of resource allocation and planning models. Such a link is in danger of being lost in a disaggregated NHS, especially with the capacity of fundholding to dilute systematic and equitable resource allocation to populations. Services should also have their capital and revenue requirements funded together; and providers should be accountable for long term plans to health authorities. If this does not happen then long term benefit is lost in short-termism and fragmentation.

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How To Do It

Doctor on a mountaineering expedition

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Doctors are welcome members on mountaineering expeditions to remote areas, but practical advice on how to prepare and what kit to take can be difficult to find. This article is a ragbag of useful advice on diverse topics. It explains the necessary preparation, provides tips for a healthy expedition, and summarises the common disorders encountered at high altitude. The comprehensive drug and equipment lists and first aid kit for climbers were used for the 1992 Everest in winter expedition. They are there to be sacrificed to personal preference and the experience and size of individual expeditions.

An offer to be the doctor on a high altitude expedition presents exciting opportunities for travel to remote areas, but practical advice can be difficult to find. In this article we offer guidelines based on our experience from large and small expeditions lasting up to three months to the Andes, Alaska, the Arctic, and Everest in winter.

Preparing for the expedition

COMMUNICATING WITH EXPEDITION MEMBERS

Write to expedition members in good time with advice on vaccination. Full courses of hepatitis A, hepatitis B, or rabies vaccine take seven months, while booster typhoid, tetanus, poliomyelitis, or meningococcal vaccine or hepatitis A immunoglobulin should be given more than two weeks before departure. Specific advice on malaria prophylaxis and vaccination can be obtained from the Travel Clinic, Battenburg Avenue, North End, Portsmouth (telephone 01705 664235) or the Hospital for Tropical Diseases in London (0171 387 4411) or Liverpool (0151 708 9393).

Issue a brief questionnaire about previous medical history, particularly asthma, peptic ulcer, diabetes, and heart disease. Do not assume good health, especially if friends or relatives of the expedition members are joining the trek to base camp. Advise members to have a pre-expedition dental check up, since a lost filling or dental abscess challenges doctors with no dental experience. Ensure members have medical insurance to cover the costs of treatment and recovery to Britain.

ASSESSING LOCAL FACILITIES

Contact doctors who have previously travelled in the region. Names of doctors are usually discovered by word of mouth, but they may be obtained from reports published in journals of the Alpine Club or Royal

FIGURE 1—Testing KED spinal splint and Stifneck cervical collar at Everest base camp

Geographical Society. Alternatively, write to the British Embassy or High Commission in the area through the Foreign and Commonwealth Office. Voluntary rescue organisations are a good source of information (for example, Himalayan Rescue Association, PO Box 495, Thamel, Kathmandu).

Determine the options for evacuating a casualty (helicopter, yak, mule, stretcher, etc). Helicopters have an absolute altitude ceiling depending on the aircraft, season, weather, and load to be carried—for example, Everest base camp (5400 m) is inaccessible to helicopters in winter, but in summer one unaccompanied casualty can be evacuated. There may be little alternative but to try to provide independent resuscitation and treatment facilities. Establish methods of summoning assistance (radio or runner) and for carrying casualties, either with a dedicated stretcher (such as Beacons stretcher, Functional Foam, Powys—telephone 01685 350011) or one improvised from expedition equipment. Spinal injuries, which are an appreciable risk in mountaineering accidents, need special care; the Ferno KED extraction device and Stifneck cervical collar are suitable (fig 1). Recovery to

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Box 1—Medical stores for the 1992 Everest in winter expedition

Drug	Quantity	Drug	Quantity	Drug	Quantity
<i>Analgesic</i>		Loperamide (2 mg)	1000	Silver sulphadiazine cream	2
Aspirin (500 mg)	200	Domperidone (10 mg)	100	<i>Eyes and ears, nose, and throat</i>	
Buprenorphine (0.2 mg)	50	Domperidone (30 mg)		Amethocaine (0.25%) drops	40
Dihydrocodeine (30 mg)	100	suppositories	10	Chloramphenicol (5 mg)	
Naproxen (250 mg)	200	Sterculia sachets	40	ointment	20
Paracetamol (500 mg)	1000	<i>Cardiovascular</i>		Gentamicin ear drops (5 ml)	5
Pethidine (50 mg/ml)	10	Atenolol (50 mg)	20	Throat lozenges	500
Lignocaine 2% (2 ml)	20	Glyceryl trinitrate transdermal			
Lignocaine gel (5 ml)	5	patch (5 mg)	10	<i>Respiratory</i>	
<i>Antimicrobial</i>		Heparin patch injection		Adrenaline (1:1000, 1 mg/ml)	10
Cephadrine (250 mg)	500	(12 500 U)	10	Aminophylline (125 mg/5 ml)	5
Cefotaxime (1 g) intravenous	10	Nicotinic acid tablets	10	Beclomethasone dipropionate	
Ciprofloxacin (250 mg)	500			(100 µg/metered inhalation)	
Erythromycin (250 mg)	500	<i>Sedative and anaesthetic</i>		inhaler	2
Flucloxacillin (250 mg)	250	Midazolam (10 mg/5 ml)	10	Codeine linctus (300 ml)	2
Metronidazole (200 mg)	500	Temazepam (10 mg)	200	Prednisolone (5 mg)	100
Metronidazole (1 g)		Chlorpromazine (50 mg)	10	Salbutamol (200 µg/metered	
suppositories	10	Ketamine (500 mg/10 ml)	2	inhalation) inhaler	5
Tetracycline (250 mg)	250	Atropine (0.6 mg/ml)	2	<i>Altitude</i>	
Mebendazole (100 mg)	20	Naloxone (0.4 mg/ml)	2	Acetazolamide slow release	
Chloroquine (300 mg)	100	<i>Dermatological</i>		(500 mg)	750
Quinine (300 mg)	100	Acyclovir (5%) cream	3	Dexamethasone (5 mg)	5
Rabies vaccine (1 ml)	5	Benzyl benzoate (25%, 100 ml)	2	Nifedipine slow release (20 mg)	50
Rabies immunoglobulin	1	Betamethasone (0.1%) ointment	1	<i>Miscellaneous</i>	
Tetanus toxoid (0.5 ml)	2	Choline salicylate dental gel	2	Cinnarizine (15 mg)	50
<i>Gastrointestinal</i>		Chlorpheniramine (10 mg/ml)	5	Terfenadine (60 mg)	100
Antacid tablets	200	Clotrimazole (1%) cream	20	Potassium chloride	
Bisacodyl (10 mg)	20	Clotrimazole (1%) powder	2	(20 mmol/10 ml)	10
Cimetidine (400 mg)	200	Hydrocortisone (0.5%)		Multivitamin tablets	500
Dioralyte sachets	100	ointment	3		

Box 2—Dressings and equipment

<i>Intravenous fluids</i>		Catheter bag	2	Bandaids (selection)	100
Infusion:		Bladder syringe	2	Sleek (7.5 cm×5 m)	1
Haemaccel	10	Nasogastric tube (12 F)	2	Tubigrip (knee, 10 m)	1
0.9% saline	20	Space blanket	5	Tubnette dressing (size 01)	20 m
Cannulae (16 G, 18 G)	10	Sutures:		Tubnette finger applicator	1
Giving sets	10	2/0 Silk, straight	20	Eye pad	10
Redinov horizontal infusion device	1	2/0 Silk, curved	5	Eye patch	4
<i>Airway care</i>		5/0 Prolene, curved	4	Surgical gloves	5
Guedel airway (sizes 2, 3, 4)	3	Needle holder	1	Kidney dish	1
Nasal airway (size 6)	2	Toothed forceps	1	Gallipot	5
Ambubag mask (size 6)	1	Scissors (pointed)	1	Syringes (20 ml, 10 ml, 2 ml)	50
Laerdal resuscitation bag	1	Spencer Wells forceps	2	Needles (18G, 25G)	50
Endotracheal tube (9 mm, 7 mm)	2	<i>Wound care</i>		Scissors (large)	1
Minitracheostomy set	1	Hibitane (500 ml)	1	Temporary dental filling	1
Laryngoscope	1	Tincture iodine BP (100 ml)	2	<i>Examination</i>	
Swivel adaptor	1	Alcohol swabs	100	Wooden spatula	20
Oxygen tubing	1	Cotton wool balls	500	Stethoscope	1
Hand suction device	1	Gauze squares (5×5 cm)	100	Sphygmomanometer	1
<i>Major trauma</i>		Ribbon gauze	1	Ophthalmoscope	1
Argyle chest drain (28 F)	2	Paraffin gauze	1	Dental probe	1
Heimlich valve	3	Triangular bandages	10	Dental mirror	1
Femoral traction splint	1	First field dressings	20	Thermometer:	
Cervical splint (Stifnek)	3	Crepe bandage (7.5×4.5 m)	10	Low reading	2
Spinal splint (Ferno KED)	1	Zinc oxide tape (5 cm×5 m)	2	Normal	2
Foley catheter (14 F)	2	Elastoplast tape (7.5×5 m)	2		

Britain can be organised by specialists such as International Medical Rescue (01737 360335), so keep a record of names and numbers to contact in an emergency.

PROVISION FOR MAJOR BLOOD LOSS

Major blood loss can follow a fall resulting in the fracture of a long bone or internal injury and is often compounded by dehydration. Initial fluid resuscitation includes infusion of at least 1-2 litres of warmed isotonic crystalloid or colloid. Unlike albumin, Haemaccel and Gelofusine are safe after being frozen and thawed. If evacuation is delayed, blood replacement may be required. Blood cannot be safely stored during an expedition. Cross transfusion between expe-

dition members is one option. This needs pre-expedition determination of the members' blood groups and antibodies and screening for viral or treponemal infection so that a donor-recipient chart can be created. The alternative, a field cross match with a commercially available kit, needs training and provides no information about infectivity. Neither option is very practicable, and when a substantial gastrointestinal bleed occurred during the Everest in winter expedition crystalloid was used despite the preparation of donor-recipient charts.

MEDICAL SUPPLIES

Choosing supplies and deciding quantities are always difficult. Boxes 1-3 show the medical kit list for

FIGURE 2—Latrine constructed on glacial morain

the 1992 Everest in winter expedition, and box 4 shows the conditions encountered. Substantial quantities of antibiotics, antidiarrhoeal drugs, paracetamol, and throat lozenges are commonly used. Other items depend on the doctor's choice and expectations of expedition members. Treatment of minor complaints is often good for morale even if there is little proof of efficacy. In case of major trauma, equipment is needed for maintaining the airway, fluid resuscitation, and immobilising fractures (box 2). Other procedures are largely impracticable in the field, but intervention will depend on personal experience. First aid packs for climbers will be needed (box 3), and requests for treating porters or local people can be expected.

INDEMNITY

Think through the medicolegal position before the expedition starts as crown indemnity will not apply.

Health during the expedition

The doctor is responsible for supervision of general health as well as treating specific disorders.

WATER PURIFICATION

For the trek into the mountains a lightweight water filter is useful and barely taints the water (for example, Pur water filter, Ibis Products, Codicote, Hertfordshire). Water from glacial streams, however, may contain mineral salts ("rock flour"), which have a laxative effect, and water from popular routes has a high risk of faecal contamination. The infective potential of wind driven snow must not be overlooked since most pathogens resist freezing. Boiling provides adequate protection against all enteric pathogens—even at 6000 m, where the boiling point is 80°C—and

need not be prolonged. Sterilisation with tablets (such as Puritabs) or iodine solution BP (8 drops/litre) is an alternative when fuel economy is paramount but takes at least 20 minutes to be effective.

WASHING

Despite water purification a high incidence of gastroenteritis is likely since hand washing may be neglected before meals or after defecation. It is worth providing hand washing facilities for all expedition members and cooks before preparation of food. If gastroenteritis afflicts people in rapid succession add an antiseptic to the washing bowl. Pack liquid antiseptic sachets separately because some will burst during the decompression of ascent.

Unfortunately, regular hand washing in subzero temperatures may cause cracking of fingertips, discomfort, and possible paronychia. Emollients may help. Few bother with general washing or shaving while climbing, and this is said to reduce the risk of facial frostbite. "Baby wipes" are a compromise for the fastidious.

LATRINES AND SOAK AWAY PITS

When a camp is established make sure that the latrine is located downwind, downstream, and at least 20 m from the main sleeping and cooking area (fig 2). At base camp the latrine should be constructed to cope with several weeks' use. When it becomes too malodorous, lime (usually available locally) or carefully ignited paraffin can be used. The latrine must be filled in on departure.

A soak away pit should be dug near the cooking area to dispose of washing up water, otherwise the area rapidly becomes muddy and unmanageable. The pit must be deep and three quarters filled with stones, roughly graded from rocks at the bottom to pebbles at the top.

SUN DAMAGE AND DEHYDRATION

Sunburn is common at high altitude because less sunlight is filtered by the atmosphere and snow reflects up to 90% of ultraviolet radiation whereas ground reflects about 15%. High protection sunscreens (factors 15–30) should protect against ultraviolet A and B. Particular care should be taken to protect the lips.

Snowblindness is the result of excessive exposure of the cornea and conjunctiva to ultraviolet radiation. It can be prevented by wearing glacier glasses or goggles, but ordinary sunglasses are inadequate. A gritty feeling is followed by intense photophobia and red eyes several hours after exposure. Climbers are usually well aware of the condition, but they may need reminding that the risks are still high on overcast days when climbing on snow since the amount of ultraviolet radiation does not correlate with the brightness of sunlight.

Fatigue, cramps, or headaches ("glacier lassitude") may be due to dehydration, which is common at altitude, even in the absence of thirst. A high fluid intake is necessary (3–5 litres a day)

Common disorders at altitude

The standard reference text is *High Altitude Medicine and Physiology*.¹

ALTITUDE SICKNESS

Acute mountain sickness, high altitude pulmonary oedema, and high altitude cerebral oedema are separate but related disorders.¹ Acute mountain sickness does not necessarily progress through pulmonary to cerebral oedema, and rapidly fatal oedema has occurred in previously well climbers. All three conditions are relieved by descending 300–1000 m. Mild

Box 3—Personal first aid kit

Drug	Directions	
Acetazolamide (500 mg×10)	1 Daily, to prevent mountain sickness	
Amethocaine eye drops (1)	2 Drops, for snow blindness, emergency only	
Buprenorphine (0.2 mg×4)	1-2, Under tongue every eight hours for severe pain	
Loperamide (2 mg×6)	1 As needed, up to 6/day, for diarrhoea	
Nifedipine (10 mg×2)	1, Bite and swallow, for pulmonary oedema	
Paracetamol (50 mg×8)	2 As needed, up to 8/day, for headaches or moderate pain	
Temazepam (10 mg×2)	1 As needed, to help sleeping	
Throat lozenges (5)	1 As needed, for sore throat	
Wound care		
Alcohol swabs (4)	Surgical blade (size 21)	Pressure dressing (1)
Steristrips (pack of 5)	Plasters (5)	Bandage (1)
Suture (2/0, straight needle)		

Box 4—Conditions treated on 1992 Everest winter expedition

Expedition team: 18 climbers, 15 trekkers, two base camp staff, 10 Sherpas, and 10 porters. Of all complaints, 72% occurred in members and trekkers and 28% in Sherpas and porters. Five people were evacuated.

Trauma	Respiratory
Fractured tibia (1)	Sore throat (14)
Hypothermia (2)	High altitude cough (18)
Soft tissue (lacerations, etc 10)	Cough induced intercostal myalgia (2)
Sunburn (5)	Respiratory tract infection (5)
	Persistent nasal congestion (2)
Gastrointestinal	Dental
Gastroenteritis (43)	Abscess (2)
Upper gastrointestinal bleed (1)	Lost crown (2)
Dyspepsia (2)	
Persistent vomiting (1)	Neurological
Haemorrhoids (3)	Acute mountain sickness (mild 24, severe 2)
	Insomnia (5)
Vascular	Macular haemorrhage (central scotoma) (1)
Frostbite (6)	Presumed retinal ischaemia (transient tunnel vision) (1)
Iliofemoral venous thrombosis (1)	

headache during an ascent is a common symptom of acute mountain sickness and is of no concern if it is relieved by good hydration and rest. However, descent is mandatory if a headache is accompanied by vomiting, mental confusion, or ataxia, as this indicates cerebral oedema. Similarly, dyspnoea at rest, with or without a cough, indicates pulmonary oedema and merits immediate descent. The crucial factor in prevention is a slow rate of ascent. As a rough guide, at altitudes above 3000 m, each night should be spent not more than 300 m above the last, with two nights at the same altitude every three days.

ADDITIONAL MEASURES FOR PREVENTING AND TREATING ALTITUDE SICKNESS

In controlled trials acetazolamide reduced the incidence and severity of acute mountain sickness, and it can be an adjunct to a sensible rate of ascent.¹² It is thought to work by inducing an intracellular acidosis in the cells of the medullary chemoreceptor, thus promoting respiratory drive and reducing nocturnal hypoxaemia. A 500 mg slow release tablet taken daily is convenient; treatment should start one day before ascent and continue for four or five days, when the risk is highest. Longer treatment may confer additional benefit: subjects who took acetazolamide for three weeks at 4846 m showed superior performance and

FIGURE 3—Inflated Gamow tent. Larger than the Gamow bag, it allows a casualty to be accompanied during recompression

reduced weight loss compared with subjects who took placebo.³ Treatment can be discontinued during descent. Side effects include diuresis, mild gastric irritation, and paraesthesia (which some find disturbing), and individuals should make their own decision about taking the drug.

High altitude oedemas are life threatening, so temporising measures may be needed if immediate descent is impossible.¹ These include oxygen (2–6 l/min, supply permitting) or nifedipine for high altitude pulmonary oedema.^{4,6} Nifedipine (10 mg sublingually and 20 mg slow release, followed by 20 mg every six hours) is effective treatment for pulmonary oedema in climbers with a previous history of the condition.⁴ In a double blind trial prophylactic nifedipine (20 mg slow release taken every eight hours) reduced the incidence of recurrent pulmonary oedema in mountaineers ascending to 4559 m.⁶ Many climbers are keen to carry nifedipine with them in case of an attack. This is reasonable, but treatment of climbers with no history of pulmonary oedema is untested and nifedipine is no alternative to slow ascent and acclimatisation. Frusemide or dexamethasone for pulmonary or cerebral oedema is controversial.¹ One study suggested that dexamethasone (4 mg every six hours) does not affect cerebral oedema but reduces symptoms and may facilitate evacuation.⁷

The Gamow bag (Chinook Medical Gear, 100 Arapoe Avenue, Boulder, Colorado, 80302) is a portable (5.5 kg) recompression chamber which can be inflated in two minutes with a foot pump and has been reported to be effective for treating acute mountain sickness and pulmonary and cerebral oedema.^{8–10} It raises the ambient pressure by 140–220 millibar, equivalent to a descent of 1000–2800 m depending on the initial altitude, and reoxygenates victims without the need for stored oxygen. However, a controlled trial of 64 climbers with acute mountain sickness showed only short term improvement, with no beneficial effect 12 hours after pressurisation.¹⁰ Either the bag or the Gamow tent (fig 3) may be considered for large expeditions to remote areas, but neither are a substitute for descent if this is possible.

POOR SLEEP AND PERIODIC BREATHING

Sleep disturbance is common among climbers and often persists after acclimatisation. Electroencephalography shows a reduction in both deep sleep (stages 3 and 4) and rapid eye movement sleep. Periodic breathing is common, and apnoeic spells of 8–20 seconds have been recorded, which may be responsible for some of the sleep disruption. Acetazolamide improves oxygenation during sleep, decreases periodic breathing, and reduces sleep disturbance.¹ The addition of a benzodiazepine (temazepam 10 mg) has been shown in a small number of subjects to improve sleep further without causing ventilatory depression.¹¹

DIARRHOEA

Infective gastroenteritis is common. Conservative treatment with fluids, oral rehydration solution, or an antidiarrhoeal agent is appropriate when physical activity is light. During the trek in or climbing, however, dehydration and debilitation occur rapidly. Since fitness is paramount and most cases are bacterial in origin, early treatment with ciprofloxacin is justified; a 500 mg tablet halves the duration of diarrhoea.¹² This contravenes ordinary medical practice, but circumstances are out of the ordinary. If ciprofloxacin is ineffective metronidazole 800 mg taken every eight hours for three days will deal with giardiasis. Descent is advisable if severe symptoms persist.

HIGH ALTITUDE WEIGHT LOSS

Weight loss is a feature of high altitude deterioration

above 5000 m and is largely due to negative energy balance.¹³ Anorexia is common. Carbohydrate, but not fat or protein absorption, may be impaired.¹⁴ Sweet liquid supplements increase carbohydrate intake and may improve performance,¹⁴ but food weight and personal preference usually govern the diet.

HYPOTHERMIA

Good reviews are available for doctors unfamiliar with the features of cold injury (hypothermia and frostbite).¹⁵ For treating hypothermia, shelter, re-warming in a sleeping bag, and rehydration are usually all that is can be done on the mountainside. Oxygen is a useful adjunct at extreme altitude. Intravenous fluids can be warmed to 37°C, but infusion bags and giving sets must be insulated. Fluids can be infused from within the sleeping bag by a hydrostatically powered device (Redinov, Cardiac Connexions, Abingdon). Active re-warming of extremities should be avoided because rapid peripheral vasodilation encourages the circulation of cool peripheral blood, causing the core temperature to drop.¹⁵

FROSTBITE

Victims of frostbite are often also hypothermic and dehydrated. Thawing may be best delayed until evacuation is possible, since refreezing should be avoided. Frostbitten parts should be bathed daily in a mild antiseptic and loosely bandaged, with cotton wool pledgets to separate swollen digits. A Tubinette applicator is invaluable for bandaging digits. Blisters should be protected, and antibiotics are indicated only for secondary infection. Peripheral vasodilators have not been shown to prevent frostbite or to improve outcome. Clinical advice and evaluation of neurovascular damage may be obtained from the Institute of Naval Medicine, Alverstoke (telephone 01705 82235 extension 41879).

Miscellaneous

ACCOUNTABILITY

A doctor who considers descent or evacuation of an expedition member to be necessary may encounter some reluctance if the indications are perceived to be marginal. Descent with an escort consumes resources and may compromise the expedition's purpose. Do not let this prejudice your medical opinion.

RESEARCH

Research often provides a scientific dimension to an expedition and may increase the appeal to potential sponsors. This is to be encouraged, but a few uncon-

trolled observations made during a climbing expedition are of limited scientific value. Aims should be discussed with someone experienced in field research and should not conflict with the primary purpose of the expedition.

SPONSORSHIP

The doctor will usually be expected to contribute to fund raising. Companies may be willing to provide products but offer cash less often. The code of practice for the pharmaceutical industry eschews any financial inducement for the purposes of sales promotion.

ADAPTABILITY

A successful expedition depends on teamwork and adaptability. An ability to get involved, to listen, and to ease tensions may be the most important contribution that a doctor makes to an expedition.

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ONE HUNDRED YEARS AGO

THE JOURNAL AND THE PROFESSION: PROSPECT AND RETROSPECT.

Those whom seas sever and distances divide the BRITISH MEDICAL JOURNAL now joins in close communion and frequent converse on common social and scientific interests. And every year their number grows; for although the supposed limits of the possible circulation of a medical newspaper have long since been passed, the expansion of the circle of our clients still continues, and knows no pause. The greatest circulation ever attained by any medical journal at the date when first the BRITISH MEDICAL JOURNAL came under our guidance was 6,000. That is now thirty years since. It was of exiguous size—less than a sixth of its present ample dimensions; its circulation was under 2,000 in the fortieth year of its existence, and we were condoled with by a distinguished surgeon on becoming the Editor of "the great uncut." The cost of production closely balanced the receipts.

It has now upwards of 18,500 medical readers and subscribers, a number which steadily grows by semi-annual increment; its contents weekly amount to those of an ordinary octavo volume. Its illustrations are profuse, and its staff of editorial writers exceeds 240, all selected for special expert knowledge and acknowledged eminence in the subjects on which they are designated to write, and an average of 50 weekly contribute the unsigned editorial articles, each according to his knowledge, so that from end to end the editorial comment is condensed and authoritative without padding or hack writing. As the result of this laborious and faithful policy the JOURNAL has achieved a popularity which enables it to contribute some six thousand a year to the resources of the Association, and towards its surplus accumulation for the purposes of stability and general usefulness. Its usefulness and acceptability are now recognised as being almost as great to the English-speaking doctors of India, Canada, and Australia, as in this country. (*BMJ* 1895;i:1221.)