TELEMEDICINE IN THE BRITISH ANTARCTIC SURVEY

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ABSTRACT

Medicine in the Antarctic is probably the most isolated situation in which a doctor can practise, differing in degree of severity even from that of the Arctic region. The increasing use of Telemedicine has helped to reduce this isolation and to improve access to secondary healthcare for those who live in the most remote bases in the world. The article describes the way in which Antarctic Telemedicine has evolved in the British Antarctic survey, outlining the use of low cost and low technology systems to improve the availability of emergency advice, both to the doctor and to isolated field parties, specialist consultation, medical education, and healthcare records. The Antarctic is a useful proving ground for technologies which may have applications in space and other extreme and isolated environments. *(Int J Circumpolar Health 2004;63(4):356-364)*

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INTRODUCTION

Medicine at very high latitudes is probably the most remote setting in which a doctor can practise. The setting is so unique that it has been described as "Fourth World" medicine. Organisations that routinely deploy personnel to the Polar Regions however, demand a service that is as close to "first world" as practicable, and to this end telemedicine has developed to enable the doctor practicing in Antarctic bases to consult with expert staff at home both for routine advice and in an emergency situation.

Antarctic medicine derives it identity from the geographical location and nature of the environment in which it is practised. There is no physiological process that makes Antarctic medicine different from other branches of medicine, as there is for example in hyperbaric work. It is simply the remoteness, the hostility and the unforgiving nature of the environment in which man struggles to survive, let alone work, which makes medicine in these areas so challenging.

While both poles of the earth share common attributes of cold, dark and severe weather, the two ends of the earth are very different. The Arctic is a sea surrounded by land while the Antarctic is a land mass surrounded by ocean. As a result, Antarctica is colder and considerably drier. The average winter temperature at the South Pole is almost 40 °C colder than at the North. The Antarctic plateau is more similar in climate to Mars, than to the rest of the earth. It is a frozen desert, much above 10,000 feet, where little in the way of natural life forms can exist, and even the climatic conditions in the subantarctic islands are much more severe than at equivalent northern latitudes.

Perhaps, above all else, it is the isolation that makes Antarctic Medicine unique. Anywhere else in the world it is usually possible to arrange a medical evacuation within at most a few days. At Halley, one of the British Research Stations, in winter, such arrangements may not be possible for several months. Indeed, it has been said that an evacuation from the International Space Station would be easier than from Halley in winter.

There is no indigenous population in the Antarctic, and the population is very transient. There are scientists, explorers and tourists. Most of those who visit, and certainly all who stay for the long harsh winter, are young, fit, and carefully medically screened before they are permitted to journey south. The total population is very small indeed

with the average overwinter base having about 20 people on the station. Nevertheless, injury and illness do occur, and in recent years virtually all Antarctic programmes have noted an increase in the age of the population with some additional morbidity and a wider range of medical problems as a result.

The geopolitical importance of the polar region is increasingly recognised, and more and more research takes place. NASA and ESA have recognised the analogies with space travel that Antarctic isolation provides at a fraction of the cost of actual space flight. Antarctic medicine grows in importance with the "development" of the continent.

The doctor cannot be too specialised in approach, a broad knowledge and wide range of practical skills are necessary to provide good Antarctic medical care. In small bases, there is no room for the luxury of anaesthetists and surgeons, dermatologists and psychiatrists. These roles all reside with the same person. Modern developments in communication and information technology help make the polar physician less isolated from advice and counsel, but it remains impossible to physically evacuate patients, or provide specialist skills "in person" to a substantial proportion of the polar population for the majority of the year. The doctor is an important member of the polar team and must strive to maintain the highest practicable standards. (1,2)

British Antarctic Survey Operations

The British Antarctic Survey (BAS) has existed in various forms and under various names since the 1940's evolving into a prestigious scientific research organisation and expert provider of research in the extreme climes of Antarctica. (Figure 1) In Cambridge, UK, about 450 staff provide the permanent laboratory and support base for the survey and from there, personnel deploy for summer field expeditions over wide areas of the Antarctic continent, and man the wintering bases. Currently the United Kingdom has 2 year round bases on the Antarctic Continent south of 66 degrees South, and two within the South Georgia Archipelago in subantarctica. The total winter population is between 45 and 55 people, who are looked after medically by three fully qualified medical officers. In the austral summer the population swells to in excess of 250 with many more people on the wintering bases, a summer only base in the South Orkney Islands, and numerous field parties of between 2 and 40 people, living in tented accommodation on the ice.

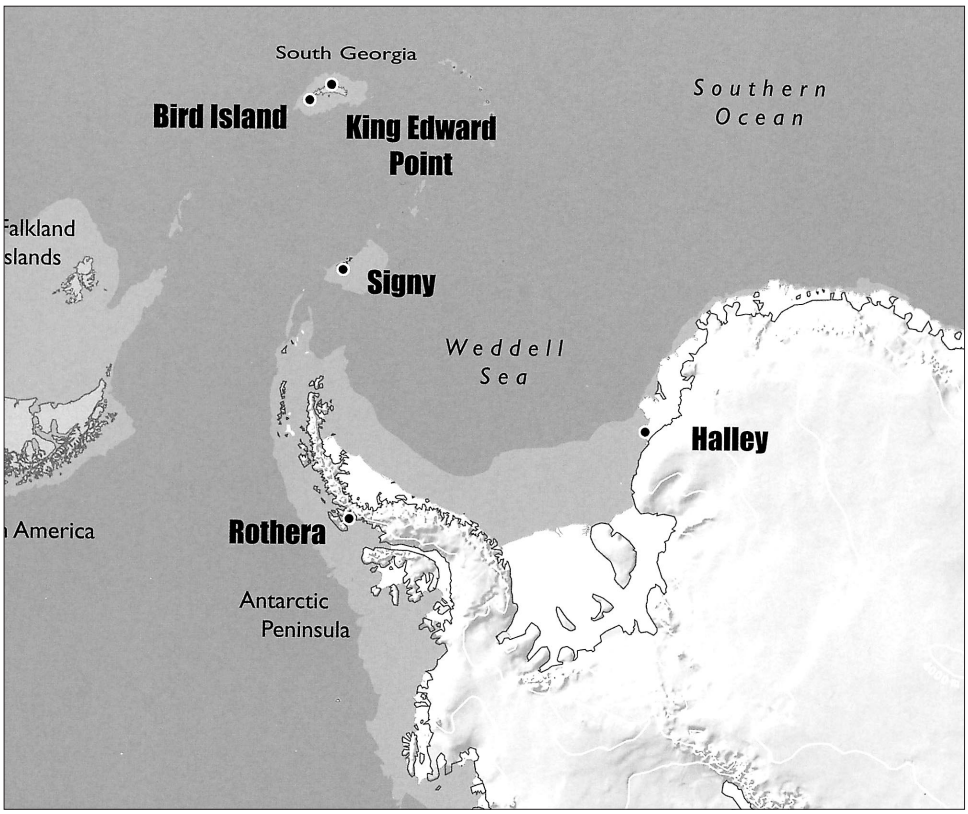

Figure 1. The British Antarctic Survey (BAS) operations area.

There are two Royal Research Ships that undertake logistic support and marine science research. The survey also operates a total of 5 aircraft in summer, based at the largest base at Rothera on Adelaide island, where there is a 900 m gravel runway, but operating also at Halley on the Brunt Ice shelf, and in the field. The Dash 7 aircraft operates a ferry service from the Falkland Islands to Rothera.

In summer medical evacuation by air is possible from both Halley and Rothera although flight time from Halley to the receiving hospital in the Falkland Islands, where there is relatively basic secondary care is of the order of 12 –15 hours, in comparison with 5-6 hours from Rothera.

If tertiary or more advanced secondary care than can be provided in the Falkland Islands is required, a further evacuation flight will be required either to Montevideo, Uruguay a mere 4-5 hours away depending on the aircraft, or to the United Kingdom itself over 19 hours flying time.

The costs of evacuation are very high indeed and telemedicine is extremely useful in limiting the number of patients who have to be evacuated simply for a diagnostic opinion.

Medical support

The British Antarctic Survey Medical Unit (BASMU) is based at Derriford Hospital in Plymouth, a large teaching hospital. Two emergency physicians with special interest and experience in remote medicine provide the leadership for the unit which essentially undertakes all aspects of medical support to BAS, recruiting and training the doctors, providing all stores and equipment, and offering 24 hour 7 day emergency support by telemedicine for the deployed medical officers, both for routine enquiries and more urgent problems.

Telemedicine in Antarctica

For more than 50 years personnel, both medical and non-medical, have used communication systems to obtain medical advice from distant sources. The use of complex and often expensive systems, so common now in other remote areas, is very limited in the Antarctic by the means of transmission. Only relatively low bandwidth systems are commonly available and transmission of large amounts of data can be both slow and very costly. Until recently, the common communications satellites were all equatorial orbiting, with footprints that just touch the Antarctic continent. This, together with high atmosphere effects, can sometimes make reception and connection difficult. Polar orbiting satellites now offer hope for the future though currently remain fairly low band width, in a system which has not yet been fully evaluated for reliability of connection and data transmission.

As a result the telemedicine used in the British Antarctic Survey tends to be relatively "low tech" in approach, using voice communication, email, fax, and still pictures rather than video, or more complex equipment.

Historically telemedicine has been used since communication with the Antarctic Continent became possible, and Antarctic doctors have rapidly embraced novel ways of improving patient consultation (3,4). In early days Morse Code Telegrams, and occasional crackling voice radio transmission both of which were subject to long period of blackout, were the only available method. In the 1950's voice transmission became more commonplace, although still often very re-

stricted in scope and availability. Radio telephone systems and in particular facsimile transmission of medical x-rays and photographs revolutionised the methods and decreased professional isolation for the doctors (5).

Recent years have of course seen a vast expansion in the technology and availability of telemedicine throughout the world, and the Antarctic is slowly but steadily catching up. Many, but by no means all, stations now have real time internet access via satellite although access is usually restricted because of the significant costs involved. Doctors however can participate in on line Clinical Personal Development programmes as well as being able to access health information and second opinions very readily. National operators sometimes still baulk at the costs of telemedicine, but evidence that even more costly evacuations can be prevented is often enough to persuade them that telemedicine has a role.

In the British operations, telemedicine was initially developed as one might expect to allow the doctor on base to advise personnel in the field on medical problems. As communication with UK became more readily available, the BAS medical unit in Aberdeen began to provide an advice service to doctors in the South, and began to audit and record all consultations by way of a monthly report sent by email (6,7).

The reporting system has now been integrated with the system used by the doctors to record their consultation, using technology to avoid excessive duplication of effort while at the same time maintaining excellent healthcare records, and ensuring that all data are captured in an easily analysed form. As the years go on, epidemiological information gathered in this way has been used to inform decisions on the levels and nature of drugs and equipment carried on the Antarctic bases, and as the dataset becomes more complex , with higher numbers of patient records, trends are becoming recognisable to assist public health decisions. Recently there has been considerable discussion in the Antarctic International Medical Community of pooling anonymised data to try to overcome one of the greatest problems of Antarctic Medical research, the lack of people at any one place at the same time (8).

Nowadays, in our practise, for most routine advice calls or consultations, the BASMU medical officers use encrypted email messages transmitted via INMARSAT but using the BAS own system

which stores messages for twice daily scheduled transmission to and from the Antarctic in an ultra compressed format. The use of digital cameras, and scanners to obtain digital images in common compressed formats such as jpeg; have been shown to allow reasonable and cost effective transmission of images. These are suitable for use to guide trauma management although the fine detail required for full interpretation of chest x-rays is not adequate. In a study where radiologists were asked to interpret such images, against the originals, little difference was found in the interpretation, but differences in quality between images highlighted the need for training of medical officers in radiographic and photographic techniques, to achieve image optimisation (9).

Digital photography has proved very valuable in obtaining the opinion of dermatologists and other specialists. The use of a camera attachment to allow digital photography using the slit lamp available on each base has permitted both routine and emergency ophthalmology advice to be obtained.

In an emergency situation contact is initially made by telephone, to the telemedicine centre within the Emergency Department of Derriford hospital in Plymouth, where the call is directed to a senior emergency physician with remote healthcare experience. In many cases this physician can deal with the query offering advice and support. In some cases other specialists within the hospital are contacted either for advice which can be relayed to the doctor in the Antarctic, or occasionally to attend the telemedicine centre for direct consultation. Relatively inexperienced doctors have been guided through some emergency operative procedures by real time teleconsultation.

Telemedicine also plays a part in the medical care of parties of personnel in the field. These groups are in radio or satellite telephone contact with the medical officer at their home base camp, and some can also contact the BASMU telemedicine centre directly. A tool known as the Medical Assessment Questionnaire (MAQ) was initially developed by BASMU in Aberdeen and has been modified in the light of experience in recent years (6). This tool is designed to guide non-medical personnel through taking the history and performing examination of a patient to allow them to record the correct information before making contact with the doctor. Anyone who has experience of providing telemedical support to lay personnel will be aware of the frustrations of such consultations, where vital informa-

tion is initially not available, making calls disjointed and protracted. The use of the MAQ has been demonstrated to reduce error and shorten duration of calls allowing more accurate telediagnosis and possibly reducing the number of medical evacuations.

We have used Fax and E mail transmission of ECG tracings to guide the diagnosis and potential use of thrombolysis by doctors in the Antarctic. Telemetry equipment is now available which can link to a satellite telephone to provide real time patient monitoring. Though not yet used "in anger" this has the potential to provide expert monitoring support by anaesthetic staff in the UK while procedures are carried under sedation or even anaesthesia by the doctor in the Antarctic leaving the remote practitioner free to concentrate on the procedure in the knowledge that the patient is being carefully monitored. On the other hand, telemetry equipment tested recently under field conditions proved unreliable and battery life was very poor (10).

Various nations have experimented, with varying degrees of success, in more high tech equipment. Some now use digital x-ray equipment. Ultrasound examination and tele-interpretation has proved useful (11-14). Tele-spirometry may have a place in the future (13).

The use of internet based education to allow both teaching of the diploma and general continuing professional development, have greatly enhanced possibilities for keeping up to date while deployed, and have great potential for increased utilisation. The possibility of offering web based courses for doctors travelling to the Antarctic with other organisations is also being explored.

Steadily improving technology, and improved satellite communication systems within Antarctica promise development of ever more useful systems of tele-consultation, relieving concerns of both the patients and the doctors.

CONCLUSION

Polar Medicine poses great challenges to the doctor. The workload is often low and remaining motivated, continuing education, and maintaining skill levels can be difficult. Telemedicine in combination with a comprehensive training programme allows the single handed general physician to practise many specialist roles, secure in the knowledge that expert advice is available on a continuous basis.

As technology advances further the medical isolation of the past will become steadily less and healthcare close to that of the first world will become ever more available to the few inhabitants of the Antarctic continent.

REFERENCES

1. Grant IC. Training of Medical Officers for Antarctic Service. Proc Tenth Symposium on Antarctic Logistics and Operations. Shanghai July 2002
2. Haston W, Horsley H, Milne A. Establishing a postgraduate qualification in remote health care. J Telemed Telecare 1996;2(2):114-8
3. Allen A. Southern Exposure: Antarctic telemedicine. Telemedicine Today 1996;4:20-21
4. Taylor D, Gormley PJ. Emergency medicine in Antarctica. Emergency Medicine 1997 (9) 237-45
5. Lugg DJ. Facsimile transmission from Antarctica as an aid to diagnosis and treatment. Med J Aust 1974;1: 472-4
6. Siderfin CD, Haston W, Milne AH. Telemedicine in the British Antarctic Survey Medical Unit. J Telemedicine Telecare 1995 1(2):63-8
7. Siderfin CD. Low-technology telemedicine in Antarctica. J telemed telecare. 1995:1(1):54-60.
8. Marquis PT. Medical Events and Records Transfer. Proc Tenth Symposium on Antarctic Logistics and Operations. Shanghai July 2002
9. Andrews CJ, Hughes PM, Marquis PT and Grant IC. Quality Control and Reproducibility in telemedical radiology using low costs techniques in the Antarctic. Medicine in Extreme Environments Symposium, Plymouth UK May 2003
10. Marquis PT. Personal Communication 2004.
11. Vietzke H. Scanning on thick ice. Radiol Manage. 2001 may-Jun;23(3):11-15
12. Ayton J. Personal Communication 2004
13. Pillon S, Todini AR, Bernini Vanni P. Telespirometry testing in the Antarctic. Proc XXVIII SCAR Open Science Conference. Bremen 2004
14. Otto C. Personal Communication 2004.

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