

INTRODUCTION

During the 2018/19 winter season, ski areas in the United States experienced 59.3 million skier visits¹. With these visits came the potential need for medical care, both from ski accidents and from general medical illness. In order to address these anticipated medical needs, ski areas employ medical units, called ski patrols, as part of their staffing department. Ski patrollers are medically trained individuals tasked with the responsibility of responding to medical incidents within, and around, a ski area's geographical location.

Most ski areas in the United States lease public land from the U.S. Forest Service, which requires that, "one or more persons be trained to provide first aid/emergency care at the Basic Life Support (BLS) level, including cardiopulmonary resuscitation", in which BLS is defined as "medically-accepted non-invasive procedures used to sustain life"². Beyond the BLS requirement, no national standard for the medical training, care, or oversight exists for ski patrols. Ski patrols are also not federally recognized as a part of the formal Emergency Medical Services (EMS)³ structure, and no uniform regulations with regards to medical equipment, facilities, leadership structure, transportation, medical oversight, communications, quality improvement, or liability exist at this time.

As many ski patrollers don uniforms, and are compensated for their medical work, it can be said that ski patrollers are acting within the official healthcare system⁴. Safe and effective medical care requires a continuous evaluation of provider training, protocols, and patient care. Since it can be argued that the medical services ski patrollers provide are indeed within the realm of medicine, it should go without saying that their training, protocols, oversight, and health care delivery should also be evaluated.

While there has been one study investigating the basic medical care provided by ski patrols at nine ski areas in Utah⁵, there have been no studies that look at ski patrols, their medical direction, and protocols throughout the entire U.S. region. The purpose of this project is to better characterize the medical training, patient care, scope of practice, and medical direction or oversight of U.S. ski patrols through a survey of both ski patrol directors, and if applicable, their medical directors.

METHODS

The project was approved by Oregon Health and Science University's Internal Review Board (#21906).

Two separate surveys were written: one for ski patrol directors, and one for ski patrol medical directors. Ski patrol medical directors were consulted on the survey's design.

Survey participants were recruited through emails to industry contacts, outreach to ski area staff via published web page contact information, advertisement in a snow science journal, and Twitter. Participants were guaranteed that survey results would be published in

aggregate form and thus be anonymous. All U.S. ski patrol directors and medical directors were eligible to complete their respective surveys. A gift card raffle was offered to all survey participants as an incentive. At least two attempts were made to contact each individual. Responses were collected from November 29, 2020 through March 20, 2021.

The surveys were delivered and analyzed through the Qualtrics survey platform. Data was downloaded and further analyzed in Excel. All data was designed in a qualitative fashion: survey results were placed into their proper categories and relative results were calculated.

RESULTS

Thirty-seven surveys were considered complete, not duplicated, and included in this project. (figure 1) The ski patrol director and medical director surveys are included in the supplementary appendix.



Figure 1

Ski Patrol Director Survey:

Twenty-two surveys were collected from ski patrol directors. The majority of the responses were located in the western U.S. (Figure 2)



Figure 2

Ski area demographics:

77% (17/22) of the included ski areas are located more than 10 miles from the nearest hospital, and less than 100 miles from the nearest level II trauma center. 77% (17/22) of the included ski areas have fewer than 500,000 skier visits per year.

Patrol Demographics:

(this section might be better presented as a bullet list, or graph)

The ski patrols in this survey varied greatly in the size and make-up of their rosters: There were 41% (9/22) with volunteers on their roster, and of the nine ski patrols that staff volunteers, 44% (4/9) allow volunteers to work on any day, while 55% (5/9) utilize volunteers solely on weekends and/or holidays. There were 68% (15/22) that require an Outdoor Emergency

Care (OEC) certification as their minimum medical requirement, while 22% (5/22), and just 5% (1/22), require a WFR or EMT, respectively. Only 50% (11/22) of surveyed ski patrols have advanced practitioners on their roster that are able to work within their full scope of practice. There were 27% (6/22) of ski patrols that are affiliated with an EMS agency, and 73% (16/22) of ski patrols that are active members of the National Ski Patrol (NSP). Only 50% (11/22) of ski patrols surveyed have a medical director. The distribution of rostered advanced practitioners are displayed below (see Table 2).

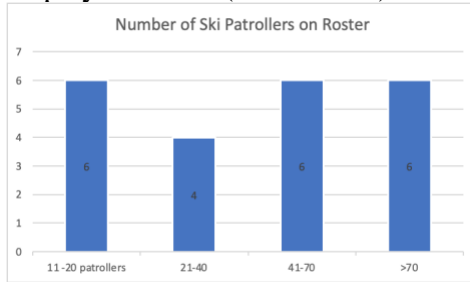


Figure 3

Table 1: Advanced Practitioners

Paramedic	10
RN	3
NP/PA	2
DO/MD	3

Base Area Clinic, Personnel, Resources:

Fifty percent (11/22) of ski patrols surveyed support a first aid or medical clinic for their ski area. Ski patrollers without an advanced practice medical license most commonly staff the clinics, followed second by an MD or DO (see figure 4). Of the ski patrols that have a base area clinic, x-ray [radiology?] and narcotic pain medications were listed as some of the more commonly available resources (63% for each). The ability to reduce a fracture was cited as being among the most utilized resources (73%) at these sites. Advanced life support (ALS) capability was absent at 41% (9/22) of ski patrols, while the remaining 59% (13/22) have some combination of ALS capability, be it on the ski slopes (15%), only in clinic (46%), or a combination of the two (31%). In addition to what is considered to be the traditional ski patrol medical equipment, 45% (10/22) of ski patrols utilize a vacuum splint for spinal immobilization. Airway devices were utilized by 45% (10/22) of ski patrols, with King Tubes (40%) taking prominence over endotracheal tubes (30%), iGels (20%), and laryngeal masks (10%). One ski patrol cited the use of a LUCAS device to aid in cardiopulmonary resuscitation.

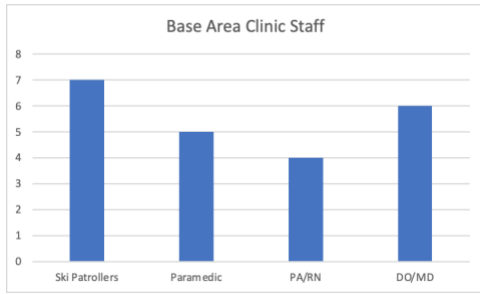


Figure 4

Incident Response:

The Incident Command System (ICS) was utilized by 77% (17/22) of ski patrols in at least some capacity with 82% (14/17) using the ICS for both avalanche and major medical response. The ICS was also used in lift evacuation, mass casualty incidents, out of area rescues, and “all incidents” (open format question, not all responded).

The majority of ski patrols participate in out of area responses, 82% (18/22). While participating in out of area response, various insurance strategies are employed: 44% are covered by their ski area’s insurance, 39% are covered by their local SAR/Sheriff’s insurance, and 17% of ski patrols are covered by other entities – their respective Fish and Game agencies and their state-licensed EMS agencies.

Helicopter transport was used by 82% (18/22) of ski patrols for at least one transport per season. No ski patrol in this survey utilized a helicopter more than 10 times per season, 14% (3/22) utilized a helicopter 6-10 times per season, and 68% (15/22) used a helicopter 1-5 times per season. Minimum indications for helicopter transport varied, including open fracture, cardiac event, stroke, TBI, or Level 1 medical care requirement.

Additional Protocols:

The majority, 86% (19/22), of ski patrols employ additional protocols beyond their baseline standard of care. Protocols pertaining to cervical collar and backboard use are among the most common additional protocols utilized (94%, 18/19). Rates of specific additional protocols are displayed below (see Figure 5).

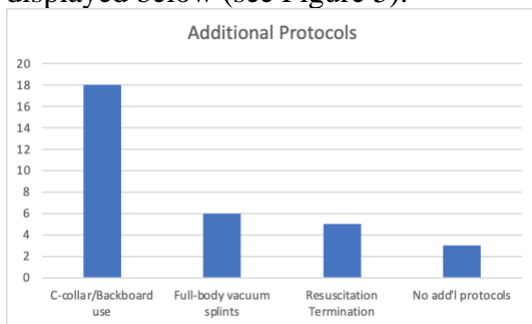


Figure 5

Ski Patrol Medical Director Survey:

15 surveys were analyzed from different ski patrol medical directors. (Figure 6)

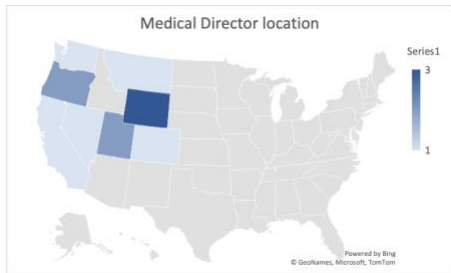


Figure 6

Medical Director Training:

Emergency medicine (EM) is the most common specialty of surveyed ski patrol medical directors (82%, 9/11). In addition, 40% (6/15) of medical directors have not completed any specific training for their role as a ski patrol medical director. WFR or Wilderness EMT training was completed by 13% (2/15) of medical directors, and 47% (7/15) have completed either an AEMT, EMT, EMS medical director training, OEC, or fellowship in academic wilderness medicine (FAWM).

Medical Director Work:

Average hours dedicated to specific ski patrol medical director work is displayed below in Table 2. In addition to phone contact, 67% (10/15) of medical directors stated that they are available on-scene, 69% (9/15) by radio, and 67% (10/15) are available in-person at the clinic. A total of 87% (13/15) of medical directors stated that they provide equipment recommendations to the ski patrol. All medical directors stated that they contribute to furthering the ski patrollers' medical knowledge and practice. The vast majority, 93% (14/15), of medical directors assist or write their ski patrol's medical protocols, and the same proportion of medical directors have also expanded upon their ski patrol's existing medical protocols (see Table 3). For quality improvement (QI), 87% (13/15) of medical directors are involved in QI for their ski patrol's medical care. All medical directors that perform QI include at least some form of case review in their QI work. One respondent that stated "other" as their QI activity, specified that they "read and submit every medical response to their state's trauma review board". With regards to personal liability protection, 29% (4/14) of medical directors stated that they purchase personal liability insurance for their medical director work, and 20% (3/15) of medical directors stated that they receive monetary reimbursement for their work, while others cited other, non-monetary forms of reimbursement. A minority of medical directors receive no reimbursement for their work (18%, 2/11).

Table 2: Medical Directors Hours per month

<10	7
11--20	4
21--40	0
>40	4

Table 3:

Protocol Expansion	14/15
Spinal immobilization	11
Resuscitation termination	5
Medication administration	8
Expanded protocols, but none of the above	3
For advanced practitioners	10/15

Table 5: Quality Improvement Activities 13/15

Patient documentation	8
Case reviews	13
Other	2

Table 6: Medical director reimbursement

No	2
Ski Pass/other non-monetary	8
Monetary	3
Decline to answer	2

DISCUSSION

This project serves as the first study to investigate the aspects of ski patroller training, medical care, and medical direction of ski patrols across the United States. Surveys were received from a variety of ski areas - with distances both near and far from definitive medical care. In general, the surveys demonstrated an appreciable variation in ski patrol demographics, patroller training, and medical direction.

Patrol Demographics

Ski area demographics do not appear to affect whether a ski area staffs volunteers in addition to paid patrollers. No ski patrol in this survey staffed only volunteers. At some ski areas, volunteers are only used during the busier times (holidays, weekends). While usually not able to perform all of the duties of a paid patroller (i.e., avalanche mitigation), a volunteer fleet can allow ski areas to accommodate for the ebb and flow of busier times⁶.

Ski area demographics do not appear to affect whether a ski patrol staffs advanced medical practitioners able to perform to their full licensed scope of practice. Paramedics are the most commonly utilized advanced practitioner, and are able to provide advanced life support (ALS) services both on the slopes and in the clinic⁷. Given that they are already trained to practice ALS in dynamic, out-of-hospital environment, a paramedic ski patroller can be a useful resource.

For a majority of the ski patrols, Outdoor Emergency Care (OEC) is the minimum required medical certification. Ski patrols that do not require an OEC as their minimum certification were largely found to require an EMT certification, or less commonly, a Wilderness First Responder (WFR) certification. The OEC is a medical certification taught and overseen by the National Ski Patrol (NSP), and this training course has recently increased from 80 to 120 hours⁸. While considered similar in scope to an Emergency Medical Technician certification, it is not incorporated within the official US Emergency Medical Services (EMS) system. OEC is considered to include less training in geriatrics, pediatrics,⁹ medical illness, and medication administration, but provides additional training in skills more specific to ski patrolling: orthopedics, environmental emergencies, and winter transport⁸.

Since OEC certification is not recognized by the EMS system, it follows that a ski patrol is not necessarily considered part of the U.S. EMS structure. In fact, only 27% of ski patrols in this survey are affiliated with an EMS agency. In the U.S., some states require ski patrol EMS affiliation (Maryland), while others have expanded their definition of “those without a medical license who can engage in care”, thus creating a space for ski patrols to exist outside of the EMS system (Idaho)³. Meanwhile, many states say nothing on the topic. An obvious question is whether ski patrols should be integrated into the EMS system. Given that ski patrols are providing compensated prehospital medical care which exceeds the scope of Good Samaritan or Basic First Aid practice¹⁰ many argue that ski patrols are, by definition, practicing EMS¹¹, and therefore should become formally affiliated with EMS agencies.

The majority of ski patrols in this survey are NSP members, which is the governing nonprofit organization designed to “provide education and accreditation to emergency care and safety service providers”¹² for the mountain recreation industry. It is the NSP who hosts the initial OEC trainings and annual recertification courses. While the NSP does require an OEC certification as every member’s minimum medical training requirement, it should be noted that the NSP does not provide nor require official medical direction for each ski patrol².

Medical Care and Resources

Of ski patrols in this survey, 50% have a base area clinic. Clinics in this survey were found to vary between simple rooms with basic first aid supplies to small medical clinics with X-Ray and

ultrasound – confirming that ski patrol base area clinics vary greatly in their staffing and capabilities.

The types of medical equipment used by ski patrols also varies significantly. Full-body vacuum splints are becoming a popular replacement to the rigid backboard, as they are often stated to be more comfortable, warmer and faster to apply. Advanced airway is utilized by 56% of ski patrols in this survey. Also, newer to the game is the LUCAS device, which is an automated, mechanical, chest compression device. Just 5% of the ski patrols had a LUCAS device at the time of this survey. While acquiring a LUCAS device is, for the smaller ski areas, potentially cost-prohibitive (about \$15,000.00), it is likely that more patrols will acquire the device with time - as medical causes of cardiac arrest will likely increase due to both an ever aging and more health-diverse ski population^{13,14}.

The Incident Command System (ICS) is the federal, standardized system for emergency response¹⁵. In recent years, its use has become standard in EMS and other industries. Of ski patrols in this survey, 77% currently use ICS – indicating that its increased use by ski patrols is following that of EMS teams.

The remote location of many ski areas can make ski patrol the closest and quickest response team for the terrain adjacent to a ski area's boundary¹⁶. A majority of the ski patrols in this survey stated that they respond to incidents outside of their boundary. This survey did not evaluate whether they responded officially as patrol, or under the auspices of their local search and rescue (SAR) group. Likely of interest to many patrols is the liability associated with such a response. A majority of responding patrols remain under their ski area's or local Sheriff/SAR's insurance, but a few patrols stated that they are under neither – instead looking to their state's Fish and Game or local EMS agency.

While only 50% of ski patrols have a medical director, 86% of ski patrols stated that they have expanded their medical protocols from beyond their baseline standard of care. C-collar use and spinal immobilization were among the most commonly expanded-upon protocols. Given the recent data illuminating the potential harm of backboards^{17,18,19}, the capability to discontinue spinal immobilization, when safe to do so, appears to be a reasonable provider skill.

Medical Direction

The majority of ski patrol medical directors are board certified in emergency medicine, which aligns with the acute and often traumatic nature of ski patrol medicine. Additionally, the sometimes austere and wilderness-like prehospital conditions that can be found at some ski areas, and in adjacent backcountry terrain¹⁵, make further training in wilderness and austere medicine (WAM) a not-unreasonable consideration. Some type of WAM training has been completed by 60% of medical directors in this survey.

Wilderness EMS (WEMS) medical direction can be divided into direct (cell phone, radio, in-person) and indirect (protocol development, provider education, quality improvement) work⁸. The majority of ski patrol medical directors surveyed provide both direct and indirect medical direction at different times. While great variability was found in the specialty and further training

that a medical director has undergone, 100% of the surveyed medical directors contribute to patroller education.

The OEC certification has traditionally provided many ski patrols with their protocols with the benefit that a minimum medical service base is ensured. However, implementing new protocols for emerging data, such as backboard utilization, can be difficult for such a large organization as the NSP to achieve in a timely manner²⁰. Individual protocol development from a qualified source such as a medical director can assist a ski patrol in providing the medical care that is most specific and beneficial for their individual situation²¹. From the medical directors surveyed, 93% have expanded their ski patrol's protocols, and 87% perform quality improvement tasks – solidifying the fact that that medical direction does have a role in furthering and monitoring the quality and appropriateness of care provided by ski patrols.

Hours and compensation for ski patrol medical directors in this survey varied greatly, which aligns with medical directors in other realms of WEMS, or EMS-like systems. It is interesting to note that just 29% of ski patrol medical directors purchase personal liability insurance specific to their ski patrol work. The survey question did not specify whether those who had not purchased insurance are provided coverage for their ski patrol work by other means.

LIMITATIONS

This study is not without limitations: most prominent is the limited sample size and spatial distribution of the responses, contributing to both selection and nonresponse bias. As most responses originated from the western region of the US, it is possible that a selection bias toward western ski patrols exists. Difficulties in survey responses are likely due to the timing of survey distribution and the Covid-19 pandemic, which made contact with medical and ski patrol directors more difficult. Although reassurances were made with regards to respondent anonymity, liability concerns could also have contributed to the limited sample size. This study does not evaluate the quality of patroller training, medical care, or medical direction of U.S. ski patrols, and future research that investigates such metrics should be sought.

CONCLUSION

Given the current heterogeneity in patroller training, medical resources, and oversight, there does not appear to be consistency in the quality or type of medical care that ski patrol patients will receive. This issue begs the question of whether further standardization and quality assurance measures, through either official EMS affiliation or requirement of a formal medical director, should be sought within the ski patrol industry.

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