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A Case Study of Antarctica Telemedicine Operations: Potential Applications to Space Medicine

by COL Annette L. Sobel

Operations in austere environments such as Antarctica require medical support not dissimilar to space operations. A myriad of environmental issues and constraints on human performance are encountered in both settings. Antarctica has similar limitations in on-site medical capability and access to aeromedical evacuation. Mission rehearsal and planning may be employed to simulate the environment, however, task performance and projection of operational needs is an iterative process. Telemedicine support to diving operations and routine medical maintenance activities is paramount to operational success on "Continent."

A needs analysis was performed to understand the medical infrastructure requirements necessary to support the aerospace and hyperbaric medicine requirements posed by a wide variety of scientific expeditions. Core capabilities consist of: dental, ophthalmologic, stabilization surgery, X-ray, hyperbaric chamber, basic laboratory, and physical therapy. Telemedicine support is essential for the following tasks: image digitization and transmission, hyperbaric chamber support, laboratory information transmission, collaborative interactive case discussions, and ECG telemetry. Of particular note is the necessity to "stage" telemedicine support requirements on Continent; from a geographically less capable site to one of greater capability. This approach is employed routinely to support operations, such as dive activities, at these remote sites. South Pole station operations have only a primary medical treatment facility but are secondarily supported by the McMurdo science station located on the Antarctic coast during the austral summer. Similarly, all Antarctic dive operations have limited on-site stabilization capability, but are augmented by McMurdo through activation of a Dive Accident Medical Plan (DAMP). Tertiary medical care may be available via aeromedical transport to New Zealand. During the austral winter, South Pole operations are autonomous. All medical support to augment capabilities at the South Pole station are virtual. Since all medical problems cannot be screened-out of the resident population and the potential for traumatic injuries and urgent medical problems arise infrequently, augmented and more specialized capabilities require telemedicine support.

Although telemedicine support in Antarctica is rudimentary, all the requisite components are either present or are in development and include high bandwidth telecommunication capability, satcom, LAN and dedicated servers. The physical facilities and personnel are adequate to support the operational requirements, however, the critical component to medical support is real-time information management in a way that enables true data fusion. This data includes a suite of information management tools essential to clinical decision-making, triage, and successful intervention. Additionally, telemedicine and information management tools must be integrated within, and exercised as, a core resource of routine mission rehearsal and accident/contingency operations planning.

In summary, challenges to remote telemedicine operations may be addressed and prioritized employing a systems analysis methodology. Critical tasks revealed using Antarctic operations as a template were:

Perform needs and information requirements analysis;

What are the mission-critical tasks and can telemedicine support these tasks?

Perform integrated environmental and human factors assessment;

What are the requirements for sustained operations?

What impact can operator failure through medical events have on the operations and what is the logical temporal and geographical support requirement considering potential human failure?

Emplace robust telecommunications infrastructure (hardware, software);

What are the requirements for redundancy which will enable continuous system operation, if necessary?

What are the opportunities for intermittent or sporadic system operation which will not impact mission completion?

What are the contingency plans for system operation?

Apply focused, mission-oriented technology insertion (telepresence, sensors, intelligent algorithms; information analysis tools; data fusion tools);

What are the potential performance enhancement and degradation issues imposed by technology?

When is human intervention and non-technologically assisted action desirable?

Perform iterative operator feedback of deployed system.

What are the system chokepoints?

When and where in the operation is human-system failure most likely?

This methodology provides a framework for the system architecture and may be used as a guideline for support to other challenging environments such as space and underwater operations.

YOUNG INVESTIGATOR AWARD

The Space Medicine Branch's Young Investigator Award is presented to an investigator who is the first author of an outstanding paper (slide or poster session) in the area of aviation and/or space medicine presented at the current or previous scientific meeting of the Aerospace Medical Association. In addition to being the first author, the work must be original and the investigator must be presenting at the AsMA annual scientific meeting for the first time.

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The Aerospace Physiology Certification Board of the Aerospace Medical Association will administer the certification examination at the 71st Annual Scientific Meeting in Houston, TX, on Sunday, May 14, 2000.

Individuals interested in certification should refer to the November 1999 issue (page 1142) for more information.

Application must be made prior to March 1, 2000, to assure consideration for the 2000 examination. Applications received after that date cannot be guaranteed consideration for the 2000 exam. Any late applications not considered for 2000, will automatically be held in abeyance for consideration for the 2001 exam.

Eligibility requires a baccalaureate degree in physiology or related field with significant training in physiology. Professional productivity should include 5 years experience and training in aerospace physiology, other factors include positions held, research, flying experience, awards, membership in AsMA and AsPS. Two letters of recommendation are required.

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