Abstract

Introduction

Aeromedical evacuation (AE) is a vital role of the Defence Medical Services (DMS). With a far-reaching Defence global footprint an AE capability is crucial to enable movement of patients in the fastest, safest and least stressful way that meets or exceeds the level of care an injured or ill person may expect to receive in the UK.

Op TRENTON is a UK military humanitarian operation in support of the United Nations (UN) Mission in South Sudan.

Methods

A retrospective analysis was carried out of all patients who underwent AE from the UK L2H at Bentiu during Op TRENTON over a 17-month period from June 2017 to October 2018.

Results

14 patients underwent AE. Median age was 36 (22-64) years and all patients were male. 21% of AEs were for UK personnel and 79% for UN personnel.

29% of AEs were due to Non-Battle Injury with the remainder due to disease. Musculoskeletal was the largest diagnostic group (n=4) followed by respiratory (n=3), cardiovascular (n=2) and undifferentiated febrile illness (n=2).

Conclusions

Patients requiring AE from L2H Bentiu mostly had musculoskeletal and medical pathology, a stark contrast to the trauma patient cohort from operations in the past. The majority of patients had definitive care under the medical team highlighting the requirement for DMS physicians, and the AE team, to be trained in acute, general and aviation medicine. The majority of AE moves were for UN personnel and on UN airframes, highlighting the importance of a sound understanding of the Nations we are working with.

Key Messages

- Aeromedical evacuation (AE) is a vital capability enabling Defence to maintain its global reach.
- Patients requiring AE mostly had musculoskeletal and medical pathology, a stark contrast to the trauma patient cohort from operations in the past.
- The majority of AE moves were for UN personnel on UN airframes, highlighting the importance of a sound understanding of the Nations we work with.
- This paper highlights the importance of the DMS being able to care for disease and non-battle injury patients within the deployed environment.
- This is of particular relevance as multi-national and non-kinetic operations become more frequent.

Introduction

Aeromedical Evacuation (AE) is a vital role of the Defence Medical Services (DMS). With a far-reaching Defence global footprint an AE capability is crucial to enable movement of patients in the fastest, safest and least stressful way that meets or exceeds the level of care an injured or ill person may expect to receive in the UK [1, 2]. The Royal Air Force provides Forward, Tactical and Strategic AE using a variety of assets to provide all levels of care up to intensive care level and includes specialist capabilities such as the Air Transportable Isolator (ATI) for those with High Consequence Infectious Diseases (HCID) [3], such as Ebola.

Aeromedical Evacuation Categorisation

Forward AE involves medically escorting patients from point of illness or wounding to the first medical facility, **Tactical** AE involves moving a patient from the initial medical facility further up the treatment chain, usually within the theatre of operations (intra-theatre) and **Strategic** AE is the airlift of patients from overseas to the home base (inter-theatre) [4, 5].

Limitations and Clinical Considerations for Aeromedical Evacuation

Although AE has its advantages as discussed above, aircraft availability, serviceability, weather and cost can be significant limitations. It is also important to consider the clinical implications in AE. Changes in the temperature, pressure, volume and relative mass of a gas at altitude can affect a patient's physiology, presenting challenges for managing certain pathologies [6]. Other stressors include fatigue, anxiety, turbulence, noise, vibration, humidity, decompression and dehydration [7].

The Aeromedical Evacuation Team

The AE team can compose of a range of specialist personnel including flight nurses, flight medics, medical officers, equipment technicians, and paramedics.

Categorisation of Aeromedical Evacuation Patients

Tactical and strategic AE patients can be categorised on the basis of **Priority**, **Classification** and **Dependency** [8]. If aircraft space is limited, patients whose condition is more serious may be evacuated before patients with a less serious condition.

Patients are categorised as **Priority** 1, 2 or 3 (Table 1).

Table 1. Aeromedical Evacuation patient priority adapted from STANAG 3204 [8]

PRIORITY		
Priority 1 Urgent	Patient requires timely evacuation; • to save life, limb or eyesight • to prevent complications of serious illness • to avoid serious permanent disability	Aim return to UK within 24 hours
Priority 2 Priority	Patient requires; • specialised treatment that is not available locally to avoid unnecessary pain or disability	Aim return to UK within 48 hours
Priority 3 Routine	Immediate treatment requirements are available locally. AE would provide a prognostic benefit.	Aim return to UK within 7 days

Classification informs of the patient's requirement for space in the aircraft and for physical assistance in the event of an aircraft emergency (Table 2).

Table 2. Aeromedical evacuation classification adapted from STANAG 3204 [8]

CLASSIFICATION			
Class 1 Psychiatric Patient	Alpha	Severe psychiatric patient	-2 psychiatric nurses to escort -Stretcher -Restraint
	Beta	Intermediate psychiatric patient	-1 psychiatric nurse -Option for restraint
	Charlie	Mild psychiatric patient	-Unescorted option
Class 2 Stretcher patient	Alpha	Escorted	-Immobile
	Beta	Escorted	-Mobile (seated for take-off and landing)
Class 3 Sitting patients	Alpha	Immobile	
	Beta	Mobile	
Class 4 Unescorted patients	Walking	Baggage assistance	
Class 5 Unescorted outpatients	No assistance required		
Class 6 Unescorted outpatients	Civilian		

Dependency refers to the level of care provided, classed as 1, 2, 3 or 4 (Table 3).

Table 3. Aeromedical evacuation dependency adapted from STANAG 3204 [8]

DEPENDENCY	
1 High Dependency	Patients who require any of the following; • ventilation • intensive support during flight • central venous pressure monitoring OR • cardiac monitoring
2 Medium Dependency	Patients who require; • regular frequent monitoring and whose condition may deteriorate in-flight • may require oxygen administration • may require one or more intravenous infusions AND/OR • multiple drains or catheters
3 Low Dependency	Patients whose condition is not expected to deteriorate during flight but may require; • nursing care • oxygen therapy • an intravenous infusion AND/OR • a urinary catheter.
4 Minimal Dependency	Patients who do not require nursing attention in-flight but may require; • assistance with mobility • assistance with bodily functions such as toileting and eating and drinking

Forward AE patients are categorised as Emergency (requiring rapid evacuation) or Routine. Routine patients are further categorised as Cat A (Priority 1 (as above)) timescale for AE within 2 hours, Cat B (Priority 2 (as above)) timescale for AE within 4 hours and Cat C (Priority 3 (as above)) timescale for AE within 24 hours [8].

Aeromedical Evacuation Process

For UK DMS AE, at the point of injury, an assessment will be completed and when appropriate a request for AE made. This request is made through a Patient Movement Request (PMR) via the Aeromedical Evacuation Liaison Officer (AELO), or local equivalent, to the UK Strategic Aeromedical Evacuation Control Centre (AECC) at Royal Air Force Brize Norton. AECC will use the information in the PMR to assess the relative clinical risk and requirements of the patient in order to specify the level of clinical/escort support that the AE transfer will require.

AE in a UN Operation requires adherence to the administrative procedure which differs from that of the UK. In South Sudan, UNMISS SOPs gave definitive guidance on how AE should be conducted [9]. AE within the UN is conducted by Aeromedical Evacuation Teams (AMET), and patient transfers are primarily categorised as either Urgent (to be moved as soon as possible) or Routine (can wait for a routine aircraft to be available).

All AE requests must go through the UN Chief Medical Officer (CMO) who is the senior UN mission medical official, located in Juba. The CMO has a small team that coordinates patient AE transfers, much like AECC. Any transfer that is classified as Urgent or which requires a stretcher requires justification to the CMO. Likewise, the number of AE escorts and quantity of AE equipment requires clear justification, so that air assets are used in the most effective manner. Due to constraints of operating in this environment, AMET routinely operated with smaller teams and more limited equipment than the UK military norm, albeit within the bounds of safety.

Whilst the mainstay of airframes used was the Mi-8, an eminently suitable medium sized rotary wing (RW) asset, due to the multi-national nature of the operations, AE was conducted using multiple different airframes (RW/FW), some more suitable than others for the purposes of AE. This required significant flexibility of AMET personnel, as is often required, to make whatever was provided work [10].

Operation TRENTON

Op TRENTON is a UK military humanitarian operation in support of the UN Mission in South Sudan (UNMISS). A task force of military engineers, force protection troops and DMS personnel was deployed from April 2017 on a three-year mission with the primary objective of providing engineering support for the UN Protection of Civilian (PoC) camps at Malakal and Bentiu [11]. UK Level 1 Primary Healthcare Centres (UK L1 PHCs) are located at both sites for UK military personnel and a UK Level 2 hospital (UK L2H) was located at Bentiu for approximately 200 UK military personnel and approximately 2000 UN military and civilian personnel [11]. Personnel at Bentiu largely comprised of the Mongolian and Ghanaian Armies, Ghanaian police, UK military and UN civilians of multiple nationalities.

We analysed all AE data from the UK L2H at Bentiu, South Sudan during Op TRENTON for UK and UN personnel. During Op TRENTON, all paperwork, PMRs and permissions for movement and emplaning were co-ordinated and approved by the UN chain of command using UN protocols.

Methods

Two data sets on the cases seen at the UK L2H were compiled and cross-referenced with each other in order to maintain consistency. Data collection was performed by consultants in emergency medicine, general medicine and by medical registrars.

Details of emergency department (ED) clinical episodes were prospectively recorded in an electronic spreadsheet listing date of attendance, national origin, ED diagnosis and disposal.

All UK L2H consultations and admissions (including those *'bedded down'* under the care of the UK L1 PHC team) were retrospectively identified from the watch-keeper's electronic record of every patient issued with a patient tracking form (FMed 830) and from the handwritten case notes stored in the deployed L2H headquarters [11]. Data on demographics, routes of referral and admission, dates of admission and discharge, diagnoses, management and disposal were extracted and entered into an electronic spreadsheet.

A retrospective analysis was then carried out of all patients who underwent AE from L2H during Op TRENTON over a 17-month period from June 2017 to October 2018. Demographics, diagnoses and destinations were analysed.

Results

From June 2017 to October 2018, 14 patients underwent AE from the L2H at Bentiu (Figure 1), 2.4% of the total 579 attendances to the facility. Median age was 36 (22-64) years and all patients were male. 21% (3) of AEs were for UK personnel and 79% (11) were UN personnel (Cambodia n=1, Ghana n=3, Kenya n=1, Mongolia n=3, Russia n=1, Sierra Leone n=1 and South Sudan n=1).

29% of AEs were due to Non-Battle Injury with the remainder due to disease. Musculoskeletal was the largest diagnostic group (n=4) followed by respiratory (n=3), cardiovascular (n=2) and undifferentiated febrile illness (n=2) (Figure 2).

Specific diagnoses included closed fracture (n=2), open fracture (n=1), fracture dislocation (n=1), pneumonia (n=2), pleural effusion (n=1), ST elevation myocardial infarction (n=1), cardiac arrhythmia (n=1), non-malarial undifferentiated febrile illness (n=2), drug induced psychosis (n=1), acute renal failure (n=1) and acute intracerebral haemorrhage (n=1). Definitive care was provided by the medical team for 5 patients, medical team plus Intensive Care for 5 patients and by the orthopaedic team for 4 patients (Figure 3). 9 patients required a medical officer escort.

Median length of stay at L2H prior to evacuation was 1.5 (1-5) days. 43% (n=6) of patients were evacuated to health care facilities in Uganda, 3 to UK, 2 to Kenya, 1 to Mongolia, 1 to Juba and 1 to Entebbe via Juba.

Mi-8 (Figure 4) and Mi-17 UN rotary assets carried out the majority of AE moves with any necessary onward moves provided by fixed wing assets such as the ATR-72, HS-125, C-130 and L-410.

Discussion

AE is a vital capability enabling Defence to maintain its global reach. Patients requiring AE from L2H Bentiu mostly had musculoskeletal and medical pathology, and there were no patients requiring evacuation for battlefield trauma. This presents a stark contrast to the trauma patient cohort from recent kinetic such as Operations Herrick and Telic. The majority (71%) of patients had definitive care under the medical team highlighting the importance of the general medical physician in the deployed environment. The high burden of medical patients (71%) highlights the importance of ensuring AE teams have sufficient competency and experience in acute, general and aviation medicine in order to meet the needs of patient cohorts in the ever-diverse commitments of the DMS. This is increasingly challenging for military physicians working in NHS hospitals were sub specialisation is common and highlights the requirement for carefully selected trainee and consultant placements. The majority of AE moves were for UN personnel and on UN airframes, highlighting the importance of a sound understanding of the nations we are working with and scope for future international AE training exercises.

To the best of our knowledge, this is the first study of AE from a UK Role 2 hospital during a UN mission. It highlights the importance of being able to care for disease and non-battle injury patients within the deployed environment and has particular relevance as multi-national and non-kinetic operations become more frequent.

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Acknowledgements

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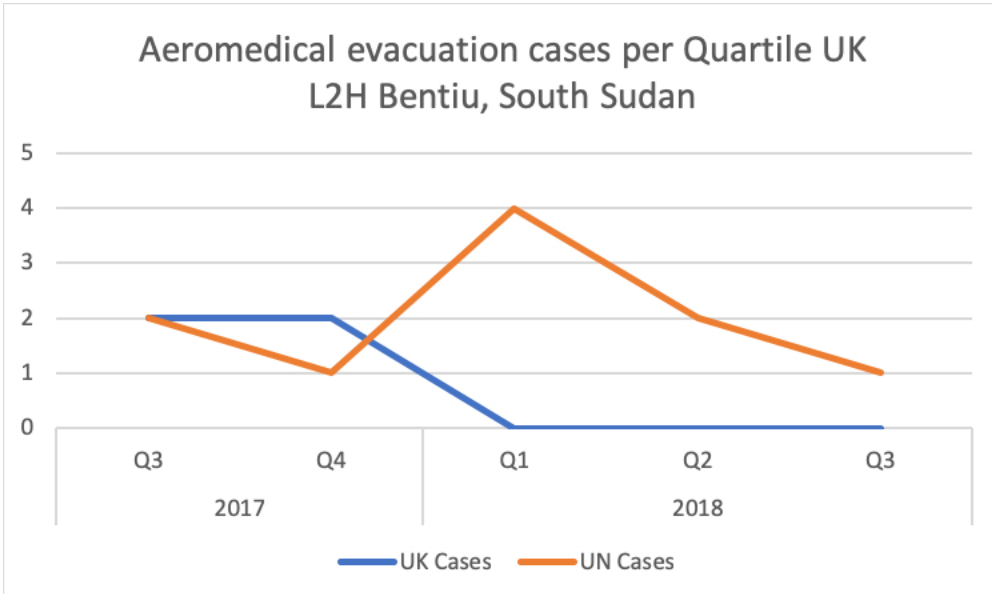

Figure 1. Aeromedical evacuation cases per Quarter at the UK Level 2 Hospital in Bentiu, South Sudan

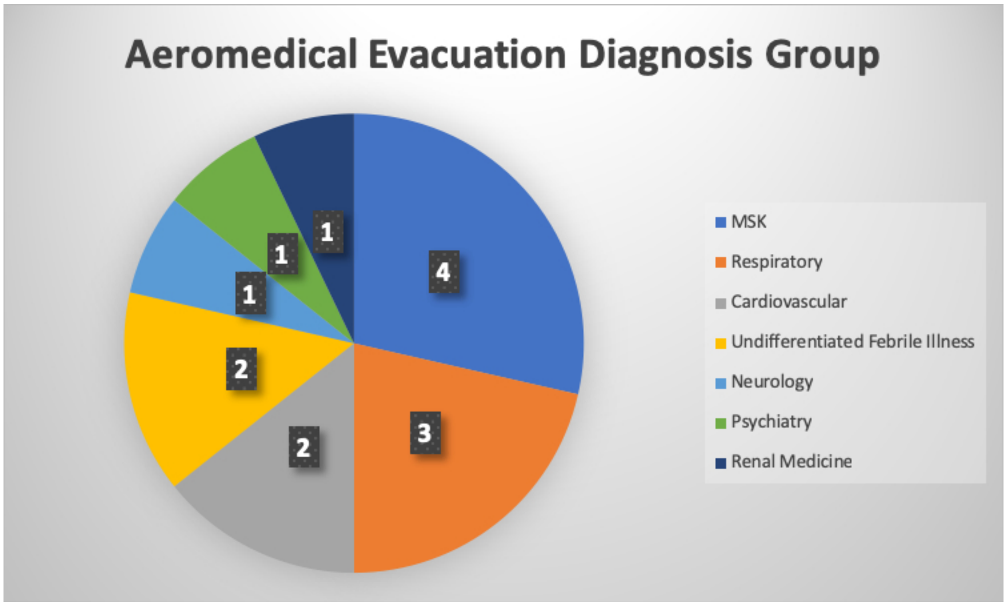

Figure 2. Aeromedical evacuation diagnosis group

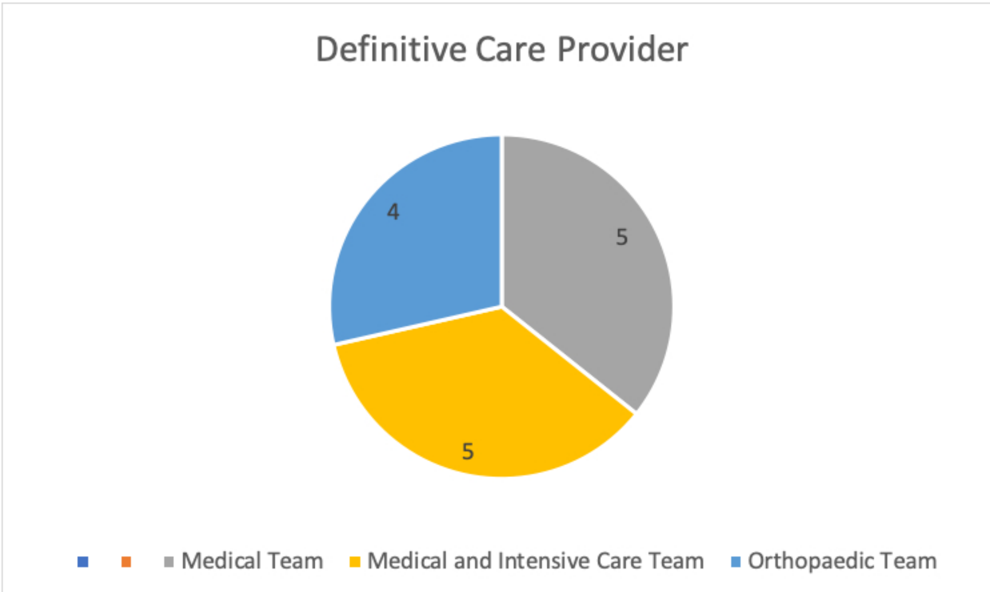

Figure 3. Definitive care provider

Figure 4. Mi-8 UN rotary asset