced. All chest drains were connected to one-way valves for the flight.

Two seriously ill patients required special pre-flight treatment. The first patient had an iron rod piercing her thorax with an accompanying haemo-pneumothorax. She had no intercostal drain in situ and this had to be inserted before flight in the back of an ambulance by torch light.

The second severely ill and unstable patient had a Glasgow Coma Score of 6/15 (E1V1M4) and required endotracheal intubation. The patient had a pre-morbid mass lesion in the pharynx and thus presented with an extremely difficult airway to manage. This patient was intubated and placed on a high-care platform, which allowed intensive care quality monitoring and support.

The patient with the Le Forte III fracture was placed on the second high-care platform as this allowed the patient to be positioned in Fowlers position during the flight.

All patients were re-assessed for increased temperature as result of the Ebola risk, but no patient had any signs.

The warrant officers commenced with compiling the loading plan for the plane, utilising patient numbers against stretcher positions. A system of colour-coded rows per column of stretchers was utilised.

**Loading Plan**

The most critical (often ventilated patients) are identified as Priority 1+ to be loaded on the high-care platforms. Two of these platforms were available and patients were identified for these positions.

Each column of patients are then planned, with planning the priority 1 patient at eye level for a sitting attendant, a priority 2 patient below and the priority 3 patients above. This allowed easy access to the priority 1 and 2 patient in flight, while the priority 3 patients who required less care in flight were in the less-assessable positions. Due to the limited number of patients (no additional patients were identified), only four stretchers per column were used for this flight.

The Warrant Officers were guided by the clinicians, compiling a loading plan by allocating specific patient numbers to each stretcher position. As soon as the complete loading plan was available, loading started per side of the plane, from the front to the back. The team, supported by the Nigerian Air Force staff, were grouped into stretcher parties and the stretchers carried on-board. (Attempts in the past to use wheeled base stretcher-carriers have proven not effective and manual stretcher parties remain the most effective method for loading). The Warrant Officer and a loadmaster checked and had to confirm that each stretcher was properly secured.

Due to limited space within a fully rigged C-130 our experience is that it is very difficult to manoeuvre stretchers past already loaded
stretcher is fully loaded before the next column is started. The high-care platforms are moved into position lastly and the critical patients brought onboard last. Loading a mass casualty evacuation aircraft is a labour intensive operation, which requires muscle strength from all members to carry and lift stretchers into position. Due to bureaucratic challenges within Nigeria the assessment team advised the plane to take-off as soon as possible, putting severe strain on the crew-duty time of the air crew. The average time to load a C-130 during exercises was 130 minutes (5, 7 min per patient/side). In Nigeria due to the condition of the patients and the need for stabilisation intervention, this process took 245 minutes (19, 6 minutes per patient/side).

By 22:30B all patients were loaded, the high-care platforms positioned and the two critical patients loaded. On 22 September at 00:05B the plane departed from Lagos International Airport.

In-Flight Care
The in-flight evacuation was fairly uneventful due to pre-flight intervention. One patient was ventilated in-flight utilising a transport volume-cycled ventilator with a FiO2 of 100% and a PEEP of 5-10 to maintain saturation. Saturation was effectively achieved throughout the flight. The other patients maintained saturation > 90% on cabin air and did not require any additional oxygen administration. Oxygen was however available at every column of stretchers.

It was possible to mount intravenous infusions to the stretcher position above utilising basic S-hooks. Very limited turbulence was experienced in-flight and no challenges were experienced with this mounting method. A fuel stop was done at Kinshasa Airport taking 45 minutes, allowing staff to do a full reassessment round of all patients. The fuel stop also allowed staff to use restroom facilities.

Except for basic contact precautions protective equipment, no special personal protective equipment was used during the evacuation.

Each child received a soft toy to comfort them in-flight and a specific nursing officer cared for the children in flight.

Lighting in the passenger compartment of the plane is limited and headlights were used by all staff members.

Clinical observations were measured and recorded throughout the flight. Due to the time spent preparing patients followed by the 10-hour in-flight care, the clinical team was exhausted. A rotation system with 2-hour shifts was implemented to allow the staff a rest break. This assisted with ensuring quality patient care.

No patient passed-away or seriously deteriorated during evacuation.

Arrival and Off-Loading Plan
An off-loading plan was compiled for arrival at the Air Force Base in South Africa. A Receiving Commander was appointed and a group of 30 stretcher-bearers was mobilised to be in position on arrival at the Air Force Base.

Thirty civilian and military ambulances were mobilised to be in position on landing. Ambulances were grouped based on available staff and equipment into Priority 1 ambulances and priority 2 and 3 ambulances. Each ambulance carried its own crew, which was independent of the stretcher-bearer parties. This allowed for off-loading to continue without delaying ambulance evacuation.

The plane landed on 22 September at 10:43 in Pretoria. On arrival of the plane, Port Heath procedures for mosquitoes and custom procedures were adhered to. Due to another activity, a secondary air force base in Pretoria had to be used. This base had to be officially declared a temporary Port of Entry for custom procedures. All equipment had to be re-checked by customs authorities and all foodstuffs left over, had to be collected as it may not be brought back into the country. A massive media presence was experienced and a specific media area was earmarked in advance.

The off-loading plan was then activated. A road-cone corridor was marked out around the plane and pickets positioned to prevent any ambulance from coming too close to the plane and to ensure a one-way circle route from parking to exit. (Antennas from ambulances had damaged planes in the past during loading and off-loading of patients).

In coordination with the Aero-Medical Team commander, the Receiving Commander called ambulances forward, based on the re- triage priority of the patients. The high-care platform’s patients were off-loaded first and dispatched to the receiving hospital. This was followed by a structured off-loading process simultaneously on both sides of the plane. Ambulances were called forward, the patient off-loaded by the bearers and the in-flight staff handed the care and clinical notes over to the ambulance crew. As far as possible, only one patient, with their personal luggage, was loaded per ambulance. As the ambulances were loaded, they formed up in a convoy and were escorted by traffic police to the receiving hospital.

The orthopaedic surgeon was transported to the receiving hospital immediately after arrival to brief clinical staff on the condition of the patients. Special arrangements were made for the orphaned children on arrival. A specific team accompanied them to the hospital where a social worker was waiting to receive them.

A separate fatigue team with a truck was provided to offload all the equipment, while a team was also pre-positioned at the receiving hospital to collect all stretchers and equipment as patients were off loaded onto hospital gurneys.

A large group of government dignitaries were accommodated to welcome the patients back to South Africa. These dignitaries were only allowed access to the plane by the Receiving Commander after the critical patients were off-loaded and dispatched to the hospital. A massive amount of personal luggage of the patients was delivered by the Nigerian authorities to the airport. This provided a serious challenge with space, but it was loaded on
the loading ramp of the plane and therefore had to be off-loaded first on arrival before any patient could be off-loaded.

Hospitalisation Plan

Due to the high publicity of the event, as well as condition of the patients, a decision was taken to transfer and admit all patients initially to the Steve Biko Academic Hospital in Pretoria, 12 km from the Air Force Base. This decision allowed for easy record keeping, full re-assessment of all patients, availability of high-technology capabilities for critical patients, proper debriefing of all victims and a coordinated reception by government at a single facility. The management and clinical staff of the hospital were briefed prior to the operation, to ensure the hospital was ready to receive patients.

A re-uniting process with social work support for next-of-kin was planned at the receiving hospital. No next-of-kin were allowed at the air force base and all re-uniting occurred in controlled circumstances out of public view, at the receiving hospital.

Within 120 minutes after landing of the plane all patients were admitted to the receiving hospital.

From take-off to admission to hospital, the entire operation was executed in 12 hours.

Lessons Learnt

Pre-planning a mass casualty aero-medical evacuation and practicing the process, with pre-packed equipment, is of critical importance for the successful execution of such an operation. The sub-division of the plane into zones with staff and equipment allocated per zone not only enhances control but ensures that patient care is structured during flight. The team must be drilled in the procedure and be in possession of the required travel documents and vaccination records.

Proper triage and assessment (if possible prior to dispatching the team) is essential to ensure that optimum care and equipment is available on-board the flight. In a large mass casualty evacuation, an assessment team must be dispatched in advance to evaluate, triage and prepare patients for evacuation.

Stabilisation prior to evacuation remains the integral part of a mass casualty evacuation. The availability of soft toys, such as a teddy bear, comforts them in flight. Special precautions need to be taken with orphaned children to ensure proper management and care.

An information system for next of kin with a re-uniting plan with social work support is an integral part of a mass casualty evacuation plan.

Conclusion

Military medical air transport assets and teams can be utilised effectively in civilian mass casualty incidents, to evacuate large numbers of patients, over long distances, on condition proper assessment and planning is done. The CSCATTT concepts itself serves as a guide to plan such an operation.

Mass Casualty evacuation is a time consuming operation. This is not a hot-extraction capability, as it required a secured airhead with time and human resources to assemble, prepare and load patients in a structured approach.

References: ref@mci-forum.com

AUTHORS

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Assignments: 1982–1996 Head of Disaster and Emergency Planning, Universitas Hospital, Bloemfontein, South Africa and Chief Training Officer, Ambulance Service; 1996–2000 Head of Patient Care, 3 Military Hospital, SAMHS; 2000–2009 Officer Commanding, School for Military Health Training, SAMHS; 2009–2012 Senior Staff Officer, Strategic Planning, SAMHS; 2012–2015 Senior Staff Officer, Force Readiness and Military Health Operations, SAMHS

Missions: Several missions and operations in the region including: 1994 Medical Commander, Merriespruit Mudslide Disaster; 2003 Medical Commander, Earthquake Response Force, Boumerdès, Algeria; 2013 Medical Coordinator, Bangui evacuations and repatriations; 2013 Commander, Field Hospital, Funeral of Mr Nelson Mandela; 2014 Medical Coordinator, Nigeria Building Collapse; 2014 Coordinator SAMHS Ebola Virus Disease Planning and member Ministerial Advisory Committee on Ebola

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Lt Col S. Martin, Wing Commander in the South African Military Health Service and the Mass Casualty Evacuation Team Commander for the Operation

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Military Medical Support in the Humanitarian Arena (MMSHA)

NATO-Accredited Training for Civilian Healthcare Providers and Military Medical Personnel

The German Führungsakademie der Bundeswehr offers a course that addresses military medical support in the humanitarian arena in the form of a NATO-accredited training measure for civilian healthcare providers and military medical personnel. The course familiarizes the participants with the principles of medical support at the civil-military interface, offers a platform for discussion and allows for a practical application of skills and knowledge during a tabletop exercise. It provides an excellent opportunity to gain an enhanced understanding of the interface between the military and civilian sphere and serves as a forum for mutual exchange.

Course Overview

As military forces face increasingly complex scenarios requiring crisis management on the sector of medical care that involves both civilian and military instruments, it is necessary to define their interaction at the civil-military interface by means of sound policy and doctrine. In addition to that, challenges also need to be addressed by appropriate education and training efforts. Whereas the doctrinal foundation was laid by Allied Joint Medical Publication 6 (AJMedP-6), the MMSHA course covers important aspects of humanitarian assistance in complex emergencies. Since 2007, the MMSHA course at the Führungsakademie der Bundeswehr in Hamburg has evolved from a binaurally planned and conducted German/Dutch program to a NATO-accredited module. The current format of the course was developed in close cooperation with NATO’s Military Medical Centre of Excellence and in November 2014, the course was granted NATO “SELECTED” accreditation. The course is open to medical and non-military medical and civilian participants. This year, it was conducted in its new format.

MMSHA Course Picture
### Military Medical Support in the Humanitarian Arena (MMSHA)

<table>
<thead>
<tr>
<th>Course Schedule</th>
<th>Monday, 14.05.2015</th>
<th>Tuesday, 15.05.2015</th>
<th>Wednesday, 20.05.2015</th>
<th>Thursday, 21.05.2015</th>
<th>Friday, 22.05.2015</th>
</tr>
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<tbody>
<tr>
<td>0800-0845</td>
<td>Welcome, opening remarks,warum Ireland, course photo</td>
<td>Scenario update</td>
<td>The Ebola Outbreak in West Africa: Medical Strategic Planning considerations from the German Perspective</td>
<td>Table Top Exercise Preparation 2</td>
<td>Practical Experience from an NGO’s Point of View</td>
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<td>0845-0900</td>
<td>Introduction into the scenario “Humanitarian Disaster” (1)</td>
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<td>The United Nations</td>
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<tr>
<td>0945-1010</td>
<td>Introduction into the scenario “Humanitarian Disaster” (2)</td>
<td>Sphere-Standards, NGO Code of Conduct</td>
<td>The Ebola Outbreak in West Africa: The German Experience</td>
<td>Table Top Exercise Meeting 1</td>
<td>Plenary Feedback</td>
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<tr>
<td>1030-1115</td>
<td>Red Cross Societies</td>
<td>Non-Governmental-Organizations (NGO) Principles, Procedures and Interfaces</td>
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<td></td>
<td>Evaluation, Administration</td>
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<td>1115-1200</td>
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<td>Table Top Exercise</td>
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<td>1345-1430</td>
<td>NATO Civil-Military Cooperation</td>
<td>Keynote-Address: The Civil-Military Medical Interface according to NATO-Docline</td>
<td>Table Top Exercise Preparation 1</td>
<td>Table Top Exercise Presentation</td>
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<tr>
<td>1445-1510</td>
<td>Legal Aspects of Humanitarian Assistance in Hostile Environments</td>
<td>Workshop (4 syndicates): Principles of Medical Contributions to Humanitarian Assistance</td>
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<td></td>
<td>Table Top Exercise Summary</td>
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<td>1530-1615</td>
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<td>1615-1700</td>
<td>Afternoon break</td>
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</tbody>
</table>

### Course Schedule

Format for the second time. From 18th to 25th May 2015, 20 field-grade officers coming from Germany, Hungary, the Netherlands, Norway, the United Kingdom and the United States and representatives from the civilian field completed the module at the Führungsakademie der Bundeswehr in Hamburg.

### Principles at the Civil-Military Medical Interface

The course is basically divided in two parts: During the introductory phase, several presentations are held, aiming at a deeper understanding of the civil-military environment. The purpose is to familiarize the participants with both the perspective of civilian actors and the perspective of military medical leadership in terms of principles and challenges. In this context, the program focuses on the role of international, governmental and non-governmental actors and organizations while discussing potential military contributions. Therefore, the interaction among these actors is discussed in terms of opportunities for coordination, collaboration and cooperation but also against the background of constraints and restraints. Introducing the perspectives of UN OCHA and the ICRC as decisive actors, the principles of humanity, impartiality, neutrality, and independence are emphasized and compared to military objectives that may differ from these principles. Moreover, important aspects such as accountability on both sides of the interface, mutual respect, and cultural awareness are covered in the introductory briefings.

Linking the theoretical part of the course to the tabletop exercise, this year’s course provided insight into the international response to the Ebola outbreak in West Africa in 2014 from a German perspective. Lessons learned addressed epidemiological findings, the coordination of this mission at the strategic level and the conduct of the mission, which revealed the strengths and weaknesses of military medical contributions. Whilst military contributions usually come with capable means of command, control and communication and also with sufficient logistic support and capable medical intelligence and health surveillance assets, all actors involved have to be fully aware of the fact that a potential conflict between military objectives and humanitarian principles might hamper the overall mission. Furthermore, the “Sphere Project” providing a set of universal minimum humanitarian standards, the principle of “do no harm,” and the “code of conduct” adopted by the Red Cross/Red Crescent movement and major NGOs were explained in detail. The keynote lecture provided by the Director of the Centre of Excellence for military medicine (MMedCOE) concluded the introductory part of the course and set the scene for the following tabletop exercise. Throughout the course, particular emphasis was placed on appropriate standards of healthcare supported by military medical forces in case of a humanitarian crisis. These standards need to be acceptable, credible and sustainable in terms of being embedded into a system that allows for appropriate follow-up treatment in the long run.

**Brigadier General (MC) Dr. Kowitz, MBA, Director of the MMedCOE**
Tabletop Exercise
The second part of the course saw a tabletop exercise with a NATO exercise scenario that was only recently introduced to the Führungskademie and that facilitates operational level planning in general staff officer courses. It is about an escalating crisis taking place in a fictional African region with an ongoing UN mission in a failing state, with commitment of international and non-governmental organizations and with the deployment of a robust NATO force. Adapting the scenario to the purpose of the MMSHA module, the course directors provided information for this exercise that focused on a response to a deteriorating humanitarian situation in a complex strategic environment. During the exercise, the course participants formed groups and assumed roles of civilian and military actors. They were tasked to develop mutually accepted civil-military solutions to challenges arising during humanitarian assistance in a crisis. A UN OCHA representative chaired several civil-military meetings, during which the participants were required to clearly define their roles and responsibilities, identify potential contributions from different perspectives, and develop a common approach to the solution of crisis-related medical problems. More specifically, the participants were asked to consider the following aspects:

- What are the most pressing requirements in this humanitarian crisis?
- What are credible contributions of single organizations to the overall effort?
- What is the role of military medical support acceptable to military forces and the international community?
- Which complementary capabilities may be provided by different actors and how can they be coordinated?
- Which financial arrangements for funding and reimbursement are in place?

Feedback on the groups’ performances was provided by facilitators from civilian organizations and from military medical experts.

Evaluation and Conclusion
Based on the feedback of course participants, it can be stated that the course has strongly enhanced the knowledge and skills of military medical planners and civilian healthcare providers. The participants seized the opportunity to learn about civilian requirements and the military perspective. Applying this knowledge during the tabletop exercise certainly helped them to deepen their understanding of these aspects. The most valuable achievement of this course, however, was that it facilitated transparency and provided a platform for exchange at the interface of the civilian and military medical spheres. The purpose of this course is not simply to familiarize the participants with this interface but to offer them a forum that contributes to mutual understanding in a modern educational environment. There is no doubt that this course hugely benefits from the contributions by a selection of civilian organizations, which is a prerequisite for achieving the aforementioned learning objectives. Moreover, the experience of a multinational environment is of utmost importance, since approaches to problem-solving do not only differ among civilian and military actors but also among military medical services of different nations.

AUTHOR
Colonel (MC) Dr med Jürgen Meyer, M Sc
born 03 Oct 1968 in Rheine, married, 2 children

Tabletop Exercise

<table>
<thead>
<tr>
<th>Year</th>
<th>Assignment</th>
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<tbody>
<tr>
<td>1988</td>
<td>Basic Military Training, MedBn 6, Itzehoe</td>
</tr>
<tr>
<td>1989 – 1995</td>
<td>Medical School, WWU Münster</td>
</tr>
<tr>
<td>1995 – 1998</td>
<td>Clinical Training, Bundeswehr Hospital Hamm</td>
</tr>
<tr>
<td>1998 – 1998</td>
<td>Qualifications in Family Practice, Sports Medicine, and Emergency Medicine</td>
</tr>
<tr>
<td>1998 – 2000</td>
<td>Medical Officer, Medical Center Augsburg</td>
</tr>
<tr>
<td>2000 – 2002</td>
<td>Company Commander, 2./MedRgt 7, Hamm</td>
</tr>
<tr>
<td>2003 – 2003</td>
<td>Lecturer at the Bundeswehr Führungskademie, Hamburg</td>
</tr>
<tr>
<td>2005 – 2006</td>
<td>Section Head G3 International Relations, Joint Medical Forces Command, Koblenz</td>
</tr>
<tr>
<td>2008 – 2010</td>
<td>Staff Officer Medical Policy, Doctrine and Education, Allied Command Transformation, Norfolk (USA)</td>
</tr>
<tr>
<td>2011 – 2011</td>
<td>SO International Relations, MOD Medical Staff II 1, Bonn</td>
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<tr>
<td>2012 – 2012</td>
<td>MA oft the Surgeon General of the Bundeswehr, MOD, Bonn</td>
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<tr>
<td>2012 – 2014</td>
<td>Branch Head Medical Command HQ I 2, Capability Management, Koblenz</td>
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<tr>
<td>since Nov 2014</td>
<td>Bundeswehr Führungskademie, Chief of the Medical Service and Health Sciences Department</td>
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</table>

Deployments:
1997 | SFOR, Field Hospital, Rajlovac
1998/1999 | KVM, Mobile Medical Physician Team, Tetovo
2000/2001 | KFOR, Medevac Company Commander, Prizren
2010 | ISAF, Deputy Medical Advisor IIC, Kabul

Address of the author:
E-mail: juergen2meyer@bundeswehr.org
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Introduction

It is estimated that about 12 million cases of leishmaniasis exist in the world, with about 1.5 – 2 million new cases occurring each year, of which 1 – 1.5 million cases are diagnosed with skin leishmaniasis and 500,000 cases with visceral leishmaniasis.

There are 500,000 new cases of visceral leishmaniasis each year, 90% occur in Bangladesh, Brazil, India, Nepal and Sudan. Mediterranean Visceral Leishmaniasis affects small children. The disease is present in Italy, France, Spain, Greece, Croatia, Albania, Turkey and other Mediterranean countries.

The number of cases with visceral leishmaniasis has increased in Albania during 1991 – 1994 as a result of movements of population from the countryside (along with pets like dogs, etc.) to cities and as a result of interruptions of application of insecticides and other collective health measures.

Many districts of our country are known as endemic areas of Leishmaniasis like: Gjirokastra, Vlora, Himara, Saranda, Fier (Seman area), Kruja, Tirana and Shkodra. Often no epidemiological connection is found between the place of infection, country and time of occurrence of the disease.

Seasonality of the disease is annual, as can be shown in all seasons as a result of its long incubation period.

Epidemiological Data

The dates of many doctors (Prof.S.Bekteshi and many other pediatricians in Kruja Tirana, etc) show numerous cases of Leishmaniasis. However, the number of cases with visceral leishmaniasis in adults admitted to No.4 Hospital and other hospitals of the country, has been rather small.

During the years 1991 – 2005, in the lower areas of Albania and through river valleys cases with leishmaniasis occurred (Table 1). In Albania, there was an increase of cases of
Leishmaniasis after 1990, when in Tirana and other cities of Albania, the free movement of people began, migrating from the countryside to the towns. In this period, together with the people came pets, especially dogs, which increased in the cities, close to restaurants and hospitals with kitchens. Also during this period, cross-infection with leishmaniasis between people and dogs increased.

During the 12 years 1990–2001, in Albania, there were 1108 cases with visceral leishmaniasis. Most cases were recorded in the years 1993, 1995 and 2001. Most of these cases, about 87–92% were in the pediatric age, 60–65% in the age group 0–4 years, 70–90% of the cases where found in rural areas, mainly from Elbasan, Gramsh, Gjirokastra, Kuja, Lukes, Lezha, Librazhd, Shkodra, Mat, Tropoja. During 2002, there were 129 cases with visceral leishmaniasis (incidence 4.2% ooo inhabitants); while in 2003 there were 118 cases with an incidence of 3.8% ooo. During the period 1990–1991, and onwards, there was a large immigration of rural population to urban centers. In many cases, the new residents brought with them animals and especially house dogs in growing numbers. These must be seen potential sources for the increasing number of leishmaniasis cases over the years 1990,1995,1998 and 2001. In our opinion, the number of cases with leishmaniasis must have been great; unfortunately, during this period, not only anti-epidemic rules were neglected but also administrative measures like registration and denunciation of infectious diseases. In these years there have been some deaths from visceral leishmaniasis, also cases with delayed diagnosis of cutan and visceral leishmaniasis.

Visceral leishmaniasis affects males more than females with a ratio of 2:1, with an average age of 27 years. Leishmaniasis is found more often at altitudes below 600 m, extending three ecosystems: northern, central and southern. Endemic situations predominate in Shkodra, Kuja, Tirana, Gjirokastra and Saranda. Clinically, anemia was found in 92%, leucopenia in 100%, thrombocytopenia in 86%, hepatosplenomegaly in 100% of cases. Most cases were treated with Glucantime which gave positive effects in 90, 41%. Allopurinol and Lomidin was also used for treatment.

In our country, this disease has increased because of massive movements of populations after 1990-1991, the termination of the use of insecticides and increased number of street dogs. These factors increased 3–4 times the prevalence of the disease, comparing 1964–1965 data to those of the period 1985–1994.

### Material and Results

14 cases (all males) with an average age of 20–24 years were studied. Of these 5 were soldiers belonging to the period 1980–1985 and 9 cases were civilians belonging to the period 1998–2000. It should be emphasized that the latter were refugees returned from Greece, who had worked mainly in the area of the Aegean Sea.

These data are presented in Table 2.

### Distribution by year is not important because of the small number of hospitalized cases. One of the important data that we want to present, is about the diagnosis of cases in our hospital. The data are presented in Table 3.

### Tab. 3: Data on diagnosis.

Clinically characterized by hepato-lienal syndrome, extended temperature, sweating, progressive decline in weight, anemia, leucopenia and hypergammaglobulinemia etc.. The tendency for a sub-acute and chronic decors as consequence of delayed or wrong diagnosis (like brucellosis) resulted in prolonged febrile conditions, as these patients were referred from one doctor to another or from one hospital to another, so complications appeared and, as a result of secondary infection, prognosis was not good at all.
Statistical Processing

First examination: Average = 3440000, DS = 4030000, V = 11.7 %, average error = 109000
Second examination: Average = 3970000, DS = 2310000, V = 3.8 %, the average error = 62000.

Based on this simple statistical processing turns out that the differences between the first analyses of red blood cells and the second are in about 2 weeks, so the difference is not significant and therefore the amount of red blood cells is not a criterion for the state of the patient. Even in the subsequent analysis of these cases red blood cell number has been increasing slowly.

White blood cells data are presented in Table 5.

<table>
<thead>
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<tr>
<td>12</td>
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</table>

Tab. 6: Data on platelets.

Average = 121000, DS = 30600, V = 25 % . From these data we can see that even platelets have a significant reduction. (we don’t have second measurement of platelets)
In Table 7 is provided data on erythrocyte sedimentation.

Tab. 7: Data on erythrocyte sedimentation.

<table>
<thead>
<tr>
<th>First examination</th>
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<td>54</td>
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</tbody>
</table>

Tab. 8: Data on liver enzymes.

ALT: Average = 60, DS = 10.8, V = 52 %, AST: Average = 50, DS = 28.5, V = 56 %, where the changes are the same in both types of liver enzymes.

Tab. 9: Data on electrophoresis.
months, we think that the infection was taken from the districts that have been as follows: Himara- 1 case, Kruja- 1 case Shkodra - 2 cases, Gjirokastra - 1 case. And emigrants who have worked for 2 – 3 years in Greece (mainly in the area of the Aegean), were treated with antibiotics for different disease, without success and the extended fever forced them to return in Albania where they are diagnosed and treated for leishmaniasis. Clinical signs like ascites, epistaxis, adenopathy, exanthem despite that they are rarely met, should be noted that they indicate serious illness. Great help in the diagnosis of disease have been awarded to complete blood cell count. In blood cell count, in all cases we see mononucleosis syndrome with expressed neutropenia. Severe neutropenia is the main cause for secondary bacterial infections and it is explained by bone suppression. Increased erythrocyte sedimentation is a consequence of the destruction of serial protein fraction ratio with each other and erythrocyte mass. High levels of eritrosedimentation have practical value but it is not a specific diagnostic test. The data are presented in Table 7. Erythrocyte sedimentation changes at the beginning of treatment and at the end of it are very important and this is confirmed by the statistical data presented, together with the table. 3 is found in 5 of our cases, and it is explained by low production of platelets due to bone marrow inhibition. Their reduction favors epistaxis, ecchymosed. Another important data is electrophoresis, which is presented in Table 9. Electrophoresis changes in favor of increasing gamma globulin that return to normal after treatment can be explained by activation of lymphocyte B responsible for hyper gammaglobulinemia. Some authors, during the disease have found antileishmania antibodies and have noticed that the humoral immune response in leishmaniasis is increased and in some cases exaggerated, as seen in Table 9. Our opinion is that the infection leads to immunodeficiency because after treatment with antileishmania medications immune cell parameters are completely neutralized, but on the other hand, people with acquired immunodeficiency or those that use cortisone therapy are predisposed to infections and further infection aggravate this situation. Hepatic cytolysis is almost constant with increasing or doubling in over 50% of cases before starting the treatment. While their normalization has progressed in parallel with the improvement of the major clinical signs. Our opinion remains that it is a result of anemia which leads to hypoxia hepatitis, hypoproteinemia from secondary bacterial infections and granulomatosis hepatitis. In 2 cases we observed increase on uremia and creatinemia and we think they can be

<table>
<thead>
<tr>
<th>Antibody titer</th>
<th>1/320</th>
<th>1/850</th>
<th>1/779</th>
<th>1/587</th>
<th>1/324</th>
<th>1/640</th>
<th>1/227</th>
<th>1/799</th>
<th>1/322</th>
</tr>
</thead>
</table>

Tab. 10: Data on serology.
explained from the deposition of circulating immune complexes in the kidney, so the appearance of a Glomerulonephritis with hematuria, proteinuria and renal failure.

In serology, an average of 1/550 sometimes have served in the definitive and rapid diagnosis and treatment of the disease. The fact that bone marrow aspiration results positive in a high percentage (80%) especially in soldiers hospitalized 2 weeks after the temperature and in 2 cases of emigrants means its diagnostic importance and priority. While positive serology realized in terms of hospitalization means late diagnosis and of course the performance and results of treatment are different from cases diagnosed earlier. (Especially emigrants). Treatment, is done with glucantim (Meglumine antimoniate is a pentavalent antimony), for two weeks then two weeks rest and then a second cycle again. Glucantime action in leishmaniasis still retains its effect in our country. In addition to treatment with glucantime we used antibiotics for secondary infection.

Blood transfusion in severe forms of anemia is performed in 5 cases with good replacement effects.

We have noticed the dominance of fever around day 3 – 5 from the beginning of treatment. Our final results were; 13 cases recovered and 1 dead. In the prognosis of the disease except the time of diagnosis other factors plays an important role such as age, tuberculosis, malnutrition, chronic diseases etc. Our patient that died had TBC, he made ascites, renal failure and secondary bacterial infection. The authors have found relapses of the disease after 6 months from 5 – 10 – 36%. From our experience we have not had a relapse.

Conclusions
1) The number of cases with visceral leishmaniasis increased / grown in Albania during 1991 – 1994 as a result of movements of population from the countryside (along with pets like dogs, etc.) to cities and as a result of interruptions of application of insecticides and other collective health measures.
2) Cases with the “skin Leishmaniasis” were obviously decreased, perhaps as a result of the derecognition of cases with skin infection.
3) The quantity of red blood cells grows slowly in relation to the improvement of the situation.
4) The quantity of white blood cells indicates positive progression of the disease.
5) Sedimentation is not important in relation to the improvement and stabilization of the disease.
6) Often no epidemiological connection is found between the place of the infection and the country and the time of occurrence of the disease.
7) Seasonality of the disease is annual, as can be shown in all seasons as a result of its long incubation period.
8) Immunodeficiency signs are reflected in electrophoresis and its improvement is loyal to disease improvement.
9) Hepatic cytolysis is present and goes parallel with the condition of the patient.

References: ref@mci-forum.com
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NEW DEVELOPMENTS – SIEMENS HEALTHCARE

Serving the Services for more than 100 Years

MCIF: Siemens has been a renowned industrial partner for medical corps worldwide for decades. What is your experience in this special environment?

Siemens: We have been working closely together with the respective users and with the technical staff for a long time. Military medical customers have a very high focus on quality. Next to diagnostic or therapeutical quality, mechanical robustness is extremely important. This is, of course, especially true for mobile applications which require much more rugged equipment than state-of-the-art hospital technology. We have extensive experience in this field, Siemens medical devices have been in deployment for decades. In the Siemens Museum you will see devices that were actually used in World War II, such as “Feldröntgengeräte” (Field x-ray systems). Also, there were the coach-integrated systems for mass screenings. We are drawing from this experience in developing new devices.

Another extremely important point is logistics and transport standardization. We are doing our utmost to bring this in line with ISO standards. This means, for example, that our CTs are mounted in standard-size ISO containers, so that all containers of a field hospital meet identical transportation specifications. In our view, it is not feasible having, for example, a container which is just a few centimetres larger than all other containers, which would cause great headaches to the logistics officer.

MCIF: What is your experience with devices that are deployed on ships?

Siemens: We have numerous X-ray units in use on ships. Experiences in the American and German navies (among others) are unanimously positive. Of course, there are always limitations in terms of space and weight. You have to look very carefully to which extent you can deploy these in a limited space. There is a clear trend to equip smaller vessels with medical technology, thus providing enhanced capability for improved immediate care before evacuation to a hospital ship or a land-based hospital. We are talking about a utilization profile which is also highly interesting for civilian ships in a similar form. The trend towards miniaturization electronics is working for us. This applies for a large part of our portfolio: For laboratory diagnostics as well as for imaging systems, as portable ultrasound units and digital X-ray units with wireless detectors. This gives us the opportunity to provide a full diagnostic spectrum while requiring minimum valuable space.

MCIF: Siemens medical technology is used in military hospitals as well as in deployment. Are there any special training offerings for military personnel?

Siemens: There is two-fold answer to your question. One for medical staff, and one for technical staff. As far as the medical personnel is concerned, I think that top priority should be that hospital equipment and field equipment should be identical or very similar, i.e. sharing the same user interface. This policy assures that all medical staff is keeping a continuous high level of practice which, in turn, eliminates the need for a separate training for deployment. In keeping with the motto: Train as you fight. For the technical staff, we offer qualified service...
engineer trainings so that technical maintenance of the devices can be guaranteed in the field. This is where the Siemens Training Centre comes in. We have a training centre that offers certified courses for medical and for technical specialists. This extends to our preparing education plans together with clients from the medical corps as well as civilian clients to the specific needs of the respective customer to ensure that the customer’s staff can be just as qualified as our own people. With these certified trainings in addition to the on-site application training we can make sure that the users can exploit the potential of their systems to their full capability.

If we look at this on a higher level now, it is important for all manufacturers of hardware and electronics to also be active in the field of services. Hardware suppliers are increasingly being looked down on as commodity movers, while services are more and more appreciated by the markets and clients and finally also paid for. We are entering an additional business field by offering customised education plans and thus addressing the client’s legal obligation for continuous education of their medical staff. These solutions are currently appreciated by advanced private institutions, for whom we train technical and medical personnel on site and here in our training centre according to an individual curriculum, and for whom we may even administer their education records as an additional service in the future. This is a trend which the German military in a way has pioneered with us, by our having trained the German armed forces’ service engineers as Siemens-qualified engineers, and who are now able to do practically anything required in terms of service and repairs for the device that is present in the field.

MCIF: Does that include certification?
 Siemens: It sure does. They are fully certified CT or X-ray service engineers. Of course, they already have a high standard of education when they start the system-specific training at our training centre. Their receiving the training in our Siemens facilities gives them two equally important advantages. On one hand, they get to know the systems inside out, with confidence that this level matches the Siemens engineers’ expertise. On the other hand, they also know the Siemens escalation process and spare part process. They know our processes. They know where our hotline is, how to talk to them and, when there really is a difficult case for once, also quickly tell them which spare parts are needed.

In actual deployment this provides a huge advantage over other concepts. Some nations have completely outsourced the service of their medical devices to private companies just like that of many other materials. If there is a need for a service engineer in a combat zone, you will have to address security. If the military can send one of their own people first, who come “from the system”, you don’t have to wait for days until it’s been sorted out who is responsible for which security and how this can be guaranteed. We have made outstanding experiences in this regard. We only recall one single case in Afghanistan where a Siemens service technician was flown in from a neighbouring country to assist. He then worked with the personnel from the medical corps to complete the repair. So, we have our own technicians worldwide, as well as our partner technicians, too, on the same level of qualification and they have to pass the same certification procedures and tests globally. This is required by Siemens as well as the supervisory authorities, be it the FDA or the Chinese SFDA or the European authorities. In this regard, just like basically all renowned producers, we maintain an extremely high standard of quality.

CT Container for UAE Armed Forces in ZEPPELIN plant in Meckenbeuren

In a nutshell: Our concept, especially service, international service, includes various components:

- We are available; we provide our service in more than 120 countries globally. Either through Siemens subsidiaries or distributors, who were all trained to the same standard in Erlangen or one of our other global training centres. That’s one point. The other point is obviously the supply of spare parts. We have central hubs for spare parts supply. More than 97 % of our spare parts will be where they are needed the very next day, anywhere in the world. This means that devices can be repaired very quickly once the needed parts are identified. That’s extremely important. And then, of course, as we already discussed in the previous question, the training of the user’s own personnel, the medical corps’ engineers. This tightly-interlocked service concept assures continuous and sustainable operation of our systems even under very adverse conditions. May I add something here? From our side, there are no problems technically to also connect systems already in use to remote diagnostics. Meaning, a device allows prospective diagnostics. Let’s take the most important consumable in computed tomography. That would be the X-ray tube. This can be identified early on as being at risk of failure, and so at least from our side there would be no problem in connecting such a device that is being deployed on a ship to the diagnostics and then be able to tell at an early stage that, watch out, it is at risk of failure.

MCIF: But this requires some kind of connection from the field directly to your company?
 Siemens: Right. Military security concerns are major obstacles at the moment, but we are increasingly seeing in various countries around the world that the military is making sure that not only devices located in hospitals, but also those used in the field, are systematically connected remotely and serviced. This is not just about technical breakdowns. It’s also about safety-related software updates, today typically performed via remote connection. We are very confident that in a few years time many armed forces will have all their systems linked to this remote point.

MCIF: This means, in layman’s terms, so-called remote diagnostics!
 Siemens: Remote diagnostics and also remote maintenance, remote software updates.

MCIF: Is there an option for a replacement in case a device is damaged beyond repair?
 Siemens: Damaged beyond repair is almost always due to massive mechanical damage from a fire or a crash.
For mobile systems, it is quite straightforward: We have a maintenance float in all major countries. If there is an emergency in a hospital, we are then able to supply a loan unit or an interim machine at short notice. This is a realistic scenario. For systems permanently integrated into containers this is not a feasible solution, since you may safely assume that the container will also be a total loss. We have to rely on the respective medical corps to have reserve units available.

**MCIF:** What do you expect further development in the area of mobile field hospitals to look like?

**Siemens:** Well, in recent years we have seen a continuous increase in medical capabilities in mobile field hospitals. There are a few medical services here, such as the German Armed Forces, who aspire to ensure the same standard of care in deployment as for medical care domestically. This, of course, also has ramifications on the requirements in field hospitals. This means that the modalities commonly used domestically must be available in deployment, too. The other thing we’re seeing here is a requirement towards reducing the footprint in-country, especially in mobile field hospitals. The smaller the space needed for the field hospital, the easier it can be securely integrated in a forward base without requiring additional forces for security. This requirement for reduced footprint is a great promoter for high-tech, since it forces the physicians to focus on equipment that is most likely to give them the best diagnosis or therapy in the shortest time with lowest space requirements.

I do think that the issue of footprint is indeed a very important one. Analysis of recent deployments shows that units were dispersed over a large geographical area, so that when attempting to stay compliant to the doctrine of “Platinum 10 Minutes and the Golden Hour”, flying times alone took up a large part of the time available. We have been witnessing a clear trend towards having multiple mobile surgery facilities distributed in forward bases in order to get soldiers to medical care within the time specified. The medical device industry must be an active partner in these considerations. Where are the priorities? What should be available in these relatively small units? In conversations with users we are observing a trend towards rather having one large modality available, which is capable of addressing all medical questions, than many different ones which then again would make the installation so big that it doesn’t fit into the country and security considerations anymore.

**MCIF:** In the field, there is not always a radiologist available. Is there a chance in this regard to link the devices to remote diagnostics in terms of telemedicine?

**Siemens:** Absolutely. That’s the standard today. The limiting factor is available data bandwidth. Using the DICOM Standard makes it possible to reduce data significantly, as not every image has to be sent as a single image, but information for the previous image is attached. This is called DICOM Multiframe. If the above mentioned notwithstanding, we make sure in development that our devices, or parts thereof, can be used in a mobile environment. In the design process we consider allowing for higher mechanical requirements, or offer additional mobile kits to meet these requirements. The combination of these measures will permit mobile usage of these standard devices to a large extent while retaining their status of full compliance with medical device legislation.

**MCIF:** Apart from purchasing devices, are there any other means of acquisition?

**Siemens:** This varies by country. We provide a wide range of purchasing and financing options tailored to the specific situation of the respective country. Here we stick to local legislation. Basically, these financing options can also be used for the military medical services. We’re open in this regard, we have the flexibility. Every offer or every procurement project requires thorough analysis of the customer’s needs, including usage-based payment, and lifecycle and so on, and then it’s surely possible to develop such a concept. Developing such a scenario for a mobile hospital in a
combat environment with possible mass casualties could become somewhat challenging. In the civilian and stationary sector where there is a continuous workload, or a usage history, this is quite possible, yes.

After all, we go all the way to provider models, where we simply provide certain capabilities. Innovation cycles for the equipment involved may be part of this service agreement in order to ascertain long-term sustainability.

All of these cases are individually tailored solutions. Let us assume a model scenario: There is an investor, or a government organisation. They want to build a new hospital and tell us they need a radiologist and want to perform this or that examination there, or they may say they'll have the following specialist departments: cardiology, gastroenterology, neurology. Based on our experience we prepare an equipment recommendation and take this as a basis for making an offer which may include a list of devices and the respective innovation cycles. So we may say that ultrasound units be replaced every 5 years. Or replacement of CTs is provided for every 5-7 years.

For the MRs, we assume a useful life of 8 years plus upgrade, so that's an extension of 50 percent, or 12 years. From this package, we then prepare a, let's say monthly, cost schedule. We then expect monthly payments of an amount X. This monthly instalment may include service, consumables and everything else. This is the chance to provide you with all essential capabilities at a predictable cost schedule and this is precisely what you need if you want to build a very big hospital without tying up too much capital.

We are currently discussing the possibility of including operating staff in these solutions. In these discussions we have to take various legal and customer-specific limitations into account.

Something we have been doing for a long time is called Integrated Service Management. This means there are hospitals, often very big hospitals, which leave the complete technical management of their medical devices to us.

In these agreements, we take over management of the entire technical department of a hospital. This is most attractive in scenarios with a large Siemens-share in the installed base. We will also include other manufacturers’ equipment and ensure that service for this equipment is performed by qualified staff (usually the manufacturer’s staff). These management models are attractive to users or end clients because they take the complexity out of their own operations. So they can transfer the entire area of service of medical technology as a black box to us and focus their efforts on patients and medicine.

**MCIF:** Telemedicine is being increasingly used by medical corps world-wide. What about Siemens’ technological development in this area?

**Siemens:** We have not only seen the introduction of telemedicine into practical routine in Afghanistan but also an extreme scenario in the Chinese earthquake of 2008 with image transfer in a disaster environment.

Sending images for remote diagnosis or a second opinion has been standard in telemedicine for some time. Our military users, in particular, have grown accustomed to sending images from the country of deployment to the specialist at home. They just need sufficient bandwidth for image transfer. We have mentioned Expert-i before that gives you the capability to remotely perform procedures. The combination of these features has a high potential for making state-of-the-art medicine available to even the most remote locations in the field.

Another aspect is the fact that telemedicine moves field hospitals and domestic hospitals much closer together. Thanks to modern intensive care, even very critical patients can be evacuated home at an early point. Telemedicine contributes greatly to the patient getting transferred to the most suitable medical institution at home without delay. It also ascertains that this institution is optimally prepared once the patient arrives.

While the concepts and some of the implementation have been around for some years, Siemens is actively pursuing further steps to make these benefits even easier to use in daily routine or in extreme situations. Standardized electronic patient records or high-performance server structures for a web-space concept for distributed reading and reporting are just some examples.

**About Siemens Healthcare**

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Management of Urethral Injuries in Foreign Assignments

D. LIEBCHEN (GERMANY)

Urogenital trauma occurs with a rate of approximately up to 12.7% in a significant proportion of battle casualties. Up to 17% of urogenitally injured patients suffer from urethral trauma. The proportion of penetrating injuries is higher in comparison to the primarily blunt trauma in civilian patients. Urethral injuries can lead to significant morbidity when diagnosed late or left untreated. Diagnostics and therapy follow the Guidelines of the European Association of Urology (EAU) and the principles of Damage Control Surgery (DCS).

Introduction

In the battles of the 20th century, a historical rate of urogenital injuries of approx. 3% (0.4 – 4.2%) has been observed. Analysis of the Iraq Freedom and Enduring Freedom operations between 2001 and 2008 revealed an increase in urogenital injuries to 5% [1]. Recent data from the US Joint Theater Trauma Registry showed that these injuries were increasing in number (12.7% in 2010) and in severity [2]. The urethra is affected in up to 17% of urogenital injuries [3]. During the Afghan conflict, the most frequent causes of injuries were from Improvised Explosive Devices (IED), mines and high-velocity bullets. Injuries caused by explosions predominate here [4].

With regard to the mechanism of injury, a distinction can be made between blunt and penetrating traumas. Whereas among civilian patients blunt urethral trauma predominates with a percentage of approx. 90%, the percentage of penetrating trauma is higher in battle casualties.

Urethral injuries are rarely life-threatening. However, they can cause profound morbidity with a permanently reduced quality of life due to subsequent urethral strictures, incontinence and impotence. They can cause profound morbidity with a percentage of approx. 90%, the percentage of penetrating trauma is higher in battle casualties.

Trauma to the female urethra is rare. Often there are concomitant injuries to the bladder, vagina and rectum. The surgical treatment required is performed conjointly. Transvesicular access is recommended for the proximal urethra and transvaginal access for the distal urethra.

Diagnosis

The male urethra comprises the penile, bulbar, membranous urethra and prostatic urethra. The urogenital diaphragm divides the urethra into the anterior (penile, bulbar) and the posterior (membranous, prostatic) urethra (Fig. 1).

The male urethra is divided into:

- Penile urethra (Fig. 1A)
- Bulbar urethra (Fig. 1C)
- Membranous urethra (Fig. 1D)
- Prostatic urethra (Fig. 1E)

Fig. 1: Anatomy of the male urethra: (A) Fossa navicularis, (B) penile urethra, (C) bulbar urethra, (D) membranous urethra, (E) prostatic urethra.

Acute urethral trauma is suspected based on abnormal clinical findings that indicate trauma event or the clinical picture of the trauma. Abnormal clinical findings that indicate trauma event or the clinical picture of the trauma event or the clinical picture of the trauma are:

- Deviation, ecchymosis or induration
- Dysuria
- Hematuria
- Rectal or vaginal bleeding
- Flank pain
- Disappearance of meatus
- Hypertension
- Hypothermia
- Shock
- Paralysis

The leucomas urgenitales surtien un taux d’approximativement 12,7% dans la proportion significative des blessures du champ de bataille. Jusqu’à 17% des patients avec blessure urinaire souffrent de traumatisme urétral. La proportion de blessures par pénétration est plus élevée que les traumatismes par contusion chez les patients civils. Les blessures urétrales peuvent conduire à une morbidité significative si elles sont diagnostiquées tardivement ou si elles ne sont pas traitées. Le diagnostic et la thérapie suivent les recommandations de l’Association Européenne d’Urologie (EAU) et les principes de la chirurgie de Damage Control (DCS).

El traumatismo urgenital tiene un índice de ocurrencia de aproximadamente hasta el 12,7% en una propor- ción significativa de víctimas de bata- llas. Hasta el 17% de los pacientes con lesiones urgenitales padecen de traumatismo urétral. La proporción de lesiones penetrantes es superior en comparación con el traumatismo romo predominante en pacientes civiles. Las lesiones urétrales pueden conllevar morbilidades significativas cuando se diagnostican tarde o se dejan sin tratar. Los diagnósticos y terapias siguen las Directrices de la Asociación Europea de Urología (AEU) y los principios de la Cirugía de Controlo de Daños (CCD).

UEPHEMIAL INJURIES

D. LIEBCHEN (GERMANY)

Urogenital trauma occurs with a rate of approximately up to 12.7% in a significant proportion of battle casualties. Up to 17% of urogenitally injured patients suffer from urethral trauma. The proportion of penetrating injuries is higher in comparison to the primarily blunt trauma in civilian patients. Urethral injuries can lead to significant morbidity when diagnosed late or left untreated. Diagnostics and therapy follow the Guidelines of the European Association of Urology (EAU) and the principles of Damage Control Surgery (DCS).
further diagnostic investigations are, for example, blood-stained discharge from the meatus, a raised prostate gland during the digital rectal examination as well as haematomas on the penis, scrotum and perineum. Blood-stained discharge from the meatus occurs in 37 – 93 % of posterior urethral injuries and in more than 75 % of injuries to the anterior urethra [5]. The degree of haematuria does not correlate with the severity of injury.

The retrograde urethrogram (RUG) is the examination method of choice for diagnosing and evaluating urethral trauma. This shows the affected portion of the urethra and the extent of the injury. Urethral trauma can be classified based on the x-ray image (Table 1). The injured area is visualised by the extravasation of contrast medium. With grade 1 and grade 2 injuries, the urethral mucosa is intact and a transurethral catheter can be intro-

<table>
<thead>
<tr>
<th>Degree</th>
<th>Description</th>
<th>Recommended management</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Elongation of the urethra without extravasation on the RUG</td>
<td>No therapy</td>
</tr>
<tr>
<td>2</td>
<td>Contusion, blood-stained discharge from the meatus, no extravasation on the RUG</td>
<td>Conservative, suprapubic catheter or indwelling catheter</td>
</tr>
<tr>
<td>3</td>
<td>Partial interruption of the urethra with extravasation into the injured area, the urethra and/or bladder are seen proximal to this</td>
<td>SPC and delayed treatment or endoscopic realignment ± delayed treatment</td>
</tr>
<tr>
<td>4</td>
<td>Complete interruption of the urethra with extravasation into the injured area, the urethra and/or bladder are not seen proximal to this</td>
<td>Primary open surgery required</td>
</tr>
<tr>
<td>5</td>
<td>Complete or partial interruption of the posterior urethra with tear to the neck of the bladder, rectum or vagina, extravasation into the area of the injury.</td>
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</tbody>
</table>

Tab. 1: EAU classification of blunt urethral injuries
tially performed to drain the urine. To restore urethral continuity, the therapy options are primary realignment and urethroplasty. If immediate surgical exploration is not indicated, primary realignment can be carried out following stabilisation of patients with often multiple injuries. During the preferred endoscopic procedures, it is important to preserve the bladder neck since this is often the only remaining functional sphincter mechanism. Primary open realignment is only indicated if an abdominal or pelvic surgical procedure is required as a result of other injuries, as well as in the case of trauma to the bladder neck or rectum. The decision for realignment is influenced by concomitant injuries. These can make lengthy anaesthesia or lithotomy positioning impossible. Endoscopic realignment is usually performed within 7 days of the patient being stabilised and should be preferred because of lower morbidity. This procedure can be performed retrogradely and antegrade/retrogradely via the cystostomy channel. The advantage of the realignment procedure compared to suprapubic urine drainage alone is the lower rate of stricture (64% vs 100%). However, in two-thirds of cases, a second procedure is necessary. Both endoscopic therapy and plastic reconstruction are technically more simple following successful realignment. Immediate primary urethroplasty to treat posterior urethral trauma is not recommended. The functional results (21% incontinence, 56% impotence, 49% stricture) are not conclusive due to the view being markedly restricted by the extensive tissue trauma [8]. Delayed primary urethroplasty within 2 weeks of haemodynamic and metabolic stabilisation of the injured person is predominantly used in the case of female urethral rupture.

**Plastic reconstruction**
The gold standard of plastic urethral reconstruction is delayed urethroplasty after 3–6 months. The often severe concomitant injuries have healed after this period. The functional results in relation to resection rate, impotence and continence are better compared to immediate reconstruction. This surgery is usually performed as a one-stage procedure via perineal access. After resection, end-to-end anastomosis is used for short segment strictures. To treat longer strictures, free grafts (e.g. buccal mucosal grafts) are used for urethral augmentation.

**Conclusions**
Urethral trauma can occur in both injuries to the external genitalia and to pelvic region. The concept of Damage Control Surgery has been used successfully for many years in the treatment of battle casualties with multiple injuries. This describes a surgical approach, the objective of which is to stabilise severely injured patients sometimes at risk of bleeding by minimising the need for an additional surgical trauma. Therefore the initial objective in the case of urethral trauma is to establish reliable urine drainage. If a retrograde urethrogram cannot be performed in this context, suprapubic urine drainage is the most reliable and effective procedure. X-ray diagnostics by means of a retrograde urethrogram and, if necessary, a cystogram can be conducted during the stabilisation phase. As part of the scheduled repeated surgeries carried out on haemodynamically and metabolically stable patients, the required initial urological treatment takes place depending on the findings and on the basis of the previously described criteria. If definitive plastic surgery is required, this takes place in the patient’s country of origin after an interval of 3–6 months. Complex urethral trauma, especially to the posterior urethra with possible involvement of the bladder neck, is a major challenge for urologists when treating these kinds of battle injuries. In addition to profound endoscopic skills, pelvic surgery and plastic reconstructive procedures must therefore be an integral part of surgical training.

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Management of Genital Injuries – From Trauma to Reconstruction

Penile and scrotal trauma are rarely life-threatening injuries, however very often associated with a loss of erectile respectively micturition function and/or fertility. In the initial phase of treatment, a safe urinary diversion is mandatory. The real dimension of genital trauma especially from battlefield injuries in most cases can be determined by surgical exploration only. The restoration of sexual function and micturition may require repeated and very complex reconstructive surgery.

Introduction

Within the context of military conflicts, the incidence rate of urogenital injuries is reported as 2.9 – 12.7 % [1 – 5]. Injuries to the external genitalia represent the majority of urogenital injuries, and studies available indicate that their frequency has increased in relative terms over the years (Table 1). Gunshot wounds to the external genitalia from modern high-velocity bullets (e.g. AK 47, G36, NATO M14 or U.S. M16A2 with muzzle velocities of 700 – 1000 m/s) are, similar to other injury areas, often more extensive than those from civilian sporting weapons or pistols (muzzle velocities of 90 – 380 m/s). This is clearly apparent from the markedly different orchidectomy rates in cases of bullet wounds to the testes (62 % for sporting weapons vs. 90 % for high-velocity firearms) [6, 7].

The reason for the comparative increase in injuries to the testes, scrotum, penis and urethra is the wearing of flak jackets, which cover the kidneys, ureter and bladder, but which do not offer adequate protection to the external genital region. Many soldiers do not want to wear the flak jacket’s groin protector because it severely restricts movement.

Another reason is the widespread increase in attacks using “Improvised Explosive Devices” (IEDs), which are characteristic of the Afghanistan conflict in particular [2, 8]. The upward blast causes injury to the lower limbs and the external genitalia. Even with correctly worn genital protection, the effect of the protection is limited [2, 9]. Besides injuries to the external genitalia, urogenital injuries also include frequent fractures and injuries to the femoral region. Table 2 shows a detailed list [9, 10].

Isolated injuries to the external genitilia are rarely life threatening. However, they are often associated with a loss of sexual function, fertility or continence and micturition function and are often disfiguring.

Scrotal and testicular trauma

Injuries to the scrotum or testes represent the majority of injuries to the external genitalia (up to 72.7 %) [1, 7, 9]. They occur as a blunt or penetrating trauma. This can result in scrotal lacerations, scrotal haematomas, haematoceles or hydroceles (Figures 1 and 2). Likewise, testicular ruptures occur due to direct or indirect trauma (rupture of the tunica albuginea with approx. 50 kg pressure, e.g. against the inferior public ramus) or complete testicular avulsion, e.g. following injuries caused by being run over. (Figures 3 and 4). Testicular tor-
sions or dislocations are also common traumatic consequential injuries [7, 11, 12]. In addition to the clinical assessment and testicular palpation, an ultrasound examination of the injured scrotum is up to now the most sensitive and most precise imaging assessment for scrotal injuries. By using a high-resolution ultrasound (7.5 MHz probe or greater) the scrotal contents can be assessed in terms of intra-testicular and/or extra-testicular haematoma, haematoceles, hydroceles, possible torsion (using a colour or pulsed Doppler ultrasound) or secondary testicular inflammations. The most important criteria for assessing the integrity of the scrotum is the loss of the oval shape, an apparent break in the tunica albuginea and the parenchymal pattern. Where there are heterogeneous echo patterns following testicular trauma, a testicular rupture must be assumed [3, 7, 13 – 16]. However, the reliability of the ultrasound examination is the subject of controversy. Some studies report specificities of up to 98.6 %, other studies reveal a much lower specificity (78 %) and sensitivity (28 %), the same applies to the differentiation of a testicular rupture with an accuracy verified intraoperatively of 56 % [7, 17]. However, colour Doppler duplex ultrasound diagnostics can provide useful information in relation to the perfusion of the (residual) testicular tissue. In general, the visual clinical findings are not a reliable predictor of the presence of testicular trauma. Penetrating scrotal injuries must be investigated surgically in a military setting especially, irrespective of the degree of scrotal injury, in order to be able to assess the extent of the trauma. Waxman et al. often noted a complete testicular rupture with only 2 – 3 mm scrotal lacerations [2]. Penetrating scrotal trauma also affects both testes in 8 – 30 % of cases [7, 18]. Where there are more extensive soft tissue injuries in the area of the scrotum and testes, trauma to the bulbourethra should also be considered (see penile trauma) and urine should be drained via a suprapubic catheter. Testicular rupture requires early exposure and reconstructive surgery [25] to avoid an orchidectomy at a later stage [3, 12]. A study by Hudak revealed that exploration, debridement and treatment of soft tissue injuries to the penis or scrotum were the most frequently performed operations (40.4 %) [9]. The dead tissue must be carefully debrided and the blood, haematomas and necrotic tubules must be evacuated. Evacuation of hematocores requires a shorter stay in hospital and the patient’s symptoms are minor [3, 7, 12, 19].

Primary reconstruction of the testes and scrotum can be carried out depending on the extent of the trauma. Closure of the tunica albuginea should be attempted over the intact testicular tissue. This is usually carried out using absorbable sutures (e.g. Vicryl® 3.0). Where destruction of the tunica albuginea is extensive, a free tunica vaginalis flap can be used to cover the defect [2, 7, 20]. The introduction of foreign material (e.g. polytetrafluoroethylene Gore-Tex®) into infected tissue must be avoided [20]. It is crucial to preserve the testicular tissue if fertility and normal endocrine function are to be preserved.

In the event of complete disruption of the spermatic cord, reconstructive surgery without a vasovasostomy can be attempted, if this is surgically possible [7, 21]. A microsurgical two-stage vasovasostomy can be attempted following rehabilitation, even if only a few cases of this have been described [7, 21]. An orchidectomy is indicated for patients in an unstable condition or in the case of complete destruction of the testes, if testicular reconstruction appears not to be possible [3, 7]. Prophylactic antibiotic treatment is recommended following penetrating scrotal trauma, although there is little data to support this [7]. It is obligatory that the vaccination status is checked and, if necessary, booster injections should be administered [7]. Local wound management by wound lavage and repeated debridement, open wound treatment or vacuum bandages are essential for infected wounds. Primary closure using a drain is only acceptable in certain cases [2, 7]. Due to the elasticity of the scrotum, coverage of the scrotal skin defect can often be achieved by mobilisation, even if the lacerated skin is minimally attached to the scrotum. [7, 22]. With injuries caused by IEDs, the extensive loss of tissue often requires complex and repeated surgical reconstructions [7, 23] including mesh grafting and flap plasty. Preservation is possible in over 90 % of blunt trauma cases, even if there has been complete testicular avulsion [12, 24]. With gunshot injuries caused by conventional firearms, the mobility of the testes means that their contents can be preserved in up to 64 % of cases. In a study on gunshot trauma to the testicles (sporting weapons, civilian environment) 6 out of 17 testicles were non-viable, 9 out of 11 could not be closed again via primary intention or by means of a tunica vaginalis patch [20]. In a 10-year review, Brandes reported over 45 % testicular preservation following testicular trauma [23, 25], in a 30-year review by Phonsombat, a 51 % rate was stated [18]. Data from Bosnia-Herzegovina reveals a split of 20 testis-preserving surgeries and

<table>
<thead>
<tr>
<th>Wounded organ</th>
<th>ISAF/EF</th>
<th>Iraqi Freedom</th>
<th>Bosnia and Croatia</th>
<th>Vietnam</th>
<th>2nd World War</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney</td>
<td>22.9</td>
<td>29.6</td>
<td>39.6</td>
<td>19.1</td>
<td>40.0</td>
</tr>
<tr>
<td>Ureter</td>
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<td>7.8</td>
<td>5.2</td>
<td>3.3</td>
<td></td>
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<tr>
<td>Bladder</td>
<td>21.3</td>
<td>13.3</td>
<td>17.2</td>
<td>10.4</td>
<td>11.6</td>
</tr>
<tr>
<td>Urethra</td>
<td>0.817</td>
<td>4.6</td>
<td>12.0</td>
<td>15.0</td>
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<tr>
<td>Scrotum</td>
<td>29.0</td>
<td>19.4</td>
<td>22.7</td>
<td>32.8</td>
<td>30.0</td>
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<tr>
<td>Testes</td>
<td>9.112</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>#</td>
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<tr>
<td>Penis</td>
<td>4.261</td>
<td>8.1</td>
<td>18.5</td>
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<td>#</td>
</tr>
</tbody>
</table>

Tab. 1: Relative frequency of urogenital injuries in different conflicts (adapter from [1]), Figures in %. * Testicular injuries are subsumed under scrotal injuries # Testicular and penile injuries are subsumed under scrotal injuries
28 orchidectomies in the case of 48 scrotal injuries, most of which were caused by explosions [10]. In a study by Hudak (military setting) involving 88 gunshot or blast injuries to the testicles, 45 (51.1%) of the testicles were preserved [23]. Further military studies show a testicular preservation rate of 30 – 39% [9, 26], thus a slightly lower preservation rate must be expected in the military environment than in the civilian environment. With injuries caused by high-velocity projectiles, testicular loss is expected in up to 90% of all cases [24]. If it is not feasible to perform reconstructive surgery of the testes, TESE mapping (testicular sperm extraction) or a MESA (microsurgical epididymal sperm aspiration) can be carried out on the removed testes to extract sperm for the purposes of later fertilisation [24]. Sperm extraction from the ablated testicles is also possible after testicular amputation (as close to the event as possible). The contents from the epididymides and vas deferens can be transferred into an appropriate medium and used for artificial insemination [5, 27].

**Penile trauma**

Trauma to the penis and urethra account for 26.3% of the injuries to external genitalia. The main causes of trauma in this respect can be both improvised explosive devices and high-velocity bullets. Penile trauma often presents itself as an extensive injury to the genital skin and soft tissue. In penile trauma, it must always be borne in mind that the urethra may be affected. In penetrating trauma, literature cites urethral involvement in 11 to 29% of cases [6, 18, 25]. Telltale clinical findings are bloodstained discharge from the urethra (in 37 – 93% of posterior and 75% of anterior urethral trauma), macrohaematuria or anuria; these symptoms may not be present despite the existence of urogenital trauma. The fact that a trans-urethral catheter was inserted as first-aid treatment at the site of the incident and urine is running through it does not rule out significant urogenital trauma. The fact that a trans-urethral catheter was inserted as first-aid treatment at the site of the incident and urine is running through it does not rule out significant urogenital trauma. A retrograde urethrogram must be performed if a urethral trauma is suspected and in all cases of penetrating trauma; trans-urethral manipulation should not be performed until such trauma has been ruled out [3, 7]. Injury to the corpus cavernosum occurs in penetrating traumas in 50% to 90% of cases. Since an appropriate diagnostic examination (MRI) is not available to use and the full extent of the injury cannot always be assessed, a surgical exploratory investigation of the findings and excision of the necrosed tissue is mandatory. With gunshot or blast injuries to the penis, the possibility of dispersed foreign bodies and infectious material must always be considered [7, 22, 25, 29]. In most cases, urine is drained via a suprapubic catheter. Even with extensive injuries, reconnection of larger parts of the penis is possible due to the good blood supply. In the case of complete traumatic penis amputations, reanastomosis can be attempted within the first 24 hours [12, 22].

In a larger number of civilian gunshot injuries to the penis (n = 43), a careful surgical exploratory investigation was carried out in 95.3% of cases, a conservative procedure was only opted for where there were obvious superficial defects. In 90.2% of cases, there was trauma to the corpora cavernosa, in 34.1% injury to the urethra and in 24.4% an additional injury to the testes [30]. A military study revealed injuries to the corpora cavernosa or urethra in approximately half of all penile traumas. These injuries were diagnosed by retrograde urethrogram, cystoscopy and/or surgical exploration with penile degloving. Corporal defects were closed immediately, where possible. In a study, 46% of patients with gunshot or blast injuries to the penis required penoplasty and/or corporoplasty compared to 54% who underwent debridement treatment or received superficial

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**Figures 5 to 7:** Coverage of a large area of genital (and abdominal) soft tissue damage (Fournier’s gangrene here) using a mesh graft on the abdomen and a non-meshed split-skin graft on the penile shaft.

**Figures 8 to 10:** Reconstruction of the external genitalia by performing a thigh and perineal skin flap plasty following subcutaneous displacement of the testes to thigh pockets.
wound management [23]. Similar to penile fractures, more minor injuries to the corpora cavernosa can be closed using simple interrupted sutures following appropriate wound cleansing.

Extensive defects must be covered with dermis, venous or pericardial patch grafts by means of plastic reconstruction. If treatment is inadequate, there is a high risk of both erectile dysfunction and penis curvature, whereas with immediate and the right treatment, the post-therapeutic virility rate is 80% [24, 31]. Data from the military environment (Bosnia-Herzegovina, US military) reveals a penis curvature rate of over 50% and impotence following penile trauma, although there was only a small number of cases and little follow-up data [3, 9].

In addition to haemostasis, urine drainage and the removal of any foreign bodies, the main treatment measures are the debridement of necrotic tissue and preservation of as much viable tissue as possible; thus any portions of tissue of doubtful viability must be left and, if possible, removed at a later stage [7]. The loss of a small area of the penile skin is often easy to cover due to the elasticity of the genital skin [7]. Where the trauma is more extensive, the use of wound management measures such as vacuum bandages or mesh graft coverage is often necessary. According to a study by Hudak, these laborious and often repetitive procedures represent 44.9 to 46.3% of all urological procedures [23].

A mesh split-skin graft provides good coverage overall, but must not be used on the penile shaft due to the contracture of the graft; meshed split-skin must not be used here [7]. McAninch et al. recommend using split-skin grafts with a thickness of at least 0.4 mm in order to reduce the risk of contraction [7, 22]. Full-thickness skin grafts on the penis shaft produce a better cosmetic result with less scarring and offer more resistant coverage once the patient recommences sexual intercourse (Fig. 5) [7, 32]. The grafts can be taken from the abdomen, buttocks, thighs or axilla, orientated to the full injury pattern and any other necessary grafts [7]. Where there are very extensive injuries, if the injury affects deeper tissues or in cases where subsequent prosthetic treatment is required at a later stage, pedicle flap dermoplasty (with adequate blood supply) can also be used.

Summary

Trauma to external genitalia are rarely life-threatening, however they are often associated with a loss of sexual or micturition function or fertility. At the resuscitation and initial surgical stage (in the case of life-threatening injuries), the primary objective of the initial urological measures is to maintain urinary drainage. The extent of urogenital injuries can often only be determined, in particular in the deployment country, by means of an exploratory investigation. This also paves the way for the later restoration of the urological function. This is usually complex and, generally speaking, requires staged procedures as well as extensive reconstructive surgery.

Table 2: Frequency of concomitant injured organs in urogenital injuries (from [10]).

<table>
<thead>
<tr>
<th>Injured organ</th>
<th>Kidney (n=65)</th>
<th>Ureter (n=6)</th>
<th>Urinary bladder (n=23)</th>
<th>Urethra (n=9)</th>
<th>Penis (n=16)</th>
<th>Scrotum (n=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest</td>
<td>25</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Diaphragm</td>
<td>14</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Liver</td>
<td>17</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>Duodenum</td>
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<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Stomach</td>
<td>8</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Spleen</td>
<td>8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Colon</td>
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<td>12</td>
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<tr>
<td>Pancreas</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fractures</td>
<td>21</td>
<td>5</td>
<td>12</td>
<td>5</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Vena cava</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Thigh</td>
<td>5</td>
<td>-</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>21</td>
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<tr>
<td>Buttocks</td>
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<td>1</td>
<td>12</td>
<td>1</td>
<td>-</td>
<td>2</td>
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<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
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</table>

Image sources:

Lieutenant Colonel Dr. Martinschek, Ulm Military Hospital (with the consent of the patient)

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About DH Function

MILMED COE was nominated by ACT Joint Force Trainer (JFT) to be the Department Head (DH) for the NATO Medical Support (Med Sup) Discipline. This appointment was approved by the North Atlantic Council (NAC) on 25 June 2015. The primary duty of the DH is to translate NATO operational requirements into education and training (E&T) solutions within the discipline framework.

Specifically, the DH for Med Sup E&T is responsible for matching the requirements with E&T solutions and for the coordination of those solutions. The DH will strive to ensure that the solutions identified are delivered in the most effective, efficient, and affordable manner through NATO Allies, Partners, and Non-NATO Entities (NNE). Additionally, the DH will conduct the Annual Discipline Conference (ADC), with participation from the community of interest, the Requirements Authority (SHAPE/ACO JMED/MEDAD), Subject Matter Experts (SME), E&T institutions and affiliated organisations and produce a Discipline Alignment Plan (DAP). The DAP will reflect the main developments and achievements and outline the way ahead, concerning NATO Med Sup E&T, as well as highlight the contributions to the MED Sup E&T by partners and NNE.

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Main events in the second half of 2015

3–5 November 2015

2nd NATO Medical Lessons Learned Workshop in Hamburg, Germany

MILMED COE will conduct the 2nd NATO Medical Lessons Learned Workshop (WS) at the Führungssakademie der Bundeswehr (Bundeswehr Staff College) in Hamburg, Germany from 3 to 5 November 2015. The WS, which is open to all Organisations and Subject Matter Experts, is supported by the Committee of the Chiefs of Military Medical Services (COMEDS). The aim of the workshop is to analyse the implications of Hybrid Warfare and Future Article V Missions for the Concept of NATO Medical Support. Specifically the goal is to have WS participants determine which regulations need to be optimized or modified in light of the current geopolitical situation and current NATO planning.

For further information, please visit our website www.coemed.org or contact the Lessons Learned Branch at pocmedli-ll@coemed.org.

11–13 November 2015

Medical Support Education and Training Annual Discipline Conference in Budapest, Hungary

MILMED COE as the proposed Department Head (DH) for Medical Support is organizing the Medical Support Education and Training Annual Discipline Conference (ADC) on 11–13 November 2015 held in Budapest, Hungary. The primary aim of the conference is information exchange and sharing among NATO and Allies, to synchronize the development strategies and directions of the individual trainings, and analyse the current status and way ahead for military medical training. This will be determined by first reviewing the current training requirement as defined by NATO Allied Command Operations, revise NATO/national training opportunities, recognize gaps, and propose solutions. The final product of the ADC will be the Medical Support Discipline Alignment Plan.

For further information, please visit our website www.coemed.org. POC: CAPT (OF5) Kimberly FERLAND, train.course@coemed.org or phone +36-1-883-0110
Canadian Armed Forces Medical Risk Matrix

From the CAF perspective, a stratified risk matrix was formulated by the Directorate of Medical Policy/Medical Standards, which balanced an acceptable level of risk to the health and safety of CAF personnel, whilst taking into consideration the potential unavailability of an appropriate level of medical care required, due to operational situation. The following article explains history and format of this matrix.

Introduction
The mission of the Department of National Defence and the Canadian Armed Forces (CAF) is to defend Canada and North America, their interests and values, while contributing to international peace and security. In order to meet these mission requirements, the CAF is given broad authority and latitude in utilizing CAF members, for which Section 33 (1) of the National Defence Act is the statutory basis (1). The Act states that “The Regular Force, all units and other elements thereof and all officers and non-commissioned members thereof are at all times liable to perform any lawful duty”. Section 33 (2) has similar requirements for the Reserve Force. This statutory requirement is the legal foundation for the Universality of Service principle, which states that “CAF members are liable to perform general military duties and common defence and security duties, not just the duties of their military occupation or occupational specification. This may include, but is not limited to, the requirement to be physically fit, employable and deployable for general operational duties” (2).

Generic Task Statements
These specific requirements of physical fitness, employability and deployability are codified in the Defence Administrative Orders and Directives (DAOD) 5023-0 and 5023-1 (3), which define minimum operational standards, for which all CAF personnel are expected to meet. These generic tasks are based on the “soldier first” principle and require an ability to fulfill 6 common “bone fide occupational requirement” physical tasks and also to perform duties whilst deployed. The latter requirement include an ability to perform duties in a variety of geographical locations and climatic conditions in any physical environment, to deploy on short notice, to sustain irregular or prolonged working hours, ability to tolerate irregular or limited meals, travel as a passenger in any mode of transportation, perform duties under physical and mental stress, to perform duties with minimal or no medical support and also perform effectively without critical medication (4).

For those personnel who are unable to meet the generic tasks of Universality of Service, they will likely be released from the CAF, for which a decision is determined by the Directorate of Military Career Administration (DMCA), a non-CAF medical organization.

Determination of Medical Fitness
Medical fitness of personnel is determined by Canadian Forces Health Services physicians, utilizing occupational medicine principles and the CAF Medical Standards. The Directorate of Medical Policy/Medical Standards, has the delegated authority on behalf of the Surgeon General, to assign permanent change of medical employment limitations and medical category, in a fair and consistent manner. In 2008, it was recognized that a change in approach regards assessment of medical fitness of CAF member’s with complex medical conditions should be considered. This decision in part was related to the number of personnel who were being released and also influenced by the operational tempo requirements at the time, which was primarily focussed on the conflict in Afghanistan.

Medical Risk Matrix
From review of the medical literature at that time, it was recognized that some organizations were already utilizing a risk matrix stratification concept; this encompassed the probability of a medical condition recurring or exacerbating and the consequences of such an event, to include the requirement, type and degree of medical intervention required. This risk stratification concept was originally developed from an engineering perspective and was subsequently further developed as a tool and guidance for aeromedical decision-making related to astronauts who were being screened for International Space Station (ISS) duties. Similar risk matrices were developed for civil aviation and also for utilization by the CAF Aerospace and Undersea Medicine Board. Civil Aviation originally utilized a risk of 1% per year, for which the probability of a catastrophic medical event being less or equal to this value, would be deemed unlikely to occur. These probabilities were further modified, dependent on the type of medical event and now utilize a risk tolerance of up to 2% per year (20% per 10 year period).
From the CAF perspective, a stratified risk matrix was subsequently formulated by the Directorate of Medical Policy/Medical Standards, which balanced an acceptable level of risk to the health and safety of CAF personnel, whilst taking into consideration the potential unavailability of an appropriate level of medical care required, due to operational situation. In addition, it considers the potential effect of a medical event on an operational mission. However the acceptance of such risk, to include the probability of occurrences of medical conditions and consequences thereof, is a Chain of Command decision. In this respect, the CAF Armed Force Council, a General Officer forum, reviewed the original proposal and endorsed this approach. The finalized risk matrix approved (Table 1), is now routinely utilized by D Med Pol/Med Stds, for review of appropriate medical cases, for which risk stratification can be applied. Its purpose is to translate medical employment limitations of CAF personnel with significant medical conditions into a stratified risk. Each determination is an individualized assessment utilizing up to date scientific evidence to predict the probable future recurrence of a medical condition, level of medical care required and associated operational consequences. The likelihood of recurrence is divided into four levels of risk, which are assigned over a 10 year time-frame, which are as follows: < 10 %/10 years, 10-20 %/10 years, 20-50% /10 years and > 50% /10 years. The severity of outcome is divided into three levels:

**Level 1**

i. Adverse medical consequences are likely to cause physical or mental discomfort which would benefit from medical attention as soon as possible, but will rarely lead to long-term consequences.

ii. Adverse medical consequences are likely to cause some decrement in performance and a CAF member would benefit from being removed from duty; however the member would be able to remain on duty and perform the mission.

**Level 2**

i. Adverse medical are likely to be in the form of an acute medical crisis. While immediate medical attention may not be crucial, lack of timely medical attention could lead to some long-term consequences.

ii. Adverse medical consequences are likely to cause moderate decrement in performance; however, will have difficulty fully safeguarding self and could be unfavourable to the mission.

**Level 3**

i. Adverse medical consequences are likely to cause serious medical outcome to a CAF member, which could lead to serious outcome or serious permanent disability, if medical support is not immediate.

ii. Adverse medical consequences are likely to cause severe decrement in performance, as the member will be totally incapacitated and incapable of defending self; this will bring serious outcomes to the mission.

The risk stratification matrix is colour coded, in a Red/Yellow/Green “stop-light” format, for which a GREEN designation indicates a member has low medical risk within a military environment, for which a CAF member can contribute greatly with the assigned medical employment limitations. For a YELLOW designation, this indicates a CAF member would have a moderate medical risk within a military environment; however could contribute acceptably with assigned medical employment limitations. For a RED designation, this indicates a CAF member would have a high medical risk within a military environment. In such cases, caution should be taken when considering unrestricted retention in these specific medical cases.

### Conclusion

D Med Pol/Med Stds utilizes the above risk stratification matrix for several medical conditions, some of which include seizure, traumatic brain injury, cardiovascular events (specifically personnel who have experienced a myocardial infarction), cerebrovascular accident, renal calculi and previous history of thromboembolic events. For such conditions, medical employment limitations which are assigned will include the probability of risk and level of medical care required and degree of incapacitation. This information is then evaluated by the Directorate of Military Career Administration, in order to determine if a member can be retained or should be released from the CAF. By utilizing this approach, medical employment limitations assigned provide a degree of flexibility for the Chain of Command to make appropriate and informed decisions, utilizing an individualized risk assessment for CAF members. This approach is both scientific and defendable; it also results in optimizing retention of trained experienced personnel, who would previously have been released from service, which is both advantageous to the member and the CAF.

### References

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Introduction

Subperiosteal preparation using a periosteal elevator leads to disturbances of local periosteal microcirculation. Soft-tissue damage can be considerably reduced using piezoelectric technology. For this reason, we investigated the effects of a novel piezoelectric device on local periosteal microcirculation and compared this approach with the conventional preparation of the periosteum using a periosteal elevator. 

Material and methods. In the first part of the study, twenty Lewis rats were randomly assigned to one of two groups. Subperiosteal preparation was performed using either a piezoelectric device or a conventional periosteal elevator. Intravital microscopy was performed immediately after the procedure as well as three and eight days postoperatively. In the second part of the study, a further 50 Lewis rats underwent subperiosteal preparation with a piezoelectric device or a conventional elevator. Specimens were obtained from these animals and examined immunohistochemically and histologically at the aforementioned time points. Statistical analysis of microcirculatory parameters was performed offline using analysis of variance (ANOVA) (p < 0.05).

Results. At all time points investigated, intravital microscopy demonstrated significantly higher levels of periosteal perfusion in the group of rats that underwent piezosurgery than in the group of rats that underwent conventional preparation. Immunohistochemical and histological assessments confirmed the superiority of the piezoelectric device.

Discussion. The use of a piezoelectric device for subperiosteal preparation is associated with better periosteal microcirculation than the use of a conventional periosteal elevator. As a result, piezoelectric devices can be expected to have a positive effect on bone metabolism. The periosteum is a membrane that consists of connective tissue and covers bone. Morphologically, the periosteum can be divided into three zones, each of which contains highly specific cells. The inner zone is the osteogenic layer that contains cells similar to those of the endosteum. Among these cells are mesenchymal stem cells, osteoprogenitor cells, active and resting osteoblasts, and/or active and resting osteoclasts. The middle zone is a translucent layer that is characterised by a large number of capillaries. The outer zone is a typical fibrous layer that contains collagen fibres. [1]
The specific structure of the periosteum is seen not only in children but also in adults and allows bones to remodel themselves over time, for example during bone fracture healing. [2–4] Periosteal cells play a major role in the supply of blood to the bone. The importance of intact periosteal tissue is underlined by the substantial contribution of periosteal blood cells to the supply of blood to cortical bone (70–80% of arterial supply and 90–100% of venous return) when compared to intraosseous blood vessels. [5] The periosteum is closely attached to bone by collagen fibres in the bone matrix and by hemidesmosomes. [6] Surgical procedures, especially those directly involving bone, often have adverse effects on the osteogenic potential of the periosteum since they are associated with the detachment of periosteal tissue from the bone. Periosteal damage can either be caused by the deliberate separation of the periosteum from the bone during surgery or it can be the result of a disease or trauma. The preparation of the periosteum is a routine procedure in trauma surgery, reconstructive surgery and especially dentoalveolar surgery. [7–10] It is commonly performed with a periosteal elevator that is used for manually lifting and separating periosteal tissue from the bone. This procedure causes damage to the morphological structure of the periosteum and especially to the cells of the osteogenic layer. The result is a complete or partial loss of periosteal function. [11, 12] It is currently impossible for surgeons to prepare the periosteum between the osteogenic layer and the underlying bone in such a way that the periosteum remains intact. The use of a periosteal elevator leads to the disruption of tissue at the periosteum-bone interface. The destruction of the connection between bone and periosteum damages the regenerative cells of the periosteum and reduces their osteogenic potential. [13–16] Successful osteoinduction and osteoconduction, however, require the preservation of cell vitality in the periosteum. [11] Periosteal cells provide nutrition to the underlying bone by free diffusion. Adequate functioning of the periosteum is of far greater importance to patients who have underling diseases such as diabetes mellitus or undergo tumour treatment and receive chemotherapeutic agents than it is to healthy people since the periosteum plays an important role in promoting rapid bone healing. If these patients undergo surgery involving bone, particular care must be taken to cause no damage or as little damage as possible to the periosteum with a view to ensuring subsequent bone healing without dehiscences or necrosis. [17] If the bone is damaged without compromising local periosteal microcirculation, good bone healing can be expected. If, by contrast, local periosteal microcirculation is compromised, the regenerative potential of the periosteum will be reduced. Good periosteal microcirculation is of paramount importance for bone modelling and remodeling. [12] In the literature, there is only a paucity of chronic studies on periosteal perfusion during and after subperiosteal preparation.

Whereas (piezoelectric) ultrasonic instruments have been available since 1988, devices utilizing the piezoelectric effect have been used for medical purposes only since 1998. Applications of piezoelectric devices include hard-tissue surgery, periodontal surgery, the removal of impacted teeth, apical surgery [18, 19], and bone expansion [20, 21]. The piezoelectric effect is based on physical interactions in crystalline materials. The application of an electric field creates nanoscale deformations in a crystal. This dynamic effect can be used to transform longitudinal or transverse movements of a ferroelectric material into a surgical cutting action. Piezoelectric devices are operated at different frequencies depending on the density of the tissue to be cut. The tip of the ultrasonic device vibrates within a range of 20–200 μm at a frequency of 20,000 Hz. Piezoelectric devices are permanently cooled with sterile physiological saline during use so that heat-induced trauma can be ruled out [22, 23] and the risk of bacterial contamination is minimised. The essential difference between piezoelectric devices and conventional preparation instruments is that piezoelectric devices operate in a tissue-specific manner. Every tissue has a specific frequency range at which it can be cut. A piezoelectric device can therefore cut a specific type of tissue without causing damage to adjacent tissues. Damage to the soft tissues (e.g. nerves) that surround bone, for example, is caused only at frequencies above 50 kHz. [24, 25] In addition, piezoelectric devices have the advantage that they cause minimal bleeding when they are used to cut bone. The extent to which piezoelectric devices adversely affect periosteal microcirculation has not yet been investigated. While there are a few studies that address the behaviour of bone when it is being cut by piezoelectric devices, there are no studies that examine local microcirculation within the periosteum during and after the cutting operation. We conducted this study in order to investigate the effects of piezoelectric surgery on local periosteal microcirculation and compared the use of a piezoelectric device and a conventional periosteal elevator for the preparation of the periosteum. This issue is of particular importance in the military setting since it is not uncommon for soldiers to sustain injuries to the facial skeleton and to the extremities during attacks and similar incidents. The periosteum plays a key role in the healing of these injuries and its function must be preserved as far as possible since an extensive loss of soft tissue and the separation of periosteal tissue lead to compromised vascularity and are thus associated with poor bone healing. [26]

**Material and Methods**

This study is based on animal experiments involving Lewis rats. Microcirculatory parameters were assessed and histological sections were examined.

**Experimental Animals**

All procedures were approved by the responsible authority (Ref. 12/0861) and were performed in accordance with the German Animal Protection Act and the Guide for the Care and Use of Laboratory Animals [27]. The study involved 70 adult male Lewis rats with a body weight between 300 g and 330 g (Harlan-Winkelmann, Borchen, Germany). The rats were housed singly in cages at a room temperature of 22–24°C and a relative humidity of 60–65% with a 12-hour day/night cycle. They received water and dry food (Altromin, Lage, Germany) at libitum during the entire investigation.

**Study Design and Experimental Groups**

Microcirculatory parameters were assessed on day 0 immediately after subperiosteal preparation with the different instruments and on days 3 and 8 after the procedure. The experiments were performed on the basis of a model established by Stuehmer et al. [28]. The rats (n=20) were divided into two experimental groups.

**Group 1** n=10, subperiosteal preparation with a periosteal elevator, intravital microscopy.

**Group 2** n=10, subperiosteal preparation with a piezoelectric device, intravital microscopy.

Immuno-histochemical and histological sections were examined after the animals had been killed. This part of the study involved 50 rats that were divided into five experimental groups.

**Group 1** n=10, control group.

**Group 2** n=10, subperiosteal preparation with a piezoelectric device, immuno-histochemistry and histology after three days of healing.

**Group 3** n=10, subperiosteal preparation with a periosteal elevator, immuno-histochemistry and histology after three days of healing.
Procedures
The animals were anaesthetised using an intraperitoneal injection of ketamine (Ketavet®, 75 mg per kg bodyweight, Parke-Davis, Germany) and xylazine (Rompun®, 25 mg per kg bodyweight, Bayer HealthCare, Germany). A surgical blade was used to make an incision through the skin and periosteum in the occipital region in order to expose the calvaria. Depending on the group, either a periosteal elevator or a piezoelectric device was used for the preparation procedure. The skin was then repositioned and secured in place with sutures (Ethicon Vicyl® sutures 4–0, Johnson & Johnson, Germany). The procedure took approximately ten minutes. Intravital microscopy was performed subsequently. Periosteal vascularisation was analysed by intravital microscopy on the following days at the time points indicated above. Every microscopic examination took approximately thirty minutes. After either three or eight days of healing, the animals were killed using an overdose of anaesthetics. Specimens were obtained and prepared for histological and immunohistochemical analyses.

Intravital Fluorescence Microscopy of the Periosteum
Under anaesthesia with intraperitoneal ketamine (Ketavet®, 75 mg per kg bodyweight) and xylazine (25 mg per kg bodyweight), intravital fluorescence microscopy was performed immediately after the preparation of the periosteum and on days 3 and 8 after the procedure. Fluorescein-isothiocyanate-labelled dextran (FITC-dextran, molecular weight: 150,000 Da, Sigma, Taufkirchen, Germany), 5% in 0.9% NaCl solution, 0.1 ml) was injected into the tail vein of each animal for contrast enhancement of blood plasma. A blue filter block (450–490 nm) permitted the imaging of microvessels with a diameter > 20 μm. The specimens were cut into 5-μm-thick sections, stained with haematoxylin and eosin (H&E) and examined by microscopy (DM4000B Leica Mikrosysteme, Wetzlar, Germany). Formalin-fixed and paraffin-embedded specimens were also cut into 5-μm-thick sections for immunohistochemical analysis. The following antibodies were used: rabbit anti-collagen type I (1:800, BIOLOGO, Kronschnagen, Germany), rabbit anti-collagen type IV (1:400, Acris Anticorps GmbH, Hiddenhausen, Germany), rabbit anti-collagen type VI (1:200, Acris Antibodies GmbH, Hiddenhausen, Germany), mouse anti-osteocalcin (1:200, QED Bioscience Inc., San Diego, USA), and mouse anti-SPARC (1:200, Santa Cruz Biotechnology, Santa Cruz, USA). A biotin-conjugated goat anti-rabbit antibody (1:600, Dianova, Hamburg, Germany) or a biotin-conjugated goat anti-mouse antibody (1:200, Dianova, Hamburg, Germany) was used as a secondary antibody. Incubation with streptavidin-horseradish peroxidase (Dianova, Hamburg, Germany) was followed by colour development with aminothylcarbazole (AEC) substrate (Axoxa Deutschland GmbH, Loerrach, Germany) at room temperature. Colour development was stopped under microscopic control by washing with water. The sections were counter-stained with haematoxylin (Merck, Darmstadt, Germany) and examined by light microscopy (DM4000B Leica Mikrosysteme, Wetzlar, Germany).

Analysis of Intravital Fluorescence Microscopy
Computer-assisted quantitative image analysis was performed off-line using CapImage image analysis software (Zeintl, Heidelberg, Germany). Functional capillary density, micro vessel diameters and volumetric blood flow were determined in the venules. Functional vessel density was assessed on the basis of the length of perfused micro vessels per observation area. Volumetric blood flow was calculated using the formula: \( n \times (d/2)^2 \times v/K \), where K represents the Baker-Wayland factor to correct for the parabolic velocity profile in micro vessels with a diameter > 20 μm.
periosteal elevator group at all time points. These results show that a major increase in mean functional capillary density occurred no earlier than after eight days of healing. From day 3 to day 8, mean functional capillary density increased by 387% in the periosteal elevator group and by 185% in the piezoelectric device group. The difference between the rats whose periosteum had been prepared with a periosteal elevator and the rats whose periosteum had been prepared with a piezoelectric device was significant postoperatively as well as after three and eight days of healing (p > 0.05). During the entire observation period, mean functional capillary density was higher in the piezoelectric device group than in the periosteal elevator group. Capillary density in the periosteal elevator groups was less than half as high as that observed for the piezoelectric device group on days 0 and 3. Densities were more similar after eight days of healing. At this time point, the difference between the two groups in mean capillary density was only 7.8 cm/cm². Means and standard deviations are given in the next table.

Red blood cell velocity
On day 0, red blood cell velocity was 0.31 mm/s (± 0.12) in the periosteal elevator group and 0.69 mm/s (± 0.43) in the piezoelectric device group. During eight days of healing, both groups showed an increase in mean red blood cell velocities. The highest increase was noted for both groups on day 8. At this time point, mean red blood cell velocity was 1.76 times higher in the piezoelectric device group than in the periosteal elevator group. During the entire observation period, the differences between the two groups were significant (p > 0.05). At all time points, mean red blood cell velocities were significantly higher in the piezoelectric device group than in the periosteal elevator group. The highest velocity (2.93 mm/s) was measured on day 8 for an animal in the piezoelectric device group and was 2.25 times higher than the mean red blood cell velocity. Red blood cell velocities

<table>
<thead>
<tr>
<th>Days after surgery</th>
<th>Periosteal elevator group [cm/cm²] (mean/SD)</th>
<th>Piezoelectric device group [cm/cm²] (mean/SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>22.73 ± 13.98</td>
<td>80.69 ± 17.66</td>
</tr>
<tr>
<td>3</td>
<td>31.00 ± 18.67</td>
<td>68.96 ± 20.31</td>
</tr>
<tr>
<td>8</td>
<td>120.15 ± 99.31</td>
<td>127.96 ± 36.56</td>
</tr>
</tbody>
</table>

Means and standard deviations (SD) for functional capillary density

Red blood cell velocities on days 0, 3 and 8. For a better view, the y-axis uses a logarithmic scale. Outliers are represented as circles and extreme values as asterisks.

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were almost constant in the piezoelectric device group and increased only moderately in the periosteal elevator group during the observation period. Means and standard deviations are shown in the next table.

**Vessel diameter**

The periosteal elevator group showed a significant increase in mean vessel diameter from day 0 to day 3 ($p > 0.05$). After eight days of healing, the mean vessel diameter was smaller than on day 3 but not as small as that measured postoperatively. In the piezoelectric device group, the mean diameter of perfused vessels decreased from day 0 to day 3 and then increased until day 8. After eight days of healing, the mean vessel diameter was similar to that measured on day 0. The difference was only 0.33 μm. A comparison of the two groups showed that the mean diameters in the periosteal elevator group were significantly smaller than those in the piezoelectric group during the entire observation period ($p > 0.05$). Means and standard deviations are given in the next table.

<table>
<thead>
<tr>
<th>Days after surgery</th>
<th>Periosteal elevator group [mm/s] (mean/SD)</th>
<th>Piezoelectric device group [mm/s] (mean/SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$0.31 \pm 0.12$</td>
<td>$0.69 \pm 0.43$</td>
</tr>
<tr>
<td>3</td>
<td>$0.42 \pm 0.25$</td>
<td>$0.72 \pm 0.31$</td>
</tr>
<tr>
<td>8</td>
<td>$0.75 \pm 0.34$</td>
<td>$1.30 \pm 0.78$</td>
</tr>
</tbody>
</table>

Means and standard deviations (SD) for red blood cell velocity

When the periosteum was prepared with a conventional periosteal elevator, the bone surface showed clear evidence of mechanical damage resulting from the use of the instrument. The inner zone of the periosteum was torn from the bone and there was no clear demarcation between the different layers. This type of damage did not occur when the piezoelectric device was used.

**Collagen type I**

In both groups, collagen type I levels were approximately identical on day 3 but different on day 8. At the latter time point, collagen type I levels were significantly higher in the piezoelectric device group than in the periosteal elevator group.

**Collagen type IV**

After the surgical intervention, collagen type IV levels in the piezoelectric device group were similar to those obtained for the
periosteal elevator group and significantly (six times) higher than those of the control group. After eight days of healing, collagen type IV levels had almost returned to those of the control group. At this time point, collagen type IV levels were still (five times) higher in the periosteal elevator group.

Osteocalcin

During the observation period of eight days, there was a significantly more pronounced increase in osteocalcin levels in the piezoelectric device group than in the periosteal elevator group.

Discussion

In the study presented here, a novel device for the preparation of the periosteum was compared with a conventional periosteal elevator in an animal model. The technique that was used in this study is an established method. It has been used by Menger et al. in the past twenty years and allows us to compare the various groups.

Microvascular perfusion of different types of tissues can be investigated in vivo by a variety of methods such as laser Doppler flowmetry and polarographic oximetry. [3, 27, 28] The main disadvantage of these methods is that tissue perfusion can be imaged only indirectly and that no information about the perfusion of individual micro vessels can be obtained. By contrast, intravital microscopy offers the possibility of studying the perfusion of individual micro vessels even over a prolonged period of time. [27, 29] This method has been shown to be suitable for investigating periosteal perfusion in other studies. [30, 31] We determined functional capillary density, blood flow within micro vessels and the diameters of micro vessels in the periosteum in order to investigate whether a piezoelectric device causes less irritation to micro vessels than a conventional periosteal elevator.

Our results show that the use of the piezoelectric device for the preparation of the periosteum was associated with a considerably higher post-procedural periosteal blood flow than the conventional method with a periosteal elevator.

One possible explanation is that the use of a piezoelectric device leads to the formation of fewer micro thrombi during subperiosteal preparation than a periosteal elevator. Functional capillary density was significantly higher after preparation with a piezoelectric device. As a result, a considerably higher number of perfused vessels were available for periosteal supply. In addition, the piezoelectric device was associated with a significantly higher microvascular blood flow than the periosteal elevator. Histological assessments of the effects of trauma on tissue and the immuno-histochemical staining of tissue specimens are common methods for examining tissue. [33] In the study presented here, the analysis of histological sections shows that a piezoelectric device is superior to a conventional periosteal elevator in preparing the periosteum.

Vessel density in the periosteum plays an important role in the supply of blood to bone. [5] Every surgical procedure that leads to subperiosteal exposure results in a decrease in periosteal perfusion. [3] Several studies reported that piezosurgery is an atraumatic process that causes only minimal tissue damage. [34] In the future, this technique can play a key role in the management of compromised patients since the vascular layer of the periosteum is largely preserved. This is one of the principles of biological osteosynthesis, which is used in the fields of orthopaedics and trauma surgery. Periosteal preparation with a piezoelectric device can be an option especially in the treatment of fractures that soldiers sustain during attacks and similar incidents and that are associated with severely compromised tissue. The use of piezoelectric devices for periosteal preparation may considerably improve the outcome of patients with injury patterns similar to those seen in military operational settings. The results reported here show that the use of a piezoelectric device for the preparation of the periosteum has considerable advantages. Further studies are required to investigate possible effects in patients who have comorbidities and, for example, are treated with bisphosphonates, chemotherapeutic agents or other medications and in soldiers who sustained blast injuries that are challenged by poor soft-tissue quality and may include thermal injuries. Such studies are underway but results are not yet available.

References: ref@mci-forum.com

Correlation

“Bladder Injuries in Military Conflicts”

The Curriculum Vitae of the author of the above article, published in MCIF issue 2/2015, contained translation errors. Here the correct wording:

Curriculum Vitae

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Since 2014 Oral surgeon at medical center Seedorf

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Quality Increase of Emergency Health Care to the Injured
– the Top Priority for Disaster Medicine


The main tasks of Disaster Medicine Service in emergency medical care arrangement and delivery in emergencies are the following: prompt response; mobilization of public health man-power and resources; movement of the Services' units to emergency zones; arrangement and timely delivery of medical care to the injured; medical evacuation of the injured. According with the Article 32 of the Federal law of the Russian Federation of November 21, 2011 #323-F3 "On Fundamental Healthcare Principles in the Russian Federation" emergency medical care is given in sudden acute diseases and states, acute exacerbation of a chronic disease, challenging life.

Analysis shows that needs in emergency medical care in everyday life is up to 15% and in emergency response it is more than 60% of all medical care delivered to population. Thus, timeliness (accessibility) and quality of emergency health care are of vital signifi- cance. Considering social significance of emergency medical care, the necessity to provide conti- nuity of all types of emergency medical care delivered to the injured, a Subprogram "Development of emergency medical care, including the specialized one, primary health care in urgent form and specialized medical care in urgent form" was included in the new version of the National Program "Public Health Development". In disaster medicine, timeliness and accessibility of emergency medical care are ambiguous notions. In emergencies, such as earthquakes and explosions the injured are in debris of ruined buildings without any access. In these situations, the role of emergency rescue units is of vital importance [2]. In everyday life mainly the injured in road accidents and residents of far and difficult of access regions including households need emergency health care.

At emergency site ambulance teams play the main role in giving emergency health care to the injured and their evacuation to the medical institutions. Thus, in 2014 more than 5400 mobile medical teams worked at emer-
Emergency sites, among them 95% were ambulance teams. During work in emergency, the role of the first medical team, which arrives at the accident site, is of utmost importance. Head of the team is responsible for medical evacuation in emergency zone and primarily for medical triage and emergency medical care and, according with the requirements of Health Ministry of the Russian Federation, for urgent submitting a report to the dispatcher service of the Territorial Centre for Disaster Medicine. Variants of work of Disaster Medicine Service’s medical teams (mobile medical teams, field multipurpose hospitals, permanent ready specialized medical teams, etc.) are tested in practice of hundreds and thousands emergency responses, beginning from the military conflict in the North Caucasus.

To provide emergency health care accessibility and quality for the residents, including those living in the sparsely populated areas and households it is planned to establish or improve existing subdivisions (emergency dispatcher departments) working on the base of emergency consultative health care and medical evacuation departments of Territorial Centres for Disaster Medicine) of the Integrated Dispatcher Service of the Executive Authority of the Russian constituent entity (hereinafter referred to as the Region) in the field of population health care. Operational-dispatching department of Territorial Centres for Disaster Medicine works round-the-clock, it should be equipped with modern communication facilities, including Internet, providing receiving and exchange of information with all executive bodies of the Russian Federation’s regions, which participate in emergency response; ambulances, medical and local institutions, villages and households.

Operational-dispatcher department should have the following functions: collection and analysis of health information; monitoring of severely injured patients in medical institutions; monitoring of arrangement and delivery of emergency health care, including emergency consultative medical care, to the residents of far and difficult of access regions.

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Ministry of Health of the Russian Federation works to provide accessibility of medical care for the population and this work includes, among other things, development of emergency consultative medical care and medical evacuation (air medical service) [3,4,5]. Analysis of the information presented by regions of the Russian Federation showed that development of air medical service demands sufficient number of modern aircrafts, equipped with special medical modules; available helicopter landing sites and runways; well-developed infrastructure for efficient operation and maintenance; necessary financial conditions for air companies - aircraft operators and introduction of long-term national contracts with air companies for the term exceeding expiration date of approved limits of budget commitments. While developing air medical service it is advisable to use experience of the regions of the Russian Federation efficiently introducing mechanisms of public-private partnership [6,7,8].

Cooperation of national health care authorities of Leningrad region and St. Petersburg with the Limited Liability Company “Helidrive” can serve as an example of such partnership, when the following tasks are solved:
- arrangement of medical air evacuation of the injured in road accidents;
- transportation of the patients to the megalopolis hospitals, equipped with helicopter landing sites;
- arrangement of interhospital evacuation to the specialized medical institutions;
- delivery of medical mobile specialized consultative teams to other regions;
- transportation of transplantation organs and donated blood to the special medical institutions equipped with helicopter landing sites.

At the expense of “Helidrive” company, helicopter landing sites were built for inter-district medical institutions of Leningrad region, light helicopters with medical equipment were bought and round the clock dispatcher service was organized. The first experience has already shown that development of air medical service on the basis of public-private partnership will reduce aircraft operating and maintenance costs.

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Introduction

In addition to the risks associated with modern operations in deployed settings, Canadian Armed Forces (CAF) personnel must cope with environmental factors. The CAF’s Health Services Group has responded to these potential additional risks by creating the Directorate Force Health Protection (DFHP). DFHP’s mission is to protect and promote the health and well-being of the CAF and its members, with leadership, stewardship, and partnership in support of the DND/CAF mission — anytime, anywhere. In particular, DFHP activates its Deployable Health Hazard Assessment Team (DHHAT) to assess potential occupational and environmental hazards in deployed settings when tasked by the Canadian Joint Operations Command (CJOC). DHHAT is made up of Bioscience Officers, Preventive Medicine Technicians, and is supported by DFHP’s Laboratory Manager, Occupational and Environmental Physicians, Toxicologist, and Industrial Hygienist. DHHAT collaborates with the DFHP’s experts and deployed medical personnel to conduct pre-deployment assessments of potential health hazards in the CAF areas of operation. Once potential hazards are determined, a sampling plan is developed, which DHHAT executes by completing a technical assistance visit (TAV) to the deployed setting. On these TAVs, DHHAT collects environmental samples that will be shipped to an accredited laboratory for analysis. Once the laboratory results are received, they are screened to identify compounds of potential concern (CoPC) to CAF members’ health. Subsequently, DFHP prepares a report that contains proposed mitigation measures to reduce potential occupational and environmental exposures. This report is sent to CJOC, the Command Team in theater, and the Directorate Health Services Operations.

DHHAT was present throughout the CAF’s mission in Afghanistan with 11 TAVs being successfully completed over an 11-year period between 2003 and 2014. The TAVs took place in either Kabul or Kandahar depending on where CAF personnel were living and working. The focus of these Afghanistan TAVs varied depending on each deployment’s specific environmental and occupational concerns. They covered a wide spectrum of monitoring and sampling including air quality measurements, water potability assessments, spill investigations, building material analyses and noise surveys.

The emphasis of this article will be on the air quality in Afghanistan since air quality was the main health concern throughout this mission. Table 1 details when and where the DHHAT TAVs took place, the list of compounds or groups of compounds that were measured in air, and which one was identified as being a CoPC to CAF members deployed to Afghanistan.

Identification of Compounds of Potential Concern

Each Afghanistan TAV generated thousands of individual air quality results. In order to sort through these results and pick out those that were most likely to cause either short-term or long-term adverse health effects (also called compounds of potential concern or CoPC), each result was compared to the most up to date internationally recognized health benchmarks, guidelines or standards. Exceeding these typically conservative thresholds does not necessarily imply that adverse health effects would occur but rather raises the need to conduct a toxicological assessment.

The Afghanistan air quality results were screened using the current American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) time-weighted average (TWA). The National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)-TWA was another health-based standard used to assess contaminants in air. For airborne compounds with no existing ACGIH or NIOSH standards, public health-based ambient air criteria were employed, such as the United States Environmental Protection Agency (US EPA) national ambient air quality standards for particulate matter and the Ontario ambient air quality criteria for dioxins and furans (D/F).

The ACGIH TLV-TWA and the NIOSH REL-TWA are standards derived for occupational exposures. For compound-specific contaminants in air, another health-based standard used to assess effects would occur but rather raises the need to conduct a toxicological assessment.

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Each Afghanistan TAV generated thousands of individual air quality results. In order to sort through these results and pick out those that were most likely to cause either short-term or long-term adverse health effects (also called compounds of potential concern or CoPC), each result was compared to the most up to date internationally recognized health benchmarks, guidelines or standards. Exceeding these typically conservative thresholds does not necessarily imply that adverse health effects would occur but rather raises the need to conduct a toxicological assessment.

The Afghanistan air quality results were screened using the current American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) time-weighted average (TWA). The National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)-TWA was another health-based standard used to assess contaminants in air. For airborne compounds with no existing ACGIH or NIOSH standards, public health-based ambient air criteria were employed, such as the United States Environmental Protection Agency (US EPA) national ambient air quality standards for particulate matter and the Ontario ambient air quality criteria for dioxins and furans (D/F).

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airborne exposures. They represent airborne concentrations of substances to which nearly all workers can be repeatedly exposed over their entire working lifetime without adverse health effects, based on an 8-hour workday and a 40-hour work week. These occupational standards are not completely suitable for CAF personnel in deployed settings because CAF personnel could be exposed to compounds in air for periods exceeding the standard 8-hour work day and 40-hour workweek. However, the duration of their deployment is much less than a working lifetime. On balance, it is believed that these occupational health thresholds provide a reasonable, though conservative, comparative benchmark for occupational airborne exposures while on deployment. Airborne contaminants that were measured at levels that were below the TLV-TWA or REL-TWA would not be expected to produce long-term adverse health effects in CAF members.

From all of the air quality sampling and monitoring performed in the 11 years of TAVs in Afghanistan, only three analytes exceeded their respective health threshold on at least one occasion and were therefore identified as a CoPC; crystalline silica, D/F, and PM (Table 1). Crystalline silica exceeded its health standard on three separate TAVs, two to Kandahar (2009, 2010) and one to Kabul (2011). D/F measured above the health guideline in 2011 from a TAV to Kabul. PM produced consistently high results on at least one occasion from all the TAVs completed in Afghanistan. Potential health impacts of crystalline silica, D/F, and PM will be discussed below.

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Compounds monitored in air</th>
<th>CoPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kabul</td>
<td>2003 Jun</td>
<td>Total particulates, Respirable particulates, PM, Crystalline silica, Asbestos fibres, Elemental carbon</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kabul</td>
<td>2003 Oct</td>
<td>Total particulates, Respirable particulates, PM, Crystalline silica, Metal scan</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kabul</td>
<td>2005 Jul</td>
<td>Total particulates, PM, Crystalline silica, VOC, Metal scan</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kabul</td>
<td>2006 Feb</td>
<td>Total particulates, PM, Crystalline silica, Metals scan, VOC</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kabul</td>
<td>2007 Oct</td>
<td>Total particulates, Respirable particulates, Asbestos fibres, PM</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kandahar</td>
<td>2009 Dec</td>
<td>Total particulates, Respirable particulates, PM, Crystalline silica, Asbestos fibres</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kandahar</td>
<td>2010 Dec</td>
<td>Total particulates, Respirable particulates, PM, Crystalline silica</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kandahar</td>
<td>2011 Mar-Apr</td>
<td>Total particulates, PM, Crystalline silica</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kandahar</td>
<td>2011 Oct-Nov</td>
<td>Total particulates, PM, Crystalline silica</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kabul</td>
<td>2011 Nov-Dec</td>
<td>Total particulates, Crystalline silica</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
<tr>
<td>Kabul</td>
<td>2014 Jan-Feb</td>
<td>Total particulates, PM, Crystalline silica</td>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

**Tab.1: Locations and dates of the Deployable Health Hazard Assessment Team (DHHAT) Afghanistan technical assistance visits (TAVs), compounds measured in air and compounds of potential concern (CoPC) identified.**

Notes:  
PM = particulate matter  
PM<sub>2.5</sub> = PM equal to or less than 2.5 μm in diameter  
PM<sub>10</sub> = PM equal to or less than 10 μm in diameter  
* PM10 results from this TAV were unreliable due to a sampling error  
PAH = polycyclic aromatic hydrocarbon  
VOC = volatile organic compounds  
D/F = dioxins and furans
Crystalline Silica

Crystalline silica is a basic component of soil, sand, granite and has three main forms: cristobalite, tridymite and α-quartz. The predominant species of crystalline silica in Afghanistan is α-quartz (Engelbrecht et al., 2008). Indeed, when detected, all crystalline silica results from the Afghanistan TAVs where observed to be of the α-quartz form. Crystalline silica, including α-quartz, is a mechanical irritant to lung tissue and has been listed by the ACGIH as an A2, suspected human carcinogen (ACGIH, 2015). There is evidence that some forms of pulmonary fibrosis are risk factors for human lung cancer and sufficient exposure to crystalline silica can cause some of these forms of pulmonary fibrosis (ACGIH, 2010). Crystalline silica can be found as both aged, and newly fractured. Newly fractured α-quartz is mainly associated with industrial processes (mining, drilling, sandblasting, glass manufacturing, quarries and foundry work); it represents the higher health risk of the two forms, and is the driving factor for the A2 carcinogen designation. Aged α-quartz is predominantly found in the environment and has low cancer association, but does represent a mechanical irritant health hazard. Sites surveyed in Afghanistan (Bagram, Khowst) by the Desert Research Institute showed no evidence of freshly fractured quartz grains (Engelbrecht et al., 2008). In all instances, quartz grains examined by the Desert Research Institute from Afghanistan were consistent with environmental aged quartz and had rounded edges (Engelbrecht et al., 2008).

Crystalline silica results from the Afghanistan TAVs were compared to the ACGIH TLV-TWA of 25 ug/m³ and α-quartz exceeded this health standard on 3 separate TAVs, in 2009 and 2010 (Kandahar) and in 2011 (Kabul). The 2009 Kandahar TAV had all air samples for crystalline silica below the analytical detection limit of 12 ug/m³ except for one sample taken at Patrol Base Sperwan Ghar (PBSG), which produced a result right at the TLV-TWA of 25 ug/m³. This highest concentration of α-quartz could have been the result of operational activities that occurred at the time of the sampling. The firing of howitzer guns at PBSG was observed to increase both total dust and respirable dust. This would indicate that gunnery activities could be responsible for the elevated ambient crystalline silica result at PBSG.

DHHAT conducted additional sampling in Kandahar in 2010 with a special focus on crystalline silica due to the 2009 results. The DHHAT TAV in 2010 was purposely conducted over the dusty summer months (also known as the ‘120 days of wind’ period) in order to capture crystalline silica concentrations during their peak. Sampling occurred at three locations in Kandahar in 2010: Kandahar Air Field (KAF), Forward Operating Base Ma’Sum Ghar (FOB MSG) and PBSG. 69 samples were taken, 24 at KAF, 18 at MSG and 27 at PBSG. Of the 24 samples taken at KAF, 5 exceeded the TLV-TWA and ranged from 26 ug/m³ to 39 ug/m³. The exceedances all occurred during the evening when PM concentrations were observed to be at their peak. All of the MSG samples were below the analytical detection limit of 12 ug/m³.

Crystalline silica (α-quartz) sampling at PBSG was conducted over three days (25–27 August 2010) and coincided with an important sandstorm that commenced 24 August 2010, and ended on 27 August 2010. This event was reported by the NASA earth’s observatory and was visible from their Aqua satellite (Figure 1). Of the 27 samples taken at PBSG, 18 were above the TLV-TWA and in some cases, the α-quartz levels were more than double the TLV-TWA. The α-quartz levels remained high throughout the sampling period regardless of the time of day as the high dust concentrations remained suspended in the air. When the dust event subsided late on 27 August, the α-quartz levels also diminished to below or near the TLV values.

With the CAF having ceased operations in Kandahar, the DHHAT sampled for crystalline silica at 5 locations in Kabul in 2011. From the 76 samples collected at that time, two α-quartz samples exceeded the TLV-TWA of 25 ug/m³: one sample taken at the Kabul International Airport (KIAA) of 34 ug/m³, and another taken at Camp Eggers of 27 ug/m³. The overall α-quartz average was well below the TLV-TWA of 25 ug/m³ as most samples were below the laboratory detection limit of 12 ug/m³. The possible sources of α-quartz include wind generated desert sand as depicted in Figure 1 but also, vehicle and airborne traffic at these locations.

Some samples of the α-quartz forms of crystalline silica taken from Afghanistan did yield results that exceeded its ACGIH TLV-TWA. However, the exceedances occurred infrequently and mainly during important dust events. Therefore, considering the short deployment period (6–12 months compared to a lifetime of working in an industry), the maximum α-quartz levels anticipated, and the fact that the bulk of this silica is not newly fractured but rather aged as observed by the Desert Research Institute, the long-term risk posed by crystalline silica to CAF personnel deployed to Afghanistan is considered negligible. However, acute health symptoms could have been expected from exposures to high concentration of crystalline silica such as during sandstorms. These symptoms could have included irritation to the eyes, nose, throat and lungs.

Dioxins and Furans

Dioxins and furans (D/F) are the generic terms for polychlorinated dibenzo-para-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF). D/F have no commercial purpose; they are formed as by-products of combustion for polychlorinated dibenzo-para-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF). D/F exposure sources in Afghanistan are likely the domestic burning of plastics, burning of municipal waste, and combustion of wood and hydrocarbons. D/F are highly persistent in air and soil; they can be transported to remote areas via winds and deposited in soils and sediments.

Fig. 1: NASA Aqua satellite image shows a widespread sandstorm over Afghanistan that commenced 24 August 2010. This image was captured during the ‘120 days of wind’ period. http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=45425

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There is no ACGIH TLVs or NIOSH RELs for D/F. To put the Afghanistan D/F results in perspective, they were compared to the Ontario ambi-
ent air quality criteria (AAQC) of 0.1 pg TEQ/m³ (MOE, 2011) and compared to concentrations measured elsewhere around the globe (Figure 2). DHHAT collected 21 D/F samples at 4 locations in Kabul in 2011. DHHAT did not collect D/F during other TAVs due to the difficulty in getting the specialised D/F sampling equipment into theatre. D/F sampling occurred in Kabul because it was felt that it represented the worst-case scenario concerning the potential presence of D/F in air. The bowl landscape surrounded by mountains promotes inversions and traps persistent compounds in air like D/F.

The D/F analyses conducted in Kabul in 2011 indicated that most results were above the Canadian urban background levels and the AAQC of 0.1 pg/m³ TEQ. The results are contained between the concentrations reported in Beijing, China and Balad, Iraq (IOM, 2011; Figure 2). It is believed that these higher levels of D/F in Kabul may be the result of increased use of plastics as a fuel source for heating and cooking in Kabul (IOM, 2011). Since the D/F samples taken on the 2011 DHHAT TAV to Kabul yielded results that surpassed the health-based guideline, and thus a toxicological assessment was performed. The toxicological assessment consisted of a D/F risk characterization conducted in two ways, firstly by comparing the estimated daily intake resulting from inhalation of Kabul air to published acceptable daily intakes, and secondly, by predicting a body burden of D/F that would have resulted from the 9 month deployment to Kabul.

The estimated daily D/F dose for the average CAF member deployed to Kabul was estimated at 0.17 pg TEQ/kg bw/day or less than 20% of the D/F toxicity reference value of 1 pg TEQ/kg bw/day. Considering that the conservatively estimated daily dose of D/F is lower than the toxicity reference value even when the estimated background exposure to D/F is added to the calculation, the risk of adverse health effects for CAF members from airborne D/F in Kabul was considered to be negligible. Moreover, the predicted body burden of CAF members deployed to Kabul for nine months was estimated to be much lower than the body burden toxicity reference value (0.2 pg TEQ/g lipid versus 12 pg TEQ/g lipid). It was therefore concluded that a nine month deployment to Kabul contributed minimally to the background body burden of CAF members and no significant risk of adverse chronic health effects from this exposure would be expected.

**Particulate Matter**

Particulate Matter (PM) is a complex mixture of small particles and liquid droplets. PM is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles (US EPA, 2013). PM equal to or less than 10 μm in diameter, is known as PM10. PM equal to or less than 2.5 μm in diameter, is known as PM2.5. Figure 3 is a graphical interpretation of PM10 and PM2.5. The size of particles is directly linked to their potential for causing health effects. Smaller particles (less than 2.5 μm in diameter) are of particular concern because those are the particles that penetrate deep into the lungs.

There are no ACGIH TLV or NIOSH REL standards for PM and their corresponding air quality index (AQI) categories. Table 2 details the different 2013 AQI categories for PM2.5 and PM10.

Every DHHAT TAV completed in Afghanistan had PM10 samples collected and analyzed systematically. As research into the field of PM evolved, the importance of conducting PM2.5 sampling became known and was implemented on every TAV from 2009 onwards. Figure 4 depicts mean 24h-average PM results grouped for all the sites and dates surveyed within a given TAV in relation to the US EPA AQI categories. The average PM2.5 results measured throughout the Afghanistan TAVs fall within the moderate to the unhealthy AQI categories while the average PM10 results extend above the hazardous AQI category. The highest mean concentration for both PM2.5 and PM10, as was the case for the

<table>
<thead>
<tr>
<th>AQI Category</th>
<th>PM2.5 mg/m³</th>
<th>PM10 mg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>0 – 0.012</td>
<td>0 – 0.054</td>
</tr>
<tr>
<td>Moderate</td>
<td>&gt;0.012 – 0.054</td>
<td>&gt;0.055 – 0.154</td>
</tr>
<tr>
<td>Unhealthy for sensitive groups</td>
<td>&gt;0.0355 – 0.0554</td>
<td>&gt;0.155 – 0.254</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>&gt;0.0555 – 0.1504</td>
<td>&gt;0.255 – 0.354</td>
</tr>
<tr>
<td>Very Unhealthy</td>
<td>&gt;0.1505 – 0.2504</td>
<td>&gt;0.355 – 0.424</td>
</tr>
<tr>
<td>Hazardous</td>
<td>&gt;0.2505 – 0.5004</td>
<td>&gt;0.425 – 0.604</td>
</tr>
</tbody>
</table>

Table 2. The 2013 United States Environmental Protection Agency (US EPA) National Ambient Air Quality Standards for Particulate Matter and corresponding color-coded Air Quality Index (AQI) (US EPA, 2013).

Notes:

PM10 = PM equal to or less than 10 μm in diameter
PM2.5 = PM equal to or less than 2.5 μm in diameter
α-quartz form of crystalline silica, occurred during the 2010 TAV to Kandahar during the ‘120 days of wind’ period. The highest levels of PM and silica during the 2010 TAV to Kandahar were temporally associated with dust events as shown by the NASA satellite imagery (Figure 1).

Based on the air quality surveys, CAF members deployed to Afghanistan were potentially exposed to PM$_{2.5}$ and PM$_{10}$ at concentrations sufficient to pose a short-term health risk such as eye irritation, nose, throat and respiratory symptoms such as cough and sputum production. While these symptoms were possible during general ambient conditions in Afghanistan, they were probable during a dust event, when the majority of personnel (whether healthy or predisposed), could be expected to demonstrate some symptoms and those with pre-existing respiratory conditions such as asthma could be expected to experience worsening of their symptoms.

Although acute air quality related symptoms while deployed were probable, it is unlikely that the exposure to infrequent, short-term dust events would produce long-term health effects. There is little evidence in the scientific literature to support clinically significant delayed onset or long-term health effects following high exposures to PM during a relatively short-term deployment (6 to 9 months). However, research in this field is limited as large, long-term studies are required and the unusual patterns of potential exposure (pertaining to a 6 to 9-months military deployment) are relevant to only a very small group of people. The majority of the PM research has focused on the adverse health effects on the general population over a long-term exposure to ultrafine urban fossil fuel derived PM, which has been associated with increased cardio-pulmonary disease and mortality. The US EPA AQI is based on this health research. There is less research and knowledge about the long-term effects of short-term exposure to high levels of PM in relatively healthy troops. This makes the interpretation of exposure limits and health risk assessments a challenge. On-going research mainly from the US Army Public Health Command pulmonary working group will hopefully shed light on these issues.

A review of the EpiNATO and Disease and Injury Surveillance System (DISS) data reflecting the time of the dust event in 2010 did not indicate any rise in clinic/hospital visits for respiratory illness. However, this lack of association could also reflect the difficulty in establishing transient PM-related health effects to short-term PM exposures.

Exposures to high PM levels during dust events can be mitigated by personnel reducing heavy outdoor activities as well as by moving indoors. This change in activity was
promoted, in the Afghanistan deployed setting, by the cessation of air operations in times of poor visibility, which in turn resulted in cessation of patrols.

**Conclusion**

Over the 11 years of ambient air quality results from Afghanistan, thousands of samples were taken from various compounds or groups of compounds; PM, crystalline silica, asbestos fibres, VOCs, metals, elemental carbon, PAHs, D/F, sulfur oxides, nitrogen oxides and ozone. Based on all the monitoring and the sampling conducted, three analytes were identified as compounds of potential concern to CAF members deployed in Afghanistan; D/F, crystalline silica and PM. The D/F toxicological assessment revealed no significant risk of adverse chronic health effects would be expected. However, CAF members’ exposures to PM and crystalline silica were, at times, enough to pose acute health effects such as eye, nose, and throat irritation as well as respiratory symptoms. Although there is currently little scientific evidence to support clinically significant delayed-onset or long-term health effects following these sporadic high exposures, research in this area is limited and still ongoing, making definitive interpretation of health risk assessments a challenge.

**Final Remarks**

DFHP employs DHHAT in a variety of ways, and DHHAT’s role is a diverse one that spans beyond air quality monitoring. DHHAT was activated for various TAVs in the recent years; in the aftermath of the Haiti earthquake in 2010, in 2013 to Israel and in 2015 to Kuwait. DHHAT also fulfills domestic taskings such as providing support to OP NANOOK in the Canadian Arctic for Joint Task Force North, and completing occupational and environmental health surveys for the Submarine Safety program. For additional information on DHHAT, its role and publications, visit the following CAF Health Services Website: http://cmp-cpm.mil.ca/en/health/personnel-providers/deployable-health-hazard-assessment-teams.page.

**References:** ref@mci-forum.com

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Dr. Lalonde holds a specialised Master’s degree in Chemical and Environmental Toxicology and a Doctoral degree in water sciences for which she won the Governor General Gold Medal. Following her graduate studies, Dr. Lalonde was hired by the Department of National Defence as the Senior Advisor in Toxicology within the Directorate of the Force Health Protection of the Canadian Forces Health Services Group. In this capacity, and with the help of a multidisciplinary team, Dr. Lalonde conducts environmental health risk assessment for CAF members in garrison and in deployed settings. She is passionate about her work and enjoys sharing her enthusiasm by teaching graduate students as well as Medical Officers from the Canadian Armed Forces.

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International DiMiMED conference on the occasion of MEDICA confronts current questions on the co-operation of civilian and military medical facilities

Attacks on major events present rescue staff with special challenges. The attack on the Boston Marathon killed three people, another 250 were injured, some of them severely. In a situation like this, civilian and military relief and rescue units must co-operate very closely. Contributions to this topic will be discussed on this year’s DiMiMED.

Düsseldorf, September 2015 – In parallel to MEDICA, the world’s largest trade fair for medical technology, the International Conference on Disaster and Military Medicine (DiMiMED) will be held for the third time. This year, the main topic of is operations in crisis areas. In view of the increasing need for humanitarian aid in disaster zones, there is an additional focus on civilian aid organizations and their work. Apart from plenary lectures on innovations and scientific questions in disaster and military medicine, there is an interactive simulation workshop dealing with the practical implementation of aid in major catastrophic events. Additional topics of interest include a session on disaster medicine in international comparison as well as a group of presentations for industry representatives on aspects of the procurement of medical technology by the German Federal Armed Forces and NATO. DiMiMED is held under the patronage of the MEDICAL CORPS INTERNATIONAL FORUM (MCIF) and is organized jointly by Beta Verlag and Messe Düsseldorf. Around 50 international speakers and 200 participants are expected to attend on 17th and 18th November at CCD Süd. MCIF is the only independent magazine aimed at medial services around the world. An editorial office consisting of top-quality professionals offers current articles of international importance from practitioners for practitioners, aimed at professionals in military medicine from more than 180 countries.

No matter if we are dealing with military conflicts, terrorist attacks, natural disasters or outbreaks of disease, the world-wide increase of crisis zones needs a sustained long-term management of medical services. In this connection, military medicine offers a broad coverage of medical care. “This year, we have put a strong focus on disaster medicine, since many military medical services world-wide find that this is increasingly developing into a large part of their work, or at least that they have to work in disaster medicine as well as in military operations”, said Rear Admiral uh MC (ret) Christoph Büttner, MD, scientific head of DiMiMED.
Within two days, the 200 experts from medicine, industry and logistics will be offered a broad spectrum of information presented and discussed by about 50 internationally respected speakers in plenary lectures and, for the first time, also in more depth in parallel sessions. Looking back, the second scientific head Brigadier General (ret) Rob van der Meer, MD, says: “I co-chaired the DiMiMED 2014 and saw a fruitful exchange of information and experiences. A shift of interest was evident from operational medical experiences in Asia to Africa. The development of new techniques and future application in the forces was important, both in very simple methods as well as sophisticated procedures and also evaluation processes.” So indeed, a further development of the concept with a more focused approach has already been initiated.

Simulation workshop raises awareness for a major catastrophic event in Dusseldorf

A special highlight will be the simulation workshop with a scenario of a major catastrophic event. “This simulation was quite consciously ‘placed’ in Dusseldorf, since an event like the Boston assassination can happen anytime and in any city. For the simulation, we have therefore invited, apart from the military guests, high-ranked responsible staff from the ministries of the interior and the police headquarters. My goal is to motivate this target group to conduct similar training scenarios in their area of responsibility – which sometimes is actually done already”, explains Dr. Büttner, thus also referring to the co-operation with CAE Healthcare who are, among others, offering the medical simulation technology.

Refugee crisis highlights urgent medical problems

The session on “Disaster Medicine & Crisis Prevention” will be chaired by Prof. Leo Latasch, MD, President of the Deutsche Gesellschaft für Katastrophenmedizin (DGKM, German Society of Disaster Medicine). He gives his opinion on the most urgent issues that need to be broached, both nationally and internationally. “Medical care for the huge number of refugees world-wide, the question of a joint (I) approach to epidemics and outbreaks of disease, as well as the tasks of the military in a national context for issues like care for refugees and natural disasters, taking into account the question why, if at all, are we always asked so late?”

Making procurement processes more transparent to the industry

Last not least: the workshop “Military Procurement for Industry Partners” will explain procurement processes in military medicine on the example of the German Federal Armed Forces and NATO. The session is especially intended to address industry representatives who want to offer their product portfolio for special military requirements in the home country and in the country of operation. “Basically, we are interested in nearly all areas of medical care and indications. Of course, some fields like paediatrics or geriatrics are not that much in demand, except in rare cases of humanitarian aid after earthquakes or after the tsunami in South East Asia. Emergency and rescue medicine are of course always extremely important – especially under the challenging conditions we meet in our operations abroad” explains Colonel Pharmacist Dr. Ulrich Kindling, Head of Branch U3-5, The Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support.

In this as well as in all other sessions on topics like infectious diseases/hygiene, trauma medicine, protection from the effects of chemical, biological, radiological and nuclear hazards as well as selected questions on how to protect the health of the relief units themselves, speaker slots are provided both for representatives of science and representatives of the industry. This not only supports the interdisciplinary approach but also offers opportunities for the initiation of research and development co-operations.

For the first time, DiMiMED will also offer a poster exhibition, and a poster prize will be awarded. On the occasion of the conference, the MEDICAL CORPS INTERNATIONAL will grant the Ambroise Paré Award for the best scientific publication in MCIF in the field of military medicine and pharmaceutics.

(Author: Nina Passoth)

Simulation workshop raises awareness for a major catastrophic event.

In the framework of this year’s DiMiMED, CAE Healthcare offers the simulation of a major catastrophic event with live scenarios and thus presents the inclusion of high-end simulations in the teaching, further education and advanced training of medical and non-medical staff.

Efficient concentration of competencies in disaster medicine and military medicine.

Rear Admiral uh MC (ret) Dr. Christoph Büttner (l.) and Brigadier General (ret) Dr. Rob van der Meer (re.) will co-chair the 3rd International Conference on Disaster and Military Medicine.

Qualified medical aid under operational conditions needs the best possible equipment

Innovations, current developments and basic conditions in the procurement system of the German federal Armed Forces medical services and in NATO as well as the resulting innovations and lines of action will be presented on the occasion of this year’s DiMiMED.
Amputations in Patients Admitted with Diabetic Septic Foot
Wad-Medini Teaching Hospital (2008 – 2009)

Hospital based and general population based data of the burden of diabetic foot disease in Sudan are scanty. Accurate information on the prevalence of the risk factors for diabetic foot ulceration is also much needed, as it is essential for developing and evaluating preventive procedures, public health practices and health care services.

Introduction
The prevalence of lower extremity amputation (LEA) is high in Sudan, but the underlying risk factors remain to be defined. This study aims at determining the pattern of amputations in diabetic patients admitted with septic foot and to explore the prevalence rate, types, clinical features and possible risk factors and clinical outcome in diabetic patients with septic foot admitted to Wad-Medini Teaching hospital, Wad-Medani, Sudan. This is a prospective descriptive cohort study of newly hospitalized, adult diabetic patients with septic foot conducted during the period from January 1st 2008 to December 31st 2009 (study period). Detailed clinical data were recorded for each patient, followed by a comprehensive physical examination. Clinical outcome was documented and analyzed using the statistical package program for social science (SPSS). The results were tabulated and presented in percentage forms. A total of 81 patients were studied. Nine patients (11.1%) had grade one, 54 patients (66.7%) had grade two and 18 patients (22.2%) had grade three ulceration according to university of Texas (UT) classification system. 46 patients (56.8%) were managed without the need for lower extremity amputation (LEA), 35 patients (43.2%) underwent LEA. 17 patients (20.99%) underwent major LEA while 18 patients (22.2%) underwent minor LEA. The risk of LEA was significantly associated with the grade of ulceration at presentation, UT staging, other co-morbidities, increasing age and gender. The mortality rate was 3.7%. The outcome of ulceration was determined by the severity and grade of foot ulceration at presentation. Despite a significant proportion of patients having an underlying neuro-ischemic etiology for foot ulceration, the majority healed and the need for LEA did not arise. There was gender difference in risk for undergoing LEA, which was higher in male patients. The risk for LEA also increased with age. The situation is more challenging in developing countries due to limited resources so that more stress should be given to prevention, patient education, and the establishment of multidisciplinary teams in small diabetic units that disseminate and apply the international guidelines on the management of the diabetic foot.

Abbreviations
D.M. Diabetes Mellitus
DSF Diabetic Septic Foot
ESRF End Stage Renal failure
H/O History Of
JDC Jabir Abu Aliz Diabetic Center
LEAs Lower Extremity Amputations
LOS Length of Stay
MLEAs Multiple Lower Extremity Amputation
NGOs Non Government Organizations
Pt. Patient
RBS Random Blood Sugar
SPSS Statistical Package Program for Social Science
U/S Ultrasound
UT University of Texas

Fig. 1: AMPUTATION RATE AMONG PT. ADMITTED TO SURGICAL WARDS WITH D.S.F

Fig. 2: H/O AMPUTATION INCREASES THE RISK FOR ANOTHER AMPUTATION
Patients and methods
This is a prospective, descriptive cross sectional hospital based study. It was conducted at Wad Medani teaching hospital, which is a (300) bedded tertiary level hospital receiving referrals from various localities of Al Gezira state and surrounding states. There are five (5) surgical units; each is headed by a consultant, (2 – 4) registrars and (8 – 12) house officers. There is a daily referral clinic run by a surgical unit. The hospital theatre has four (4) rooms for general surgery and one room for laparoscopic surgery. The study population included all patients (81) admitted to the surgical wards with diabetic septic foot, from January 1st 2008 to December 31st 2009. All patients were consented to participate in the study.

Inclusion Criteria
1. All patients admitted to surgical ward.
2. Aged 18 years and above.

Exclusion Criteria
1. Patients managed at the outpatient clinic or at home.
2. Private Patients.
3. Young patients below 18 year of age.

A full detailed history was taken from each patient and a proper systemic examination was performed by the author, together with relevant investigations. All patients were assessed further for ischemia, neuropathy, grade of ulcer, infection and associated complications (e.g. renal function impairment, sepsis, hypertension...etc.)

Data were collected after obtaining consent from all patients using a pre-designed data collection sheet which was constructed in sections to address different aspects of the problem:

Section (1): Personal data.
Section (2): Diabetes history.
Section (3): Chronic illness history.
Section (4): Investigation.
Section (5): Treatment.
Section (6): Complications.
Section (7): Rehabilitation.

Data collected included age, sex, type/duration of diabetes, cause of ulceration, duration of ulcer, previous history of ulceration, presenting signs & symptoms and previous treatment and socio-economic status. Diabetes control was assessed based on the fasting (FBS) & random (RBS) plasma glucose levels.

The examination of the diabetic feet followed the recommendations of the American diabetes association (ADA).

Each patient underwent assessment of the vascular status by manual palpation of femoral, popliteal, dorsalis pedis and posterior tibial arteries to define patency and grade: (a) good volume (b) diminished volume or (c) absent. Neuropathy was quantified assessing vibration sensation using a 128 HTZ tuning fork and a 10 g monofilament applied perpendicularly to the planar aspect of the first toe, the first, third and fifth metatarsal heads, the plantar surface of the heel and dorsum of the foot avoiding any callosities, corn or wound site and graded as normal, diminished or absent. Ankle and knee reflexes were assessed as normal, reinforced or absent. Osteomyelitis was determined by radiological examination. The University of Texas Classification System was used to classify the severity of ulceration at presentation.

The treatment provided covered these aspects:
- Surgical debridement (figure 16)
- Dressing
- Control of infection
- Control of diabetes

All foot ulcers were photographed at the initial presentation and at each stage of review through the study. Outcome is recorded as: No amputation or LEA defined as loss of any part of the lower limb as major if proximal to tarso-metatarsal joint and minor if distal to this joint. All collected data were finally entered in the computer using the statistical package program for social science (SPSS).

Objectives
Main objectives:
To study the pattern of amputations in diabetic patients admitted with septic foot.

Specific objectives:
- Prevalence of DSF related amputations.
- Types of DSF related amputations.
- Clinical features of DSF related to amputations.
- Possible risk factors for DSF leading to amputations.
- Relation to age and sex.
Survival after amputations (peri operative).
- The need for a different approach to deal with the problem of DSF in our community.
- Patient awareness of the role of prevention.

Results

The total number of patients involved in the study was 81. The mean age for the study population was 55.5 years; the majority of patients (71%) had type 2 diabetes mellitus. Most of the patients (83.5%) presented with foot ulcers. Nine patients (11.1%) had grade one, 54 patients (66.7%) had grade two and 18 patients (22.2%) had grade three ulceration. 46 patients (56.8%) were managed without the need for LEA, 35 patients (43.2%) underwent LEA (Figure: 1). Nearly 21% of patients underwent major LEA while 22.23% of patients underwent minor LEA. The risk of LEA was significantly associated with the grade of ulceration at presentation, UT staging, other co-morbidities, increasing age and male gender (Figure: 6). The mortality rate was 3.7%. Inflicting cause was identified in (40.4%) of the patients. The most commonly affected toe was the big toe in 39.0% of the patients, followed by the second toe in 18.5% of the patients. The plantar aspect of the foot was affected in 42.6% of the patients whereas only the heel was involved in 10% of the patients. Dorsum of the foot was involved in 13.6% of the patients.

The mean duration of diabetes among patients who underwent amputation was 16 years. It was recorded that 43.2% of patients had different types of amputations. (Figure: 1) 20.99% of the patients had major amputations. Above knee amputations were reported in 8.64% of the patients, Ray’s amputations and Syn’s amputation represented 12.35% and 2.47% of the patients respectively (Figure 2).

It was recorded that 22.23% of the patients had minor amputations. Toe amputation was reported in 8.64% of the patients, Ray’s amputation and trans metatarsal amputations were recorded in 9.88% and 3.71% of the patients respectively.

History of lower extremities amputations was present in 13.58% of the patients. This group represented 31% of the amputees (Figure: 2).

A re-amputation rate of 8% was reported (Figure: 3).

The toes were the most commonly amputated in 18.52% of the patients (Ray’s and minor toe amputations) and accounted for 43% of total amputations (Figure: 4).

Gangrene was the commonest indication for amputation (59%), followed by osteomyelitis 23% (Figure: 5)

The risk for amputation increased with age. Maximum amputations occurred between ages of 54 to 70 years (figure: 6). (table: 1)

Anemia was common among admitted patients (27.16%) representing an important risk factor for amputation as 45.71% of the amputees were anemic (Figure: 7). On the other hand, 72.73% of the anemic subjects were amputated.

Few (10.5%) patients had critical limb ischemia as determined by Doppler U/S scan. This was found to be the most significant risk factor for major amputations.

There was no association between LEA and poor glycemic control as 45.71% of the amputees were on regular diabetic follow-up (Figure: 8, table 2). This can be explained by the fact that most of the patients have poor diabetic control. It was noted that six out of eight newly discovered diabetics were amputated (75%).

Significant number of patients (57%) did not receive foot care advice at the time of diagnosis of diabetes, which is an important preventive measure (Figure: 9).

This study recorded that 97% of patients were of low socio-economic class, nevertheless only 14% of them were covered by health insurance!

Discussion

Diabetic foot ulceration is the most frequent cause of hospitalization among diabetic patients. LEA, is the most feared and costly consequence of foot ulceration. In this study the majority of patients presented at an advanced stage of foot ulceration with a resultant high amputation rate (43.2%) in agreement with several other studies. Furthermore, male subjects had a greater chance of undergoing LEA than female subjects as shown in other studies. Patients with neuropathy and ischemia were more likely to undergo LEA but neuropathy alone was not independently associated with LEA, as shown in a number of other studies. Analysis showed that beside age, hospital admission was independently associated with LEA. Clearly this is related to more advanced grade and stage of ulceration requiring hospitalization for intravenous antibiotics and surgical intervention leading to LEA.

Patients with previous history of limb amputation were at a higher risk for amputation, representing 31% of amputees. Compared to our hospital, Jabir Abualiz Dia- betic Centre (JDC), Khartoum reported a lower amputation rate of 38% among patients admitted with diabetic foot according to world diabetes foundation, Sudan project. The majority of patients presented with advanced stage and grade of ulceration reflecting a lack of structure in the health care delivery system of Sudan between primary, secondary and tertiary care units. Attempted home surgery, trust in traditional and faith healers and undetected diabetes further aggravates the problems. Moreover, inadequate antibiotic treatment and the use of non-sterile instruments for dressing, results in the growth of multi resistant organisms necessitating hospital admission and surgical interven- tion. This will also contribute to increase the length of stay (LOS) in the surgical wards, causing additional pressure on the health services.

These poor outcomes also reflect the low priority in terms of health spending. Only 2% to 5% of the total household expenditure is spent on health, while the required amount is much higher.3 Most of the patients (97%) come from a low socio-economic back ground and therefore can not meet the demands of treatment (dressing material, drugs, investi-gations... etc) which are usually required for long periods of time. They need financial sup-

Fig. 6: RISK OF AMPUTATION INCREASES WITH AGE

Fig. 7: Common complications associated with D.S.F.
port, which they seldom get. Unfortunately, only 14% of them are covered by health insurance which is meant basically to support the poor and needy sections of the society. This issue needs to be addressed by the authorities taking in consideration the serious consequences of neglected D.S.F, the scale and the impact of this problem on the community.

The mean duration of diabetes among patients who underwent amputations was 16 years. This explains the increased risk for amputations associated with aging. The peak incidence of amputation occurred at the age of 55 to 75 years.

In this study, there was no association between LEA and poor glycemic control as shown in other studies. We noticed that patients with neuropathy underwent LEA independent of poor diabetic control. This reflects the fact that all these patients had poor glycemic control. It is of interest that 17.14% of LEAs were performed in persons newly and recently diagnosed as having diabetes. Moreover, six out of eight newly discovered diabetics (75%) underwent a sort of LEA. It would appear, therefore, that some patients presenting with established foot complications of diabetes would not be able to benefit from secondary preventative health care.

Anemic patients were at greater risk for amputations as 72.73% of them underwent L.E.A., representing 45.71% of the amputees. Anemia will complicate the ischemic state of the diabetic foot and delays healing, therefore if present, anemia should be corrected immediately.

The current study confirms a high amputation rate as a consequence of diabetic foot ulceration in Wad-Medani teaching hospital. The major deficiency in this study is that it is not population based and represents patients referred to a tertiary care center. However, it has the advantage of accurate characterization of the stage and severity of foot ulceration with a high follow up rate. Earlier presentation with aggressive and appropriate medical and surgical treatment according to the severity of ulceration can improve morbidity and reduce mortality. This can be achieved by educating health care professionals and patients through education programs and instituting comprehensive multi-disciplinary foot care programs. At the patient level, effec-

<table>
<thead>
<tr>
<th>Pt.s admitted with DSF</th>
<th>Regular follow up</th>
<th>Neglected</th>
<th>Newly discovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>82</td>
<td>51 (62.96%)</td>
<td>22 (27.16%)</td>
<td>8 (9.88%)</td>
</tr>
<tr>
<td>Amputated Pt.s</td>
<td>16 (45.71%)</td>
<td>13 (37.14%)</td>
<td>6 (17.14%)</td>
</tr>
<tr>
<td>Amputation</td>
<td>31.37%</td>
<td>59.09%</td>
<td>75%</td>
</tr>
</tbody>
</table>

**Tab. 2: FOLLOW-UP AND CONTROL OF D.M**

**Fig. 9: FOOT CARE ADVICE**
tive foot care advice should be propagated to reduce the burden imposed by diabetic foot complications, particularly in developing countries. The implementation of these measures has led to a 77.8% decrease in amputation rates amongst persons with diabetes in Brazil where 'Save the Diabetic Foot Project' has been implemented. This shows that even in resource-poor countries strategies can be put in place to improve the outcome of diabetic septic foot without the need for expensive equipment. In parts of India and in Brazil, careful screening of patients, education of the patient and health professionals and the institution of preventive measures have been successful in reducing ulceration and amputation rates. These successes are heartwarming and should encourage us. Our ultimate target should be to make available effective preventative foot care and education programs that will work effectively in primary, secondary and tertiary health care settings throughout the country. „We can and should begin to follow the examples set before us. We must not wait till the present situation reaches catastrophic proportions before we begin to act“.

A study conducted at Jabir Abu Eliz Diabetic Center (JDC), University of Khartoum, implemented a system for prediction of lower extremity amputation. They used the criteria for wound classification adopted by the International Consensus for the Diabetic Foot to get a reliable grading of the diabetic foot and predict the outcome. These criteria were: the degree of limb ischemia, sensory neuropathy, depth and surface area of the wound, severity of sepsis, and ESRF.

Risk factors for diabetic LEA, based on several types of analytic studies, are quite similar to those for foot ulceration. In fact, foot ulceration itself seems to be a major predisposing risk factor for LEA, preceding approximately 85% of amputations. Most studies indicate that duration of diabetes, level of diabetic control, and various degrees of neuropathy are independent predictors for amputations, as are blood pressure, retinopathy, nephropathy, and peripheral vascular disease. Cigarette smoking is an inconsistent risk factor across a variety of study designs. In their landmark paper, Pecoraro et al determined the causal pathways responsible for LEAs in a series of consecutive male diabetic patients.

Using the model established by Rothman, the causal sequence was defined by both component causes with various combinations of component causes that produce the outcome. A sufficient cause, therefore, is a constellation or grouping of the minimal number of specific component causes that, in concert with each other, inevitably produce disease. There can be a number of sufficient causes with various combinations of component causes that produce the same outcome. However, removal of any component cause will block the completed pathway to the sufficient cause and thereby prevent disease through this specific pathway.

A study conducted in Nigeria reported LEA rate of up to 50% among patients admitted with diabetic septic foot to a tertiary health care center, while the rate was 27.5% in another study conducted in Pakistan (Figure: 12 – 16)

Conclusions
Hospital based and general population based data of the burden of diabetic foot disease in Sudan are scanty. Accurate information on the prevalence of the risk factors for diabetic foot ulceration is also much needed, as it is essential for developing and evaluating preventive procedures, public health practices and health care services.

The prevalence and outcome of diabetic foot disease are influenced by genetic factors, cultural factors, and the quality and availability of health care services. Lack of proper health education, knowledge and skills by both patients and health care providers, as regards the care of the diabetic foot, still results in insufficient prevention and management. For many people access to health care is still very limited, with a great number of patients presenting very late to hospital.

The low socio-economic status and unsatisfactory diabetic control of many patients are significant contributory factor to the high morbidity and mortality associated with diabetic foot ulcerations. Delayed referrals to secondary and tertiary centers by medical practitioners are also common. Unfortunately, even in tertiary hospitals in Sudan, inadequate facilities and socio-economic burdens also hinder prompt and appropriate treatment. Presently, there are no podiatrists, orthotists or specialized foot clinics. Most tertiary centers are not even equipped for vascular intervention. There are also no facilities for customized footwear, and offloading devices. The inadequacy (or sometimes total lack) of foot care program provisions at primary and secondary health care settings is a considerable barrier to the provision of foot care for patients with diabetes mellitus. This emphasizes the need for the provision of foot care programs, not
just at tertiary level, but also at primary and secondary health care levels. To reduce the amputation rate, however, attention should be paid through a multidisciplinary setup to timely referral from the physician, patient education, total contact cast, and appropriate revascularization. The situation is more challenging in developing countries due to limited resources so that more stress should be given to prevention, patient education, and the establishment of multidisciplinary teams in small diabetic units that disseminate and apply the international guidelines on the management of the diabetic foot.

Recommendations
The situation of diabetic foot care in Sudan is not satisfactory, resulting in high LEAs rates with major economic consequences for the patients, their families, and society and have a huge impact on health services. In order to tackle this growing problem we recommend the adoption of the following measures:

1) Policy makers should understand the devastating effects caused by diabetic foot problems and the urgent need for an integrated DSF care program in primary, secondary and tertiary health care settings.

2) Training health professionals in foot examination techniques and diabetic foot care at health centers and hospitals throughout the country. This leads to the provision of sufficient interested and trained personnel.

3) To enhance preventive measures and provide adequate education facilities for people with diabetes and their families. The golden rule: “prevention is better than cure”.

4) Introduction and implementation of hospital based specialist multidisciplinary foot care clinics and the addition of orthotists to the team. These teams are to be built up step by step, introducing the various disciplines at different stages

5) To establish multidisciplinary care and the integration of work between the orthotists and nurses.

6) Expansion of the national health insurance coverage to include and cover the weaker and low socio-economic sections of the society. This service should provide the necessary support for rehabilitation of amputees.

The time has come for a concerted effort to provide foot care programs for patients with diabetes mellitus. Governments, other health control agencies and non-government organizations (NGOs) need to be made aware of the importance and suffering relating to diabetes mellitus and diabetic foot problems, so that proper resources for diabetes education, care and foot care programs can be allocated. A concerted effort must be made towards obtaining nationwide epidemiological data on the burden of diabetic foot disease.

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Introduction
University Hospital of Trauma & Military Hospital (UHT&MH) is a continuation of the Central University Military Hospital (CUMH coming). By government decision from January 2013 UHT is depending from the Ministry of Health. Military medical personnel is depend-ent from the Ministry of Defense, but is included in the structure of trauma and is part of the mission. UHT&MH is a tertiary hospital, the second in the country, qualified for the mission “trauma management at the national level”. UHT&MH has the following specialties: basic services, Emergency, Surgery, Orthopedics, Neurosurgery, ENT, Ophthalmology and Maxillofacial, ICU, Reconstruc-tive Surgery, Therapy and Rehabilitation services. It has a capacity of 192 beds, but in emergencies, disasters and catastrophes the capacity can be extended to 250 beds. The total personnel is 321 (81 doctors, 200 nurses and technician pharmacists plus 40 for administration & logistics). The history of the UHT&MH as the National Trauma Centre since 1993, reflects some culminating moments in emergencies and disasters - such as the treatment of wounded in riots in 1997 in Albania, during the Kosovo war in 1998-1999, the car crash with students from Kosovo 2004 in Fushe-Arez, treating injured by the explosion of munitions in Gërdec 2008 (Picture 3,4) and the bus crash with students in south, Himara 2009 (Picture 2,5).

UTHMH is located in a strategic position close to the crossing of the national road north-south, which makes possible the transporta-tion of the wounded in a car accident on time.

Methods:
Study material consists of all statistical cases presented in UHTMH for a five-year period 2010–2014, which include emergencies, admissions, operations, automobile accidents analyzed in an analytical manner arranged in tables and graphics, subject to statistical analysis to determine indicators for a rate of change.

General Remarks
In the world today, trauma occupies a special place with a growing trend and due to high

Epidemiological Profile of Trauma
University Hospital Trauma & Military Hospital in Tirana, Albania

Nowadays the “epidemic of trauma” is evident in Albania, its treatment in the University Hospital of Trauma and Military Hospital (UTHMH) remains of primary importance. The statistical data and the volume of work as described in this article, give a full profile of UTHMH as a tertiary hospital that treats trauma at a national level.
rate of death with impact on society and the economy. Every year in the world are estimated about 5-6 million people who die as a result of trauma. Trauma affects the productive part of society, the young. At ages between 0-45, trauma is calculated second behind HIV/AIDS as a cause of death. Head trauma takes the first place in early and later mortality.

The road safety is among the most debated issues worldwide as road traffic deaths and injuries are considered a major public health and development issue. More than 1.2 million people are killed and up to 50 million are injured, every year, in road crashes. The World Health Organization’s Global Status Report on Road Safety, 2013, recognizes road traffic injury eighth leading cause of death globally. Current trends suggest that road traffic injuries will become the fifth leading cause of death by 2030, unless urgent action is taken. Half of the world’s road traffic deaths occur among vulnerable road users, including motorcyclists (23%), pedestrians (22%) and cyclists (5%). In charts 1 and 2 Albania rates very poorly in both indicators, compared with other countries. Limited road safety constitutes a major problem for Albania, as the number of road crashes with either fatal casualties, serious or light injuries have increased significantly over years.

Tab. 1 During the period 2010-2014 medical emergencies occupied a significant place where are counted 40,000 patients per year (averaged over 100 per day) and the main share of surgical emergencies 59-60%, the rest are therapeutic urgency. (Table 1). According to the census in medical emergencies during the past three years, etiology of trauma in UTMH emergency are:

- Car accidents ...................... 12%
- Gunshot wound .................... 4.8%
- Work trauma ....................... 38.8%
- Wound caused by blind and sharp tools ............... 19.4%

During Ammunition Explosion in the demolition center in Gërdec on March 15, 2008 at 12:15 h, 10 km NW of Tirana, near the Tirana-Durrës national highway, in a distance of 3-4 km from National Airport (Foto), Just at the moment of explosion, 26 persons were dead (Picture 3). In less than two hours UTMHMM received 176 wounded with severe medium and heavy injuries, which were managed professionally by medical personnel. The Gerdec case shows that a trauma hospital can be confronted at any moment with trauma of tragic proportions.

The issue of road traffic crashes and the high number of victims is highly debated in Albania as well. While efforts are made in years to make the roads safe, data show that crash victims are of huge concern for the Albanian public health. Chart 3 show the trend of all types of road crashes, number of casualties and fatalities. During the last five years (2009-2013) fatalities have remained within a band ranging between 300 and 390 per year, equivalent to a rate of between 10 and 12 fatalities per 100,000 persons. However, from 2009, the number of those seriously injured is increasing every year compared to fatalities (chart 4).
There are 5000 to 6000 patients per year at UHTMH where the traumatic surgical admission predominates by 84% and therapeutic by 16%. Surgical interventions are 53%. The Hospital conducted 600 operations per year and 28-30 thousand microsurgery interventions.

This data is typical for a national emergency hospital as well as for a traumatic surgical hospital. (Tab. 2)

Data for basic morbidity show that cases of “trauma” hospitalized are 40.3% of surgical and 51% of emergencies that occur in the hospital. Head trauma has higher figures, 38%, fractures 20%, 15.3% abdominal trauma. By age group at 74.5% are active ages 15 to +65 years, at 74% are males and 26% females. With an incidence 61-62 per thousand (Tab. 3)

Based on the number of recoveries and registered deaths, the total mortality in UTMH is 2.2%, while in ICU the average mortality in the years of the survey showed 18%. This is due to the fact that cases treated in intensive care are those with high mortality. (Tab. 4)

The comparison of the data for the treatment of trauma at UTHMH tertiary hospitals of the University Hospital Center (trauma of medium and heavy severity) shows that 40% of the cases were treated at our hospital and only 5.7–6% in the University Hospital Centre in Tirana. Other hospitals treat minor trauma. The data proves that UTHMH has its weight in the proper treatment of trauma (Tab. 6).
### Conclusions

Nowadays the “epidemic of trauma” is evident in Albania. Its treatment in UTHMH remains of primary importance.

- The statistical data and the volume of work provide a full profile of UTHMH as tertiary hospital that treats trauma at national level.
- Work trauma and car accidents occupy a leading place in the epidemiological profile.
- Further modernization, personnel training in UTHMH is and should have the attention of health policy at the Ministry of Health, to set up a national program for the treatment of trauma in the whole country.
- Creating a national trauma registry and computerization, currently lacking, needs to be looked at.

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The Committee of the Chiefs of Military Medical Services in NATO (COMEDS) met the first week of June in Berlin for its 43rd plenary session. 81 participants attended representing 33 nations (22 NATO and 11 partners).

In the follow-on of the Wales Summit, NATO works on the Readiness Action Plan (RAP) which is the biggest reinforcement of NATO’s collective defence since the end of the Cold War, the enhancement of the NATO Defence Planning Process (NDPP), the Smart Defence (SD), the Connected Forces Initiative (CFI) and the Framework Nation Concept (FNC). CFI and the future RAP implementation will be the tool to secure well trained and exercised soldiers and a highly professional NATO Forces in the future. A point on all these priorities have been presented and discussed in the plenary.

COMEDS, through all its working groups and panels, works currently on around 150 topics that cover both operational medical support and capability development. The NATO operational medical support doctrine is depicted in 72 allied publications that are revised every three years. This should regularly raise questions on management of the committee. Therefore, this plenary had a session on governance supported by four syndicates (system of meetings, information sharing, evaluation and collective training). The findings will serve for further developments.

Among all topics, several ones were particularly discussed during the meeting: Medical leadership, future medical support, medical ethics, force health protection capability, lessons learned process, shortfall of medical personnel, enhancement of the medical reserve support to NATO missions, food defense and training.

A great step forward has been made on Lessons Learned as COMEDS wanted to increase participation and interconnections and to improve the responsiveness of the system. To achieve these goals COMEDS supported the Centre of excellence for military medicine in Budapest that develops a NATO Medical Information and Knowledge Management System with a key component of a modified LL process using Lessons Learned Portal.

France, Germany, United Kingdom and United States of America presented each an update of their commitments to the Ebola crisis. A new Smart Defence project, called “Tier 2.96 Smart Defence – Responsiveness to Biological Outbreak” has been presented to the chiefs of military medical services. The proposal’s aim is to increase efficiency and effectiveness of existing bio-response capabilities and provide availability for NATO or participating nations in this project. The proposal will allow NATO and nations to better prepare for a bio threat. COMEDS is sponsor.

The next plenary meeting will be in NATO HQ, Brussels, 16–18 November 2015. It will then be the last meeting of the French presidency and Canada will take over. In 2016 Ireland will be the host of the spring-plenary session. The wonderful and very interesting city of Dublin will be a great place for the international participants.

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<th>Event</th>
<th>Location</th>
<th>Website</th>
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<tr>
<td>8.–14.11.2015</td>
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<td>Tozeur, Tunisia</td>
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<td>Düsseldorf, Germany</td>
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<td>MILITARY AND VETERAN’S HEALTH RESEARCH FORUM</td>
<td>Quebec, Canada</td>
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<td>7.–12.12.2015</td>
<td>Bioterrorism and Health Intelligence</td>
<td>Sydney, Australia</td>
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<td>Moscow, Russia</td>
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