**Aim:** To describe injuries and illnesses in casualties rescued by Scottish mountain rescue teams during 1998 and 1999, with particular emphasis on major trauma.

**Methods:** Retrospective study. Information from mountain rescue reports, Scottish Trauma Audit Group database, and hospital case notes.

**Results:** Teams undertook 622 emergency callouts in the two years. A total of 333 casualties with injuries and illnesses rescued. There were 57 fatal incidents, 261 (78.4%) rescued with traumatic injuries, 12 (3.6%) suffering from major trauma, and 12 (3.6%) had spinal injuries. Half had lower limb injuries. Twenty six (7.7%) were suffering from non-traumatic medical problems. Forty six (13.8%) were suffering from cold or exhaustion. Fifty three casualties were dead when the rescue team arrived. Four died during or after rescue, one from hypothermia and three from trauma. All major trauma casualties were evacuated by helicopter.

**Discussion:** No previous similar studies identified. Significant numbers of seriously injured and ill casualties are being cared for by mountain rescue team casualty carers, many of whom are not healthcare professionals. The need for improved training, research, and equipment is discussed.

**Conclusion:** Scottish MRTs are called upon to provide an advanced level of care for a significant number of casualties. There is a need for formalised opportunities for in hospital training, management protocols, and continuing research and audit—none of which currently exists.
haematomas. Four of these casualties had a reduced conscious level, however only one was in coma, with a GCS of 4.

All people in the major trauma category were men. Their ages ranged from 25 to 53 years.

Non-traumatic medical conditions
Seventy two (21.6%) of the 333 people who survived were suffering from conditions not related to trauma. Twenty six (7.7%) of casualties were suffering from medical problems (fig 2). Forty six (13.8%) were described in the MRC of S reports to be suffering from cold or exhaustion alone. As actual temperatures and clinical features were not recorded in the reports it is not possible to say if these casualties were hypothermic or not.

Fatalities
A total of 57 people died in the Scottish mountains in the two year study period. Causes of death in this group are shown in figure 3. Fifty three of these 57 people were dead when the mountain rescue team arrived on scene. The remaining four deaths occurred after the arrival of the mountain rescue team.

Three of these deaths were attributable to trauma (table 2) and one due to hypothermia. Of the three trauma casualties who died after rescue, two were unconscious at the time of rescue team arrival. One casualty was initially conscious at the time of rescue but died from hypovolaemic shock because of an open femoral shaft fracture during rescue.

Mode of transport used in rescue
Although helicopters were not involved in all rescues in the two year period, all patients with ISSs exceeding 15 and the four people who died after rescue were transported to hospital by military search and rescue helicopter or ambulance service helicopter.

DISCUSSION
The mountain rescue service in Scotland is responsible for the care of substantial numbers of injured and ill casualties. During this two year period, teams were called upon to rescue 390

Table 1 Injuries and physiological parameters of major trauma casualties on admission to hospital (surviving casualties only) n=12

| Age | Sex | Injuries | ISS | RR | Sys BP | GCS |
|-----|-----|----------|-----|----|--------|-----|
| 34  | M   | L1 #, spinal cord damage, tibia and fibular #, minor head injury | 21  | 23 | 87     | 15  |
| 28  | M   | L1 to 4 transverse process #’s, pneumothorax, humerus # | 17  | 24 | 162    | 15  |
| 43  | M   | Depressed skull #, Neck of femur #, pelvis #, radius # | 19  | 12 | 130    | 15  |
| 42  | M   | Open skull #, pubic ramus #, retroperitoneal haematoma | 20  | 7  | 165    | 15  |
| 53  | M   | Base of skull #, occipital contusions, 4 ribs #, tibia #, | 27  | 24 | 124    | 15  |
| 31  | M   | Open depressed skull #, abrasions | 17  | 36 | 152    | 15  |
| 25  | M   | Diffuse axonal injury, SAH, occipital contusions, pneumothorax | 35  | 20 | 150    | 4   |
| 48  | M   | Occipital contusions, intraventricular haemorrhage, humerus # | 26  | 24 | 137    | 12  |
| 35  | M   | Cervical spine #, cervical spinal cord damage, humerus # | 19  | 30 | 150    | 10  |
| 28  | M   | Pneumothorax, pulmonary contusion, pubic ramus #, ankle #, dislocation | 21  | 28 | 113    | 15  |
| 31  | M   | Depressed skull #, extradural haematoma, facial #,Cervical subluxation | 20  | 20 | 106    | 13  |
| 28  | M   | Open skull #, parieto-occipital contusion and haematoma, open elbow # | 25  | 24 | 140    | 15  |

ISS, injury severity score; RR, respiratory rate; Sys BP, systolic blood pressure; GCS, Glasgow Coma Score; #, fracture; L, lumbar vertebra; SAH, subarachnoid haemorrhage.

Table 2 Trauma deaths during and after rescue (n=3)

| Age | Sex | Injuries | Outcome |
|-----|-----|----------|---------|
| 58  | M   | Open femoral fracture, scalp wound | Died during rescue |
| 18  | M   | Head, pelvic and chest injuries | Died during rescue |
| 30  | M   | Liver laceration | Died in operating theatre |

Figure 1 Scottish mountain rescue casualties 1998 and 1999 (n=390).

Figure 2 Medical problems in Scottish mountain rescue casualties 1998 and 1999 (n=26).

Figure 3 Cause of death in Scottish mountain rescue casualties 1998 and 1999 (n=57). (Information from MRC of S annual reports.)
people who had sustained injuries or illnesses or who had died in the Scottish mountains. These teams are frequently required to assess casualties in difficult conditions and provide treatment for them for prolonged periods during evacuation.

A search of the medical literature found only one previously published study examining injuries in people rescued by Scottish MRTs. This study by Kerr looked at people rescued in 1994 and 1995 using the MRC of S annual rescue reports. The total number of casualties with illnesses and injuries rescued in this period was 546, 20% more than were rescued in the period of this study.

In 1994 and 1995 Kerr noted 93 deaths in the Scottish mountains. This number is significantly higher than the 57 deaths reported in 1998 and 1999. Kerr's study showed that half of all people rescued had sustained lower limb injuries. A similar proportion was found in this study.

Kerr's study however is based on information from the MRC of S reports alone and therefore did not aim to identify or closely examine those people with severe injuries. Reid et al. examined the postmortem findings of a number of people who died in the Scottish mountains between 1978 and 1983. This study of 42 necropsies showed trauma was the cause of death in 81% of cases. In this study period 61% of deaths were the result of trauma, with a higher proportion of fatalities resulting from non-traumatic medical conditions.

A study of fell walking injuries in Cumbria published by Goel and Addison in 1992 suggested that a significant number of people rescued by teams in that area were seriously unwell. Six per cent of the 90 casualties in this series required admission to the intensive care unit, although injury scores are not detailed in the paper.

The author previously carried out a study examining medical training and equipment in mountain rescue teams throughout the United Kingdom. This study revealed that most teams were well equipped to deal with a wide variety of injury types. It showed however that the wide variations among teams with regard to drugs carried, advanced first aid training, and in the involvement of medical professional on rescue call outs. With no detailed studies of conditions treated the paper suggested that there was a need for specific information on illnesses and injuries encountered to assess and plan medical training and equipment in United Kingdom mountain rescue teams.

People with major trauma require intensive medical management, which is particularly difficult in the prehospital environment. In this two year period 12 people who survived suffered major trauma. This represents 3.6% of all injured and ill casualties cared for by teams. The types of injury sustained in this group are diverse (table 1). The most common being head injuries, spinal fractures, and chest injuries.

Mountain rescue teams in the UK are well equipped to care for patients with suspected spinal injuries. A significant number of surviving casualties (3.6%) rescued in the study period had sustained spinal fractures. Mountain rescue casualty carers should be aware of this incidence and maintain a high suspicion of spinal injury.

Teams treated four unconscious injured casualties in the two year period. Three of these died during or after rescue and one survived. Treatment of such seriously injured patients calls for competence in a wide range of advanced resuscitation techniques in the mountain rescue team casualty carer.

Non-traumatic medical problems occurring in the mountains may necessitate the involvement of the mountain rescue service for prehospital treatment and evacuation. Almost 8% of those rescued were suffering from medical problems. This figure is similar to that found by Kerr. Predominantly these problems were asthma, chest pain, epilepsy, and diabetic problems.

The perception of hypothermia as a significant problem in Scottish mountain rescue casualties prompted the production of a hypothermia management protocol for teams. It is of interest to note however that only one person died in the two years from hypothermia in the Scottish mountains, after the arrival of the rescue team.

Overall, almost 14% of those rescued were suffering from cold or exhaustion without injury or illness. As no system exists to record temperatures in this group it is not possible to assess the incidence of true hypothermia. No previous studies have examined the incidence of hypothermia in Scottish mountain rescue casualties.

During the two year period four people initially alive at the time of rescue, died during or after rescue. Two of these were from multiple injuries, one from hypothermia, and one individual died from haemorrhage from an open femoral fracture. Such casualties present a great challenge to the skills of any mountain rescue casualty carer or health care professionals. In the great majority of fatal incidents (93%) death had occurred before the arrival of the mountain rescue team.

The diversity and severity of conditions identified in this study highlight the need for well trained, equipped, and experienced mountain rescue teams in Scotland. The outcome of these casualties is partly dependent on their prehospital medical treatment, which in turn is dependent on the medical skills and experience of the mountain rescue team, most of whom are not medical professionals.

Currently, there are no medical training requirements or standards for mountain rescue teams in Scotland. Medical training for mountain rescue personnel is currently based on classroom and simulated scenario teaching. There is no formally organised clinical teaching, or organised provision for exposure to clinical cases in a hospital environment.

This study shows that teams are required to assess and care for a significant number of seriously ill people. With a frequency of six cases of major trauma a year, it is possible that exposure to seriously injured patients in the mountain rescue setting alone may not be sufficient for casualty carers to attain and maintain the appropriate level of skills and experience of patient management.

A formally organised system for in hospital clinical teaching for Scottish mountain rescue casualty carers should be considered. This might include the attainment of basic airway skills in the anaesthetic room and time spent in emergency departments. Such training would be especially important for teams who do not regularly have appropriately skilled health care professionals on call outs.

Teams in Scotland are provided with equipment for the treatment of a wide variety of traumatic injuries. Almost 8% of people in this study were rescued suffering from medical illnesses. It is possible that a number of these patients may have had indications for the use of emergency medication during their often prolonged transfer to hospital. MRTs in Scotland are not currently supplied with medication for medical emergencies. The status and management of this group merits further investigation in order that the provision of medication to teams be considered.

The MRC of S supplies equipment and analgesia to teams. This includes codeine and morphine (personal communication). This is distributed to teams who request it, including those with no health care professionals as members.

Currently there are no guidelines or protocols produced by the MRC of S for the use of codeine or morphine by team members. Team members are also not indemnified for the MRC of S for their medical management of patients. In our increasingly litigious society these matters perhaps should be investigated.

It is encouraging to note the high level of service provided by military search and rescue helicopters in the rescue of mountain casualties in Scotland. All people who had suffered major trauma were evacuated to hospital by helicopters from the Royal Navy, RAF, or ambulance service.

This study made use of the current MRC of S rescue reporting system. This contains detailed information about the
circumstances associated with accidents such as weather, terrain, and equipment. Unfortunately the system collects limited information about the medical condition of patients or treatments administered by teams. This made collection of data on this group difficult. There is an urgent need for an improved rescue data collection system so that these patients can be more easily researched and audited. This would facilitate an evidence based approach to medical skills, medication, and equipment in Scottish mountain rescue.

In conclusion, Scottish mountain rescue teams are called upon to provide prehospital medical care to large numbers of injured and ill casualties. A significant number of these are seriously injured.

If we are to expect mountain rescue casualty carers to assess and treat seriously ill and injured patients for prolonged periods in a hostile environment, the introduction of medical guidelines and protocols should be considered. The potential need for clinical training and exposure to clinical cases should also be considered.

Further research is particularly required to examine the incidence and severity of hypothermia and non-traumatic medical illnesses in the Scottish mountains. This is an area that has not previously been studied.

The current paucity of audit and research into mountain rescue casualty care in Scotland needs to be resolved to maintain and improve the care we provide to the significant number of people who sustain injuries and illnesses in the remote and hostile mountain environment. This is required to facilitate the introduction of an evidence based approach to mountain casualty care.

The responsibility for the care of seriously injured casualties lies in the hands of mountain rescuers who are not health care professionals. These people should be supported with improved training and management guidelines based on continuing research and audit.

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