

Point of Care Ultrasound in Mountain Rescue – Protocol of a Scoping Review

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Objective

Develop recommendations for using Point of Care Ultrasound (POCUS) in Mountain Rescue (MR) based on a scoping review about the available evidence. We will also identify gaps in knowledge and areas with a need for future research.

Introduction

The increasing application of point-of-care ultrasound (POCUS) in emergency medicine has transformed diagnostic and pre-hospital assessments (1), particularly in resource-limited and challenging environments. Mountain rescue operations, characterized by difficult terrain, high-altitude conditions, and limited access to advanced medical facilities, require innovative solutions to improve patient outcomes. POCUS offers the potential for rapid, bedside assessment of trauma, guide emergency interventions, and facilitate decision-making(2) in these remote settings(3). Despite its promising utility(4), the current body of evidence on POCUS in mountain rescue remains scattered, diverse, and often limited to small case series or localized studies. As a result, there is a critical need to map existing research, identify gaps, and clarify the scope of available evidence to inform clinical practice and guide future investigations.

A scoping review is particularly well-suited for this purpose, as it allows comprehensive exploration of the breadth and nature of literature on POCUS applications within mountain rescue contexts. It enables the identification of study designs, outcomes evaluated, barriers and facilitators to implementation, and areas where evidence is lacking. By systematically collating and synthesizing this information, a scoping review can highlight the current state of knowledge, support the development of guidelines, and inform training programs tailored for rescue personnel operating in high-risk environments.

Given the growing interest and technological advancements in portable ultrasound devices(5), understanding how POCUS is utilized, the challenges faced, and the benefits observed is essential for optimizing rescue strategies and patient care in mountain environments. Therefore, conducting a scoping review is a necessary step toward establishing an evidence-informed foundation for integrating POCUS into mountain rescue protocols, ultimately aiming to improve safety, efficiency, and patient outcomes in these extreme settings.

Methods

Source of evidence selection

The records identified from the search will be uploaded in the EndNote 20 program, and duplicates will be removed. Two reviewers (J. Manuel Funk & Peter Paal) will independently screen the titles and

abstracts of the retrieved studies, to check for their eligibility, using the Rayyan app for systematic reviews. All eligible references will be retrieved in full text. Both reviewers will independently analyse all the full text references to confirm their inclusion. Any disagreement will be solved by consensus between both reviewers or, if not possible, by a third reviewer.

Data extraction

The data will be extracted from the included studies by one reviewer, and then will be checked by another reviewer. Disagreements will be resolved through discussion, or, if not possible, by a third reviewer. A data extraction table will be developed, which will include the key information. This will include information on the source (year, author, reference, country), on the study design, on the population (type, sample size, age), on the intervention, on the comparator and on the outcome (hospital admission, survival, neurological outcome).

A draft of the data extraction table is provided (Appendix 2). The data extraction table is susceptible to be modified to include any key findings that would relate to the scoping review questions. The scoping review will be reported following the Preferred Reporting Items for Systematic Reviews and the Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) statement.

Inclusion and Exclusion Criteria

We include original studies, reviews (preferably systematic reviews), observational studies and case reports and case series published from the inception of the data base until March 31 2026. We exclude studies unrelated to the use of POCUS in mountain rescue or wilderness scenarios, unless relevant.

Review questions

1. What is evidence of the benefit of using point of care ultrasound (POCUS) in mountain rescue?
2. What POCUS applications of point of care ultrasound are proven to be beneficial in mountain rescue?

PICOST questions for a scoping review on point-of-care ultrasound (POCUS) in mountain rescue:

PICOST 1: Utilization of POCUS in Mountain Rescue

- **Population:** Rescue personnel and patients involved in mountain or wilderness rescue operations
- **Intervention:** Use of point-of-care ultrasound for assessment and decision-making
- **Comparison:** Standard assessment methods without ultrasound or other diagnostic tools
- **Outcome:** Diagnostic accuracy, time to diagnosis, improvement in patient management, rescue success rate, delay in treatment because of using POCUS.
- **Study Type:** Original studies, reviews (preferably systematic reviews), observational studies and case reports and case series
- **Time Frame:** Published from the inception of the database until March 31 2026.

PICOST 2: Types of POCUS Applications in Mountain Rescue

- **Population:** Patients in mountain rescue scenarios
- **Intervention:** Specific applications of POCUS such as trauma assessment (e.g., FAST), lung evaluation or cardiac assessment.
- **Comparison:** Other assessment modalities (e.g., physical exam, clinical judgment)
- **Outcome:** Diagnostic utility, feasibility, and safety of various ultrasound applications in the field
- **Study Type:** Original studies, reviews (preferably systematic reviews), observational studies and case reports and case series
- **Time Frame:** Published from the inception of the database until March 31 2026.

PICOST 3: Barriers and Facilitators to POCUS Implementation

- **Population:** Mountain rescue teams and pre-hospital emergency responders

- **Intervention:** Training, equipment, or protocols for POCUS deployment, oversight and accurate documentation.
- **Comparison:** Absence of these factors
- **Outcome:** Barriers (e.g., training, device durability) and facilitators (e.g., portable devices, training programs) affecting effective implementation
- **Study Type:** Original studies, reviews (preferably systematic reviews), observational studies and case reports and case series
- **Time Frame:** Published from the inception of the database until March 31 2026.

PICOST 4: Outcomes of POCUS-guided Interventions

- **Population:** Patients in mountain rescue settings
- **Intervention:** POCUS-guided medical interventions or rescue decisions
- **Comparison:** Interventions without ultrasound guidance
- **Outcome:** Patient outcomes such as morbidity, mortality, complication rates, or rescue efficiency
- **Study Type:** Original studies, reviews (preferably systematic reviews), observational studies and case reports and case series
- **Time Frame:** Published from the inception of the database until March 31 2026.

Keywords

POCUS, Point of care Ultrasound, Ultrasound, Sonography, Ultrasonography.

Mountain Rescue, Alpine Rescue, High altitude, Wilderness medicine.

Prehospital, Emergency, Rescue.

1. Databases

2. Clinicaltrials.gov (NLM)
3. Cochrane Library (Wiley)
4. MEDLINE (Ovid)
5. Embase (Ovid)
6. Web of Science
7. Core Collection (Science Citation Index Expanded, Social Sciences Citation Index; Clarivate)

The reference lists of the included studies will be searched for additional studies. There will be no restriction of language or date.

8. Draft search strategy for MEDLINE (Ovid)

Mountaineering/ or Wilderness/ or Altitude/ or Altitude Sickness/

(mountain* or alpine or wilderness or altitude* or backcountry).ti,ab,kf.

(remote adj (area* or setting* or location* or region* or site* or context or environment*)).ti,ab,kf.

or/1-3

Rescue Work/ or exp Emergency Responders/ or "Failure to Rescue, Health Care"/ or
Emergencies/ or Emergency Medicine/ or Evidence-Based Emergency Medicine/ or Emergency
Medical Services/ or Emergency Treatment/

(rescu* or emergency or emergencies or mission* or prehospital or pre-hospital).ti,ab,kf.

or/5-6

4 and 7

Wilderness Medicine/

(ICAR MedCom).ti,ab,kf.

(Avalanches/ or avalanche*.ti,ab,kf.) and ((rescu* or emergency or emergencies or
medicine or mission* or victim* or patient* or buri* or accident* or death* or dying or
fatal* or surviv* or hypotherm* or snow or ski*).ti,ab,kf.)

or/8-11 [Population: Patients requiring mountain rescue]("point-of-care ultrasound").ti,ab,kf.

(POCUS).ti,ab,kf.

exp Ultrasonography/

(ultrasound* or ultrason* or scan* or imaging or sonogra* or echogra* or echotomogra* or echocardiogra* or echosound or echoscop* or doppler* or duplex* or flowmetr*).ti,ab,kf.

diagnostic imaging.fs.

or/13-17 [Intervention: Point-of-care ultrasound]

12 and 18 [Population AND Intervention]

Full, reproducible search strategies of all databases will be reported according to the PRISMA-S guideline (6).

Appendix 2. Data extraction table. The data extraction table is susceptible to be modified to include any key findings that would relate to the scoping review questions.

VARIABLE	EXAMPLE
Title of source	POCUS in MR.
First author	Holthof N
Year	2025
Country of publication (1 st and/or last author)	Switzerland

Study design	Questionnaire
Study population	Human
Sample size (overall)	25
Sample size (number of avalanche victims)	NA
Intervention	None
Comparator	None
Outcome	Quantitative paramers
Key findings (related to avalanche knowledge)	None
For which avalanche-specific PICOST question(s) may this study be relevant?	1, 2

References

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6. Rethlefsen ML, Kirtley S, Waffenschmidt S, Ayala AP, Moher D, Page MJ, et al. PRISMA-S: an extension to the PRISMA statement for reporting literature searches in systematic reviews(). *J Med Libr Assoc*. 2021;109(2):174–200.