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ORIGINAL RESEARCH

Research Gaps in Wilderness Medicine

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Introduction—Wilderness medicine involves the treatment of individuals in remote, austere environments. Given the high potential for injuries as well as the unique treatment modalities required in wilderness medicine, evidence-based clinical practice guidelines are necessary to provide optimal care. In this study, we identify evidence gaps from low-quality recommendations in wilderness medicine clinical practice guidelines and identify new/ongoing research addressing them.

Methods—We included relevant clinical practice guidelines from the Wilderness Medical Society and obtained all 1C or 2C level recommendations. Patient/Problem/Population, intervention, comparison, outcome (PICO) questions were created to address each recommendation. Using 24 search strings, we extracted titles, clinical trial registry number, and recruitment status for 8899 articles. We categorized the articles by trial design to infer the effect they may have on future recommendations.

Results—Twelve clinical practice guidelines met inclusion criteria. From these we located 275 low-quality recommendations and used them to create 275 PICO questions. Thirty-three articles were relevant to the PICO questions. Heat-related illness had the highest number of relevant articles (n=9), but acute pain and altitude sickness had the most randomized clinical trials (n=6).

Conclusion—Overall, few studies were being conducted to address research gaps in wilderness medicine. Heat-related illness had the most new or ongoing research, whereas no studies were being conducted to address gaps in eye injuries, basic wound management, or spine immobilization. Animals, cadavers, and mannequin research are useful in cases in which human evidence is difficult to obtain. Establishing research priorities is recommended for addressing research gaps identified by guideline panels.

Keywords: practice guideline, evidence-based emergency medicine, immobilization, snakebites, wound, injuries

Introduction

Wilderness medicine involves the treatment of individuals in remote, austere environments. This field of medicine is increasing in popularity because of heightened interest in adventure tourism and the spread of civilization into a greater variety of environments.[1] As more people participate in such activities, the likelihood for injury in these environments will increase.[1,2] Although epidemiological data are preliminary, soft-tissue wounds, strains, sprains, and fractures have been the most frequently reported injuries.[3–5] The most common causes of death in remote environments are head trauma, cardiac arrest, drowning, and hypothermia.[6] Given the high potential for injuries and the unique treatment modalities required in wilderness medicine, evidence-based clinical practice guidelines (CPGs) are necessary to aid practitioners in providing the best care for individuals injured in austere environments.[7]

CPGs are based on the best available evidence and are used by physicians to provide high-quality patient care. For example, the Wilderness Medical Society's wound management CPG[8] advocates for the use of tourniquets with severe injuries because evidence suggests that tourniquets can stop bleeding in 85% of patients compared with 17% of patients not treated with a

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tourniquet.[9] Because physicians and patients rely on the recommendations of these guidelines, assessing the literature behind each recommendation has recently become an important area of further research.[10] A grading scale was developed by the American College of Chest Physicians (ACCP) to permit clear identification of the strength of a recommendation and the quality of the evidence supporting it.[11] The authors of wilderness medicine CPGs chose this scale because it allows authors to assign grades for recommendation strength and quality of evidence separately.[7] This scale ranges from strong recommendations with high-quality evidence to weak recommendations with low-quality evidence. Critically evaluating the recommendations at the latter end of the scale is particularly important because they are the least helpful in guiding clinicians. These areas of low-quality or very low-quality evidence are defined as "research gaps," and they need to be appropriately addressed.[12]

Addressing these gaps in wilderness medicine can be extremely difficult because of the potentially isolated locations and unpredictable nature of injuries covered by wilderness medicine CPGs.[7] Recommendations that have already received an A grade for research support do not require as much additional investigation as those with a C grade. Projects that focus on areas with exceptional amounts of research are allocating resources to already well-studied areas, producing waste and leaving research gaps in less-studied topics.[13] Scientific research toward biomedical advancements has seen a substantial increase in annual funding to over $240 billion nationally in 2009.[14,15] Four main themes are apparent in wasted research funding: repetitive investigations, research that is not published/reported, lack of access to research data/journals, and research currently underway in clinical areas that are not pertinent to practitioners or patients.[14,15] Our project aims to identify the low-quality evidence recommendations in wilderness medicine CPGs that need further research and to identify recent publications that may address them.

Methods

OVERSIGHT AND REPORTING

This study was not subject to institutional review board oversight because it did not meet the regulatory definition of human subject research as defined in 45 CFR 46.102(d) and (f) of the Department of Health and Human Services' Code of Federal Regulations. We applied relevant statistical analyses and methods in the published literature reporting guidelines for reporting descriptive statistics.[16]

We located the latest CPGs for wilderness medicine, found in Figure 1. Recommendations from these guidelines are rated based on the quality of evidence described by the ACCP Clinical Guideline (Table 1).[11] For each grade 1C or 2C recommendation, we constructed one or more research questions using the patient/problem/population, intervention, comparison, outcome (PICO) format.[16] This method is used to identify clinical components for systematic reviews and is endorsed by the Cochrane Collaboration.[17] It was chosen over the participants, intervention, comparator, outcomes, study design and the sample, phenomenon of interest, design, evaluation, and research methods because evidence suggests that this method produces searches with greater sensitivity. In addition, PICO questions are widely used and are the best framework to identify research gaps and investigate the reasons that they exist.[18] Board-certified emergency medicine physicians constructed all initial PICO questions independently and then convened and reconciled any differences for accuracy before drafting the final questions.[16]

DEVELOPMENT OF THE SEARCH STRINGS

PICO questions were reviewed to identify high-yield keywords. These keywords were then used to design search strings for the questions. Search strings are part of a search strategy for finding information in databases. A search strategy is the process used to translate a clinical query (ie, research question in PICO format) into a format that can be correctly understood by the search engine.[19] The goal of a search string is to strike a balance between retrieving relevant studies and excluding irrelevant ones. For this study, we used a highly sensitive search strategy. Our searches retrieved a large number of false-positive results to ensure that important studies were not missed.

The keywords were compared with Cochrane systematic reviews, Medical Subject Headings, and PubMed automatic term mapping to determine relevant synonyms, entry terms, and variant word forms. A search string was formulated leveraging Boolean operators (eg, OR, AND) and parenthetical groupings to optimize the use of key terms to retrieve as many relevant records as possible in the clinical trial registries. Although both ClinicalTrials.gov and the World Health Organization's International Clinical Trials Registry Platform (ICTRP) databases employ the Unified Medical Language System to enhance interoperability of vocabularies, their search engines work differently. For this reason, 2 separate search strings were developed for this study, one for ClinicalTrials.gov and a second for ICTRP. We consulted a previous study that used multiple registries[20] to