

BEEN THERE, DONE THAT...

Medical Support on a Himalayan Expedition

L Wallis, J Matthews

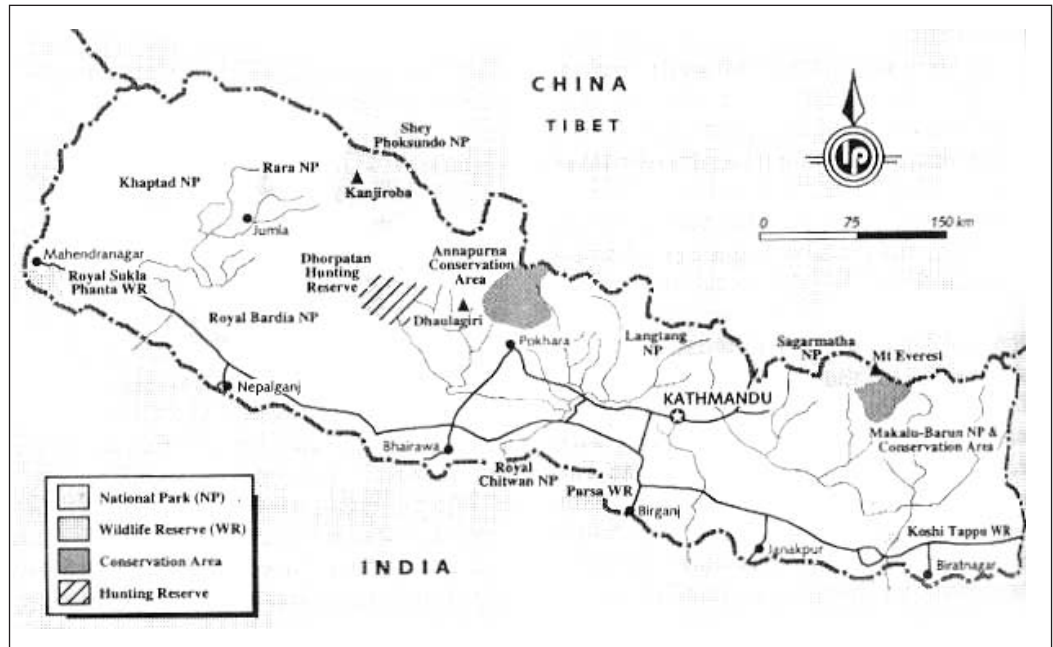


Fig 1.

Introduction

The number of people travelling to high altitude regions, especially in South America, Nepal and India, has risen enormously in the past 10 years. Alongside this increasing popularity of altitude trekking there has been an increase in the number of service expeditions. In October 2000, a Joint Service Expedition spent a month in Nepal attempting to scale Lobuche East, one of the trekking peaks in the Everest region of Northern Nepal. This expedition was one of four Service expeditions in Nepal at that time. Despite being unsuccessful in reaching the summit at 6119 metres, the group trekked to a maximum elevation of 5100m before being forced to return to Kathmandu.

Providing medical support in the unique environment of the mountains presents a challenge both due to the high altitude and also the remoteness of the region. We describe the preparations that were undertaken prior to the expedition leaving the UK and also the medical supplies taken. We then discuss three cases of altitude related illnesses from the expedition to illustrate the type of problems that can be faced in this unique environment. Finally we discuss the use of a pulse oximeter at high altitude and the controversial use of prophylactic acetazolamide by the group.

Preparation

The group for the expedition came together about a year before it was due to depart. Amongst the group were two Naval doctors and one Naval Chief Medical Assistant. The expedition, four weeks in total, was to include a short visit to a clinic that had been set up by the Chief MA in the Megauli region of Southern Nepal (see maps Figures 1 and 4). For most of the nine members of the group, it was their first trip to Nepal and would be their first mountaineering experience. It was essential, therefore, that we had two RAF mountain leaders in the group (Figure 2).

Advice about medical stores was sought



Fig 2. The Expedition Group

Surg Lt Cdr
Lee A Wallis RN
Specialist Registrar in
Emergency Medicine

Surg Lt Jon Matthews
RN
Senior House Officer in
Surgery
Derriford Hospital,
Plymouth,
PL6 8DH



Fig 3. The foot of Lobuche East

from Commander Steve Jackson and Major Louise Woolrich (both at MDHU Derriford), who both have extensive experience of expeditions to Nepal. Local experience was also available from the Sherpa climbing guides once we got to Kathmandu. The medical equipment for an expedition like this is limited by the fact that it will all have to be carried. *Annex 1* is a list of the medical stores taken on the expedition.

The medical supplies fitted well into a single day sack. Oxygen was obtained in Kathmandu on a sale or return basis. We declined to take a portable hyperbaric bag on this expedition but certainly larger expeditions should consider including this piece of equipment in their stores. These bags

are nylon fabric cylinders, which act as portable hyperbaric chambers and allow the environmental pressure around a patient to be increased to the equivalent of a descent of about 600m. They allow you to 'buy time' prior to the evacuation of a patient with high altitude illness. These bags can be hired in Kathmandu.

Prior to departure essential information about altitude related illness and its prevention were obtained from the following websites:

Himalaya Rescue Association:
<http://www.nepalonline.net/hra/>
 High Altitude Medicine Guide:
<http://www.gorge.net/hamg/>

Of particular use were the Acute Mountain Sickness (AMS) Worksheets (*Annex 2*) which were available on the High Altitude Medicine site. They consist of a questionnaire based on the Lake Louise Score of AMS, which allow a quantitative assessment of AMS to be made. This proved to be useful both in monitoring the general well being of the group and also in the treatment of AMS when it arose. They are also available in Nepali, which proved useful on several occasions when we were asked to see sherpas and porters with medical problems.

Altitude Related Illness

Case 1

A 22-year-old porter was seen at Tuglha at an elevation of 4600m with a severe headache. Previously he had been well at Pheriche (4280m) the day before. He was on no medication. Prior to being in Pheriche he had travelled from Namche (3450m) in a day, with his brother who was well. This was a total ascent of 830m. On examination he

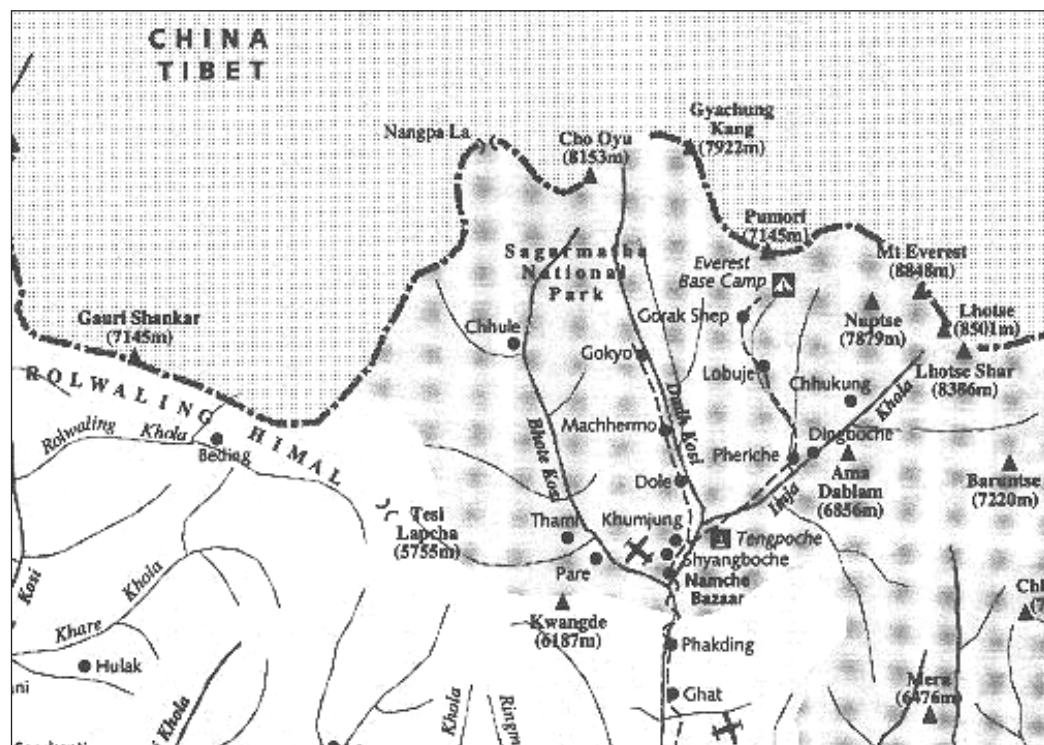


Fig 4.

had a Glasgow Coma Score of 14 (he was confused), was tachycardic at 120bpm and had oxygen saturations of 70%. He was ataxic and required support to walk. His Lake Louise Score was 8 on self-assessment and 4 on clinical assessment. He was treated with acetazolamide 500mg and dexamethasone 8mg orally, and immediately descended back to Pheriche (4280m). He spent two nights in Pheriche and then reascended to Lobuche village (4940m) where he remained symptom free.

Case 2

A 50-year-old lady was seen in Lobuche village at an elevation of 4940m with moderate headache, nausea and vomiting. She had ascended from Dingbuche (4350m) during the day. The day before she had travelled from Deboche (3770m), making her total ascent in the last two days 1170m. She was part of an organised trekking party. The other members of the group were all extremely tired but were on the whole well. Previously she had felt well and was on no medication. On examination she had a Glasgow Coma Score of 14 (confusion), a heart rate of 80 and was normotensive. Her respiratory rate was 25bpm. She had oxygen saturations of 64% and vomited once whilst she was being assessed. Her chest was clear. She was treated with acetazolamide 250mg orally and dexamethasone 8mg intramuscularly before immediate descent to Tuglha (4600m). The next day she was well and symptom free, but chose not to reascend and made an uneventful descent with the rest of the group.

Case 3

A 38-year-old gentleman was seen feeling generally unwell, weak, short of breath, dizzy and with a mild headache. He had ascended to Kala Patar that morning at an elevation of 5554m and was reviewed in Lobuche at 4940m. The day before he had ascended from Dingbuche (4350m) where he had been well. On examination he was alert, tachycardic (110bpm) and had a respiratory rate of 26bpm. His oxygen saturations were 52% at rest. On auscultation of his chest he had scattered crepitations in his left lower lobe. He immediately descended to Tuglha (4600m) and felt much better. His oxygen saturations improved to 88% and his chest cleared. Apart from descent he required no additional medical treatment.

Discussion

High altitude medical problems usually occur at altitudes above 1500m and are primarily caused by hypoxia compounded by the cold and exposure. There are three forms of high altitude illness:

1. Acute Mountain Sickness (AMS)
2. High Altitude Pulmonary Oedema (HAPE)

3. High Altitude Cerebral Oedema (HACE)

There is considerable overlap between the three types of high altitude illnesses but HACE can be considered the end point of untreated AMS. HAPE is usually considered a separate illness, but can be preceded by AMS. AMS commonly affects otherwise fit and healthy individuals who travel rapidly to altitude. Typically AMS presents as a collection of symptoms including headache, nausea, vomiting, lack of energy, lethargy and disturbed sleep which begin six to twelve hours after arrival at altitude. The incidence of AMS primarily depends on the rate of ascent and the altitude reached. In the Mount Everest Region of Nepal the incidence of AMS has been reported to be between 30 to 50% in trekkers who travel to altitudes above 4000m(1,2). Generally the symptoms of AMS will disappear after five days provided no further ascent is made.

Avoidance of AMS depends on a slow, gradual ascent with plenty of time for acclimatisation to occur. The current advice from the Himalayan Rescue Association is that after 3000m your sleeping altitude should be no more than 300 to 400m higher than the previous nights sleeping altitude, with a rest day every two to three days or every 1000m. All three of the cases reported above exceed this recommendation. Worryingly both case 2 and case 3 involved people on commercial treks who were being guided by reputable companies.

Case 1 describes a typical case of HACE, which is a rare but life-threatening form of altitude sickness. Generally AMS precedes HACE and the typical feature is ataxia and confusion. Any ataxic and unwell person at altitude should be considered to be suffering from HACE until proven otherwise.

Case 2 illustrates the problems of diagnosis of high altitude illness. The lady described more general symptoms than the porter in Case 1 and exhibited none of the obvious signs of HACE. Her condition could easily have been basic fatigue from her arduous ascent during the day. However none of her group was complaining of similar symptoms and so the only safe thing to do was to assume that she was suffering from HACE and treat her accordingly.

Case 3 describes a typical story of HAPE. As many as 10% of those people ascending very rapidly to 4500m will develop HAPE(3). Typically HAPE presents with dyspnoea on exertion and reduced exercise tolerance. Its presentation can be relatively insidious and the patient may only appear to be mildly dyspnoeic when compared to his or her fellow trekkers. If not treated the symptoms will progress to dyspnoea at rest and particularly at night. The dry annoying cough will then become bubbly and wet. Episodes of haemoptysis may occur. Signs may also be subtle especially at first. Tachycardia and tachypnoea are present at

rest and then as the disorder progresses crackles appear typically at the lung bases(4).

The most important step in management of any high altitude illness is rapid descent. This is particularly important in HAPE. In case 3 descent was the only treatment needed as the patient felt significantly better after he had descended 340m. Several drugs have been used to treat HAPE. Nifedipine, 10mg sublingually, followed by the slow release preparation by mouth four times daily has been shown to help relieve symptoms and is most useful(5). Oxygen and hyperbaric bags can also help 'buy time' before the patient can be evacuated off the mountain.

The treatment of HACE also includes rapid descent and oxygen. Dexamethasone 8mg initially followed by 4mg every six hours (orally or intramuscularly) is advised. Portable hyperbaric chambers can also be very effective but their effect is only temporary. They can however improve the patient's condition such that they can descend unaided rather than requiring evacuation by helicopter.

Most cases of AMS will improve in 24 to 48 hours with no treatment. Rest alone relieves the symptoms(6). However if a person is suffering from AMS it is vital that no further ascent is made and if there is no improvement in their condition then descent is needed. Immediate descent is indicated if there are symptoms or signs of HAPE or HACE.

Acetazolamide (diamox) has been shown to be an effective treatment of AMS as well as

a prophylactic(7,8). The treatment dose of acetazolamide is 250mg every eight hours, which relieves symptoms and improves arterial oxygenation(8). Prophylactic acetazolamide remains a controversial issue. The Himalayan Rescue Association currently does not recommend the use of prophylactic acetazolamide. It emphasises that the best way of preventing AMS is by a slow, graded ascent, allowing time for acclimatization to occur. However acetazolamide is the drug of choice for prophylaxis(9). It is a carbonic anhydrase inhibitor, which increases renal bicarbonate excretion and produces a metabolic acidosis and stimulates respiration. The most common dose regimes are 250mg twice daily or 500mg once daily of the slow release preparation, starting at least 24 hours before ascent above 2500m. On our expedition we used the 500mg slow release tablets. There are two common side effects, and these were present in our group. 47% of the expedition members suffered from mild to moderate paraesthesiae of the hands and feet. Most people also noticed a mild diuresis. The side effects were not bad enough to stop anybody taking the drug. Nobody on the expedition suffered any serious AMS symptoms. Whether this was due to the prophylactic acetazolamide or the slow graded ascent is hard to say. Certainly members of the expedition who had been to the Himalayas before and not used acetazolamide said they noticed some beneficial effects from the drug, in particular the more rapid recovery after exercise. Its

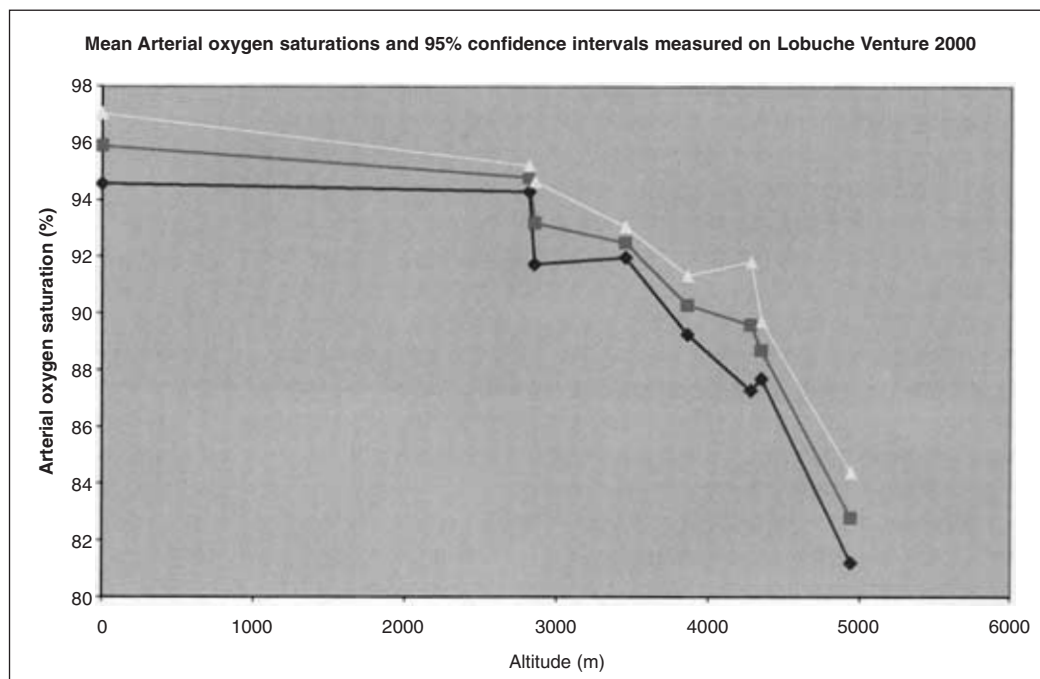


Figure 5. This graph is based on arterial oxygen saturation readings performed on the nine members of the Lobuche Venture 2000 expedition.

At each altitude two separate readings were taken from each separate expedition member on both the ascent up to Lobuche and then again on the descent. This provided a total of 36 readings at each altitude.

Assuming the data to be normally distributed the mean saturations (middle line) have been plotted above with 95% confidence intervals (upper and lower lines).

safety is assured by its widespread use in glaucoma, where it is used for years at doses similar to that recommended for AMS prophylaxis.

We took a Nellcor pulse oximeter on the expedition. During the ascent up to Lobuche and the subsequent descent readings of arterial oxygen saturations were made on each member of the group twice a day. We endeavoured to take the readings at the same time each day, just after breakfast and just after dinner. Figure 5 shows a graph of these readings. The saturations correlate well with similar data provided by Nick Mason from the 1994 Mount Everest Medical Expedition published in the High Altitude Medicine Handbook(10). Previous work has shown that Nellcor N-10 pulse oximeter worked reliably up to an altitude of 8235m although it was difficult to use at oxygen saturations below 50%(11). A number of studies have shown a correlation between SaO₂ and AMS (12). A low SaO₂ on arrival at altitude is a good predictor for the later development of AMS. Certainly the three patients described above all had significantly reduced arterial oxygen saturation readings then that expected for the altitude that they were at. The pulse oximeter was an extremely useful piece of kit on the expedition both in monitoring the general well being of the group but also in treating the various patients we came across.

Table 1 shows the breakdown of the patients that we saw through the expedition.

Table 1: Medical Problems Encountered on Lobuche Venture 2000

Medical team:

Surgeon Lieutenant Commander Lee WALLIS RN

Surgeon Lieutenant Jon MATTHEWS RN

CPOMA Kevin Shore

Condition	Numbers
Acute Mountain Sickness	21
HACE	2
HAPE	1
Upper respiratory tract infection	8
Lower respiratory tract infection	3
Exacerbation of asthma	1
Diarrhoea and vomiting	6
Pyrexia of unknown origin	1
Otitis Externa	1
Carbuncle	1
Infected foot	2
Gastritis	7
Minor head injury	2
Frozen shoulder	1
Hand laceration	1
Acute exacerbation of schizophrenia	1
Lateral ligament sprain of ankle	2
Hypothermia	1
Dental problems	2
Fungal skin infection	2
Tonsillitis	4

Burns to leg and hand	1
Cervical spondylosis	1
Leg abscess	1
Facial laceration	1
Dislocated ring finger	1

Conclusions

In this article we have tried to present some useful information for any doctors who find themselves on an expedition to areas at high altitude. Both authors had limited experience of working at high altitude before the expedition but found that there are plenty of people within the Services who are very experienced in this subject and can be contacted for advice. The numbers of patients we had to treat surprised us. Worryingly a lot of the patients were on organised trips that had blatantly ignored the recommendations about gradual ascent and acclimatisation. Our experience would suggest that any expeditions going to high altitude areas, such as Nepal, should take a doctor who is well educated about the various forms of high altitude illness. In addition to all the literature available there is also an annual 'High Altitude Medicine and Physiology Course' run at Plas Brenin, which is extremely good and well recommended.

References

- Hackett PH, Rennie D and Levine HD. The incidence, importance and prophylaxis of acute mountain sickness. (1976) *Lancet*. ii: 1149-54.
- Basnyat B, Lemaster J, Litch JA. Everest or bust: a cross sectional, epidemiological study of acute mountain sickness at 4243 metres in the Himalayas. *Aviat Space Environ Med* 1999 Sep; **70(9)**: 867-73.
- Bartsch P, Vock P, Maggiorini *et al.* (1990) Respiratory symptoms radiographic and physiological correlations at high altitude. In: JR Sutton, G Coates, JE Remmers (eds). Hypoxia: the adaptations. DC Decker Inc, Burlington, Ontario, Canada.
- Ward MP, Milledge JS and West JB – High Altitude Medicine and Physiology
- Oelz O, Maggiorini M, Ritter M *et al.* (1989) Nifedipine for high altitude pulmonary oedema. *Lancet*. ii:1241-4.
- Bartsch P, Merki B, Hofsetter D, Maggiorini M, Kayser B and Oelz O. (1993) Treatment of acute mountain sickness by simulated descent: a randomised controlled trial. *BMJ* **306**: 1098-101.
- Bradwell AR, Winterbourn M, Wright AD *et al.* (1988) Acetazolamide treatment in acute mountain sickness. *Clin. Sci* **74** (Suppl. 18), 62P.
- Grissom CK, Roach RC, Sarnquist FH and Hackett PH (1992) Acetazolamide in the treatment of acute mountain sickness: clinical effect on gas exchange. *Ann Intern.Med.* **116**, 461-5.
- Birmingham Medical Research Expeditionary Society Mountain Sickness Study Group (1981) Acetazolamide in control of acute mountain sickness. *Lancet* **1**, 180-3.
- Pollard AJ and Murdoch DR – The High Altitude Medicine Handbook
- Glanfield M (1988) High altitude testing of pulse oximeter. *BMJ* Dec **10**;297 (6662): 1516.
- Roach RC, Greene ER, Schoene RB and Hackett PH (1998) Arterial oxygen saturation for prediction of acute mountain sickness. *Aviat. Space Environ. Med* **69**, 1182-5.

Annex 1: Lobuche Venture 2000 Medical Supplies

1. RESUSCITATION / TRAUMA CARE**AIRWAY**

Guedel Airway	4 (2 x size 3/ 2 x size 4)
Laerdal Resusci face mask	1

INTRAVENOUS

Cannulae	4 x 16G & 4 x 18G
Giving sets	2
Haemaccel	3 x 500ml
Nacl 0.9% for injection	3 x 5ml

TRAUMA

Full leg inflatable splint	1
Military chest drain kit	1
SAM splint	2
Set of stiff neck collars	1

2. EXAMINATION

Stethoscope	1
Sphygmomanometer	1
Pulse Oximeter	1

3. WOUND CARE**DRESSINGS**

Bandage, triangular	2
Bandage, crepe, 10cm	5
Micropore tape	2
Elastoplast tape	2
Plasters, assorted	1 box
Melolin dressings (10x10cm)	5
Mepore dressings (9 x 15cm)	5
Steristrips	2 packs
Gauze swabs	1 pack
Tincture iodine BP	1 bottle
Sterile dressings packs	2

4. SURGICAL KIT

Gloves, sterile	2 pairs
Examination gloves	10 pairs
Fine suture set (forceps, needle-holder & scissors)	1
Sutures	3/0, 4/0, 5/0 novafil – 3 of each
Syringes	2ml x 5, 5ml x 5
Needles	green x 5, orange x 5
Small sharps bin	1

5. DRUGS**ALTITUDE**

Acetazolamide 500mg SR	150
Nifedipine 10mg	50
Dexamethasone 8mg IM/IV	4
Dexamethasone 4mg	50

ANAESTHETIC AGENTS

1% Lignocaine/adrenaline	50ml
1% lignocaine	50ml

ANALGESIA

Nubain 10mg IV/IM	10
Naloxone 0.4mg	10
Paracetamol 500mg	100
Ibuprofen 400mg	200
Diclofenac Sodium 100mg	10
Codeine Phosphate 30mg	60
Aspirin disp. 300mg	50

ANTIMICROBIALS

Augmentin 375mg	50
Ciprofloxacin 250mg	50
Metronidazole 500mg	25
Erythromycin 250mg	50
Mebendazole 100mg	10

ALLERGY / ANAPHYLAXIS

Salbutamol Inhaler	1
Piriton 4mg	10
Piriton 10mg IV	2
Adrenaline (1 in 1000) IM	2
Hydrocortisone 100mg IV	2

DERMATOLOGICAL

Calamine lotion	1 bottle
Athlete's foot powder	5 bottles
Canesten HC cream	1 tube

ENT / EYES

Amethocaine eye drops	5
Fluorescein eye drops	5
Chloramphenicol ointment	2
Sofradex ear drops	2
Menthol crystals	
Bradosol lozenges	100
Pseudoephedrine 60mg	20

GASTROINTESTINAL

Anusol ointment	1 tube
Gavison chewable tablets	2 tubes
Metoclopramide 10mg	20
Stemetil 12.5mg IV	5
Ranitidine 150mg	30
Loperamide 2mg	50
Senokot tablets	10
Oral rehydration sachets	20

6. DENTAL

Clove oil	1 bottle
Temporary dressings	1 bottle
Cotton wool rolls	5
Dental mirror & probe	1

7. MISCELLANEOUS

Small pill bags	10
Alcohol swabs	20
Oxygen	

Annex 2: AMS Worksheet

Based on the Lake Louise AMS Questionnaire						
NAME	AGE	SEX	DATE			
Prev Hx AMS/HAPE/HACE?						
Ascent Profile:						
Treatment:						
	Time	-	-	-	-	-
	Altitude	-	-	-	-	-
Symptoms:						
1. Headache:	No headache	0_	-	-	-	-
	Mild Headache	1_	-	-	-	-
	Moderate Headache	2_	-	-	-	-
	Severe, incapacitating	3_	-	-	-	-
2. G.I.:	No GI symptoms	0_	-	-	-	-
	Poor appetite or nausea	1_	-	-	-	-
	Moderate nausea or vomiting	2_	-	-	-	-
	Severe N&V, incapacitating	3_	-	-	-	-
3. Fatigue/weak:	Not tired or weak	0_	-	-	-	-
	Mild fatigue/weakness	1_	-	-	-	-
	Moderate nausea or vomiting	2_	-	-	-	-
	Severe F/W, incapacitating	3_	-	-	-	-
4. Dizzy/light-headed:	Not dizzy	0_	-	-	-	-
	Mild dizziness	1_	-	-	-	-
	Moderate dizziness	2_	-	-	-	-
	Severe, incapacitating	3_	-	-	-	-
5. Difficulty sleeping:	Slept well as usual	0_	-	-	-	-
	Did not sleep as well as usual	1_	-	-	-	-
	Woke many times, poor night's sleep	2_	-	-	-	-
	Could not sleep at all	3_	-	-	-	-
SYMPTOM SCORE:						
Clinical Assessment						
6. Change in mental status	No change	0_	-	-	-	-
	Lethargy/lassitude	1_	-	-	-	-
	Disoriented/confused	2_	-	-	-	-
	Stupor/semi consciousness	3_	-	-	-	-
7. Ataxia (heel to toe walking)	No change	0_	-	-	-	-
	Manoeuvres to maintain balance	1_	-	-	-	-
	Steps off line	2_	-	-	-	-
	Falls down	3_	-	-	-	-
	Can't stand	4_	-	-	-	-
8. Peripheral Oedema	No oedema	0_	-	-	-	-
	One location	1_	-	-	-	-
	Two or more locations	2_	-	-	-	-
CLINICAL ASSESSMENT SCORE:						
TOTAL SCORE						