ORIGINAL RESEARCH

Wilderness Medicine Curricula in United States EMS Fellowship, Emergency Medicine Residency, and Wilderness Medicine Programs

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Abbreviations:
ABEM: American Board of Emergency Medicine
ACEP: American College of Emergency Physicians
ACGME: Accreditation Council for Graduate Medical Education
ED: Emergency Department
EM: Emergency Medicine
EMS: Emergency Medical Services
GME: Graduate Medical Education
MedWAR: Medical Wilderness Adventure Race
NAEMSP: National Association of EMS Physicians
NRMP: National Resident Matching Program (NRMP)
SAEM: Society for Academic Emergency Medicine
US: United States
WEMS: Wilderness Emergency Medical Services
WM: Wilderness Medicine
WMS: Wilderness Medicine Society

Abstract

Objective: Wilderness Medicine (WM) focuses on care delivered in austere or resource-scarce environments. The Accreditation Council for Graduate Medical Education (ACGME) requirements and core content for Emergency Medicine (EM) residency and Emergency Medical Services (EMS) fellowship in the United States (US) include some WM topics that are covered to varying degrees in these programs. Furthermore, there are no ACGME-approved WM fellowships or specific curricula. Different training programs may develop WM content and curricula that differ significantly, leading to variations in WM competencies and training. In 2009, the American College of Emergency Physicians (ACEP) Wilderness Medicine Section created a Fellowship Subcommittee and Taskforce to develop a standardized curriculum and core content for EM-based WM fellowships. However, to date, EMS fellowship and EM residency WM curricula in the US content have not been analyzed for consistency with the ACEP WM fellowship curriculum.

Methods: In this study, the WM curricula components of EM residency and EMS fellowship were evaluated using the ACEP WM fellowship curriculum as a control. Potential curriculum gaps for each program type were identified.

Results: Of the 19 WM competencies developed by the ACEP Wilderness Medicine Section Fellowship Subcommittee and Taskforce, EMS fellowship covers more WM topics (16 topics, or 84%) than EM residency (12 topics, or 63%), and combined, they cover 89% of these topics.

Conclusions: By expanding to cover two additional WM topics, all WM curricula topics recommended by the ACEP WM fellowship curriculum could potentially be covered in EM residency + EMS fellowship; however, the depth of education in each topic may vary. It may be beneficial for Graduate Medical Education (GME)-level learners for programs to implement hands-on educational experiences in WM topics.

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Introduction

Wilderness Medicine: An Introduction

Wilderness Medicine (WM) – a unique field of medicine focusing on patient care in austere environmental conditions with limited resources – has roots stretching back to ancient Greek and Roman civilizations.[1] In the United States (US), WM guidelines were initially described in 1979 by Dr. William Forgey in *WMS Practice Guidelines for Wilderness Emergency Care*, which is now in its fifth edition.[2]

The Wilderness Medicine Society (WMS; Austin, Texas USA) was established in 1983 by Drs. Paul Auerbach, Edward Geehr, and Ken Kizer to support WM in areas such as health care delivery, research, and education via conferences, workshops, journals, and other outreach tools.[3] Dr. Auerbach subsequently authored *Wilderness Medicine*, an educational textbook that is currently in its seventh edition.[4] Numerous other texts have since described the field of WM as the field continues to evolve, and there have been significant advances in incorporating WM aspects into other subspecialties, including Hawkins' *Wilderness EMS* and published text by the National Association of [Emergency Medical Services] EMS Physicians (NAEMSP; Overland Park, Kansas USA).[5,6]

In addition, clinical practice guidelines for WM continue to be amended and up to date with recent medical literature. The WMS Clinical Practice Guidelines are peer-reviewed and published in *Wilderness & Environmental Medicine*.[7] Recently, WM has evolved to include topics such as Altitude Medicine, Dive Medicine, Envenomation, Trauma, Environmental Exposure, Avalanche, Military Medicine, Epidemiology, Search and Rescue, Travel Medicine, Disaster Medicine, and Ultrasound.[3]

Physician Fellowship Training

As of 2022, there were 20 civilian WM fellowships and one military WM fellowship that Emergency Medicine (EM) and Family Medicine (FM) residents can pursue in the US. Of note, there is at least one WM fellowship, located at the Carilion Clinic at Virginia Tech (Blacksburg, Virginia USA), that also offers training to Physician Assistants and Nurse Practitioners.[8,9] Additionally, there is a combined EMS-WM fellowship offered by the Wake Forest University School of Medicine (Winston-Salem, North Carolina USA).[9,10]

Currently, WM fellowships are not Accreditation Council for Graduate Medical Education (ACGME; Chicago, Illinois USA)-accredited and do not participate in the National Resident Matching Program (NRMP) Subspecialty Matching Service (SMS).[11,12] However, many EMS fellowships that are ACGME-accredited and do participate in the NRMP also offer WM educational opportunities and activities. The NAEMSP EMS Fellowship Guide offers a list of EMS fellowships as well as whether or not they incorporate WM activities. This opportunity to study WM topics as part of an ACGME-accredited fellowship in a separate subspecialty is a topic for additional discussion within this analysis of WM education.[13]

These WM fellowship programs follow a standardized curriculum created by the American College of Emergency Physicians (ACEP; Irving, Texas USA) Wilderness Medicine Section detailing the core competencies that a WM-trained physician should acquire over their subspecialty training.[14] The website of the Wilderness Medical Society notes that fellowships must demonstrate that they meet core content as set out by Lipman, et al.[15] Currently, 13 WM fellowship programs are certified by the Wilderness Medical Society.[12] Additionally, six WM fellowship programs are certified by the Society of Academic Emergency Medicine (SAEM; Des Plaines, Illinois USA), which also notes that fellowships must meet the core content as expressed by Lipman, et al.[16]

At the 2009 ACEP Scientific Assembly, a Fellowship Subcommittee and Taskforce of experts in the field was organized to create the standardized curriculum, which was developed in response to a growing interest in WM from an EM perspective.[14] These experts included individuals involved in WM fellowships and professionals actively practicing in academic WM.[14] During ACEP Scientific Assemblies, SAEM meetings, and the WMS World Congress from 2010 to 2012, the group identified common topics covered by WM fellowships and topics unique to WM.[14] These topics were refined and voted on by each member and the final draft was ultimately accepted by all members of the Fellowship Subcommittee and Taskforce.[14] The 19 main competencies include four academic skills (Education of Wilderness Medicine, Quality, Research, and Leadership) and 15 core content topics (Altitude, Environmental Exposure, Wilderness Trauma, Expedition Medicine, Drowning, Dive Medicine, Aquatic Medicine, Poisonings and Envenomation, Fire, Wilderness EMS, Search and Rescue, Survival, Lightning, Avalanche, and Wilderness Toxicology).[14] Currently, EMS fellowships are the only ACGME-accredited fellowship programs that provide training in WM core content topics.[17]

Many EMS fellowships have incorporated elements of WM into their programs by the very nature of their training. Additionally, Wilderness Emergency Medical Services (WEMS) is defined as addressing a medical emergency in a specific location or environment with a specialized wilderness training.[18] The 2019 EMS core curriculum was developed by the American Board of Emergency Medicine (ABEM; East Lansing, Michigan USA) and the NAEMSP and includes several WM topics such as Wilderness Survival, Wilderness Trauma, and WEMS Systems.[2] The incorporation of WM into EMS systems includes topics such as physician oversight, protocols for WEMS programs, and WEMS scope of practice.[19] However, an important distinction between WM fellowship and WEMS training is that there are limited medical resources in WM fellowship training, whereas WEMS training usually uses more medical equipment.[18]

Physician Residency Training

Among Graduate Medical Education (GME) residency programs that include WM training, EM residency has the most WM overlap.[19] Many WM topics are covered under basic EM residency training, such as toxicology, avalanche injuries, and diving injuries.[20] Residency programs for EM do not typically cover all WM topics outlined by the ACEP WM curriculum task force, and thus, additional post-graduate training is required to cover the entire scope of WM.[14]

Given the variation in WM education across EM training programs, the objective of this study was to analyze these differences. The hypothesis was that WM fellowship, EMS fellowship, and EM residency programs have overlapping content regarding their WM education.

Methods

Control Curriculum

A list of 19 WM competencies was derived from the core content ACEP WM fellowship curriculum developed by the ACEP

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Wilderness Medicine Component	Description from Lipman, et al
Altitude Medicine	Physiologic response to high altitude and hypobaric hypoxia; acclimatization; high altitude sickness and subtypes; risk assessment
Aquatic Medicine	Injuries from marine animals, poisonings, infections
Avalanche	Terrain and snowpack assessment, avalanche victim physiology, patterns of injury, rescue equipment
Dive Medicine	Physics and physiology, barotrauma, decompression illness, risk assessment
Drowning	Drowning
Education in WM	Didactics, bedside, and applied skills education
Environmental	Heat illness, hypothermia, cold injuries
Expedition Medicine	Pretravel, evacuation criteria, medical kits, acute and chronic medical conditions, infectious disease, water disinfection, nutrition, legal considerations
Fire Injuries	Predictable injury and illness patterns, medical complications
Leadership	Leadership skills
Lightning Injuries	Risk assessment and physiology
Poisonings/Envenomation	Animal attacks, snakes, spider bites, tick-borne diseases, Hymenoptera stings, scorpion stings, mosquito-borne diseases, rabies
Quality	Wilderness and prehospital treatment protocols; data collection, management, and analysis; quality improvement; evidenced-based practice
Research	Research project design, epidemiology and biostatistics, completion of scholarly project
Search and Rescue	Theory and application; high-angle, swift-water, and alpine rescue
Survival	Shelter, water procurement and disinfection, fire building, navigation and signaling
Wilderness EMS	Interface with EMS, air medical transport
Wilderness Toxicology	Poisonous plants and mushrooms
Wilderness Trauma	Basic principles; head, spinal, chest, pelvis, penetrating, and extremity trauma; sprains/strains; wound management; foreign body management

Table 1. Wilderness Medicine Components from Lipman, et al and their Descriptions[14]
Abbreviations: EMS, Emergency Medical Services; WM, Wilderness Medicine.

Wilderness Medicine Section Fellowship Subcommittee and Taskforce, as described by Lipman, et al.[14] These competencies included Education in Wilderness Medicine, Quality, Research, Leadership, Altitude, Environmental, Wilderness Trauma, Expedition Medicine, Drowning, Dive Medicine, Aquatic Medicine, Poisonings and Envenomation, Fire, Wilderness EMS, Search and Rescue, Survival, Lightning, Avalanche, and Wilderness Toxicology. Table 1 displays the WM components and their descriptions from Lipman, et al.[14]

Training Curricula

National curricula for EM residency and EMS fellowship were gathered from *The 2013 Model of the Clinical Practice of Emergency Medicine*[20] and *The 2019 Core Content of Emergency Medical Services Medicine*,[21] respectively. The EM residency curriculum by Counselman, et al was chosen because it was created, approved, and continuously updated by seven leading EM expert organizations, including ABEM, ACEP, the Council of Emergency Medicine Residency Directors (CORD; Irving, Texas USA), the Emergency Medicine Residents' Association (EMRA; Irving, Texas USA), the Residency Review Committee for Emergency Medicine (RRC-EM), SAEM, and the American Academy of Emergency Medicine (AAEM; Milwaukee, Wisconsin USA).[20] The EMS fellowship curriculum was chosen because it was developed by NAEMSP and ABEM, updated by ABEM, cross-referenced with the ACGME core competencies, and validated by the NAEMSP.[21] These curricula were analyzed for their WM components. Both EM residency and EMS fellowship were also evaluated for their WM components.

Study Design

The EM residency and EMS fellowship published curricula were analyzed and identified for topics related to WM. These were then evaluated against the ACEP WM fellowship curriculum topics as a control. Descriptive analysis was used to identify overlapping topics, gaps, and differences between each program's WM curriculum and the ACEP WM fellowship curriculum.

Results

Comparison of WM Components in Each Curricula

Figure 1 displays the WM components found in each physician training curriculum. Altitude Medicine, Dive Medicine, Drowning, Environmental, Fire Injuries, Leadership, Lightning Injuries, Poisonings and Envenomation, Quality, Research, and Wilderness Toxicology were covered by both EM residency and EMS fellowship. Avalanche and Expedition Medicine were not included in either curriculum, as shown in Figure 1.

Comparison of Each Curricula to ACEP WM Fellowship Curriculum

Many of the 19 WM topics were covered in each type of training program (Table 2). Analysis showed EMS fellowship covered more WM topics (16 [84%]) than EM residency (12 [63%]; Table 3. Overlap and differences are shown in Figure 1.

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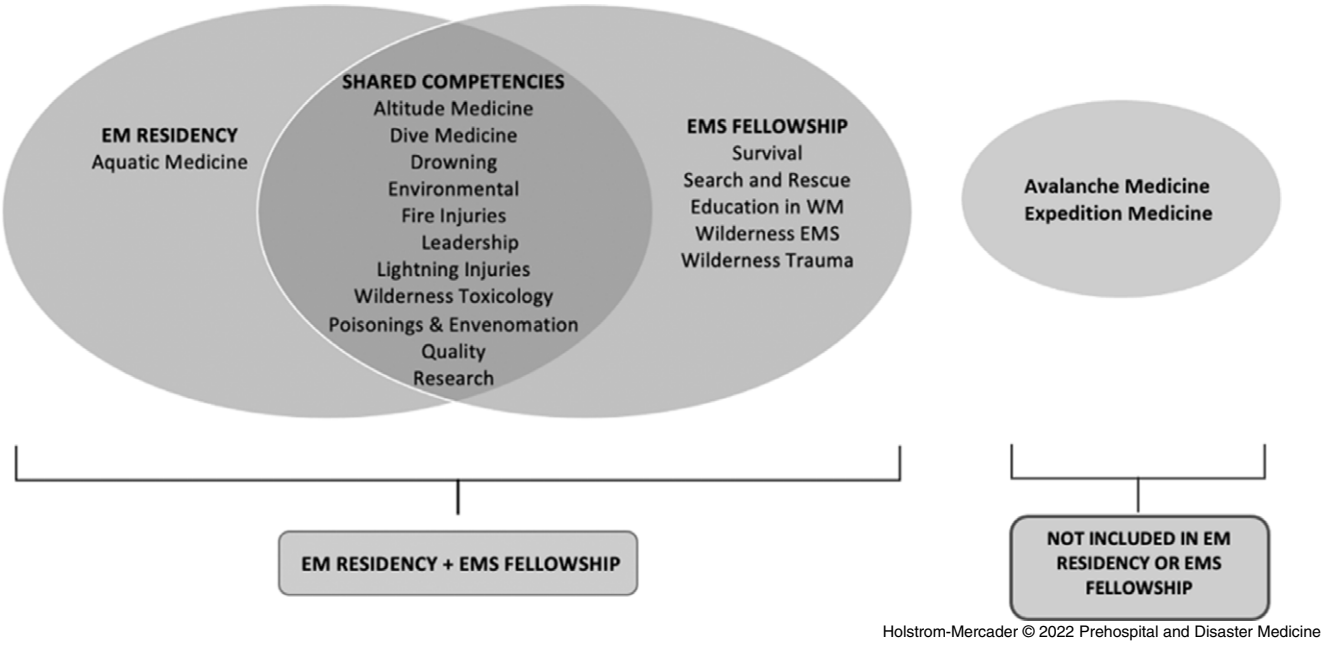

Figure 1. Wilderness Medicine (WM) Components Found in EM and EMS Training Program Curricula. Abbreviations: EMS, Emergency Medical Services; EM, Emergency Medicine; WM, Wilderness Medicine.

Discussion

Differences Between the Programs

This study found a notable overlap of WM curriculum topics between ACEP WM fellowship curriculum, EMS fellowship, and EM residency in the US. However, the setting, depth, and manner in which each topic is covered may differ. For example, EM trains physicians to care for acutely injured or ill patients in the Emergency Department (ED), while EMS fellowship focuses on prehospital patient care and physician oversight of prehospital systems.[22] The ACEP WM fellowship curriculum topics are broad in nature and can be covered in a variety of ways. For example, environmental emergencies may be covered in EM residency in regard to their care in the ED, while EMS fellowships may cover the topic in regards to prehospital care, but not specifically in the wilderness environment. Likewise, WM fellowships may cover certain topics in regards to an austere environment, whereas EMS fellowship curricula may cover those topics with a focus on prehospital care and EM residency curricula may cover those topics with a focus on care within a well-equipped ED. This may explain why, unlike EM residencies, EMS fellowships cover WM trauma and WM EMS; these topics are specific to austere environments outside of the hospital setting that are more likely to require immediate prehospital training.

Implications

A study surveying US EM residencies found that 63% of the survey respondents have some WM training.[23] Four-year programs are more likely to offer a WM elective.[23] Notably, the study found that of the survey respondents, more than two-thirds created their own WM curriculum, at least in part.[23] This may further indicate that, while EM residencies teach WM-related topics, not all of them address the education of these topics in the austere environment setting in the same manner. For instance, envenomation could be taught in regards to treatment in the austere environment in addition to the prehospital setting and the ED. Programs addressing one of these components could expand their education by addressing other settings of treatment. Some EM residencies have incorporated different styles of WM training. For example, at Warren Alpert Medical School of Brown University (Providence, Rhode Island USA), EM residents undergo a unique WM-focused event designed after the Medical Wilderness Adventure Race (MedWAR).[17] The MedWAR is an outdoor competition focused on simulating WM experiences. At Warren Alpert Medical School, the event is designed to deliver hands-on WM education to the participants. Other EM residencies may not teach WM through events such as this race. With that being said, there should be further study into the depth in which EM residencies teach WM compared to the minimum requirements.

Neither EM residency nor EMS fellowship covered all 19 WM components. Altitude Medicine, Dive Medicine, Drowning, Environmental, Fire Injuries, Leadership, Lightning Injuries, Poisonings and Envenomation, Quality, Research, and Wilderness Toxicology were covered by both types of programs. This may be because these conditions are traditionally considered a part of these medical fields. Neither EM residency nor EMS fellowship covered Avalanche or Expedition Medicine. It should be noted, however, that WM components may overlap in their subtopics. For example, injuries from avalanches may be included in Wilderness Trauma training in addition to or instead of in Avalanche Medicine. Although there is limited information regarding this training, Expedition Medicine is not routinely practiced in the ED or the EMS setting. To adequately address why Expedition Medicine is not widely taught, further studies must inquire as to the standardized training on this topic. Notably, EM residencies had training in Dive Medicine and Poisonings and Envenomation but not Aquatic Medicine. The subtopics of Aquatic Medicine include injuries, poisonings, and infections from marine animals.[14] This differs from Dive Medicine, which covers physiology, decompression illness, and barotrauma, and

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ACEP WM Fellowship Curriculum Topics	EMS Fellowship	EM Residency	EM + EMS
Altitude Medicine	Yes	Yes	Yes
Aquatic Medicine		Yes	Yes
Avalanche			
Dive Medicine	Yes	Yes	Yes
Drowning	Yes	Yes	Yes
Education in WM	Yes		Yes
Environmental	Yes	Yes	Yes
Expedition Medicine			
Fire Injuries	Yes	Yes	Yes
Leadership	Yes	Yes	Yes
Lightning Injuries	Yes	Yes	Yes
Poisonings/ Envenomation	Yes	Yes	Yes
Quality	Yes	Yes	Yes
Research	Yes	Yes	Yes
Search and Rescue	Yes		Yes
Survival	Yes		Yes
Wilderness EMS	Yes		Yes
Wilderness Toxicology	Yes	Yes	Yes
Wilderness Trauma	Yes		Yes

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Table 2. Coverage of ACEP WM Fellowship Curriculum Topics by GME Programs

Abbreviations: ACEP, American College of Emergency Physicians; EMS, Emergency Medical Services; EM, Emergency Medicine; GME, Graduate Medical Education; WM, Wilderness Medicine.

Program	Number (%) of WM Components Covered out of Total 19 Components
EM Residency	12 (63)
EMS Fellowship	16 (84)
EM Residency + EMS Fellowship	17 (89)

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Table 3. WM Components Covered in GME Programs

Abbreviations: EMS, Emergency Medical Services; EM, Emergency Medicine; GME, Graduate Medical Education; WM, Wilderness Medicine.

Poisonings and Envenomation, which covers land animal attacks, insect bites, and rabies.[14] With an increasing volume of people traveling in the wilderness environment,[24] there could be value in increasing WM topics in EM residency or EMS fellowship programs.

The differences in WM components between each curriculum reflect the different training settings of each program. The standardized ACEP WM fellowship curriculum may not apply to each professional program. However, it can provide an expert-guided framework from which individual programs can build when developing their own WM curricula. It can be important to expand WM training for EM residents and EMS fellows to prepare them to apply these WM skills to any emergency, whether in a populated city or a scorching desert. One may question whether there is value in having an EMS-trained physician undergo WM training to understand how to treat patients on a mountaineering expedition, for example. It can certainly make a difference for this physician to know not only how to treat the patient in the prehospital setting, but also to understand the physiology behind mountain medicine to provide optimal care. According to the National EMS Scopes of Practice, EMS personnel may not be trained for all environments and thus may need additional specialized training.[19] Including additional WM topics in current EMS curricula would be a facile addition without EMS personnel having to undergo additional specialized training.

Utilizing the standardized ACEP WM fellowship curriculum as a template may help expand WM education in GME programs in the US. By adding more focus on the necessary considerations in austere environments, EMS fellowships and EM residencies could potentially cover all WM curricula topics recommended by the ACEP WM fellowship curriculum.

Limitations

One limitation of this study is that only national curricula for each program type were analyzed. These curricula serve as a baseline for training programs, but many programs may exceed their recommendations. The extent and manner in which WM components are covered by an individual training program are also not encompassed in this research. For instance, one program may focus heavily on WM because of its geographic location or a faculty member with a special interest in the topic, whereas another program may cover WM topics more superficially. Further research is required to accurately determine the extent to which EM and EMS programs undergo WM training.

Another limitation of the study is that only curricula that define didactic topics rather than hands-on education were analyzed. However, the implementation of a successful WM curriculum may include more than didactics (ie, hands-on sessions) and may encompass many elements of Bloom's Taxonomy.[25] A United Kingdom study showed that a mixed didactic and skills session WM course was not only enjoyable for medical students, but was also statistically significant in improving their WM knowledge and skills.[26] Although they had a small number of medical students participate, clinical students in the study learned the most from skills sessions, pre-clinical students benefited most from the didactic sessions, and all students learned most when covering novel topics such as space medicine.[26] When developing a WM curriculum, a combined skills and didactics course may have the greatest impact on GME-level learners who have entered the clinical stages of education.

Another study from Norway found that an in-situ simulation in WM education of nursing students taught these students to work efficiently in an unknown environment, think "outside the box" when under pressure, and trust their knowledge and abilities while working in critical situations.[27] These skills are not only essential for WM-trained professionals, but are applicable for all medical residencies and fellowships. Although only six students participated, this may be an educational design worth incorporating into a WM curriculum, as WM professionals often care for patients in unexpected conditions and environments. A WM curriculum may benefit learners most by using the ACEP WM fellowship curriculum as a baseline and incorporating more involved, hands-on training components.

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Conclusion

More WM topics were covered by EMS fellowship than by EM residency. The EMS fellowship training following completion of an EM residency covers 89% of the WM fellowship curriculum topics. While EM residencies can cover the entire list of topics suggested for WM fellowship by addressing an additional seven topics in their curriculum, EMS fellowship can cover the entire list of suggested topics for WM fellowship by covering three additional topics. However, even when covering the entire list of topics for the suggested WM curriculum, the depth of education and extent of hands-on learning may vary between training programs.

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