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Mountain medicine development in Nepal: Karnali Academy of Health Sciences as strategic institution

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ABSTRACT

Nepal, home to most of the world's highest mountain peaks, presents both challenges and opportunities for healthcare delivery, particularly in mountain medicine. It requires tailored approaches to medical care, emergency response, and health research as it is characterized by rugged terrain, limited infrastructure, and diverse cultural settings. This editorial explores the concept of mountain medicine, tracing its historical evolution, outlining its current scope, and discussing its future potential in the Nepalese context. It further proposes the Karnali Academy of Health Sciences (KAHS) as a strategic institution to advance mountain medicine in Nepal, emphasizing interdisciplinary collaboration, capacity building, and sustainable practices. The article advocates integrating mountain medicine into Nepal's health system to improve outcomes for local communities, mountaineers, and visitors, and highlights KAHS as a key institution to lead these efforts.

Keywords: Climate change, Everest, Herbal medicine, Himalayan, Mountain medicine, Rescue medicine, Wilderness medicine

INTRODUCTION

Nepal's geographical landscape is dominated by the Himalayas, with eight of the world's 10 highest peaks, including Mount Everest.[1] These mountains have long symbolized adventure and spiritual pilgrimage, attracting thousands of trekkers, climbers, and tourists annually. However, the perplexing terrain and extreme environmental conditions pose significant obstacles to healthcare services, emergency response, and medical research.[2] Mountain medicine, a specialized discipline that addresses health issues in high-altitude, remote, and harsh environments, has gained recognition globally for its vital role in safeguarding health in such settings.[3]

In Nepal, the significance of mountain medicine extends well beyond tourism and adventure sports. It plays a vital role in improving health care for people living at high altitudes. It also keeps trekkers and climbers safe. Additionally, it helps build strong health systems in remote and rugged mountain areas.[4] This article explores the scope of mountain medicine in Nepal, its historical evolution, current scope, and future directions.

Overview of Mountain Medicine:

Mountain Medicine is a specialized interdisciplinary field of healthcare focused on the prevention, treatment, and management of medical issues encountered in high-altitude and mountainous environments.[3] It includes various domains, including altitude physiology, emergency medicine, environmental health, sports medicine, and public health. Primary concerns include acute mountain sickness (AMS), cold injuries, high-altitude pulmonary edema (HAPE), high-altitude cerebral edema (HACE), trauma management, and chronic health issues associated with prolonged high-altitude residence.[2-4]

In addition to addressing the physiological challenges of high-altitude environments, mountain medicine also emphasizes cultural competence, psychological resilience, and sustainable healthcare practices to ensure the well-being of both local populations and visitors at height.[3-4] In this context, the author highlights the significance of indigenous knowledge systems, particularly traditional healing practices that use herbal remedies derived from mountain flora and fauna. The local people strongly believe in them as a vital and under-recognized component of mountain medicine.[5]

Historical Perspective and Evolution in Nepal

Historically, Nepal's mountainous regions have been inhabited by indigenous communities with adaptations to high altitude for centuries. Traditional knowledge systems have contributed to survival strategies against environmental stressors. However, formalized mountain medicine as a scientific discipline began to take shape in the late 20th century, paralleling Nepal's rise as an international mountaineering hub.[6]

Established in 1978 by a group of doctors, Emergency Medical Technicians (EMTs), and nurses, Mountain Medicine was created to address the unique challenges of providing medical care in rugged mountainous settings.[6, 7] The founders aimed to promote mountain safety and to teach medical and evacuation skills for the emergency management of victims of mountain or wilderness accidents or illness.[6] This initiative was among the first of its kind, preceding many of today's wilderness, disaster, and emergency medicine organizations.

In 2011, Mountain Medicine expanded its scope following the earthquake in Haiti. The response highlighted key similarities between wilderness medicine and disaster medicine, particularly in their adaptation to limited resources and unpredictable conditions.[6-7] Since then, Mountain Medicine has incorporated these insights into its training programs, offering scenarios that blend the principles of both disciplines to enhance real-world problem-solving skills.

The first notable recognition of mountain medicine in Nepal occurred during the era of expeditions to Everest and other Himalayan peaks.[7] Mountaineering agencies, medical professionals, and research institutions collaborated to develop protocols for acclimatization, rescue, and emergency care. Mountain Medicine Society of Nepal (MMSN) is one of the collaborative organizations.[7] The Nepalese government and international partners established medical facilities equipped to handle altitude-related illnesses and trauma.

In recent decades, Nepal has seen the emergence of specialized training programs, research initiatives, and healthcare policies aimed

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at integrating mountain medicine into national health strategies.[8] The Nepalese government's commitment to promoting sustainable tourism and adventure sports has further underscored the need for specialized medical expertise.

Role of KAHS as a Strategic Institution for Mountain Medicine Development

The Karnali Academy of Health Sciences (KAHS) is an academic health institution offering undergraduate and graduate programs in medicine and allied health sciences, as well as tertiary healthcare services. It is situated in the remote and mountainous Karnali Province of Nepal. Given its geographic location and institutional command, KAHS embraces considerable potential to advance the field of mountain medicine in the country. Established with the primary goal of addressing healthcare disparities in underserved regions, the academy is uniquely positioned to serve as a hub for research, education, clinical services, and policy development related to high-altitude and wilderness medicine.[9] The following sub-headings highlight the probable components of Mountain Medicine model development in Nepal and the role of KAHS as a strategic and potential institution for mountain medicine development.

Healthcare Delivery in Remote Settings: KAHS's geographical location offers a strategic advantage for developing a region-specific healthcare system. The establishment of high-altitude clinics, telemedicine services, and mobile health units can substantially improve access to specialized medical care for both local populations and trekkers in high-altitude regions.[3,4,9] Additionally, KAHS can develop clinical protocols for altitude-related illnesses, trauma management, and emergency response tailored to the environmental and logistical challenges of mountainous settings.[4]

Education and Capacity Building: KAHS can offer specialized academic programs, certification courses, and continuing medical education in mountain medicine. Integrating high-altitude and wilderness medicine into the undergraduate and postgraduate curricula will help produce a team of healthcare professionals adept at providing medical services in challenging mountain settings.[10] Furthermore, partnerships with international institutions can facilitate faculty exchange, technical training, and curriculum development, thereby enhancing the institution's academic profile.[11]

Research and Data Collection: Given its location, KAHS is well-suited to become a center for high-altitude biomedical research. Priority areas may include epidemiological studies on chronic mountain sickness, hypoxia adaptation, cold-related injuries, mountain herbal medicines, and the effects of climate change on public health.[12,13] Research into traditional knowledge and community practices related to health at altitude can also offer novel insights. The development of a regional health database would significantly contribute to both national policy-making and the global literature on mountain medicine.[13]

Research & development of Mountain Herbal Medicine: Mountain herbal medicine is a critical yet often underexplored component of mountain medicine, particularly in regions such as the Himalayas, where access to formal healthcare remains limited. Indigenous communities have traditionally relied on locally available medicinal plants to treat a wide range of ailments, including altitude sickness, gastrointestinal disorders, respiratory infections, and wound care.[14] These ethnobotanical practices not only reflect deep ecological knowledge but also provide cost-effective and culturally accepted alternatives to modern pharmacological treatments.[15] Integrating validated herbal remedies into mountain medicine could enhance primary healthcare delivery in remote settings, while also preserving traditional knowledge systems.[14,15] Scientific studies on Himalayan flora, such as ***Rhododendron anthopogon***, ***Nardostachys jatamansi,*** and ***Swertia chirayita***, have demonstrated pharmacological properties including anti-inflammatory, adaptogenic, and antimicrobial effects.[16] As such, systematic documentation, research, and standardization of mountain herbal practices are essential to ensure safety, efficacy, and sustainable use within mountain medicine frameworks.[14-16] School of Pharmacy, especially the Pharmacognosy department in KAHS, along with some pharmaceutical industry, can also take the initiative in drug development with the flora and fauna.

Policy Advocacy and Public Health Initiatives: KAHS can play a pivotal role in shaping national health policies related to mountain environments. By providing evidence-based recommendations, the academy could influence strategies on sustainable mountain tourism, including grey and health tourism, environmental protection, and disaster preparedness.[17-18] Public health outreach initiatives tailored to high-altitude communities focusing on nutrition, infectious disease prevention, and climate adaptation would further enhance health outcomes in the region.[8] School of Public Health, KAHS can take the initiative in it.

Collaborations and International Partnerships: Mountain medicine is an inherently global discipline. KAHS could strengthen its impact by partnering with international organizations, universities, and research centers focused on high-altitude health, wilderness medicine, and emergency care.[19] Such collaborations can lead to joint research projects, resource sharing, training programs, and increased funding opportunities.[13]

Sustainable and Culturally Sensitive Practices: Incorporating culturally appropriate healthcare approaches is essential in ensuring the acceptability and effectiveness of interventions in indigenous communities.[15,19] KAHS can promote the integration of traditional healing systems with evidence-based medicine to create a holistic model of care.

Environmental Health and Sustainable Tourism: The health of mountain ecosystems is closely linked to human health, particularly in high-altitude regions where environmental degradation can have direct and lasting impacts on local communities. The KAHS is well-positioned to lead initiatives that promote environmental sustainability through awareness campaigns and training programs focused on eco-friendly tourism, waste management, and the conservation of local water sources.[14] The integration of sustainable health tourism and grey tourism (travel undertaken by older adults)—as proposed in previous work by the author[18] can serve as a model for responsible tourism practices, particularly when guided by a credible academic health institution such as KAHS. Through these efforts, KAHS can contribute meaningfully to both community well-being and the preservation of fragile mountain ecosystems.

Addressing the Health Impacts of Climate Change: Mountain regions are particularly susceptible to climate change, including glacial retreat, shifting disease patterns, and more frequent extreme weather events. In this context, the KAHS has a critical role to play in developing and implementing adaptive strategies to mitigate these risks. By promoting climate-health education, conducting region-specific research, and raising community awareness, KAHS can enhance local resilience and contribute to a more robust, climate-adaptive health system in high-altitude areas.[20]

CONCLUSION

Mountain Medicine holds a vital place in Nepal's healthcare scenario, addressing the unique needs of its high-altitude populations, visitors, and disaster-prone environment. By recognizing mountain medicine as a multidisciplinary, collaborative effort, Nepal can serve as a model for other high-altitude regions worldwide. Embracing this discipline not only enhances healthcare delivery but also preserves the cultural and environmental integrity of the Himalayas for future generations. The evolution of this field requires institutional commitment, collaboration among multidisciplinary stakeholders, and innovative research. KAHS, with its strategic location and dedicated focus, is honored to become a leader in Nepal's mountain medicine endeavors.

The KAHS has immense potential to contribute significantly to the development of mountain medicine in Nepal. By focusing on research, education, healthcare delivery, and policy advocacy, KAHS can address the unique health challenges posed by the high-altitude environment. Its strategic initiatives can serve as a model for other institutions and regions, ultimately enhancing health resilience in Nepal's mountainous terrain and contributing to the global body of knowledge in mountain medicine.

DECLARATION

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Authors also declare that ChatGPT (AI tools) was used in some paragraphs to modify the flow and language.

Conflict of interest

The author declares there is no conflict of Interest.

Ethical clearance

Not applicable.

Consent for study

Not applicable

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