HEALTH OUTCOME PREDICTION AND MANAGEMENT SYSTEM AND METHOD

RIGHTS IN THE INVENTION

[0001] This invention was made with support from the United States Government, specifically, the United States Army Research Institute of Environmental Medicine; and, accordingly, the United States government has certain rights in this invention.

FIELD AND BACKGROUND OF THE INVENTION

[0002] The invention relates generally to systems, methods and apparatus for providing statistical estimates useful for decision support, including computer networks and software configured to provide such support. The methods and apparatus herein are particularly useful for providing information to health care providers, mission commanders and decision makers as it relates to the statistical modeling of the severity, prevalence and category of prevalence of various diseases in general, and to Acute Mountain Sickness in particular.

[0003] ACUTE MOUNTAIN SICKNESS (AMS) is a syndrome of nonspecific symptoms including headache, nausea, vomiting, sleepiness, difficulty breathing, dizziness, anorexia, tachycardia, and insomnia (1). AMS may progress to high altitude pulmonary edema (NAPE) or high altitude cerebral edema (HACE), both of which are potentially life threatening.

[0004] AMS is caused by exposure to altitudes exceeding 2500 m and often resolves by acclimatization without further ascent (2). The symptoms frequently appear within a few to 24 h of exposure and usually resolve after several days as acclimatization to altitude develops.

[0005] High altitude, rapid ascent, and lack of prior acclimatization are the primary risk factors for developing AMS (1, 3, 4, 5). Symptoms are avoided or reduced in severity by slow or staged ascent to allow progressive acclimatization at higher altitudes, but optimal ascent patterns are uncertain, and recommendations range from 150 to 600 m/day. Acetazolamide ameliorates the effects of AMS and is the preferred prophylactic (1).

[0006] With increased participation in mountain recreation, recent deployment of U.S. troops to Afghanistan, and modern means of transportation allowing for rapid ascent to altitude, more people are being exposed to the dangers of AMS (6, 7, 8).

[0007] Despite decades of research, no biomathematical models exist to estimate AMS over a wide range of altitudes and time points in unacclimatized lowlanders following rapid ascent utilizing demographic and physiologic descriptors. Previous models of AMS have severe limitations due to select study populations (i.e., mountaineers and trekkers), limited range of altitudes and time points, and lack of control for factors such as acclimatization status, ascent rate, medication usage, hydration status, and environmental conditions (2, 6, 9, 10). Furthermore, none of these models estimate different grades of AMS (i.e., mild, moderate, severe) which is extremely important given that mild AMS is a mere nuisance whereas severe AMS can turn into a life-threatening situation (11). In many cases estimates of altitude illness and acclimatization status are derived from non-validated, limited tables of estimates published in mountain medicine textbooks and high altitude mountaineering literature. The currently available estimates typically represent a "snapshot" usually presenting the estimates as an overall incidence of altitude illness or acclimatization status for a given altitude with no assessment of the changes in altitude illness and acclimatization as a function of time at high altitude. Given that a typical high altitude operation or activity occurs over several days to weeks at altitude, predicting the dynamic change in AMS severity and prevalence over time is essential for mission success.

[0008] The invention comprises a number of substantial, novel and non-obvious improvements over the prior art, including but not limited to uniquely presenting the predicted estimates as a function of time at high altitude thus capturing the dynamic nature of altitude illness and acclimatization; basing estimates of altitude illness and acclimatization on validated predictive models over a wide range of altitudes; incorporating into the model factors (e.g., altitude, time, sex and physical activity, etc.) that significantly modify the predictive estimates; and, integrating novel and non-obvious predictive models into a user-friendly (possibly networked) software application or as part of a system or apparatus that provides clear, easy-to-use screens for entering relevant mission parameters and displaying estimates of altitude illness, acclimatization, and work performance in both text and graphic formats.

[0009] Another problem is that there are no predictive models of altitude acclimatization as a function of altitude exposure. Further, there is no single until of measurement for quantifying and comparing altitude exposures of varying ascent profiles.

[0010] Therefore, a need exists for medical and mission planners to obtain accurate estimates of altitude illness and physical performance capabilities in order to effectively plan high-altitude operations.

[0011] Additionally, a need exists for leaders to obtain accurate, real-time, individual assessment of acclimatization status, altitude illness and performance capabilities.

[0012] Further, a need exists for medical providers to obtain point-of-care decision support tools for diagnosis and treatment of illnesses in general and altitude illnesses specifically.

SUMMARY OF THE INVENTION

[0013] A system, method and apparatus is disclosed, comprising an Altitude Illness Management Decision Aid (AIAMDA) that integrates novel and nonobvious predictive models of altitude sickness, physical work performance, and altitude acclimatization for populations ascending to high altitudes into a user-friendly software application which itself may be part of a networked system. This decision aid tool provides estimates of altitude illness risk and work performance decrements for a wide range of altitude ascent profiles, and provides customized (individualized) altitude acclimatization protocols as well as the ability to track real-time acclimatization status. The invention represents the next generation of state-of-the-art guidance for risk management of altitude stress.

[0014] In one embodiment, the invention is a decision aid, based on a validated predictive models, that provides guidance on risk management associated with "altitude stress", e.g., altitude illness, acclimatization, work performance at high altitude, etc. One embodiment of the decision aid feature of this invention incorporates several modules, each designed to predict prevalence and severity for different aspects of altitude stress. For example, one module provides informa-