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SHORT COMMUNICATION

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Abstracts from The Cold Weather Operations Conference 2021

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ABSTRACT
A common effort for both military and civil healthcare is to achieve knowledge-based health care in cold weather injuries and fatal accidents in harsh arctic environment. The *Cold Weather Operations Conference* in November 2021, having more than 300 participants from 20 countries, was addressing the prevention and treatment of injuries and trauma care in cold weather conditions and the challenges for military prehospital casualty care. The intention of the programme was to stimulate further research and systematic knowledge-based clinical work. The abstracts from the conference present cold weather research and clinical experience relevant for readers of the International Journal of Circumpolar Health.

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Introduction

The global climate threat challenges all of us, and the changes are even more pronounced in the polar areas of the globe. Additionally, many parties in the polar and sub-polar regions have great interest in the accessing the natural resources, using the Northeast passage (NEP) as shipping route, and establishing a military presence.

The northernmost parts of the Norwegian mainland, the Arctic Norway, lies above the Arctic circle at 66°33′, and Longyearbyen at the Svalbard archipelago is the northernmost town in the world. Norway is safeguarding peace, stability and promotes the high north collective security being a member of the North Atlantic Treaty Organization (NATO) [1].

NATO has signalled a need to enhance the ability to manage military operations in a cold weather environment. In 2007, Norway was accredited to host the Centre of Excellence for Cold Weather Operations (COE-CWO) to support NATO within cold weather-related skills for ongoing and future military operations [2].

Even if the main effort is simply to enhance NATO's capability to operate in a cold weather environment, COE CWO serves as the provider for expertise in the field utilising a joint military and civilian supported network organisation. The *Cold Weather Operations Conference* (CWOC-21) at Terningen Arena in Elverum, Norway from 2 to 4 November 2021 is a milestone in the collaborative efforts on how to adapt to the cold weather challenges [3].

The theme of this year's conference was: "NATO cold weather warfighting capability for the future". A substantial part of this is the focus to reduce the risk of Cold Weather Injuries (CWI) and fatal accidents in harsh Arctic environment.

The Cold Weather Operations Conference 2021

The CWOC-21 program outlined three tracks and an exhibition. The main track of the conference focused

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on the strategic and operational level, the Education & Training-track covered planning, training, and operations in a cold weather environment, while the Cold weather medicine-track (CWMT) was addressing the prevention and treatment of CWI and trauma care in cold weather conditions. The exhibition was arranged in parallel to the conference, being aligned with the conference theme.

The CWMT addressed CWI in civilian life and in military service. The Tactical Combat Casualty Care (TCCC) [4] has been revolutionary for military prehospital casualty care, but how does this concept adapt to cold weather warfare? Lacking evidence-based medicine for CWI, experimental and off-label treatments have contributed to an increased interest in the medical community regarding CWI [5]. Long-term frostbite sequelae previously lacked treatment options, but new knowledge-based achievements have been presented [6]. Modern diagnostic equipment and invasive medication in CWI were presented within the cold weather context [7].

Conference participants

The target audience for the conference was individuals at the strategic to operational level in the NATO command structure. Invitations to the conference were distributed through all military communications channels, alongside announcements on the internet. Additionally, civil institutions cooperating with the military healthcare were specifically invited to contribute.

This first ever COE-CWO conference had more than 300 participants from 20 countries. More than 100 researchers and healthcare personnel attended during the two-day CWMT. In addition to scholars in this field, senior medical officers, military and civilian physicians, and Norwegian health authorities were present.

Scientific and clinical program at the conference

The aim of the CWMT was to combine medical knowledge and clinical experience with winter military training and challenge any military operation in the Arctic. Invitations for presentations were therefore forwarded to both the operational level in the civil and military medical communities.

The intention of the CWMT-program was to address quite different aspects of Cold Weather Medicine, and to stimulate further research and systematic knowledge-based clinical work. Specific invitations were sent to international research and clinical organisations. Civil parties within the Norwegian Emergency Medicine & Pre-Hospital Emergency Medicine environments were also specifically invited to contribute.

The medical field care, emergency handling and evacuation within TCCC had a specific focus when setting up the program since injury-related mortality increases with decreasing temperature. Addressing hypothermia was the main topic addressing preventable death related to CWI. The aim of the program was summarised the panel discussion at the end of CWMT.

Relevance to the readers of the international journal of circumpolar health

Natural disasters and cold related health-crises pose a challenge to the capabilities of civilian healthcare systems. Most NATO-countries have a collaborative national and international engagement, allowing both civilian and military participation within the concept of a total defence healthcare. In reverse, the military is also involved in support to civil healthcare challenges during national emergencies [8].

Experiences from the medical management during armed conflicts have resulted in numerous medical achievements and a significant reduction in the trauma-related mortality rate [9]. This is particularly the case with CWI as many injuries take place during training and military operations [10–13]. Military experience might therefore close the gap and provide new useful, early, clinical prognostic guidelines to CWI treatment [14].

The increased civilian–military medical collaboration also naturally stimulates the debate about the value of maintaining dual military-civil healthcare systems [15]. This broad context of increased civil-military collaboration makes military research and clinical experience in CWI relevant for readers of the International Journal of Circumpolar Health.

Abstracts from CWOC-21

Cold Weather Operations Conference – setting the scene

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Introduction: The geopolitical, military strategic and environmental trends have in recent years led to an increased focus towards the Arctic areas. Military operations in this area needs to mitigate the overall challenges that come alongside cold weather.

Discussion: Norway is located at the edge of the polar ice and, and with much of the country beyond in Arctic Circle, Cold Weather Injuries (CWI) is highly relevant for both civilian and military activity. The Norwegian Armed Forces is host for the Centre of Excellence for Cold Weather Operations (COE-CWO) in The North Atlantic Treaty Organization (NATO). The aim of COE CWO is to develop joint concepts for military operations in cold weather environments. This includes specific education, training, and medical knowledge for the warfighting capabilities in the Arctic. A vital part of the Arctic military strike force is Cold Weather Medicine with the focus to prevent, diagnose and treat CWI according to the best knowledge, guidelines, and standards. These principles were brought up at the Cold Weather Operations Conference 2021 (CWOC 21) in Elverum, Norway from 2 to 4 November 2021 [2]. Target audience the Cold weather medicine track at were researchers and scholars in this field, senior medical officers, military physicians, and healthcare personnel.

Conclusion: Cold weather medicine is important for the armed forces as it is for the civilian communities in the high north. The CWOC 21 is an important arena for knowledge in the field, addressing CWI and trauma care in Arctic conditions.

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Occurrence of freezing cold injuries in the Norwegian Armed Forces between 2004–2021

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Introduction: Increased knowledge is necessary to mitigate freezing cold injuries (FCI) in our military personnel.

Discussion: FCI is the most common cold weather injury representing around 5% of all types of registered injuries in the Norwegian Armed Forces. 30% were registered with 2nd degree injury, and 20% had ailments affecting their ability to work and their leisure activates more than two years after the injury (1). Fingers and toes were the most frequent location (70%). The consequences for the soldier's personal health can be severe and render them unfit for continued service. New material from the Norwegian Armed Forces Health Register show that between 2004–2021, approximately 2400 military personnel with a mean age of 20 years, 24% women were burdened with FCI (2). Additional nonreported cases are expected. The yearly variations seem to be associated with large winter exercises like f.i. "Cold Response" and extreme climate as seen during a recent incident this year with temperatures down to minus 38°Celsius. FCI have gained more attention over the last years, and the fluctuation might also be due to an increased reporting. Ongoing research will explore the effects of the cold in terms of identification, prevention and follow up of FCI in military personnel.

Conclusion: The Norwegian Armed Forces, Joint Medical Services collaborate with UiT – The Arctic University of Norway in future research to identify risk factors, describe clinical outcome and impact of health-related quality of life.

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Frostbite and peripheral circulation

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Introduction: The skin is the body´s largest organ with many functions, two being important for cold exposure and cold injuries (CI´s). By vasomotor control (vasodilation/ vasoconstriction), heat exchange from the skin is finely regulated. The skin is also a complex sensory system with cold and cold pain thermosensors. Peripheral circulation (PC) shows a wide range of variation, from almost zero (in cold) up to 8 l/min (or ~60% of cardiac output) in heat, with large local differences, ranging from 60-fold variations in the fingers to 7 times in the torso. In many body areas, including the fingertips and toes, nose, helix of ears and cheeks, there are short circuits from arteries directly into veins called arteriovenous anastomoses (AVA´s) that bypass flow resistant capillaries. The AVA´s shunt large volumes of blood in the heat but are closed in the cold.

Discussion: CI´s like frostbite not only affect PC but also sensory function, e.g. increased cold hypersensitivity. Understanding the effect of CI´s on PC, not least for treatment, requires knowledge of PC in healthy subjects. A simple method to examine PC is by infrared thermography, whereby skin temperature (ST) provides indirect information on the underlying blood perfusion. Following thermal provocation tests such as local cooling, valuable information on PC can be obtained by comparing changes in ST patterns before, during and in the recovery period after the thermal challenge. In the hands, for example, ST during rewarming in healthy subject follow a distinct symmetrical pattern starting at the AVA´s in the fingertips.

Conclusion: Following CI´s thermal patterns in the skin are disturbed providing information on injury severity.

Treatment of frostbite

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Introduction: The Department of Plastic and Reconstructive Surgery (UNN) works closely with the Joint Medical Services (JMS) of the Norwegian Armed Forces to optimise the treatment of soldiers with frostbite sequelae and of frostbites sustained during military operations in the Arctic. The purpose of this lecture is to provide an update of our approach

Discussion: Cauchy grading for frostbites after rewarming should be implemented and registered. Superficial frostbites can be treated locally using a standard treatment protocol that has been distributed to the Joint Medical Services. Deep frostbites should be referred immediately but the standard protocol can be started before transport. Thrombolysis with a 2-days treatment with Tissue Plasminogen Activator (t-PA) can be started within 24 hours after thawing, but not later, and only in selected cases with Cauchy grad III and IV and when there is no risk for bleeding. This is followed by a 5-days treatment with Iloprost infusion. In other cases, with Cauchy grad II, III, and IV, a 5-day treatment with Iloprost infusion in combination with the standard treatment protocol will be initiated. A pilot project is planned on the use of ultrasound -guided botulinum toxin A around the radial artery and/or posterior tibial artery for the treatment of frostbites with Cauchy grad I–II. Based on our published research, a pilot study is planned on the use of this technique for treatment of frostbite sequelae.

Conclusion: Collaboration between the Department of Plastic and Reconstructive Surgery and Joint Medical Services has resulted in an algorithm for the treatment of frostbite and a treatment of frostbite sequelae using an active approach.

Non-freezing cold injuries: long term effects

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Introduction: Non-freezing cold injuries (NFCI), which typically may occur in military personnel, may result from exposure to cold, at temperatures around 0°C or above, and worsened by wind and moisture. The injury is due to cooling but not freezing of tissue like in frostbite. NFCI may result in in chronic neuropathy and cold hypersensitivity. Military personnel have been investigated by neurophysiological testing, including with nerve conduction studies (NCS) of major nerves in upper- and lower extremity, small fibre testing (Quantitative Sensory Testing , measurement of thermal thresholds).

Results and Conclusion: The first results are from a four-year follow-up investigation of large – and small-fibre function in 26 naval cadets and officers who were exposed to cold injury (five days boat-ride at temperatures slightly below ^{0}C the two last days). Investigations found place two months following the injury, with follow-up investigations of affected soldiers at six – to twelve months and up to three-four years. Of 26 soldiers, nineteen complained of numbness in feet and a large majority of 16 of cold hypersensitivity two months following injury. There were significant alterations of both large- and small-fibre function, indicating a general large- and small-fibre neuropathy. The most prominent finding was a pronounced cold allodynia, inversely correlated with the amount of subcutaneous fat. During the first year, results of NCS and thermal testing gradually normalised in most, indicating regeneration of nerve fibres. Seven soldiers developed chronic symptoms in the form of cold hypersensitivity upon exposure to cold and with findings of cold allodynia (elevated thresholds to cold pain). Seven soldiers were free of symptoms from the start of the investigation, probably because they had been more eager to keep their legs moving during the exposure to cold. The clinical outcome following cold exposure is depending on several factors, both the severity of the injury (weather conditions, temperature) as well as the time of exposure to cold. Although it is difficult to generalise, long lasting cold injury (several hours – days) or repeated cold injuries of shorter duration may result in clinical symptoms and findings dominated by large fibre involvement and/or also lasting small fibre neuropathy. A single case of long-lasting cold exposure with ongoing neuropathic pain and small fibre neuropathy was presented. Less severe injury may result in chronic clinical symptoms of cold hypersensitivity upon exposure to cold and findings of cold allodynia.

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Nutrition in the cold

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Introduction: Energy costs are higher in the cold (~6,000 kcal/d) because of extra clothing and movement across snow and ice. Concepts for energy dense high fat rations to meet these requirements were based on low carbohydrate keto diets of cold-dwelling natives, even though science highlighted this as a bad idea for soldiers. Recent biomedical research has evaluated macronutrition and specific performance enhancing dietary components.

Discussion: Polar explorers subsisted on tedious high fat foods, but this diet is not well tolerated by soldiers. In cold weather feeding studies, soldiers eat less (<3000 kcal/d) than their actual energy requirements (>4,500 kcal/d) (1). During intensive Norwegian soldier ski patrol, inadequate intake resulted in weight loss, negative protein balance, and reduced performance (2). Supplementing rations with protein-based snacks led to preferential use of the supplements without a net increase in intakes (3). Strategies for thermogenic activation to prevent hypothermia have included Tum-yo yoga, caffeine-ephedrine activation of brown adipose tissue, and intake of retinol-rich seal liver. Frequent snacking in military operations provides a benefit through the thermic effect of feeding. The vasodilation effect of dark chocolate flavonoid may help to preserve manual dexterity. Tyrosine is the rate limiter to catecholamine production and sustains cognitive performance during intensive cold stress.

Conclusion: High fat rations are not well tolerated by soldiers. Food discipline is an important concept to sustain performance in the cold, and to improve rehydration. Specific performance enhancing dietary supplements may support thermogenesis, maintain peripheral blood flow (hands), and preserve cognitive and psychomotor performance in the cold.

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Preventing pre-hospital hypothermia: what is the science?

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Introduction: Armed forces operating in arctic, and sub arctic conditions are exposed to temperatures that are defined as cold weather operations. Due to the nature of armed conflict and military operations, injuries will occur and the need for hypothermia protective equipment is of the essence in these conditions (1).

Discussion: The arctic and subarctic environment can be harsh and extreme with cold temperatures, strong wind, and challenging conditions for humans to operate in. Preventive measures towards hypothermia and heat loss are crucial for the injured patient, especially during military operations were delayed evacuation is expected. Hypothermia (>35°C) and temperature loss occur in all seasons and is a severe contributor to morbidity in trauma. Most military activity in arctic will reach the definition of cold weather operations)(2). Injuries that are pacifying, severe or require painkillers like opioids or equivalents can reduce the ability to thermoregulate. This heightens the need for effective hypothermia prevention equipment and the investigation of other methods to prevent hypothermia and loss of body temperature. ASTM F3340-18 Is an established standard that can be used as a practical approach to reducing temperature loss to the ground(3).

Conclusion: Reduction in heat loss will most likely increase survivability and reduce comorbidity.

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Swimming in cold water – what are the risks?

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Introduction: Naval Special Force Operators in Nordic countries are frequently exposed to cold water in many of their operations and during training. Water temperature during winter in the arctic is regularly below 5°C (41 °F). Therefore, knowledge about the operator's physiology during cold water operations is essential.

Discussion: To protect from the cold water, the use of a wetsuit or drysuit is feasible for soldiers doing in-water operations. We investigated the impact of a -10.000 m swim in cold water during a recent study performed on Norwegian Naval Special Forces recruits.[1] The study found typically decreased core temperature, power and dexterity on the recruits after exiting the water. Further, we discuss the occurrence of Swim Induced Pulmonary Oedema amid participants in strenuous water activities. A study among SEAL team candidates found that 5% of all participants had SIPE identified.[2] More alarming is our case reports among starters at a hard long distance triathlon, where SIPE incidents occur several hours after the swim.[3]

Conclusion: Focus should be put on the period where the soldiers exit cold water. Particularly when there is an ongoing operation continuing after the swim.

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Avalanche rescue – Fighting trauma, hypoxia, and hypothermia

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Introduction: Avalanche victims are trauma patients. Patients in the surface have traumas comparable with patients from RTI-incidents. Buried victims without signs of life have a poor prognosis. Prevention strategies and companion rescue training are most important factors for survival.

Discussion: Avalanches have incomprehensible amounts of energy, and blunt trauma mechanisms are the cause of death in up to ¼ of the victims. All patients from avalanches must be examined and treated according to standard principles of trauma care. Hypothermia prophylaxis should be applied on the scene, and severely injured patients evacuated as fast as possible to trauma centres. The buried patient has a high risk of a compromised airway. Compared with cold water drownings, cooling during burial in snow is less significant. Asphyxia is the major cause of death in buried victims. In patients with cardiac arrest presence of air pockets, short burial times (<20-30 minutes) (1) and a core temperature below 32°C are factors associated with survival. These patients should be evacuated with continuous CPR to the closest ECLA centre for ECMO rewarming (2). ECMO rewarming is not indicated for patients receiving ALS on the scene with a core temperature >32°C, or if serum potassium levels are above 12 mmol/L on admission. ICAR/ERC guidelines use a core temperature of 30°C and a potassium level of 8 mmol/L in triage of avalanche victims (3).

Conclusion: Search and rescue, and trauma care, in avalanches are demanding. Visible patients have a significant risk of trauma, and immediate trauma care and hypothermia prophylaxis are essential. Burial above 20–30 minutes are associated with poor outcome, but ECMO rewarming is recommended for arrested patients if an air pocket is likely, burial times are short and severe hypothermia is present (2).

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Managing severe hypothermia at The University Hospital North Norway

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Introduction: Patients with accidental hypothermia are relatively common in the regions of northern Norway and the Island of Spitsbergen. Clinical evaluation and triage of patients with severe hypothermia could be challenging.

Discussion: Main causes for accidental hypothermia are exhaustion and prolonged exposure to cold climate, cold water drownings and avalanche accidents. In a patient with circulation, body metabolism is reduced with 6% per degree Centigrade fall in core temperature. In cases of severe hypothermia (<30-32°C) clinical evaluation of organ function and even signs of life could be extremely difficult. Adequate CPR can produce approximately 20% of a normal cardiac output, and due to the lowered metabolism, continuous CPR might be well tolerated in arrested hypothermic victims for several hours.

Management in Northern Norway are guided by a communication protocol between the local community hospitals and the University hospital with ECLA capacities in Tromsø (1,2). Severely hypothermic patients with a temperature >28°C, presenting with a stable circulation, can be treated by a local community hospital with external rewarming principles (heated blankets, mattresses). Patients with unstable circulation or on-going CPR should be transferred to a ECLA centre for ECMO rewarming. Further clinically evaluation and triage are postponed until the patient is normothermic. In cases where transport is unavailable, fast-responding ECMO retrieval teams should be considered if present. In cases where transport is impossible, re-warming under continuous CPR is recommended. Patients triaged to intensive care after successful ECMO rewarming have a relatively good prognosis (3).

Conclusion: Severe cases of accidental hypothermia are difficult to evaluate clinically. Patients with stable circulation could be treated at a local community hospital, but patient with unstable circulation or arrest should be transferred to the closest ECLA centre for ECMO rewarming. Triaged patients should not be declared dead until they are warm and dead (3).

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Comfort, thermal stress, and clothing design

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Introduction: Performance in the cold is strongly impacted by clothing. Military cold weather clothing is highly optimised based on extensive historical experience in the field. Nevertheless, developments in the sports and in the outdoor clothing sector suggest that there may be further potential for improvement based on the so-called "body mapping" approach.

Discussion: Weight distribution of the clothing across the body is an important factor. Clothing insulation distribution has been shown to impact wearer comfort. Rather than having uniform clothing layers across the body, moving more of the available insulation to colder skin areas is shown to improve thermal comfort in the cold. Performance in cold weather clothing is strongly impacted by the weight, bulk, and stiffness of the clothing, adding to the metabolic requirements and internal heat production (1). Increases in metabolic rate up to 20% are observed due to the clothing, having direct implication on performance and food ration requirements. While cold weather clothing is mainly designed towards cold protection, in periods of high activity it is not unusual for the soldier to experience heat stress (2). This means that sweat management becomes important. Based on sweat distribution maps (3), base layers can be differentiated in different body parts to optimise sweat absorption, transport, and evaporation. Enabling ventilation of the clothing microclimate is most effective, but if placed in the wrong area of the body, can itself cause cold discomfort. Body sensation maps (4) can help in selecting the optimal location.

Conclusion: Developments in sports and outdoor clothing based on body mapping research suggest that there may also be future potential for cold weather clothing optimisation in the military.

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Tactical Combat Casualty Care under arctic conditions – the GAP

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Introduction: In 1996, Butler et al. published a new perspective on military pre-hospital care known as Tactical Combat Casualty care (TCCC) (1). Conducting TCCC under cold weather conditions is a completely new game. There is a GAP in research, technology, and guidelines when it comes to preventing pre-hospital hypothermia in cold weather operations.

Discussion: Preventing hypothermia in the polar climate starts with choosing the correct clothing. Multi-layered with moist absorbing inner material (wool), allowing for venting. Already during Care Under Fire (CUF), the patient must be insulated from the environment, and the tourniquet (TQ) should be constructed for placement over multiple layers of clothing and be possible to apply without removing mittens/gloves. Distally to the TQ, the patients will soon need protection from freezing cold injuries. During Tactical Field Care (TFC) the medick need to expose the patient to evaluate and treat. New examination algorithms combining minimal exposure with key clinical findings needs to be developed. Heated gloves to preserve dexterity for the medick, robust heating systems for medications including blood, more effective patient warming systems and portable treatment facilities (tents) for medick/patient that can be established in seconds. Avoiding exposure during Tactical Evacuation Care (TEC) can be facilitated by technology and sensors detecting vital signs, including body core temperature, but also moisture, blood, and skin temperature.

Conclusion: Preventing pre-hospital hypothermia under cold weather conditions represents a formidable challenge. Only a system of improvements can overcome the challenge. We suggest that research, new technology, innovations, and explicit cold weather guidelines is the way forward.

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Field research under arctic conditions

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Introduction: Several UK military expeditions have successfully used physiological sensors to monitor participant's physiology. In partnership with the Hamlyn centre for Wearable Technology, the academic department of military general practice has successfully developed and tested a wearable multimodal biochemical sensor. The project transmitted remote real-time physiological data back to the UK during the first all-female unassisted ski crossing of the Antarctic land mass. The biosensor devices were designed to be continuously worn against the skin and capture: HR, ECG, body surface temperature, bio-impedance, perspiration pH, sodium, lactate, and glucose. The data were transmitted from the devices to an android smartphone using near field technology and secure transmission of the data to a UK research centre, using a commercially available satellite transceiver. Post expedition feedback from the participants contributed to the ergonomic and technical advancement of the next generation of devices. Future trials are planned to test the next generation of this device, a wrist device that can detect the above and other biosensors along with a patch. Both can have Bluetooth capability and so can integrate with other platforms being developed within the UK military.

Discussion What is the gap that wearable technology can fill within defence to aid optimising performance and protecting our people? Through robust and methodical testing, the Defence Medical Services within the British Military are reviewing off the self-products and in collaboration with the Hamlyn Centre developing a product that may help answer these questions.

Conclusion: The future success of wearable technologies lies in establishing clinical confidence in the quality of the measured data and the accurate interpretation of those data in the context of the individual, the environment and activity being undertaken.

Cold Weather Operations – A national research and development program

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Introduction: As natural resources and navigability will increase in the High North due to climate changes, human and military activity will increase as well. Despite the expected increased temperature (up 4–5°C by 2040), armed forces will be faced with extreme cold in these areas. However, managing the extreme conditions better than an enemy gives operational advantages. How can research support this warfighter capability?

Discussion: Only the feeling of freezing can do much with the morale and consequently the performance in a military operation. At worst, frostbite and other cold injuries can put the soldier out of play for good. There is a high variance in the cold resistance and tolerance between individual humans. This is partly due to physiological and psychological differences, and the level of knowledge and experience. Based on knowledge of which routines and behaviour responses that protect against the effect of cold weather, FFI has in cooperation with the Armed Forces, produced several animations about the appropriate mindset, behaviour, and equipment for cold weather operations.

Results from military exercises have shown that soldiers burn far more calories than they eat. Can this problem be mended by modification of the field ration? This question is currently investigated by FFI and the USA Army Research Institute of Environmental Medicine.

Treating the injured in cold weather is a challenge. Trauma and blood loss can cause the patient to lose their ability of thermoregulation and hypothermia to occur. By providing shelter, by deploying pop-up tents and smart heat sources. These are questions currently investigated by FFI in cooperation with the Joint Medical Services.

Conclusion: During wartime, cold weather can be your worst enemy. With the appropriate technology, training, and experience, you can make it your allied.

Adapting the Medical elements of the UK's Commando Force to be able to operate effectively in the Extreme Cold Weather Environment

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Introduction: The UK has committed to supporting Arctic Partners with an increase in military presence. To facilitate this a review of current capability gaps at delivering Role 2 care in the Extreme Cold Weather (ECW) was conducted and recommendations were made.

Discussion: A 5-man team embedded with the Norwegian Role 2 Facility on Ex NORTHERN WINDS 19 and assessed the current UK level of capability and identified the keys gaps. The 5 domains reviewed were:

(1) Command and Control
(2) Deploy and Establish
(3) Treat
(4) Manoeuvre
(5) Sustain.

Following this assessment, there were 9 key recommendations. These recommendations were:

(1) Review Tentage infrastructure and acquire a more suitable solution
(2) Review methods of transport of bulk medical supplies
(3) Increase holdings of damtherm heaters
(4) Introduce a Cold Weather Medical Training Package for all medical personnel
(5) Introduce a tailored Cold Weather Warfare Course for Arctic Deployment 20
(6) Comprehension Pre-Deployment training for all medical personnel
(7) Improve basic level of soldiering for Royal Navy Medicks and Secondary Care personnel
(8) Investigate the ability of 3 Commando Brigade to transport water in ECW
(9) Improve coordination with Norwegian Medical Assets for future deployments to facilitate coalition patient care pathways.

Conclusion: Returning to operating at scale in the Arctic presents significant challenges to Armed Forces and particular to medical elements. Alterations to standard methods of care and the usual logistics and infrastructure is required to deliver a safe operational patient care pathway.

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