



Council of Managers of National Antarctic Programs  
COMNAP Secretariat  
Private Bag 4800  
Christchurch, New Zealand 8140  
[www.comnap.aq](http://www.comnap.aq)  
ISBN 978-0-473-38699-3

Proceedings of the COMNAP Symposium 2016: Winter-Over Challenges

# Proceedings of the COMNAP Symposium 2016 Winter-Over Challenges



**PROCEEDINGS OF THE COMNAP SYMPOSIUM 2016**



**PROCEEDINGS OF THE COMNAP SYMPOSIUM 2016**

WINTER-OVER CHALLENGES

GOA, INDIA

19 & 20 AUGUST 2016

COMNAP SPECIAL PUBLICATION

THE COUNCIL OF MANAGERS OF NATIONAL ANTARCTIC PROGRAMS

# THE COUNCIL OF MANAGERS OF NATIONAL ANTARCTIC PROGRAMS

COMNAP Secretariat  
Private Bag 4800  
Christchurch, New Zealand  
[www.comnap.aq](http://www.comnap.aq)

© COMNAP AND CONTRIBUTORS 2017

First published 2017

This book is copyright. Apart from any fair dealing for the purpose of private study, research or review, as permitted under the Copyright Act, no part may be reproduced by any process without the permission of the publisher.

**ISBN 978-0-473-38699-3**

Cover photo: © Chris Wilson/Australian Antarctic Division

## Foreword

The COMNAP Symposium 2016 was held in Goa, India, on 19 and 20 August 2016, hosted by one of our COMNAP Members, the National Centre for Antarctic and Ocean Research. The theme of the Symposium was “Winter-Over Challenges”. This is a timely topic for two reasons. First, within the Antarctic Treaty System we now have a long history of maintaining year-round Antarctic facilities. The work began with the historic expeditions in the early 1900s, but came to the fore only during the International Geophysical Year (IGY) 1957–58, which saw many year-round facilities established in order to support Antarctic year-round scientific activities. In the historic era, and even at the time of the IGY, little was known of Antarctic winter conditions, with those deployed to the region unsure of what challenges they would face. Now, with some of our programmes having over 50 years’ experience of winter-over in the Antarctic, it is important to share the knowledge we have gained in regards to the requirements for buildings and associated infrastructures, and for operations and logistics, as well as the knowledge from the relatively new research that is contributing to our understanding of the human dimension required in a winter-over team. Such knowledge ensures there is understanding of the risks related to providing science support in the Antarctic year-round, which helps us to ensure that our pre-deployment, recruitment, and training practices are robust and are based on sound research and best practices.

This highlights an important aspect of our winter-over challenges and the COMNAP Symposium 2016. That is, not only does surviving in the Antarctic in winter conditions require infrastructure, but there is also an important human dimension to winter-over. Understanding the personal and psychological challenges humans face in the Antarctic is critical to a successful winter-over outcome.

The Symposium Review Committee was very insightful, therefore, in ensuring that the two-day event included a range of presentations and posters on the “human element”, with talks from medical experts and those involved in the psychology of aspects of the winter-over experience. It is important that the medical experts continue to work with the operations and logistics experts to ensure not only that we have the technical skills to run our year-round facilities in support of science, but also that the people with those skills can cope with the often isolated and unique situations that living and working over winter in the Antarctic can present. We also recognise that not all year-round stations face the same challenges. For example, those stations in the Peninsula region are fortunate to be relatively close to South America, making transport of people to and from the Antarctic a relatively easier thing to do than from other Antarctic areas more remote from other land masses. The Peninsula’s relative proximity to another land mass helps in case of medical emergency when there is an urgent need to transport winter personnel to medical assistance outside of the Antarctic region. However, for those programmes based in the Northern Hemisphere, whose personnel work in the Peninsula region, the sense of remoteness and isolation from their families might be the same as if they were not so physically close to South America. The Symposium discussions helped us to recognise that isolation can have many different perspectives.

The second reason the topic of “Winter-Over Challenges” is a timely one, perhaps the more important reason of the two, is related to the recent outcomes of the Scientific Committee for Antarctic Research (SCAR) Horizon Scan and the COMNAP Antarctic Roadmap Challenges (ARC) projects. The Horizon Scan delivered the 80 highest-priority Antarctic and Southern Ocean scientific questions across seven thematic clusters. Looking across these 80 questions one can see the vital need to obtain data from a range of Antarctic situations and across the range of research disciplines continent-wide and year-round. In fact, some of the most critical gaps in our scientific knowledge about the Antarctic region stem

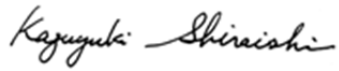
from the very fact that we have not had the opportunity to support some science projects during the critical times of the beginning of the Austral winter season (for example, when sea ice formation begins) and late in that season (for example, when the Antarctic ozone hole begins to form). Many of the 80 identified research questions would require year-round, so including winter-over, data collection or observations. Mention of year-round data requirements is made in particular in the research clusters for ocean/sea ice, astronomy, and biology. The results of the ARC project support the thinking that some of these data acquisition requirements can be met by remote sensing applications from outside of the Antarctic. The ARC results also, however, clearly reiterate the need for permanent year-round stations to act as hubs for field-based science, to collect data in midwinter, to house sophisticated technologies that will require technicians to deploy, maintain, and retrieve them, all of which will require winter-over teams with data management and communications skills who can ensure that required data are transmitted out of Antarctica in a timely manner and in a usable form. Some of the greatest scientific discoveries have been made because of Antarctic data and long-term observational datasets that were acquired in the Antarctic from a winter-over team; the discovery of the Antarctic ozone hole is but one example. Scientific data from the Antarctic and surrounding Southern Ocean are critical to providing answers to global scientific questions. The provision of the data will continue to require year-round access to winter-over science support from national Antarctic programmes.

As a result of the “Winter-Over Challenges” Symposium, we learned a great deal. For that, we are very grateful to all those who participated. The open COMNAP Symposium and these published proceedings will continue to be an excellent opportunity to share our Antarctic knowledge and experience.

The Antarctic Treaty Consultative Meeting (ATCM) acknowledged in ATCM XXXV Resolution 3 (2012) that “. . . further international co-operation will better equip Parties to respond to multiple



challenges posed by Antarctic activities". COMNAP was very pleased to explore, in this Symposium, one of those challenges and to co-operatively share, amongst our international membership of 30 national Antarctic programmes, ways to address those challenges.

A handwritten signature in black ink, reading "Kazuyuki Shiraishi". The signature is written in a cursive, flowing style.

**Kazuyuki Shiraishi**  
COMNAP Chairman

## Acknowledgements

This is the seventeenth COMNAP symposium that has taken place; the first was held in Boulder, Colorado, USA in 1962. The symposiums were first organised by the Working Group on Logistics of the Scientific Committee on Antarctic Research, then by the Standing Committee on Antarctic Logistics and Operations (SCALOP), and they are now organised every two years by COMNAP. Each symposium builds on previous meetings while also delivering new ideas and topics for discussion in an open forum. The next symposium is already in the planning stage for 2018 in Davos, Switzerland, in collaboration with the SCAR Open Science Conference organisers and the Alfred Wegener Institute.

The goal of the seventeenth COMNAP Symposium was to share information and ideas related to the winter-over situation in Antarctica in order to identify and overcome winter-over challenges. Such challenges broadly fall into the categories of those related to the “human element”, those related to the “built element”, and those related to the future; and so the Symposium sessions focussed on these three themes. This provided an opportunity to hear from those involved in the well-being of members of the winter-over team: medical doctors and psychologists, as well as logisticians, operations personnel, and technical experts. The diversity of topics gave a good overall picture of the challenges those with winter-over stations face every year to support winter science in Antarctica.

The Symposium was a special event which the National Centre for Antarctic and Ocean Research (NCAOR), under the aegis of the Ministry of Earth Sciences, Government of India, was very pleased to host in Goa, India.

As Convenor, I would like to thank the other Symposium Review Committee members, who were Hyoung Chul Shin (Korea Polar Research Institute), Robb Clifton (Australian Antarctic Division),

Brian Stone (US National Science Foundation), John Guldahl (Norwegian Polar Institute), and Tijun Zhang (Polar Research Institute of China). Thanks also to Michelle Rogan-Finnemore, COMNAP Executive Secretary, for her support in organising the symposium and in publishing these proceedings; to copy-editor, Janet Bray, for her efforts on the proceedings; and to Dr Yogesh Ray, my colleague at NCAOR, for secretarial assistance.

The number and quality of the applications for oral and poster presentations meant that the Symposium was extended and ran for two days. The success is, no doubt, due to the work of the authors of the oral presentations and posters. Thanks go to each and every one who dedicated time and effort into the Symposium presentations and posters and who also provided the abstracts and papers that appear in this Symposium proceedings publication.

It was a great pleasure to convene the COMNAP Symposium 2016, “Winter-Over Challenges”, and to see the publication of these proceedings as a record of the Symposium that will last into the future.

A handwritten signature in black ink, appearing to read 'Javed Beg', with a stylized flourish at the end.

**Javed Beg**  
COMNAP Symposium Convenor  
COMNAP Vice-Chair





# Contents

Foreword, *K. Shiraishi*..... v

Acknowledgements, *J. Beg*..... ix

## Oral Presentations

From Leadership in Extreme Environments to Extreme Leadership:  
How to Shape the Future of Antarctic Operations *N. Pattyn*..... 5

Antarctic Year-Round Stations: Under-Utilised Platforms to Fill the  
Gap in Science Observations *H.C. Shin* ..... 7

How to Minimise the Risk of Field Activities During Winter-Over  
*G. Hashida* ..... 9

Building Effective Wintering Communities: The Role of 24-Hour  
Selection Centres *R. Wooding* ..... 13

Health Care Planning and Delivery in Antarctica: An Analysis of  
Health Disorders *P. Malhotra, A. Bhatia* ..... 22

Counter Measures to Improve Quality of Life, Performance, Health  
and Well-Being *N. Pattyn, A. Hicks, P. Marquis* ..... 29

Medical Management System and Severe Cases in Japanese  
Winter-Over Situations: Fatal Case, Surgical Operations,  
and Medical Evacuations *G. Ohno, N. Sekiguchi, T. Yoshida,  
N. Ishizaki, O. Fujimoto, Y. Katsuta* ..... 37

The Role of Technology in Antarctic Medicine  
*A. Bhatia, P. Malhotra* ..... 45

Changes of 25-OH-Vitamin D During Winter-Over at the German Antarctic Stations Neumayer II and III <i>M. Steinach, E. Kohlberg, M. A. Maggioni, S. Mendt, O. Opatz, A. Stahn, J. Tiedemann, H. Gunga</i> .....	51
Personality Characteristics and Training Programmes Useful for Better Adaptation During Winter-Over Expeditions to the Antarctic in Multicultural Groups: The Results of the Last 11 Missions at Concordia Station <i>D. G. Ferravante, P. LaForet</i> .....	59
Psychological Evaluation and Screening Pre-Deployment to Antarctica <i>M. Barbarito, M. L. Naveira</i> .....	61
How to Face the Winter-Over Challenge in Terms of Team Building and Training? The Approach of Alfred Wegener Institute <i>E. Kohlberg, C. Wesche, U. Nixdorf, D. Mengedoht</i> .....	67
The Limitations of Digital Communication when Dealing with a Medical Emergency in a Remote Location: Lessons Learned from Military and Antarctic Missions <i>N. Pattyn, P. Neirinckx, P. Marquis, S. Horne, A. Hicks</i> .....	73
First Aid and the Role of the Information and Communication Technologies (ICTs) in Critical Incidents <i>M. Barbarito, M. L. Naveira</i> .....	75
A Major Winter-Over Challenge: Medavac Case Analysis in the Korean Antarctic Station over 28 Years <i>E. Yi</i> .....	79
Use of E-Communication and its Psychological Influence on Winter-Over <i>M. Barbarito, M. L. Naveira</i> .....	83
Yoga: A New Strategy to Facilitate Human Adaption in Antarctica <i>B. Ragavendrasamy, M. N. Ramesh, N. K. Manjunath, S. Saini</i> .....	89
Safety Expertise Support from the Korean Government for the Winter-Over Party <i>W. Kim</i> .....	97

When the Lights Go Out: Challenges, Strategies, and Management During Wintertime Incidents <i>T. Stockings, J. Hall, S. Garrod, J. Eager</i> .....	99
Concordia: The Third Continental Station <i>C. Le Calvez, G. Bianchi Fasani</i> .....	101
Development of Telemedicine: A Substantial Contribution to Medical Safety During Winter-Over <i>E. Kohlberg, C. Wesche, U. Nixdorf, D. Mengedoht</i> .....	109
Crevasse Detection for Safety Issues During the Antarctic Winter using High-Resolution Synthetic Aperture Radar (SAR) Imagery <i>C. Wesche, E. Kohlberg, U. Nixdorf</i> .....	115
The Halley Relocation Project <i>A. Bradley, J.Eager</i> .....	121

### **Poster Presentations**

Pilot Study: Winter-Over Psychological Telecare at the Korean Antarctic Station in 2010 <i>E. Yi</i> .....	125
The History, Present, and Futures of Polar Medicine in the Case of South Korea: 30 Years and Beyond <i>E. Yi</i> .....	127
Key Issues to be Solved for the Winter-Over Party of Jang Bogo Station <i>S. Choi</i> .....	129
Using the DLR NRT Satellite Imagery Service for the Navigation of Vessels through Sea Ice <i>C. Wesche, K. Höppner, E. Diedrich, E. Kohlberg, U. Nixdorf</i> .....	131
EDEN ISS: Providing Fresh Food to Winter-Over Neumayer Station III Crews and Long-Duration Missions <i>M. T. Bamsey, P. Zabel, D. Schubert, E. Kohlberg, D. Mengedoht</i> .....	133



Improvement of Transportation and Construction at the Syowa Station: Future Plans and Challenges <i>Y. Katsuta, G. Hashida, Y. Nagi</i> .....	135
Construction of Wind Power Generation at Japanese Antarctic Station Syowa: A Case Study using the CFD-GIS Wind Synopsis Simulator <i>K. Kim, T. Uchida, K. Ishizawa, H. Fujino, H. Nakamura</i> .....	137
Challenges of PV Generation in Polar Regions Case Study: the Norwegian Research Station Troll in Antarctica <i>S. Merlet, T. Thiisa, B. Thorud, E. Olsenban, J. Nyhus</i> .....	139
Appendix A: COMNAP Symposium 2016: Winter-Over Challenges Programme .....	142
Appendix B: List of Posters.....	148

# Oral Presentations



# **From Leadership in Extreme Environments to Extreme Leadership: How to Shape the Future of Antarctic Operations**

Nathalie Pattyn  
[nathalie.pattyn@mil.be](mailto:nathalie.pattyn@mil.be)

Belgium Royal Military Academy

Leadership training in "normal" environments is usually full of examples about leadership in extreme circumstances (see, for example, <http://fuellearning.com/amundsen-scott-or-shackleton-what-type-of-leader-are-you/>). However, when looking at models of leadership, field studies, training schemes, and performance analyses, there is a striking lack of data regarding extreme environments. As pointed out by Bass (2008),<sup>1</sup> these situations are limited in number, and have been treated by previous research as homogeneous. However, space flight is not a military deployment in a combat zone, which in turn is very different from an oil rig, which again bears little similarity to an Antarctic station.

When aiming to implement a culture of management in extreme environments, one has to consider a trade-off between a top-down, theory-based approach, and a bottom-up fully contextual system. As is often the case, striking the golden mean seems ideal, however unrealistic. Nevertheless, there are frameworks available, both in the literature and in the operational world, that are worth exploring to allow for a more professional management of Antarctic operations.

Based on the work of Hannah et al. (2009),<sup>2</sup> the typical context of an Antarctic deployment was analysed, its level of "extremity" was determined, and attenuators and intensifiers were defined. This allowed the definition of an adaptive leadership response, depending on organisation types and the contextualisation of leadership.

The aim was to provide the audience with a practical tool they could apply to their own organisation, while addressing the following issues: corporate culture, selection and training of leaders in the field, health and safety, conflict resolution, crisis management, and personnel appraisal.

### **References**

1. Bass, B.M. & Bass, R., *The Bass Handbook of Leadership Theory, Research & Managerial Applications* (4<sup>th</sup> edition), 2008.
2. Hannah, ST et al. (2009). A framework for examining leadership in extreme contexts. *The Leadership Quarterly*, 20: 897–919.

# **Antarctic Year-Round Stations: Under-Utilised Platforms to Fill the Gap in Science Observations**

Hyoung Chul Shin  
[hcsin@kopri.re.kr](mailto:hcsin@kopri.re.kr)

Korea Polar Research Institute (KOPRI)

Antarctic year-round stations provide a valuable platform for sustained observations across different realms. A total winter population nearing a thousand people per annum and a substantial level of investments warrant careful archiving and better co-ordinated use of any collected data.

Such observations and data collection can span from atmospheric including upper-atmospheric physics measurements, to geophysical recordings, to marine observations. These can help address some of the data gaps identified in the recent Scientific Committee for Antarctic Research (SCAR) Horizon Scan and the subsequent COMNAP Antarctic Roadmap Challenges (ARC) initiatives.

These data are sometimes archived and prepared for shared use by an international body or entrusted organisations, as is the case with meteorological and seismological observations. This can allow more comprehensive analyses and value-added products, although the mechanisms to enable this can vary from case to case.

Marine observations appear to be a more poorly co-ordinated and rather under-utilised source of data. In the presentation, sample cases were collated with a view to giving an overview and forward-looking suggestions, not only for research scientists but also for operators. Part of the focus was on station activities around the South Shetland Islands and Antarctic Peninsula region.



## **How to Minimise the Risk of Field Activities During Winter-Over**

Gen Hashida  
[gen@nipr.ac.jp](mailto:gen@nipr.ac.jp)

National Institute of Polar Research (NIPR)

Since the opening of Syowa Station on 29 January 1957, the Japanese Antarctic Research Expedition (JARE) has conducted various year-round observations in the vicinity of the station. These long-term observations comprise measurements related to upper atmospheric physics, meteorology, glaciology, geology, geophysics, biology, and other science disciplines, with the only hiatus in observing being during the years from 1962 to 1965.

Syowa Station is located on an island 4 kilometres away from the Antarctic continent. Because of this location, the wintering parties must often perform long-distance travel on sea ice in particular, for the maintenance of unmanned scientific equipment that is set up approximately 90 kilometres from the station.

In addition to traverses across sea ice, there is an annual inland traverse of approximately 250 kilometres in one direction (500 kilometres in total). This annual traverse takes three to four weeks to complete and is usually carried out during the months of September or October. It is thus one of the characteristics of JARE that there is quite a range of field activities carried out during winter.

The wintering team, usually consisting of 30 people, is a mix of experienced Antarctic winter-over personnel and newcomers to the winter-over experience. The team of 30 usually comprises a leader, plus 12 people in the science and science observations group, and a range of station-operations and science-support



personnel. The chart (Figure 1) is a typical winter-over configuration.

Station Leader		1
Monitoring	Meteorology	5
	Geo, Atmosphere, Upper Atmosphere	3
Science	Atmospheric Radar	3
	Upper Atmosphere	1
Logistics	Mechanics & Electronics	6
	Radio Comm	1
	Chef	2
	Doctor	2
	Environment	1
	Antenna	1
	IT	1
	Carpenter	1
	Field Assistant	1
	Co-ordinator	1
	Total	

Figure 1: Typical configuration of a JARE winter-over party at Syowa Station.

Safety is the first priority of any activity, in and around the station, on the sea ice, and during any traverse across land or land-based ice. However, experience has shown it can be extremely difficult to maintain and accomplish this motto during wintering. Therefore, the NIPR designed a series of pre-deployment safety training modules for JARE. The module begins each March with the JARE team members participating in a winter training camp (five days in March). The pre-Antarctic training module concludes in November, just before the JARE team deploys to Antarctica. The chart (Figure 2) shows the typical timings for the various components of the training module. The training familiarises the JARE team with the expected weather and snow and ice conditions, explains proper survival techniques, provides first aid skills, and reminds the team

about the limited medical capabilities in such a remote and isolated environment.

March	Winter training (5 days): Lecture and field activity
June	Summer training and meeting (5 days): Lectures and first aid
July	JARE starts preparation
August	Meeting (1 day): Lectures
September	Meeting (1 day): Lectures and firefighting
November (Departure)	Meeting (1 day): Lectures
December (In-transit)	Onboard <i>Shirase</i> : Lectures Upon arrival in Antarctica: <i>in situ</i> training on sea ice
February	On-the-job training: Vehicles, Field gear, First aid, Firefighting Desktop exercises; Accidents and near-miss reporting

Figure 2: Annual training programme for JARE expeditioners which includes a pre-deployment and on-ice component.

Once JARE sets out for the Antarctic, the team continues to participate in lectures and training on board the *Shirase* and after it arrives in Antarctica. This serves to reinforce the safety message and act as a reminder of key information.

While there is never any absolute way to eliminate all risk related to Antarctic activity, especially during the winter period, the training is provided to assist with addressing identified risks as much as possible. It is, however, difficult to measure quantitatively the effectiveness of such training, but JARE team members feel it is very beneficial.

New information and communications technologies add benefit to the winter-over experience and assist safety. However, too much reliance on such technologies may cause an expeditioner to feel too “comfortable” and to therefore not correctly identify the level of the risk. Such levels of expectations and expeditioners’ responses should be continuously monitored in order to assess

how we can effectively cultivate the sense of danger for winter-over personnel and prepare their training appropriately. In addition to training programmes, strategic recruitment is a key component of a strong commitment to safety.

# **Building Effective Wintering Communities: The Role of 24-Hour Selection Centres**

Rob Wooding  
[rob.wooding@aad.gov.au](mailto:rob.wooding@aad.gov.au)

Australian Antarctic Division (AAD)

## **Background**

Australia operates four southern research stations: three on the Antarctic continent and one on sub-Antarctic Macquarie Island. Our three Antarctic stations, Casey, Davis, and Mawson, are among the most isolated on the continent, being respectively around 3,500, 4,500, and 5,500 kilometres from the nearest seaport, with Casey and Mawson also hundreds of kilometres from the nearest research station.

Living and working in an isolated, confined, and extreme environment as part of a small wintering community, typically 10 to 20 expeditioners, for an extended period requires participants in the Australian Antarctic Program to be medically fit and well-equipped both psychologically and in terms of their personal qualities and capabilities. Given the environmental conditions, our stations are physically inaccessible for most of the March to October period.

As with most other Antarctic nations, the AAD has a medical assessment process that screens out would-be expeditioners with current mental health concerns and psychiatric conditions. And the selection process, like that of many other nations, also includes rigorous psychological screening (“adaptability assessment”). This screening is designed to identify those individuals with personality and/or behavioural traits that might make their deployment an unacceptable risk in terms of their impact on the small wintering community and their ability to effectively respond to the psychosocial demands of living and working in this unique environment.

However, over and above our medical and psychological screening processes, the AAD also requires all potential wintering expeditioners to participate in a 24-Hour Selection Centre. More commonly referred to as assessment centres in the broader selection and recruitment context, the AAD Selection Centres focus on assessing an applicant's personal qualities to ensure that they are able to contribute to the harmonious and effective functioning of an isolated community over winter.

This paper will explain how the Selection Centres fit into the AAD's overall recruitment and selection process for wintering expeditioners, what positive and negative attributes we are looking for through the process, and the contribution that we consider the Selection Centres have made to improving the experiences of our winter-over communities.

### **The AAD's selection process for winterers**

The AAD typically has only very small numbers of wintering scientists. The main wintering roles on stations are as follows:

- Station Leaders
- Diesel mechanics and supervisors
- Building services workers (electricians, carpenters, plumbers, etc.) and supervisors
- Medical practitioners
- Chefs
- Information and communications technology specialists
- Field training officers
- Bureau of Meteorology employees

A key strength of the Australian Antarctic Program selection process is that it is multifaceted with a number of stages that applicants must progress through prior to being selected into the Program. The multifaceted approach is designed with the intent of reducing selection errors. While the process differs for Station Leaders and Antarctic medical practitioners, most wintering expeditioners will progress through the following stages:

1. Applicants submit written applications online that primarily require them to outline their trade/technical qualifications, skills, and relevant experience.
2. Technical specialists within the AAD then shortlist the applicants considered to be most suitable on technical grounds.
3. A medical checklist submitted by the applicants is used for initial screening.
4. The shortlisted applicants then progress to a 24-Hour Selection Centre.
5. Shortlisted applicants are also subjected to a face-to-face technical interview by a discipline supervisor to further assess their critical technical skills.
6. Those who are found suitable through the Selection Centre process progress to full medical and psychological screening.

An exception to this process is that applicants who have been found suitable at a Selection Centre within the last three years, or who have been south within that same period, are not required to attend another Selection Centre. These applicants progress directly to medical and psychological screening.

Medical practitioners, who often have considerable difficulty in obtaining leave from their practice, are currently excluded from the Selection Centre process, but this is currently under review.

Station Leader applicants are required to attend the 24-Hour Selection Centre to assess their personal qualities. If found suitable through this process, they will then proceed to a rigorous four-day Station Leader Selection Centre that focusses on observation and assessment of their leadership ability applicable to the Station Leader role.

### **The 24-Hour Selection Centres**

Selection Centres were introduced in 2003 as part of a wider reform of expeditioner selection processes designed to make them more transparent and to demonstrate that the personal qualities of expeditioners were being given equal weight to their technical capabilities in determining who would be deployed to Antarctica, particularly over winter.

Since 2003, the AAD has conducted between 12 and 15 of the 24-Hour Selection Centres in any given year. Each one has an average cost of around 20,000 AUD, most of which is the travel and accommodation costs involved in bringing together participants from all parts of Australia. Most are held in Hobart, and a few are in other centres (usually Brisbane and Adelaide), for the convenience of those expeditioners who face the longest travelling times in reaching Hobart.

Essentially, the Selection Centre replicates a “day in the life” of an expeditioner, with each Selection Centre comprising a group of applicants of similar diversity (in gender, station roles, etc.) and of a similar number (up to 18 participants) to what would occur in a wintering community. Extending over a 24-hour period from mid-morning on the first day through to mid-morning the next day, the Selection Centre activities are designed to simulate work, community, and social aspects of living and working on-station.

Each Selection Centre has two Facilitators (at least one of whom comes from AAD Human Resources area) who are responsible for guiding the applicants through the scenarios, and four Observers who are responsible for observing and assessing the applicants. Observers, who by the nature of their roles and previous Antarctic experience have a strong understanding of the requirements to be a positive member of the Antarctic community, are drawn from different areas of the AAD, or are sometimes former employees, such as past Station Leaders.

### **Assessment process**

Across the Selection Centre, applicants are being assessed on their personal qualities, which are aligned with the Antarctic Service Code of Personal Behaviour. These qualities against which applicants are to be assessed are:

- a strong work ethic;
- an ability to make a positive contribution to community and team;
- an ability to respond to authority and be compliant with the law, legislative requirements, and AAD policies and procedures; and
- a commitment to AAD specific requirements (including participation in training, commitment to science, and willingness to participate in “common duties”).

Breaking these down further, the different activities allow for observation and assessment against criteria, including:

- capacity to work productively, to contribute to the success of the work group, and to recognise the effect of their behaviour on others;
- ability to address and resolve conflict;
- capacity to exercise sound judgement;
- demonstrated flexibility, tolerance, and acceptance of changing circumstances;
- responsible use of alcohol;
- compliance with authority and supporting lawful instructions;
- recognition of harassment and discrimination issues and likely compliance with legislative requirements; and
- commitment to and compliance with Work, Health & Safety (WHS) policies and practices.

Many of the Selection Centre activities (or scenarios) are based on “real life” situations, and present problems, tasks, or situations that the participants are required to respond to in either small or large groups. Some scenarios require the participants to decide on a



solution or particular course of action; others may simply require them to consider the issues presented, to present their thoughts, ideas, and opinions, and to discuss the issues.

Each scenario during the Selection Centre allows for observation of at least one, and in most instances multiple selection criteria – this provides multiple opportunities for the candidate to demonstrate that they have the necessary personal qualities, and for the Assessors to observe and assess the candidate across multiple activities. Selection Centres assess what applicants will actually do if selected, not just how good they are in interviews – which arguably allows for a more accurate assessment.

Alongside these scenarios, the Selection Centre also allows for observation and assessment of applicants in a social setting – not dissimilar to social interactions outside of work hours on-station. The provision of alcohol in this social setting, for example, provides an opportunity to observe how they manage alcohol; while you may expect that applicants would be on their best behaviour during this process, participants have been observed to over-indulge in alcohol in the social setting, or to purchase additional alcohol and take it back to their rooms to consume after the conclusion of the day's activities. Not dissimilar to what may occur on-station, we also require participants to share accommodation while attending the Selection Centre – some of the participants have expressed concern about having to share a room with another person. Outside of the formal exercises, both of these situations are potential “red flags” when you consider the environment in which these individuals are seeking to live and work.

The assessment criteria and rating scales used during the Selection Centre are designed with the intent of, as much as possible, removing subjectivity and ensuring that the process is fair and objective. All new Observers are required to participate in training to provide them with skills in observing, recording, and rating behaviours, and a small pool of Facilitators are used to ensure the process is standardised across the many Selection Centres

conducted each year. Supporting the conduct of the Selection Centres are detailed Facilitator and Observer manuals.

While the primary role of the Selection Centre is to assess an applicant's suitability, it is a two-way process. Not only do they provide the AAD with an opportunity to observe and assess an applicant's personal qualities, the Selection Centres also provide an opportunity for the applicants to learn more about the Program and the AAD – this allows them to make an informed choice about whether this is a role they wish to pursue and an organisation that they wish to work for.

Through their participation in the Selection Centre, which provides more insight into the role and the demands of living and working in this unique environment, some applicants choose to “select out” and not to continue with their application – a satisfactory outcome from our perspective. For the majority, the information they receive at the Selection Centre reinforces their interest and desire to go south, alongside providing advice and information to assist them in preparing for potential employment (e.g. one activity during the Selection Centre addresses the impact of separation from family and friends – many applicants later comment that as a result of this scenario they have initiated conversations with family and friends after the Selection Centre about the impact of separation and how this can be managed).

#### **Warning signs of unsuitable expeditioners**

With an attrition rate of around 30 per cent (reflecting those applicants who are rated as Unsuitable or Marginal), the Selection Centre process is effective in selecting out those applicants who demonstrate unsuitable or concerning personal qualities. Behaviours that would likely see an applicant being selected out or identified as marginal during the Selection Centre process could include the following:

- Lack of insight into the impact of their behaviour on others – such that they may consistently talk over others, be over-bearing and dominant in the group setting, not allow

others to contribute to discussions, be routinely dismissive of an opinion or idea that differs from their own

- Attitudes and opinions that suggest poor tolerance for diversity and individual differences, non-inclusiveness of others, and/or propensity for bullying or harassing behaviours
- Propensity to engage in conflict, poor conflict management skills, and/or belligerent behaviour
- Comments and/or behaviours to suggest that an applicant is unlikely to be responsive to authority and/or compliant with AAD policies and procedures
- Poor attitude towards WHS and/or suggestions of risk-taking behaviours evidenced in their contributions to discussion, or suggestions of poor work ethic
- Suggestion of irresponsible use of alcohol through contribution to discussions or demonstrated misuse of alcohol in the social settings

### **Conclusion – Why we run Selection Centres**

The AAD invests close to 300,000 AUD per annum in Selection Centres, but considers this to represent very good value given the risks and costs that result from the deployment of unsuitable people to Antarctica over winter.

Every wintering expeditioner we deploy who does not have the appropriate personal qualities for his or her role is the source of substantial risks to:

- the success of our work programme at that station over winter;
- the health and well-being of both the individual and the other members of the community on that station; and
- the AAD's finances, both in terms of the direct cost of urgent repatriation, and also the longer-term costs of addressing personal injury or psychological harm, which in the most serious cases can run to hundreds of thousands of dollars.

Like any form of recruitment process, Selection Centres are never going to produce perfect results, but the AAD considers that they do significantly reduce the likelihood of deploying unsuitable people.

While anecdotal indicators suggest that the Selection Centres are effective, and feedback to date suggests that they have good face validity, the AAD is currently undertaking a two-year evaluation of the process with particular attention being given to their reliability and validity. The results of this evaluation will inform the future conduct of the Selection Centres and may include revisions to the Selection Centre activities, assessment criteria, and ratings, and to Assessor and Facilitator training.

# Health Care Planning and Delivery in Antarctica: An Analysis of Health Disorders

Pradip Malhotra<sup>a</sup> and Abhijeet Bhatia<sup>b</sup>  
[pradip.malhotra@gmail.com](mailto:pradip.malhotra@gmail.com)

<sup>a</sup>22<sup>nd</sup> and 28<sup>th</sup> Indian Scientific Expeditions to Antarctica (ISEA), 1<sup>st</sup> Indian South Pole Expedition

<sup>b</sup>North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences (NEIGRIHMS) and 27<sup>th</sup> ISEA

## Introduction

The Antarctic Treaty has ensured that human activities in Antarctica are restricted to scientific and other peaceful activities. Human presence in Antarctica is substantial, though temporary. The emphasis has now shifted from exploration to scientific activity. Hence, comfortable and healthy living conditions with adequate health care facilities are now expected. Because of the small size of national expeditions, extensive health care facilities are not feasible. Secondary referral and emergency evacuation are rarely possible. Optimum health care facilities with health care professionals trained in polar health are essential. This article attempts to suggest improvements in the planning and delivery of health care infrastructure in modern day Antarctica for national Antarctic organisations as well as physicians visiting Antarctica, based on an analysis of the disease pattern encountered in Indian Scientific Expeditions to Antarctica (ISEA).

Health care in ISEA is provided by the expedition doctors. The medical infrastructure facilities at Maitri Station and the expedition ship are limited. No diagnostic or major operating theatre facilities are available on board the expedition vessel.

Maitri has a consultation/treatment room, an operating theatre with general surgical instruments, and basic diagnostic, basic radiological, haematological, and biochemical investigation facilities. Higher referral facilities are not available. Emergency

evacuation is not possible from March to November because flights cease as a result of the adverse physical conditions. The expedition team is selected from a pool of volunteers after interviews and detailed medical and psychological examinations. Hence, the fitness levels of the team members are high.

### **The analysis**

The health records from November 1989 to February 2011 were analysed for seven expeditions (13<sup>th</sup>, 15<sup>th</sup>, 17<sup>th</sup>, 22<sup>nd</sup>, 24<sup>th</sup>, 27<sup>th</sup>, and 29<sup>th</sup>). These included 1,989 medical consultations for 327 ISEA team members (325 men and 2 women). Data were available for all 1,989 medical room consultations.

The data show that injuries were the most common medical room presentation in ISEA (n=542; 27.25%). These include musculoskeletal injuries, bruises and lacerations, fractures and dislocations, and backache. Injuries were observed to be more common in the convoy team because of heavy physical activity in adverse climate and terrain.

Gastrointestinal disturbances such as diarrhoea, constipation, and dyspepsia (n= 391; 19.66%) were the second most common disorders. Psychological disturbances accounted for 53 (2.66%), a relatively small number of consultations, and included insomnia, loss of appetite, anxiety, and depression. Prolonged physical isolation was implicated as the primary cause. However, anecdotal evidence suggests that the number is under-reported.

Skin rashes accounted for 186 (9.35%) cases. These have been reported to be more common in individuals working with chemicals such as fuels and lubricants, and also in plumbers who come in contact with wastewater. Cold injuries, including frostbite, chilblains, and hypothermia accounted for 40 (2.01%) consultations.

Photophthalmia accounted for 21 (1.06%) consultations. This low number was on account of good quality clothing and eye gear available in ISEA.

Infectious diseases, including fever, upper respiratory tract infections (URTI), pneumonitis, malaria, tuberculosis, hepatitis, fungal infections, helminthiasis, urinary tract infections (UTI), herpes simplex, stye, sinusitis, acute tonsillitis, and soft tissue infections accounted for 141 (7.08%) consultations.

### **Discussion**

Mortality and serious morbidity in Antarctica are in most cases accidental and hence usually avoidable. High latitudes have been observed to have a higher mortality and morbidity due to accidents. For example, the accident mortality in Alaska is twice that of the United States of America as a whole.<sup>1</sup> Such incidents may require expensive and hazardous evacuation efforts, often involving multiple nations.

The ISEA team members are involved in hectic physical activity during the brief summer months and a large proportion of the winter team is involved in intense physical activity for convoy duty during the Antarctic winter. Constant outdoor physical activity in harsh climatic conditions and terrain is one of the causes implicated in the high incidence of injuries in ISEA.<sup>2,3,4</sup> Most of these injuries have been, however, minor. Japanese and British expeditions too have reported a high incidence of injuries.<sup>5,6</sup> However, these included injuries due to adventure activities. Such activities are not encouraged in ISEA.

Consumption of old food stocks has been implicated as one of the causes of gastrointestinal disorders in ISEA, along with lack of adequate physical exercise and poor nutritional habits.<sup>7</sup> Psychological stress, along with the above-mentioned factors, is known to cause gastrointestinal disturbances.<sup>8</sup> Diarrhoea in ISEA might occur because of contaminated food or water and eating with unwashed hands because of extreme cold.<sup>9</sup> Regular analysis of

the drinking water source for presence of pathogens must be carried out. Sprouted pulses may serve as an effective natural nutritional supplement, and during the 27<sup>th</sup> ISEA a practice of providing sprouted pulses in all meals was followed.<sup>2</sup>

The authors recommend formal and informal interactions between the team members and the team doctors to create awareness about healthy diet and regular exercise in conditions prevalent in Antarctica.

Psychological changes, a restricted but prominent affliction in Antarctica, continue to be due to physical isolation. Other reasons include prolonged outdoor activity in extreme climatic conditions and hostile terrain; living in a small, closed community for prolonged periods; prolonged periods of darkness during the winter; poor communication facilities; and periods of under-occupation.<sup>4,10</sup> These factors have been mitigated to a large extent in modern Antarctic expeditions. Expeditions are restricted to between 12 and 15 months as compared with a few years during the days of Antarctic exploration.<sup>11,12</sup>

Increased alcohol consumption might be an effect as well as cause of psychological issues.<sup>4</sup> Psychological stress in modern-day Antarctica does not usually impair well-being and it may be that no medication is required.<sup>2</sup> Most of the psychological abnormalities are observed in the winter-over teams during the third quarter of the isolation period (“third quarter phenomenon”).<sup>13</sup>

Cold injuries and photophthalmia occur because of inadequate protection and hence are almost always preventable.<sup>2</sup> These are more common in individuals regularly involved in outdoor work, particularly the convoy team. Photophthalmia commonly occurs because of exposure to ultraviolet radiation and can be prevented by using protective glasses.<sup>15</sup> It has been reported to occur in ISEA on account of arc welding and exposure to bright snow surfaces.<sup>4,14</sup> Cold injuries can easily be prevented by using adequate clothing.



URTIs are known to occur in Antarctica towards the end of the isolation period, when fresh infection is introduced into the relatively sterile Antarctic environment by the new team members.<sup>5</sup>

Incidence of hypertension and other cardiovascular disorders has been shown to increase in cold regions.<sup>16</sup> A close watch for onset and progression of disease with timely intervention is recommended. One member of 28<sup>th</sup> ISEA passed away as a result of acute massive myocardial infarction.

Seasickness has often been reported as the commonest medical event on Antarctica cruises. The expeditioners must be recommended anti-motion sickness medication (promethazine in the authors' personal experience) when rough seas are expected and if the individual concerned is prone to developing motion sickness. Light meals should be served and the team members advised to minimise movements.

The risk of carbon monoxide poisoning is omnipresent in Antarctica because of the practice of using stoves and lamps for heating and lighting in sealed tents and huts.<sup>10</sup> Four Indian expedition members died of carbon monoxide poisoning in 1990 during the ninth expedition.<sup>17,18</sup> Such accidents are entirely avoidable by adequate pre-induction training and caution.

Careless handling of fuels and lubricants has been implicated as a cause of accidental poisoning and contact dermatitis.<sup>19</sup> Adequate precautions during use of such chemicals should be emphasised during pre-induction training.

Although we have tried to understand the effects of wintering for a long time, there is still a long way to go before we understand its full effects on our body and mind. This understanding is essential because the scale and the scope of Antarctic expeditions are constantly expanding, and because it also has implications for space travel.

## References

1. King H. Epidemiology in Antarctica? *J Epidemiol Community Health*. 1986 Dec;40(4):351–6.
2. Bhatia A, Pal R. Morbidity Pattern of the 27<sup>th</sup> Indian Scientific Expedition to Antarctica. *Wilderness Environ Med*. 2012.
3. Bandopadhyay G. Technical report for the 24<sup>th</sup> Indian Scientific Expedition to Antarctica. Goa (IN): National Centre for Antarctic and Ocean Research (IN). 2012. Common Medical Problems Encountered During 24<sup>th</sup> Indian Expedition to Antarctica; p. 292–6.
4. Anant S. Department of Ocean Development, Technical Publication. Number 12 [Internet]. Goa (IN): National Centre for Antarctic and Ocean Research (IN). c1998. Medical Report - XIV Indian Antarctic Expedition; [cited 2012 Jun 20]; p. 357–60. Available from: [http://dspace.ncaor.org:8080/dspace/bitstream/123456789/434/3/ARTICLE+26\\_1.pdf](http://dspace.ncaor.org:8080/dspace/bitstream/123456789/434/3/ARTICLE+26_1.pdf).
5. Otani S, Ohno G, Shimoeda N, Mikami H. Morbidity and health survey of wintering members in Japanese Antarctic research expedition. *Int J Circumpolar Health*. 2004;63(2 suppl):165–8.
6. Cattermole TJ. The incidence of injury with the British Antarctic Survey, 1986–1995. *Int J Circumpolar Health*. 2001 Jan;60(1):72–81.
7. Biswas DK, Bhargava N. Medical Report XXIX ISEA, Maitri, Antarctica. 2010.
8. Freeland W A; Antarctic Medicine 25 Years at Halley Bay 1956–1980; Army Personnel Research Establishment; 1990.
9. Coldron J. Management of a respiratory emergency in the Antarctic winter: a case of foreign body aspiration. *Wilderness Environ Med*. 2007 Summer;18(2):120–6.
10. National Centre for Antarctic and Ocean Research. Guidelines to members of Indian scientific expedition to Antarctica [Internet]. Goa (IN): National Centre for Antarctic and Ocean Research (IN). [cited 2012 Jun 20]; Available from: <http://www.ncaor.nic.in/Antarctic%20Guidelines.pdf>.
11. Carrington-Smith D. Mawson and Mertz: a re-evaluation of their ill-fated mapping journey during the 1911–1914 Australasian Antarctic Expedition. *Med J Aust*. 2005 Dec 5–19;183(11–12):638–41.
12. Piggott JR. Shackleton's men: life on Elephant Island. *Endeavour*. 2004 Sep;28(3):114–9.
13. Décamps G, Rosnet E. A Longitudinal assessment of psychological adaptation during a winter-over in Antarctica. *Environment and Behavior*. 2005 May;37(3):418–35.
14. Sharma SK. Department of Ocean Development, Technical Publication. Number 15 [Internet]. Goa (IN): National Centre for Antarctic and Ocean Research (IN). c2000. Medical cover during 17<sup>th</sup> Indian Antarctic expedition; [cited 2012 Jun 20]; p. 269–70. Available from: <http://dspace.ncaor.org:8080/dspace/bitstream/123456789/536/3/ARTICLE+25.pdf>.

15. Kirschke DL, Jones TF, Smith NM, Schaffner W. Photokeratitis and UV-radiation burns associated with damaged metal halide lamps. *Arch Pediatr Adolesc Med.* 2004 Apr;158(4):372–6.
16. Ansa VO, Ekott JU, Essien IO, Bassey EO. Seasonal variation in admission for heart failure, hypertension and stroke in Uyo, South-Eastern Nigeria. *Ann Afr Med.* 2008 Jun;7(2):62–6.
17. Ravindra R. Department of Ocean Development, Technical Publication. Number 6 [Internet]. Goa (IN): National Centre for Antarctic and Ocean Research (IN). c1994. The Ninth Indian Scientific Expedition to Antarctica — Events & Achievements; [cited 2012 Jun 20]; p.1–20. Available from: <http://dspace.ncaor.org:8080/dspace/bitstream/123456789/336/3/ARTICLE+1.pdf>.
18. Jayaraman KS. Four dead on Indian expedition. *Nature.* 1990;343(6258):501.
19. Tripathi ACP, Lal R. Department of Ocean Development, Technical Publication. Number 13 [Internet]. Goa (IN): National Centre for Antarctic and Ocean Research (IN). c1999. Medical report for the wintering period of the 15<sup>th</sup> Indian Antarctic Expedition; [cited 2012 Jun 20]; p. 413–6. Available from: <http://dspace.ncaor.org:8080/dspace/bitstream/123456789/480/3/ARTICLE+35.pdf>.

# Counter Measures to Improve Quality of Life, Performance, Health, and Well-Being

Nathalie Pattyn<sup>a</sup>, Anne Hicks<sup>b,c</sup>, and Peter Marquis<sup>b,c</sup>  
[nathalie.pattyn@mil.be](mailto:nathalie.pattyn@mil.be)

<sup>a</sup>Belgium Royal Military Academy

<sup>b</sup>British Antarctic Survey Medical Unit (BASMU)

<sup>c</sup>Plymouth Hospitals NHS Trust

## Introduction

Counter measures to improve quality of life, performance, health, and well-being that contribute to organisational effectiveness and efficiency have been highlighted through research and analysis by the medical unit of the British Antarctic Survey (BASMU) working closely alongside operations and logistics staff. This paper and presentation expand upon and illuminate information from several areas of that research. The areas are: psychometric testing, CO<sub>2</sub> monitoring, drug efficacy testing, post-expiry drug study, medical consultations analysis, medical screening, and medical service capability outcomes.

## Psychometric testing

A research project attempted to validate the core battery of tests being used by Antarctic operators.<sup>1</sup> No overall validation was found. Thus, such tests are not used in the selection process, though three factors are highlighted through the interview process as key markers. The title of the project was SOAP (Selection of Antarctic Personnel). It involved a seven year study on 348 subjects to validate or otherwise a core battery of tests. No validation was found; thus such testing was not instigated by the British Antarctic Survey (BAS) on its deployment cohorts.

The project did inform debate, and future interview/selection processes took note that applicants with the following markers were less likely to perform well during an Antarctic deployment:

- High levels of defensive hostility
- Low levels of emotional stability
- Significant levels of subjective health complaints

The discussion section of this paper produced pointers as follows as to where future work on this topic may lead. When testing for inter-rater agreement, there were no significant agreements for any of the variables in the SOAP battery and the decisions from the operational BAS selection panel: all Cohen's Kappas were below .20.

The interview board based its selection on factors other than personality, social skills, and motivation as they were measured in the SOAP battery. The issue, then, is whether our post hoc analyses suggest that the SOAP battery identifies risk factors that may improve the selection process.

This is by necessity a post hoc analysis, which makes necessary a caution against the general value of the conclusions. On the other hand, this has been a unique project, since no information from the SOAP battery was available for the selection process. This is as close as we can get to a "blind" evaluation of the potential value of adding systematic psychological testing to this type of selection process. As BAS does not use any psychological instruments in the selection process, there was no bias in this respect.

Not all the tests were predictive. The composition of the battery was based on a highly selective process, building on experience from selecting personnel for this and similarly hostile environments. We picked tests that have been used by many of the other countries participating in Antarctic missions. We refrain from recommending any particular tests, but according to our results even a small and restricted version of SOAP appeared to predict all poor and all extremely good performers.

Based on his studies on American winter-over personnel in the 1970s, Eric Gundersen identified three clusters of personality traits that were associated with effective performance during the long polar winters. These clusters were called *emotional stability*, *task performance*, and *social compatibility*.<sup>2</sup> The first cluster was about the individual's ability to maintain emotional stability, i.e. to stay "calm" and avoid extreme alterations in affect in response to the challenging surroundings. The second cluster referred to the person's task motivation, proficiency, and effectiveness, while the third cluster regarded the subject's humour, mood, sensitivity toward others, and kindness.<sup>3</sup> There were no direct implications for our battery for tests that could be drawn from these findings, but the general principles appear to be the same as predicted earlier.

The selection process has two primary goals: to "select out" and to "select in". To "select out" includes minimising the risk of selecting persons with psychological disorders or personality disorders. To "select in" the ones who are especially well suited for coping and high performance in collaboration with others is equally important as "selecting out" the ones who are not. The purpose of the SOAP project was to investigate whether measures of personality, stress, mastery, and mental health are able to predict behaviour at an Antarctic station, when these measures are made *before* departure to Antarctica. The tests in the SOAP battery will, hopefully, in the future, contribute to the "selection out" and the "selection in" of candidates for appointments at Antarctic stations. To this day and to our knowledge there have not been any similar attempts to validate these tests for use in selection of Antarctic personnel, even among the nations that are presently including them in their selection procedure for this purpose.

#### **Non-invasive CO<sub>2</sub> monitoring**

The field use and analysis of results from a Mazimo non-invasive CO<sub>2</sub> monitor confirmed field practice and procedures were acceptable in reducing the risk of CO<sub>2</sub> poisoning. The observed CO<sub>2</sub> levels in the blood of field staff were lower than anticipated considering the frequency of CO<sub>2</sub> alarms activation.

The BAS standard for burning carbon-based fuel in huts and tents is that inhaled concentrations of CO should not rise above 50 ppm for more than eight hours or 200 ppm for more than 15 minutes. Also, there should be no rise in CO blood levels above 3% in non-smokers and 10% in smokers. This standard is in line with Health & Safety Executive Exposure Limits.<sup>4</sup> The Mazimo carboxymeter monitor confirmed CO blood levels were in line with the above limits.

#### **Drug efficacy testing and post-expiry study**

Drugs that were repeatedly frozen and thawed in field medical supplies were tested for efficacy to confirm ongoing usage and to remove items that had degraded or posed a threat, e.g. through crystal formation in eye solutions and gels. Another programme of testing looked at drugs well past their expiry date. The Antarctic resupply cycle means drugs may be used that have expired and/or that have been frozen and thawed. Efficacy testing has confirmed a degree of comfort is warranted when this occurs (Table 1).

The equipment and chemicals used in the drug efficacy analysis were as follow:

- The High Performance Liquid Chromatography (HPLC) system comprised a ConstaMetric 3000 solvent delivery system and SpectroMonitor 3100 UV/Visible detector (ThermoElectron, Hemel Hempstead, UK) and Jasco 851-AS autosampler, 821-FP fluorescence detector and Borwin data handling (Jasco UK Ltd, Great Dunmow, UK).
- HPLC columns were obtained from Phenomenex (Macclesfield, UK), except for the Waters ODS2 (Waters Ltd UK, Elstree, UK).
- Syringe filters used were Minisart GF-prefilters (0.7µm) from Sartorius (Epsom, UK).
- All chemicals used were either of analytical or HPLC grade, and were obtained from either Sigma-Aldrich Company Ltd (Poole, UK) or Fisher Scientific (Loughborough, UK).

<b>Drug</b>	Per cent remaining after four weeks at -15°C	Per cent remaining after four weeks at -15°C + 5 freeze-thaws
Epinephrine injection	97.0 ± 1.8	101.1 ± 0.6
Cefuroxime powder for injection (Zinacef)	98.9 ± 1.2	98.9 ± 1.1
Chlorpheniramine injection (Chlorphenamine)	97.2 ± 1.0	99.1 ± 1.9
Erythromycin tablets	98.8 ± 2.0	97.0 ± 0.9
Hydrocortisone cream	89.2 ± 7.5	73.5 ± 3.9
Hydrocortisone sodium succinate powder for injection (Solu-Cortef)	99.4 ± 1.0	100.2 ± 0.7
Lidocaine HCl gel	96.8 ± 3.2	100.3 ± 1.8
Lidocaine HCl injection	98.8 ± 1.5	99.9 ± 0.9
Nalbuphine HCl injection (Nubain)	99.6 ± 2.2	99.3 ± 1.5
Paracetamol tablets	100.4 ± 1.2	100.6 ± 2.0
Tetracaine HCl eye drops (1.0% Minims)	95.4 ± 1.0	99.2 ± 1.0
Tetracaine HCl eye drops (1.0% Minims) 0.7µm filtered	101.1 ± 1.0	-

Table 1: Results from drug efficacy testing.

The results of the study that looked at a number of drugs that were past their expiry date are presented below.

<u>Item</u>	<u>Months past expiry date</u>	<u>% remaining</u>
Epinephrine (1 mg/ml)	6	85.47
Nalbuphine HCL	12	100.69
Amoxicillin (500 mg)	4	104.95
Aspirin Tablet (300 mg)	11	103.42
Aspirin Tablet (300 mg)	31	94.15
Penicillin VK (250 mg)	3	101.31
Penicillin VK (250 mg)	26	101.29

Table 2: Results from post-expiry study.



These studies led to some items being removed from Field Medical Boxes and provided comfort to the decision-making process when expired drugs need to be prescribed. It is recommended to look at a detailed study in the paper on the Shelf Life Extension Program (SLEP) operated by the USA Federal Drug Administration and Department of Defense.<sup>5</sup>

### **Medical consultations database analysis**

Being able to interrogate electronic medical consultations for the past 20 years has resulted in numerous evidence-based organisation decisions and procedure changes, e.g. moving away from double winters and awareness that certain staff positions entail greater levels of stress and subjective health complaints. The electronic consultations amounted to over 10,000, covering 20 years, allowing evidence to instigate and confirm issues and to prompt changes such as the following:

- A cessation of double continuous winter-overs
- A recognition that the end period of significant project work schedules should allow for the fatigue factor
- Greater vigilance over stress indicators in Station Leaders, chefs, and Field Guides
- Monitoring of an ageing southern population with issues such as weight problems, high blood pressure, and potential cardiac conditions
- Health and well-being interventions to those whose baseline medical statistics give cause for concern

### **Medical screening**

Moving to an evidenced-based system of bespoke screening for individuals rather than just a pass/fail on various diagnostic tests has maintained a lower than “continent” average for medical mishaps and evacuations.

Various procedures were put in place as follows:

- Chest X-ray only when clinically indicated, not for TB screening
- ECG at first medical if over 40 or clinically indicated

- Extensive blood analysis only if clinically indicated
- Enhanced dental screening for wintering population
- Consultant-to-applicant telecom to clarify issues
- Every set of medical papers reviewed and cleared by one of three BASMU consultants

### **Medical service capability**

Ensuring good communications between the medical service and operations and logistics service helps overcome perception difficulties when issues come to the fore. Issues that have contributed to difficulties include the following:

- Medical skills redundancy during deployment
- Limited capability
- Salvage futility in winter medevac scenarios
- Team cohesion problems
- Interpersonal conflict on-site
- Treatment and/or evacuation planning
- Recruitment concerns

### **References**

1. Grant, I., Eriksen, H., Marquis, P. et al. (2007). Psychological selection of Antarctic personnel: The "SOAP" instrument. *Aviation, Space and Environmental Medicine*, 78(8), 793–800
2. Doll, R.E., & Gundersen, E.K.E. (1970). The Relative Importance of Selected Behavioral Characteristics of Group Members in an Extreme Environment. *The Journal of Psychology*, 1970, 75, 231-237.
3. Stuster, J., Bachelard, C., Suedfeld, P. (2000). The relative importance of behavioral issues during long duration ICE missions. *Aviat, Space, Environ Med* 71(9):17–25.
4. United Kingdom, (1998). The Gas Safety (Installation and Use) Regulations 1998. No. 2451.
5. Lyon, R., Taylor, J., Porter, D. et al. (2006). Stability profiles of drug products extended beyond labeled expiration dates. *Journal of Pharmaceutical Sciences*, 95(7), 1549–1560. DOI 10.1002/jps.20636).



# Medical Management System and Severe Cases in Japanese Winter-Over Situations: Fatal Case, Surgical Operations, and Medical Evacuations

Giichiro Ohno<sup>a,b</sup>, Noriyasu Sekiguchi<sup>a,b</sup>, Tsuginori Yoshida<sup>a,c</sup>,  
Norio Ishizaki<sup>a</sup>, Osamu Fujimoto<sup>a</sup>, and Yutaka Katsuta<sup>a</sup>  
[oonog@mb.infoweb.ne.jp](mailto:oonog@mb.infoweb.ne.jp)

<sup>a</sup>National Institute of Polar Research (NIPR)

<sup>b</sup>Tokatsu Hospital

<sup>c</sup>Tokyo Medical University

<sup>d</sup>Kanagawa Health Service Association

## Background

The Japanese Antarctic Research Expedition (JARE) has had a presence in Antarctica and winter-over activity since 1956. Syowa Station (Figures 1 and 2), at a latitude of 69° S and a longitude of 39° E, is 15,000 kilometres from Japan. An icebreaker ship operates between Tokyo and the station once every Austral summer.



*Figure 1: Aerial view of Syowa Station.*

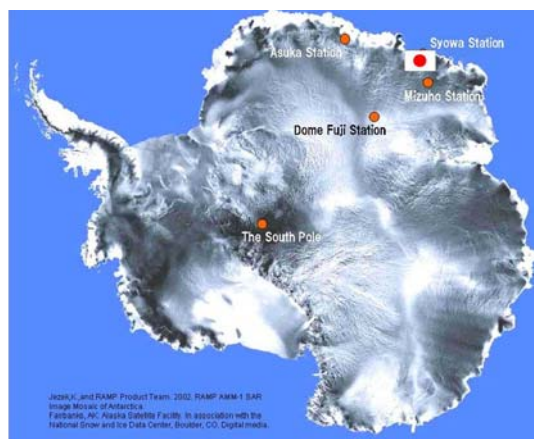


Figure 2: Map of Antarctica showing approximate location of Syowa Station.

In this decade it has become possible to use several intracontinental flight operations, but only during the summer season. Once the ship leaves Syowa Station in February there is no regular transport to the station in winter. Therefore, Syowa Station winter-over doctors deal with health care of an isolated wintering team. The character of Antarctic medical operations is summarised in Table 1. The summary indicates that, while morbidity rates are rather low, diseases occur, and one or two doctors have to manage all such illnesses with restricted equipment and in most circumstances without the possibility of rescue or evacuation.

58 years of data (1956–2014)
55 winter-over teams
Total number of wintering personnel: 1708
Total number of medical consultations: 6626
Deaths: 1
Major operations: 2
Medical evacuations: 4

Table 1: JARE Medical consultations summary.

It is therefore important to analyse severe medical cases to prevent fatal disease and the need for evacuation when it cannot be provided. Also, such extreme medicine is an under-explored area of research.

### Analysis

Medical data from 2002 through January 2015 were analysed with a focus on JARE 54 and JARE 55. According to the proportion of diseases (Table 2), 95 cases were treated in JARE 54 and 223 cases in JARE 55. The top three medical consultations presented were internal medicine, orthopaedic cases, and surgical problems.

	JARE 43–52 (2002–2012)	JARE 54 (Feb 2013–Jan 2014)	JARE 55 (Feb 2015–Jan 2015)
<b>Number of personnel</b>	347	30	24
<b>Number of consultations</b>	1392	95	223
Internal medicine	25%	23%	29%
Orthopaedic	28%	16%	28%
Surgical	20%	18%	15%
Teeth	8%	12%	7%
Skin	10%	8%	10%
Eye	7%	3%	4%
Ear, nose and throat	2%	19%	7%
Urology	0%	1%	0%
Psychiatry	0%	0%	0%

Table 2: Summary of analysis of proportion of disease types during winter-overs.

The analysis shows that the number of cases and the frequency of consultation alter widely every year. It does not necessarily mean however that there are practical differences in health conditions. One of the main reasons for such variation may be due to individual doctor diagnosis, which also means the number of total diseases is not suitable for comparison by year or between stations.

On the other hand, it is important to examine severe cases. Common standards for judging are clear with these, and there is

little variation of diagnosis. As a result, such an analysis produces data that can be effectively compared. In addition, urgent medical issues requiring practical improvements are identified.

In this study, we consider the seven severe cases with JARE in three categories – fatal cases/deaths (1), major surgical operations (2), and medical evacuations (4) – with a focus on the last category.

### Results

As regards fatalities, there was one fatal accident in 1960. The death was a result of an accident, not illness, and limited information on the case is available.

As regards major surgical operations, the equipment at Syowa Station is of a standard for operations under general anaesthesia. The surgical operations were for appendectomy, which had been successfully performed twice for the two appendicitis cases.

As regards medical evacuations from Syowa Stations, JARE has experienced medical evacuations four times. Table 3 summarises each of the four medical evacuations:

Case	Date of medical incident	Site of occurrence	Method of patient extraction from site			Arrival in Japan	Time taken
			Ship	Local aircraft	–		
1	12 Nov. 1984	Inland	Ship	Local aircraft	–	Mar. 1985	4 months
2	13 Jan. 1989	Inland	Ship	Local aircraft	–	6 Feb. 1989	25 days
3	3 Dec. 1997	Station	Ship	-	–	Feb. 1998	2 months
4	8 Jan. 2005	Inland	–	Local aircraft	Inter-continental aircraft	14 Jan. 2005	6 days

Table 3: Summary of medical evacuations from JARE.

The patient in case 1 was a hit by snow vehicle at an inland base. The patient was sent Syowa Station with local aircraft. Upon examination, a pelvic fracture and urethral injury were revealed. Complete rest was needed for three months, then the icebreaker

*Shirase* arrived to evacuate the patient, who returned to Japan four months after the accident.

The patients in case 2 were involved in a snow vehicle plunge into a crevasse, and three personnel were injured at the same time. Diagnosis included femoral bone fracture, costal fracture and neck injury, and bruising to the whole body. The icebreaker *Shirase* had departed the station and was on the return journey north, but voyaged back to the station to pick them up, with transfer by way of helicopter. Once the patients were transferred to the ship, *Shirase* headed to Cape Town, South Africa. Subsequently, they arrived in Japan 25 days after the accident, where further treatments, including surgery, were performed.

The patient in case 3 had acute renal failure. In that case, the icebreaker *Shirase* was in Australia. *Shirase* departed and headed to Syowa Station immediately upon receiving the news. It needed two weeks to travel to Syowa Station and two months to come back to Japan via Cape Town, South Africa.

The patient in case 4 experienced cardiac failure at Dome F (Dome Fuji). This was our first case in which we applied aeroplane evacuation. The patient was taken from Dome F to a coastal station, then was sent to Cape Town, South Africa, and arrived back in Japan on 14 January 2005. Because of the severe nature of the medical condition, and given the use of an intercontinental aircraft that was available, it took only six days to transport the patient from Dome F back to Japan to receive further medical treatment (Figure 3).



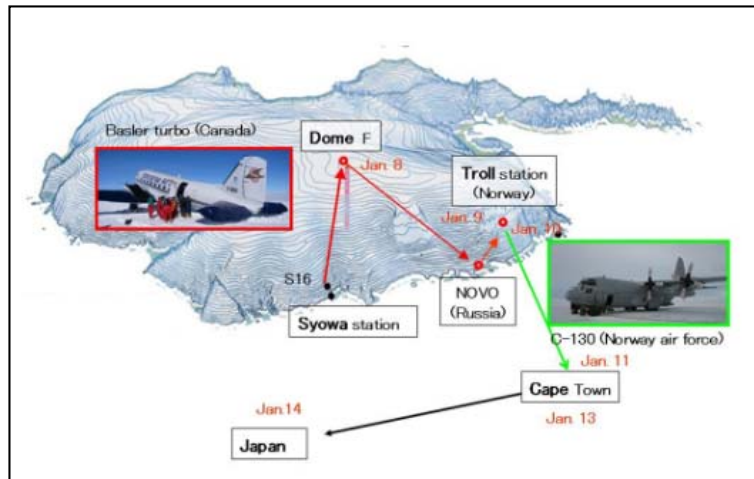


Figure 3: Graphic illustrating the route used for Case 4 medical evacuation.

### Discussion

We had made two separate surveys of severe cases at other Antarctic stations. The winter-over doctor at Syowa Station in 2000, Dr Giichiro Ohno, surveyed and received replies from 14 other Antarctic stations. And in 2005, the winter-over doctor at Syowa Station, Dr Hasegawa, surveyed and received answers from 18 Antarctic stations.

The results of the surveys are summarised in Table 4. In the Ohno survey results there were 76 fatal cases reported, with 72% of these being from accidents, including aircraft accidents, and 9% from illness/disease, principally cardiac-related disease. The survey responses indicated that operations were performed for appendicitis and bone fractures. In the Hasegawa survey, results indicated there were a total of 23 evacuations for a range of conditions.

	<b>JARE</b>	<b>Ohno 2000</b>	<b>Hasegawa 2007</b>
	1708 persons	14 stations/ 10 nations	18 stations/ 13 nations
Fatal cases	1	76	18
Operations	2	Some	32
Evacuations	4	Some	23

*Table 4: Summary of two surveys in response to questionnaires sent to other winter-over Antarctic stations and comparison with JARE analysis.*

There is therefore a need to prepare for a range of diseases and illnesses. For this reason, in Japan a selection committee investigates candidates with strict medical criteria. Also, a medical control working group improves management systems and an Antarctic research project examines human biology contributing to health care. So, there are effectively three sections working on prevention of disease in the winter-over population even before the personnel are at the station.

A telehealth support system was discussed at the COMNAP Telemedicine Workshop 2015, Tromsø, Norway. Discussions showed such a system is effective and indispensable to Antarctic health care. In Japan, for Syowa Station, we have been using the system practically and have tried simulations from many fields of clinical cases. For example, in 2014 over the period from February through December, simulation training using the telemedicine system covered the topics of communication/technology capabilities; dental treatments; emergency contact management; orthopaedics; anaesthetic support for surgical operations; urological treatment; psychiatric, eye, ear, nose, and throat problems; and ultrasonographic diagnosis.

It should be also emphasised that the annual Asian workshop on Antarctic medicine is an important opportunity to share valuable experiences and information.

### **Conclusions**

There are four principle conclusions from this work: 1) It is recommended to make a data archive of all severe cases from all Antarctic stations; 2) It is clear that aeroplane evacuation is effective and timely if such transportation is available and possible; 3) An evacuation in the winter season is difficult under most circumstances; 4) It is important to accelerate collaboration between medical research and operational medicine.

# The Role of Technology in Antarctic Medicine

Abhijeet Bhatia<sup>a</sup> and Pradip Malhotra<sup>b</sup>  
[abhijeetbhatia77@gmail.com](mailto:abhijeetbhatia77@gmail.com)

<sup>a</sup>North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences (NEIGRIHMS) and 27<sup>th</sup> ISEA

<sup>b</sup>National Centre for Antarctic and Ocean Research (NCAOR)

## Introduction

Until the recent past, the model of health care delivery in Antarctica revolved around providing physicians and basic medical equipment and supplies to an expedition. Upgrades to such infrastructure can best be in the form of enhancing the skills of the polar physicians and providing them with optimal equipment. However, the demands of a physician's job in Antarctica are vastly different from those on the home country. Firstly, very few Antarctic programmes recruit paramedical staff. Therefore, the polar physician has to perform the role of doctor, nurse, radiographer, laboratory technician, electrocardiographer, pharmacist, physiotherapist, and clinical assistant. The USA's McMurdo Station is the only station to have a full complement of paramedical staff.<sup>1</sup>

Physicians are generally neither trained nor expected to perform such a wide spectrum of duties in the home country. This drawback is generally negated by pre-induction training in the form of modules for prospective polar physicians.

Secondly, there are no referral facilities available on the continent. Patients have to be managed at the station itself, even under the direst circumstances, within the resources available. Evacuation, if at all possible, requires a monumental, multinational effort, often at great risk to the rescuers and at a high cost. Therefore, the primary limitations are lack of technical expertise and specialist care.

Technology has taken technical expertise and specialists to the doorstep of Antarctic stations. Telemedicine is the foundation on which this next level of health care is built. Telemedicine is essentially exchange of medical information electronically. Since the technology is available, it should be used; especially keeping in view that medical staff and their skills cannot be increased significantly beyond a certain limit.

There are essentially five components of telemedicine that can be offered:

1. Telephonic conversations are the most widely used mode for seeking specialist opinion. This is usually the first line of communication with the specialist in an emergency setting.
2. Emails can be used to convey written and photographic/ videographic data on the patient. They are readily usable since no specialised hardware or software is required: a working Internet connection is essential and sufficient for this purpose. Higher bandwidths can enable transfer of images and videos.
3. Video-conferencing adds the visual dimension to the communication process with the specialist and thereby enables better exchange of patient-related information. The polar physician can be guided for various procedures using telemedicine.
4. Data transfer from diagnostic and monitoring equipment has enabled real-time assessment of a disease process and the patient's condition remotely. Settings of the equipment can be controlled remotely in some cases. This modality utilises two kinds of technology: store and forward (asynchronous), wherein the data can be stored and then sent online; and real-time (synchronous), wherein the data can be transmitted in real time from the instrument itself, which is connected to the Internet. This mode of data transmission is invaluable for radiology, dermatology, ophthalmology, otology, pathology, and dental consultations.

5. Remote access diagnosis and therapy can be used for endoscopies. This modality has not yet found applications in the Antarctic setting.

To enable a reliable and efficiently functioning telemedicine facility, it is essential to have a stable Internet connection with efficient use of bandwidth. A high bandwidth would facilitate real-time data transfer and video-conferencing.

#### **Remote patient monitoring**

Antarctic stations usually have one or two physicians. In a situation requiring constant monitoring of any patient, the polar physicians might be under tremendous stress due to inadequate sleep for a prolonged period. Using remote interactive devices, a patient's condition can be monitored in real time by professionals in their home country. The various parameters that can be monitored include blood pressure, pulse rate, body weight, blood sugar, ECG and SpO<sub>2</sub>. This system can be invaluable, keeping in mind that even paramedical support staff is not available at most stations.

#### **Telesonography**

Ultrasound devices are usually available at Antarctic stations. However, physicians may not be adequately trained in performing the procedure, and some may not be efficient at reading the images. Specialist help might be useful under such circumstances. In remote settings, ultrasounds are chiefly required for abdominal complaints. Images can be transmitted in real time or by store and forward. However, a robust bandwidth is essential for transmission of clear ultrasound images.

Focussed Assessment with Sonography in Trauma (FAST) scans are used for ultrasound of the abdomen in space stations. This technique involves training of personnel on spacecraft to take four standard views of the abdomen by ultrasound. The images are then transmitted to a specialist for assessment. The FAST scans have been proven to be a useful application in the hands of non-expert users on the International Space Station in a study by NASA.<sup>2</sup>

### **Electronic Patient Records**

Electronic Patient Records involves placing the complete health records of a patient online in a secure form for access by authorised medical practitioners and administrators at any access point. Data are stored in the form of text, images, videos, and graphs. Such records shorten the response time and simplify data processing. Electronic patient records are essential in Antarctic programmes because multiple personnel and organisations separated by great distances might require access to the data. Time might be lost in synchronising the data available at all access points.

Examples of medical devices enabling online data transfer are as follows:

1. Otoendoscopes and ophthalmoscopes with camera attachments enable storage of captured videos/photographs for onward transfer and for real-time data transfer.
2. Stethoscopes with attached/built-in microphones enable online transfer of auscultable examination findings.
3. Patient monitoring devices, as described in a separate section, enable remote monitoring of certain vital parameters.

### **Current status in various Antarctic stations**

The USA, which operates the largest Antarctic programme, has outsourced medical services to the University of Texas Medical Branch, which also provides telemedicine services. This outsourcing might be necessary considering the scale of operations undertaken. ARGONAUTA (Austral On-line Network for Medical Auditing and Tele-assistance) is a unique model for other Antarctic programmes to adopt. This was a collaborative effort between Argentina, Chile, Germany, and Italy, specifically aimed at providing telemedicine facilities at the stations of the respective countries. Under this arrangement, several nodes were built in Argentina, Chile, Germany, and Italy. Facilities in Antarctica primarily used the two nodes in South America. On demand, physicians in Germany and

Italy could become involved in the process of health care delivery. This infrastructure could also cater to the rural population in South America. This collaboration enabled establishment of infrastructure to become cost-effective and enabled optimum use of the available infrastructure.<sup>3</sup> The current status of ARGONAUTA is unknown.

In most of the other countries, the medical facilities, including telemedicine, are maintained by the managers of the national Antarctic programmes. Many of the Antarctic programmes have a separate medical unit. Two examples are the British Antarctic Survey Medical Unit (BASMU) and Polar Medical Unit of the Australian Antarctic Division.

#### **Success stories from Antarctica**

Japanese Antarctic Research Expeditions (JARE) have utilised various modes of communication for seeking expert medical advice since establishment of the Syowa Station, and teleconsultation is now a well-established part of health care delivery. In 2005–06, out of 185 medical consultations, 29 involved teleconsultations, and 34 such communications took place. This was soon after telecommunications switched over to International Telecommunications Satellite organisation (INTELSAT).<sup>4</sup> Similarly, the Australian National Research Expedition (ANARE) reported 400 telemedicine consultations among 9,000 medical consultations during a 10-year period, among an annual population of about 450.<sup>5</sup>

#### **Guarded applications**

Tele-endoscopy is an application of telemedicine that is fast gaining ground to provide the facility to populations residing in under-served areas. However, endoscopies are invasive procedures, and hence the procedure is to be performed only by trained endoscopists to ensure patient safety. Polar physicians may not be trained to perform unsupervised endoscopies. It is therefore not advisable currently to introduce tele-endoscopy services in Antarctic stations.



## Conclusions

Impediments to the efficient use of telemedicine systems in Antarctica, as in any remote community, include inadequate telecommunication facilities, lack of training, and absence of operating protocols. Limited interest may also hinder the successful implementation of telemedicine in such communities.

Telemedicine can be used to supplement the skills and training of polar physicians in Antarctic stations and provide the best possible health care system to the team. This would enable a more secure living experience on the frozen continent. After all, the age of exploration in Antarctica is long over. This is the age of scientific exploration. So let us use science optimally to provide the best possible health care to our friends in the southernmost end of the globe.

## References

1. University of Texas Medical Branch, UTMB Health, Centre of Polar Medical Operations. Working Together to Work Wonders [Internet]. Galveston: University of Texas Medical Branch at Galveston; c2016. Job Opportunities; [cited: 16 Aug 2016]. Available at: <https://www.utmb.edu/polar/joblisting.html>.
2. Sutherland JE, Sutphin D, Redican K, Rawlins F. Telesonography: foundations and future directions. *J Ultrasound Med.* 2011 Apr;30(4):517–22.
3. Quade G, Novotny J, Burde B, May F, Beck LE, Goldschmidt A. Worldwide telemedicine services based on distributed multimedia electronic patient records by using the second generation Web server hyperwave. *Proc AMIA Symp.* 1999:916–20.
4. Ohno G. Practical Results of Telemedicine System Between Antarctic Station and Japan. In: Grasczew G, Rakaowski R, editors. *Telemedicine Techniques and Applications.* Croatia: InTech; 2011. Available from: <http://www.intechopen.com/books/telemedicine-techniques-and-applications/practical-results-of-telemedicine-system-between-antarctic-station-and-japan>.
5. Nicogossian AE, Lugg DJ, Doarn CR. Civilian telemedicine in remote and extreme environments. In: Robert SHI, Laxminarayan S, Pattichis CS, editors. *M-Health: Emerging Mobile Health Systems.* New York: Springer US; c2006. p. 517–29.

# Changes of 25-OH-Vitamin D During Winter-Over at the German Antarctic Stations Neumayer II and III

Mathias Steinach<sup>a</sup>, Eberhard Kohlberg<sup>b</sup>, Martina Anna Maggioni<sup>a,c</sup>, Stefan Mendt<sup>a</sup>, Oliver Opatz<sup>a</sup>, Alexander Stahn<sup>a</sup>, Josefine Tiedemann<sup>a</sup>, and Hanns-Christian Gunga<sup>a</sup>  
[Eberhard.kohlberg@awi.de](mailto:Eberhard.kohlberg@awi.de)

<sup>a</sup>Center for Space Medicine and Extreme Environments Berlin, Institute for Physiology, Charité Universitätsmedizin Berlin

<sup>b</sup>Alfred Wegener Institute (AWI) for Polar and Marine Research

<sup>c</sup>Department of Biomedical Sciences for Health, Università degli Studi di Milano

## Introduction

Life and work of humans in high latitudes are often associated with adverse conditions such as very cold climate, changed circadian cycle, and altered exposure to ultraviolet (UV) light. In addition, extended human stays in Antarctic research stations may be associated with psychosocial isolation, sensory deprivation, and exhaustion. Polar regions receive less-intensive solar radiation because the sunlight hits the Earth at an oblique angle. In addition, the Antarctic climate is dominated by seasonal changes. Months of complete darkness during the Antarctic winter alternate with months of 24-hour bright daylight in the Antarctic summer. This has particular consequences on vitamin D homeostasis for humans residing there.

The collective term "vitamin D" (calciferol) combines vitamin D3 (cholecalciferol) and vitamin D2 (ergocalciferol). The formation of vitamin D in the human skin makes up to 95% of the vitamin D requirement, indicating the importance of adequate UV light for vitamin D formation. A photochemical conversion of the pro-vitamin D3 (7-dehydrocholesterol 7-DHC) by UV light of wavelengths 290–315 nm causes the formation of pre-vitamin D3,

which is converted to vitamin D<sub>3</sub> through thermal isomerisation. In the liver and kidneys the final activation steps to 1,25-dihydroxyvitamin D (calcitriol) are catalysed. 1,25-dihydroxyvitamin D has calcaemic and non-calcaemic effects. The former are to maintain the calcium and phosphate homeostasis through regulation of intestinal and renal calcium absorption, bone tissue calcification, and inhibition of parathyroid hormone. The latter serve to regulate cell growth and differentiation, to regulate immune function, to control the renin-angiotensin system, and to control muscular function, brain development, and mood. Positive effects of vitamin D have been shown on the nervous system, inhibition of diseases such as the metabolic syndrome, susceptibility to infection, and several types of cancer. Genetically low vitamin D serum concentrations seem to be associated with increased all-cause mortality. 25-OH-vitamin D serum concentration has been accepted and used as an accurate measure of a human's vitamin D content, which considers both intake from diet and skin production. Serum concentrations of 25-OH-vitamin D of at least 75 nmol/l have been shown to effectively prevent fractures and are seen by some authors as the lower limit to maintain health. Lower, more conservative thresholds of at least 50 nmol/l, have been introduced as being sufficient. Around one billion people worldwide are estimated to be vitamin D deficient. Wearing cold-protective clothing, shielding the skin for cultural or religious reasons, residence at high latitudes, and having dark skin pigmentation are known to increase the risk for vitamin D deficiency. Especially at higher latitudes, during local wintertime, vitamin D production requires longer exposure time to UV light or it ceases completely.

The German Antarctic research stations Georg-von-Neumayer II (Neumayer II) and III (Neumayer III), located at 70° 40' S, 08° 16' W, served as the site of the presented study. The aim of the study was to assess changes in 25-OH-vitamin D serum concentration in winter-over personnel of the stations for 13 months during a total of six campaigns, from 2007 to 2012. We hypothesised that vitamin D would be significantly decreased during the Antarctic winter.

Furthermore, we assessed whether these changes were affected by age, gender, baseline fat mass, baseline 25-OH-vitamin D serum concentration, and the type of inhabited station (station II was located below ground; station III was located above ground).

### **Methods and materials**

The crew of Neumayer II and III in the Antarctic winter consisted of employees from different fields and professions (meteorologists, chemists, geophysicists, electricians, engineers, computer technicians, a cook, and a medical doctor who also acted as commander of the crew). The members of each winter-over crew resided at the Antarctic station for 13 to 14 months (from November prior, to January after, the respective winter-over year). The recruitment and training of the crews was carried out by the Alfred Wegener Institute for Polar and Marine Research. Each winter-over season, nine adult crew-members of Caucasian descent lived and worked at the station. From a total of 54 participants of the six winter-over seasons, a total of 43 (28 men and 15 women) took part in the study. All of them gave their written informed consent. The study was approved by the local Ethics Committee at Charité Universitätsmedizin Berlin. All procedures were conducted in accordance with the Declaration of Helsinki regarding human subjects.

Adverse weather conditions during the darkness phase made it nearly impossible to reach the stations by aeroplane or snowmobile, which led to complete isolation of the inhabitants. The location of the research stations at 70° S determined the amount of sunshine that reached the surface: for a period of about 60 days around midwinter (21 June), virtually no sunlight reached locations at that latitude, while for another 30 days before and after that period the sunshine radiation was very low. This low level of sunshine led to a period of complete darkness between the end of April and the end of August. Less than 50 W/m<sup>2</sup> were measured between the beginning of April and the end of September, and less than 5 W/m<sup>2</sup> from the middle of May until the beginning of August. This also led to very low temperatures. At 12 p.m. the mean

ambient temperature at the Neumayer Stations between 2008 and 2011 ranged around  $-2.7 \pm 2.0^{\circ}\text{C}$  ( $n = 124$ ) and  $-25.2 \pm 7.2^{\circ}\text{C}$  ( $n = 124$ ) in January and July respectively.

Stations Neumayer II and III serve to gather data in aerial-chemical, geophysical, and meteorological investigations, and, since the beginning of 2000, also for medical and physiological studies. Neumayer II was located underground. Since February 2009, the new Neumayer Station III has been in operation. This is the first German Antarctic station that combines human stay and research on a platform above the ice surface with a garage built within ice. This station has the unique ability to lift itself up according to snow accumulation by the use of hydraulic technics attached to the supporting feet.

Anthropometric data of the study participants were gathered using standard equipment (medical scale and height meter, SECA, Germany), with the participants in minimal clothes. Baseline fat mass was determined using the bioelectrical impedance analysis (BIA 101, AKERN, Italy) according to Sun et al. (2003)<sup>1</sup> for campaigns 2007–2011, and the Whole Body Plethysmography (BODPOD, COSMED, USA) for campaign 2012. Both are established methods for determining body composition.

Venous blood samples were collected in the morning before breakfast and after an overnight fast as part of the crew's routine medical check-ups by the stations' physician, using SARSTEDT Monovettes for blood collection (SARSTEDT, Nümbrecht, Germany). The amount and frequency of blood collection varied between winter-over seasons, as a result of different operational constraints. Samples were dated then assigned to an appropriate time period for comparison even with the seasonal variations. 25-OH-Vitamin D was determined with the ELISA-method (IDS, Frankfurt/Main, Germany (Ref AC57F1)), standard values 47.7–144 nmol/l (male and female, 5<sup>th</sup> to 95<sup>th</sup> percentile). The intra- and inter-assay coefficient of variation (CV) ranged between 4.6% at 40.3 nmol/l and 8.7% at 132 nmol/l.

Descriptive data are reported as means and standard deviations (median and 25<sup>th</sup> and 75<sup>th</sup> percentile respectively for fat mass). Differences over time were assessed by one-way repeated measures ANOVA for all subjects, as well as separately for the two sexes. Holm-Šidák corrected post-hoc multiple comparison tests were conducted to track significant main effects. A quadratic curve was fitted to describe the change over time. In addition, a regression analysis was performed for the dependency of 25-OH-vitamin D serum concentrations on local daily sunlight radiation at noon averaged per two-week intervals measured in W/m<sup>2</sup> after compensation of the phase difference between these two parameters. For the purposes of categorising vitamin D insufficiency, rather conservative threshold values of > 50 nmol/l as sufficient, 25–50 nmol/l as insufficient, and < 25 nmol/l as deficient were used. Analysis of covariance (ANCOVA) and multiple linear correlation were performed, with 25-OH-vitamin D serum concentration during August–September and December–January being the dependent variable, and the parameters age (years), gender (male or female), fat mass (kg), 25-OH-vitamin D serum concentration at the first measurement (nmol/l) and inhabited Neumayer Station (II or III) being the covariates. All data were handled through Microsoft Excel Version 2007 (12.0.4518) and analysed using Systat SigmaPlot Version 12 (12.2.0.45) and 13 (13.0.0.83). A two-sided p-value of below 0.05 was considered to be an indicator for statistical significance.

## Results

We observed a decrease in 25-OH-vitamin D mean serum concentrations towards the months of complete darkness and a subsequent increase during the post-darkness period in both men and women. One-way RM ANOVA yielded significant results for all subjects ( $p < 0.001$ ), as well as for both male and female subjects separately ( $p < 0.001$ ). There were no differences between the sexes ( $p = 0.823$ ). The fitted quadratic regression curve follows the Eq (a):

(a)  $y = 0.108x^2 - 3.17x + 52.81, r = 0.490, r^2 = 0.240.$

The equation of the fitted quadratic curve confirms the gradual drop in 25-OH-vitamin D over time and its progressive increase towards the end of the campaign ( $p < 0.0001$ ). Regarding dependency of 25-OH-vitamin D serum concentration on local daily sunlight radiation at noon averaged over two-week intervals, we found a delay of the nadir of the fitted quadratic curve of the 25-OH-vitamin D serum concentrations compared with the nadir of a fitted quadratic curve of the local daily sunlight radiation of 5.4 weeks. A linear regression analysis after compensation of this phase-shift through respective advancement of the 25-OH-vitamin D serum concentrations yielded Eq (b):

(b)  $y = 0.039x + 29.48, r = 0.396, r^2 = 0.156.$

The equation confirms the positive relationship between averaged local daily sunlight radiation at noon and 25-OH-vitamin D serum concentrations measured 5.4 weeks later ( $p < 0.001$ ). The percentage of participants with deficient values increased towards the period of complete darkness, while the percentage of participants with sufficient values decreased. For example, in August none of the 27 subjects exhibited sufficient values: 66.7% showed insufficient values, and 33.3% showed deficient values. The percentage of deficient values decreased towards the end of the winter-over and the percentage of sufficient values increased. However, the percentages at the end of the winter-over did not reach the same values as at the beginning; in addition, none of the female subjects returned to sufficient values. Analysis of covariance revealed that only the covariate of baseline 25-OH-vitamin D serum concentration significantly affected the values of the dependent variable (25-OH-vitamin D serum concentration in August–September and December–January) ( $p < 0.001$ ). The other covariates did not significantly affect the 25-OH-vitamin D serum concentration in August–September and December–January: age ( $p = 0.068$ ), gender ( $p = 0.688$ ), baseline fat mass ( $p = 0.069$ ), and station inhabitance ( $p = 0.066$ ). Multiple linear regression models,

in which the baseline 25-OH-vitamin D serum concentration was the only significant predictor for the 25-OH-vitamin D serum concentration during both subsequent periods ( $p < 0.001$ ), explained 33% ( $p = 0.015$ ) and 42% ( $p = 0.022$ ) respectively of the variance of the 25-OH-vitamin D serum concentrations during August–September and December–January.

### **Discussion**

Our study confirms substantial decrements in 25-OH-vitamin D serum concentrations in those wintering-over in Antarctica. Interestingly, 25-OH-vitamin D started to decrease in March, despite the fact that at this time of the year in Antarctica the ambient sunlight still prevails. It is speculated that this decrease might be mostly due to indoor activities and to the clothing necessary for cold protection of the subjects, which blocks most of the UV radiation. The changes of 25-OH-vitamin D serum concentrations over time during the years 2007–2012 follow a pattern that can be described by a quadratic trend. This substantiates previous findings regarding the seasonality of 25-OH-vitamin D metabolism and its dependence on UV radiation. Both men and women showed a similar decrease in 25-OH-vitamin D serum concentrations. This is in accordance with previous findings. Furthermore, we observed no influence of age, whereas other studies did find age-related differences. This could be explained by the relatively young age of the participants in our study (the eldest being 60 years of age). Strikingly, no significant influence of residence in either station (Neumayer II or III) could be observed, which suggests similar conditions in both stations. This finding was rather unexpected given that Neumayer II was completely covered by ice, while Neumayer III is located above the surface. Most importantly, none of the subjects exhibited sufficient 25-OH-vitamin D serum concentrations during midwinter (August). Less than 25% of all participants exhibited sufficient values at the end of the winter-over period. Furthermore, it should be noted that a considerable proportion of the participants already started from low values at the beginning of the study: only 35.5% showed sufficient values then. The analysis of covariance and multiple



linear regression analysis revealed that the baseline values of 25-OH-vitamin D had significant influence on the values subsequently developed during the periods of complete darkness. Only the 25-OH-vitamin D serum concentration taken at the first measurement significantly affected subsequent concentrations as a covariant during August and September and at the end of the winter-over during December and January. This parameter was the only one to significantly predict the subsequent values during these periods.

Our findings give rise to the recommendation that, at remote research stations, such as Neumayer, vitamin D supplementation should be considered with doses higher than previously thought necessary, or the diet should be composed of foods naturally rich in vitamin D. Alternatively, artificial UV-B light sources might be implemented to increase the production of vitamin D in those wintering-over.

### **Reference**

1. Sun SS, Chumlea WC, Heymsfield SB, Lukaski HC, Schoeller D, Friedl K, et al. (2003) Development of bioelectrical impedance analysis prediction equations for body composition with the use of a multicomponent model for use in epidemiologic surveys. *Am J Clin Nutr* 77: 331–340.

# **Personality Characteristics and Training Programmes Useful for Better Adaptation During Winter-Over Expeditions to the Antarctic in Multicultural Groups: The Results of the Last 11 Missions at Concordia Station**

Denise G. Ferravante<sup>a</sup> and Paul LaForet<sup>b</sup>  
[denise.ferravante@enea.it](mailto:denise.ferravante@enea.it)

<sup>a</sup>Italian National Agency for New Technologies, Energy and Sustainable Economic Development-Antarctic Technical Unit (ENEA-UTA)

<sup>b</sup>French Polar Institute Paul-Emile Victor (IPEV)

This paper concerns the results of the recruitment processes and training programmes for the crews that took part in the last 11 expeditions (from 2004 to 2015) to Concordia Station. The winterers are multicultural groups in that they include both Italian and French people. They are selected and trained by Italian and French specialists through specific psychological tests and training methods.

In particular, we presented the results of some psychological tests we used for the aptitude evaluation of Italian subjects who had participated in the last 11 winter expeditions to Antarctica and who had remained in a confined environment for one year at Concordia Station.

For the Italian participants we utilised the Adjective Check List (ACL), together with other standardised tools: Eysenck Personality Inventory (EPI), Gordon Personal Profile Inventory (GPP-I), and the Rorschach Test. The results of the ACL and Rorschach Test were presented in order to identify the personality characteristics that are useful to better adaptation during winter-over expeditions.

The Adjective Check List by Gough and Heilbrun Jr is composed of 300 alphabetically listed adjectives and adjectival phrases

commonly used to describe a person's personality. Respondents are asked simply to check the adjectives they feel are descriptive of themselves. The test consists of 37 scales that provide a powerful assessment of personality: four validity scales, fifteen needs or wants scales by Henry A. Murray's theory of personality, five scales about Transactional Analysis theory, and nine achievement scales assessing attributes, potentialities, and role characteristics. For these scales, the standard scores are adjusted according to the number of items that are endorsed.

Administration time varies from 10 to 15 minutes. For the study, the Italian version of the ACL in terms of its linguistic and cultural equivalence, norms, factorial structure, reliability, and construct validity was used.

The results of the Rorschach Test, a well-known evaluation tool composed of 10 symmetric inkblots, were also presented. Among the most important indices for response interpretation, those for the following were identified: Productivity, Cognitive and Perceptual Organisation, Localisation, Contents, Reality, Affective, and Impulsivity.

Also presented were results of the debriefing of the Italian crew-members of one of the last three expeditions, made using ACL in addition to questionnaires and interviews. The objective was to identify whether there were differences between the results of the ACL tests carried out on the members of the crew before their stay in Antarctica and those made after. Of particular interest was to analyse which features were stable and which ones were modified. The group was composed of four subjects, who were tested during the selection process and again after they had come back to Italy.

In conclusion, a sample was presented of the Italian training programme for preparing wintering participants for better adaptation to the wintering mission.

# **Psychological Evaluation and Screening Pre-Deployment to Antarctica**

Marta Barbarito and Maria Laura Naveira  
[mbarbarito@dna.gov.ar](mailto:mbarbarito@dna.gov.ar) and [fcpsico@kennedy.edu.ar](mailto:fcpsico@kennedy.edu.ar)

National Antarctic Directorate (DNA)-Argentine Antarctic Institute (IAA)

## **Introduction**

The institution implementing the psychodiagnostic processes to evaluate the personnel who will perform the scientific work in the Argentine Antarctic stations is the National Antarctic Directorate together with the Argentine Antarctic Institute (DNA-IAA). Other organisations, such as the armed forces, perform similar processes for the logistics personnel, using a group of psychological tests.

## **Pre-deployment preparations**

There are ongoing exchanges between the psychologists of the institutions deploying personnel in Antarctica, with a view to establishing common criteria for the psychological tests and the preparation of model questionnaires to be used in the interviews for evaluation of personnel for wintering deployment. Criteria employed in psychological evaluation of scientific and support personnel for Antarctic expeditions are subject to updates in knowledge in the relevant fields: new technologies and, in particular, results obtained from the application of the evaluation techniques. The criteria used in the psychological evaluation of prospective staff to be deployed in Antarctica discriminates the adaptive resources in three different levels: the emotional integration and personal cognitive level, the group adaptation level, and the work-team integration level.

It is extremely important to ensure that the wintering personnel, who will be submitted to an extreme environment of isolation and confinement, are in an adequate psychological condition, in order

to lessen the possibility of circumstances that might create risks either for the individual or the rest of the group.

### **Indicators of unsuitability**

There are different indicators to determine unsuitability for participation in an Antarctic wintering. Among them we can mention the following:

- Going through a mourning process due to the recent passing of a loved one
- Divorce or a critical family situation
- Severe physical disease or psychological disorder
- Psychiatric hospitalisations
- Very symptomatic neurosis

Moreover, although not necessarily implying amendments to the procedures, we should consider the variations of skills in each group (especially in regards to the formal and informal leadership duties) and the different kinds of environments where they will perform duties (winter stations, summer stations, shelters, huts, camps, ships, etc.)

### **Techniques applied**

Currently, the techniques applied are the psychometric and the projective. Others could be family interviews and group interviews with the rest of the Antarctic crew. Additionally, group dynamics techniques may be used in order to promote group cohesion and the mutual knowledge of team members who are being selected for the different Antarctic stations.

The DNA-IAA psychodiagnostic processes aim to evaluate the personnel differences in main variables such as the following:

- The duration or phase of the campaign: in winter (CAI: Winter Antarctic Campaign), in summer (CAV: Summer Antarctic Campaign), or in the pre-summer campaign (PreCAV)
- The prior Antarctic experience of the applicants (“rookies” versus “veterans”)

The following is a proposal from DNA-IAA for psychological evaluation using its techniques. The techniques are not rigid; they may be subject to change. It would be interesting to receive contributions from, and to exchange proposals with, other countries, for mutual improvement.

The techniques used for members of the CAV (Summer Antarctic Campaign) are these:

First meeting (approximate length: two hours)

- 1) Semi-structured interview
- 2) Biographic questionnaire
- 3) Personality inventory MMPI-2

Second meeting (approximate length: two hours)

- 1) Sentence completion test (specific)
- 2) Holahan Test
- 3) HTP.Test
- 4) COPE questionnaire
- 5) Adjustment/non-adjustment questionnaire
- 6) Self-evaluation questionnaire

Third meeting (approximate length: one hour)

- 1) Final interview

In cases of personnel with prior Antarctic experience, MMPI-2 may be avoided since its validity extends between three and five years, thus allowing for the evaluation to be completed in just two meetings.

The same techniques are applied for members of the CAI (Winter Antarctic Campaign), but the general procedure is modified as follows:

- 1) The initial interview is longer and takes up the whole of the first meeting.
- 2) There are family interviews.
- 3) Once the personnel are selected, there are group interviews aimed to promote knowledge and cohesion in the group deployed to each of the bases.

A post-Antarctic campaign evaluation also takes place, consisting of an oral debriefing (interview) and a written debrief in the form of a specific enquires which include, COPE questionnaires, self-evaluation, and adaptation and non-adjustment questions. Occasionally, interviews are carried out on board ships during the redeployment to the original place of departure.

For those with formal leadership roles (Station Leaders, project leaders or scientific co-ordinators, and logistics personnel), we often add a final interview to discuss issues relating to their staff. The role of the Station Leader is of great importance, as the environment and group cohesion at the stations during the winter-over depend greatly on these people.

The Orcadas Argentine Antarctic Station has a telemedicine team, which can be used to determine different physiological parameters that are transmitted online to the corresponding medical centre. Its purpose is to provide the stress study as an additional tool towards the physical and psychological well-being of Antarctic workers.

### **Return behaviours**

The most common behaviours observed upon return from a wintering season are related to a lack of adaptation to family life and routine activities, which are more varied and intense than the usual monotony in the Antarctic stations. Other manifestations are a low tolerance to sensory stimuli such as lights, sounds, and smell. Frequently, redeployed Antarctic personnel undergo a process of self-perception of inner emptiness, because they have spent a whole year without direct contact with their families. If necessary, people who have symptoms of poor adaption to home life can be treated by psychologists or referred to other specialists.

The role of psychologists is essential in all the stages of the process of preparation and adjustment of Antarctic personnel. Their professional tasks include diagnosis when selecting the most suitable candidates, monitoring during the annual stay, and evaluation after deployment.

## **Bibliography**

Barbarito, M. (1998). El descongelamiento. [The defrosting] Technical Report DNA – IAA – Psychological Area - Buenos Aires.

Barbarito, M. (2007) Criterios y procedimientos para la evaluación y selección psicológicas de los integrantes de campañas antárticas de la argentina. [Criteria and procedures for the psychological evaluation and selection of the members of the Antarctic campaigns in Argentina] presentation RAPAL.

DNA-IAA, Coordinación de Ciencias de la Vida. (2005) Programa de Psicología Antártica, Grupos humanos en situaciones de aislamiento: Psicología Antártica. Buenos Aires: Ed Talleres Gráficos Dirección Nacional del Antártico.

Mocellin, J. , Suedfeld, P., Bernaldez, J. , Barbarito, M.(1990): Levels of anxiety in Polar Environments. *Journal of Environmental Psychology*, 11, 265–275, Academic Press Limited.

Muchnik E. & Seidmann S. (1988) Aislamiento y Soledad [Isolation and loneliness]. Buenos Aires, Argentina: Ed. Universitaria de Buenos Aires.

Naveira M., Barbarito M. (2016) Nadie sobrevive solo en la Antártida.[Nobody can survive alone in Antarctica] *Revista Borrromeo*, 7. (en prensa), Buenos Aires, Argentina: Ed. Facultad de Ciencias Psicológicas. Universidad Argentina John F. Kennedy.

Palinkas, L. A. (1992): Going to extremes. The cultural context of stress illness and coping in Antarctica, *Social Science and Medicine*, 35,651–664.

Palinkas, L.A., Houseal, M. (2000). Stages of change in mood and behavior during a winter in Antarctica. *Environment and Behavior* 32, 1: 128–141.

Suedfeld, P., & Weiss, K. (2000) Antarctica: natural laboratory and space analogue for psychological research. *Environment and Behavior* 32 No 1: 7–17.





# **How to Face the Winter-Over Challenge in Terms of Team Building and Training? The Approach of Alfred Wegener Institute**

Eberhard Kohlberg, Christine Wesche, Uwe Nixdorf, and Dirk Mengedoht  
[eberhard.kohlberg@awi.de](mailto:eberhard.kohlberg@awi.de)

Alfred Wegener Institute (AWI) Helmholtz Centre for Polar and Marine Research

## **Abstract**

For 36 years, the German national Antarctic programme of the Alfred Wegener Institute (AWI) has had experience with pre-deployment training for winter-over personnel. The wintering teams started in the 1980s with five people, but soon, after two years, the group was extended to nine persons. The nine person team is still the norm today. The team includes two geophysicists, one meteorologist, one atmospheric chemist, one medical doctor, one IT engineer, two other engineers, and one cook.

The first two teams went through a very simple structured training, only for a short period and mostly dealing with their future tasks. There was no real idea of team building prior to the deployment. The only training that focussed on team building and confidence-building measures was the mountain course starting in 1984 and still practised to the present day. It is also one of our most safety-related courses.

A first change in the training programme was made at the end of the 1990s. We developed a more detailed, structured, and specialised training concept, which includes courses for the entire team as well as separate ones for the different specialist areas, concerning science, technics, and medicine. Moreover, we change the programme, as some of the courses have been ineffective and we have added other more appropriate ones. The complete pre-deployment period in Bremerhaven takes three to five months,

from the beginning of August till mid-November, and focusses equally on team-building measures and training on the job. We do not have psychological tests for evaluation; our approach is to derive from the practical side to see how the team's interactions and working together develop.

At the beginning of this period everyone gets a detailed schedule listing all information on the training programme. This schedule is subdivided into courses for the entire team and special training on-the-job for engineers, scientists, and the medical doctor. The training system should also give the winter-over personnel the feeling of safety, which is also to be considered a main concern.

### **Practising team building and group dynamics as a whole**

The preparatory programme is started by a traditional "Icebreaker Meeting" in our warehouse, for participants to get to know each other right from the beginning. This can be considered as the first team-building measure. Team building means to get to know and better understand each other whilst living together in the same building and participating in special courses that promote collaboration in small groups. The participants learn more about the quirks of their colleagues and thus should be able to learn to react correctly. In order to implement this aim, some main team-building measures that we are focussing on must be pointed out.

During the last eight years the teams have lived together for the whole training period. From the first day of pre-deployment the whole team is accommodated in an apartment house in the manner of a flat-sharing community. This allows them to meet during the weekends and to develop a common spirit and solidarity, and even to start joint activities.

One of our most important courses in the sense of team building, confidence building, and development of group dynamics is the mountain course (Figure 1), which is held after a short induction seminar. The mountain course takes place in the Alps on glaciers,

and all participants stay in an alpine hut for about eight days. There they work together on safety and rescue on the ice, detached from their original tasks and professions.



*Figure 1: Pictures taken during the mountain course.*

The other very important pillar of team building is the intensive firefighting course (Figure 2) for five days. During both trainings the team members have to work in groups, and they can experience how group dynamics grow and can also build up trust in each other.



*Figure 2: The firefighting course takes place over five days.*

These courses are accompanied by a supervisor from AWI to see how the team members collaborate and accept each other. Afterwards, a critical individual follow-up is performed with every member of the future wintering team.

The third very essential team-building measure, which we started two years ago, is the training on conflict management and an accompanying coaching for the team during winter-over. This training is subdivided into three sections. The first section, a two-day seminar, takes place shortly after the mountain course and after the team has gained some first experiences. The second is in the middle of the pre-deployment period, just after the firefighting course; it is also a two-day seminar. The third section, close to the end of the preparatory period, is for only the Station Leader and his or her deputy. During the winter-over period all team members have the option to confidentially call the coach in case somebody needs support or advice.

**Training on the job**

Engineers, scientists, volunteers in the team, and the doctor receive training related to their particular jobs. Engineers have to be trained on a very wide spectrum of different systems.

Some volunteers in the group learn how to assist the doctor in the operating theatre or in the emergency room. The scientists are instructed in special scientific measuring methods and how to launch the daily balloon with radiosondes. The doctor goes to a hospital for internships in dentistry and anaesthesia.

**Conclusion**

During the preparatory period a very important policy of AWI is put in place to avoid problems during the isolation period. To allow for a team concluding during the pre-deployment training that one member is not a team player and is expected to cause serious problems during the winter-over, the team members can state whether they want to winter-over as the existing group or whether somebody has to leave. This decision can be made only by eight members unanimously.

Last but not least, to create a sense of togetherness, the group travels down to Antarctica and back as an entire team. The fact of arriving at the station together and identifying themselves as the new team unites the group into a coherent whole.

The entire preparatory period is a combination of team-building measures and getting familiar with the specialities of the different jobs and the special living conditions.

Our experience with the new structure of the training programme, and regular adjustments in response to latest requirements, have convinced us during the last 17 years of the programme's effectiveness.



# **The Limitations of Digital Communication when Dealing with a Medical Emergency in a Remote Location: Lessons Learned from Military and Antarctic Missions**

Nathalie Pattyn<sup>a,b,c</sup>, Pierre Neirinckx<sup>b</sup>, Peter Marquis<sup>c,d</sup>, Simon Horne<sup>c</sup>, and Anne Hicks<sup>c,d</sup>

[nathalie.pattyn@mil.be](mailto:nathalie.pattyn@mil.be)

<sup>a</sup>Belgium Royal Military Academy

<sup>b</sup>Belgium Military Hospital Queen Astrid

<sup>c</sup>British Antarctic Survey Medical Unit (BASMU)

<sup>d</sup>Plymouth Hospitals NHS Trust

The last decade has seen an exponential growth of the involvement of digital communication/systems in patient care. In isolated and remote environments, the development of robust and reliable telemedicine systems is a known area of research.

The COMNAP Telemedicine Workshop 2015 convened by the Joint (COMNAP and SCAR) Expert Group on Human Biology and Medicine was devoted to the topic and allowed national delegates to compare the different solutions available in the national Antarctic programmes.

However, the technological pull cannot deliver solutions without a conceptual push, and, too often, the terms "telehealth", "telemedicine", or "eHealth" create unrealistic expectations outside of the medical community – not only about available technologies, but also about medicine in general.

The purpose of the talk was to give operational actors a realistic overview of what can and cannot be realised in remote health care, based on practical issues encountered in the field. These served to illustrate the following points:



- Technology is not the issue.
- Medicine is not an exact science.
- Human communication between health care practitioners falls prey to the same traps as "normal" communication.
- The sole doctor in a remote site: can you do without?
- Feasible vs reliable.
- The skill fade issue.

# **First Aid and the Role of the Information and Communication Technologies (ICTs) in Critical Incidents**

Marta Barbarito and Maria Laura Naveira  
[mbarbarito@dna.gov.ar](mailto:mbarbarito@dna.gov.ar) and [fcpsico@kennedy.edu.ar](mailto:fcpsico@kennedy.edu.ar)

Dirección Nacional del Antártico (DNA)-Instituto Antártico Argentino (IAA)

Currently, the use of Information and Communication Technologies (ICTs) allows for real-time contact between Antarctic personnel and their families at home. E-communication allows personnel to try to handle difficult situations. These situations are called critical incidents (CI) because they are beyond the framework of regular events; they are sudden and unexpected, and they therefore disrupt or interfere with the sense of control, involving the perception of a threat to life and elements of emotional or physical loss. Critical incidents annul the psychic mechanisms used in everyday life. Because of this effect, they constitute a threat to the affected person's biological and psychological integrity.

Life in Antarctica is considered to be highly risky per se, with ever-present dangers. Critical incidents can occur, such as witnessing an accident or facing the death of a work partner who has suffered an accident, or when a certain required evacuation is unavailable. The Antarctic environment entails some risk of accidents, such as: disorientation or getting lost (in white-out conditions, at sea, or in other conditions), falls into crevasses, and accidents in landing boats, ships, or other vehicles. These disruptive situations cause stress, including collective stress if many are affected. Reactions may differ: some reactions to an incident may occur even after many days or weeks, and they can be physical, cognitive, and/or emotional.

In case of an occurrence of a situation of great significance or impact the Department of Psychology of the Dirección Nacional del

Antártico (DNA) recommends the complete redeployment of affected staff members, since continuation of the winter-over is a risk to the worker's biopsychosocial integrity. However, it should be noted that replacement of staff can sometimes prove to be difficult or even impossible.

Since 2015, psychologists of the DNA and of the armed forces providing logistics meet regularly in order to exchange experiences, standardise criteria, and make recommendations aimed at the well-being of those who work in Antarctic stations. Families of primary victims are also considered as victims of an event; therefore there is also a need to provide them with emotional support. There are specific support programmes for families in these situations, as on many occasions anxiety and anguish are caused by the fact that it can take some time for them to meet their relatives.

E-communication is used by Antarctic psychologists in order to provide assistance in cases of post-traumatic stress disorder (PTSD). It is estimated that 33% to 50% of the population exposed to a critical situation suffer some kind of psychological manifestation. Not every exposure event is traumatising on its own, as the reaction depends on length of exposure, social support, perception of threat, and self-control.

The human being has the capacity and the strength to take something positive out of extreme experiences. An early intervention will strengthen those resilience capacities. At this point, the importance of the role of the Antarctic psychologist becomes evident, as he or she can establish a link with the victims via the limited resources at hand (video calls such as Skype, email, Internet chats, and phone calls), while the victims await evacuation procedures or the arrival of first aid or medical assistance.

Research and experience with subjects exposed to critical incidents can provide many techniques to assist them through and after the event. There are techniques such as Defusing, originated in the

protocol by J. T. Mitchell, and consisting of informal and self-structured sessions immediately after the event, in which participants describe their feelings and develop strategies to enable them to continue with their everyday life at the stations and their usual activities. In case a psychologist cannot be present, it is possible to have these sessions by means of video calls, or to have them with Station Leaders with specific training.

The Debriefing, also created by Mitchell, is a highly structured intervention out of which many models were developed. It must take place within 24 to 72 hours of the event for optimal results. The objective is to rule out the effects of the stress after a critical incident and prevent possible psychopathological sequels. This would shorten the time of recovery for the average person experiencing normal reactions to abnormal events.

In order to provide first aid, Station Leaders and medical doctors have a basic guidance provided by Antarctic psychologists to use in case a PTSD or CI situation arises. This helps them to be prepared for this first period of emotional need of their co-workers. In the case of critical incidents in Antarctica, “lifeguards” are members of crews who could become involved emotionally in the success of the response, with feelings of identification and empathy. Professional lifeguards in other environments apply dissociation, a strategy in order to isolate an affected person’s feelings and to enable them to swiftly resume their duties. In Antarctica, this is not possible because of the closeness of the members of the group.

This affective involvement can lead to a situation of huge collective stress at the station, so it is recommended to act quickly with regard to the main people affected. E-communication provides a platform to address the sorrow and grief of these initial moments.

### **Bibliography**

Bárbara Alter (2015) Salud mental: Recomendaciones para la intervención ante situaciones de emergencias y desastres. [Mental health: Recommendations for

intervention facing situations of emergency and disaster] Ministerio de Salud de la Nación Argentina.

Barbarito, M. (1998). El descongelamiento. [The defrost] Technical Report DNA – IAA – Psychological Area - Buenos Aires.

Barbarito, M., Bortnik, R. (2001) Incidente Crítico Manual. [Critical Incident Manual]. Buenos Aires, Argentina: Publicación de la Dirección Nacional del Antártico.

Flanagan, J. The critical incident technique (1954) Psychological Bulletin, vol 54, 4, online: <https://www.apa.org/pubs/databases/psycinfo/cit-article.pdf>.

Mitchell JT. (1981) Crisis worker stress and burnout. In: Mitchell JT, Resnik HL, editors. Emergency Response to Crisis. Maryland: RJ Brady Co.

Naveira M., Barbarito M. (2016) Nadie sobrevive solo en la Antártida.[Nobody can survive alone in Antarctica] Revista Borrromeo, 7. (en prensa), Buenos Aires, Argentina: Ed. Facultad de Ciencias Psicológicas. Universidad Argentina John F. Kennedy.

Naveira, M. L. (2016) El quehacer del psicólogo y la cohesión grupal influidas por el uso de las TIC en las bases antárticas argentinas. TFI Licenciatura en Psicología, Buenos Aires Argentina: Facultad de Ciencias Psicológicas, Universidad Argentina John F. Kennedy.

Palinkas, L. A. (1992): Going to extremes. The cultural context of stress illness and coping in Antarctica, Social Science and Medicine, 35,651–664.

# A Major Winter-Over Challenge: Medevac Case Analysis in the Korean Antarctic Station over 28 Years

Eojin Yi  
[eojinkorea@gmail.com](mailto:eojinkorea@gmail.com)

Korea Polar Research Institute (KOPRI)

## Introduction

One of the biggest challenges facing the Antarctic station during the winter period is medical evacuation (medevac) in the case of emergency. Since its establishment in 1988, the Republic of Korea's Antarctic King Sejong Station (62° 13' S, 58° 47' W) has been operated by a winter-over team consisting of an average of 16 people each year. In cases of medevac, the patient is transferred from King Sejong Station to near the Chilean Frei Base using a helicopter or Zodiac boat, and subsequently transported to an intercontinental flight to Punta Arenas, Chile.

## Research method

We referred to the *Wintering-over Report of the Korea Antarctic Research Program at King Sejong Station*<sup>1</sup> and to medical records of the King Sejong Station clinic for 1988–2015, and we found some cases through interviews.

## Subject of analysis

In this study, we summarised and collected 19 cases (21 people) of medevac from the station in the past 28 years (1988–2015). This is 0.35% of the estimated total of 5,940 incidences of disease in the station clinic over that time period, and 0.042 case per person-year (0.67 case per 16 person-years). There was one fatal incident from exposure to a blizzard resulting in one death, and three cases of rescue (of seven people) and evacuation.

**General aspects**

All people involved in the 19 medevac cases were Korean nationals: 19 men and 2 women. Eighteen of them were winter-over personnel and three were summer season people. Ten people (including all three of the summer season people) were completely evacuated from Punta Arenas, Chile, to Korea; eleven were returned to King Sejong Station after successful treatment. Seventeen people suffered from a problem requiring surgery after a traumatic injury, while four were associated with a non-surgical problem.

**Ways to medevac**

All medevac cases were air evacuations using C-130, BAe-146, and/or Twin-Otter aircraft. The evacuation from the station was by a two-stage route: (1) several minutes by helicopter, or 0.5 to 1 hour by Zodiac boat, to Frei Base (10 km distance); and (2) an additional 2 to 2.5 hours by aircraft to Punta Arenas (1,200 km distance). Out of the seven winter cases, all but one was transported by helicopter to Frei Base (one injury occurred very near to Frei Base so helicopter transport was not required). The Zodiac boat transportation was used most often in the summer season (11 cases) and there was one snowmobile transport case across the sea ice early in summer.

**Morbidity**

Orthopaedic problems (nine cases) due to trauma constituted the highest proportion of the entire medevac cases. In addition, there were frostbite cases, burns, tooth fractures, eye problems, head trauma, gastritis, tuberculosis, and a decompression sickness case.

**Severity**

There were cases where the patient was completely transferred back to Korea. These cases were: ruptured lumbar disk herniation, open fracture of mid-phalanx, fracture of bilateral calcaneus, tooth fractures (two cases), blunt trauma of the chest, active pulmonary tuberculosis, decompression sickness, and bile reflux gastritis. The decision as to whether to completely evacuate the patient is

medical but also depends on the winter-over position and working ability rather than solely on disease severity.

### **Urgency**

There was only one case in which there was a need for emergency life-saving evacuation (< 24 hours): in July 1989, a patient with head trauma and in a semi-coma (~stupor) state was urgently evacuated. The others were rated as urgent to priority (delayed), and routine evacuations.

### **Winter challenges**

There were seven winter (April to September) medevacs: five orthopaedic, one neurosurgery, and one ophthalmic case. Six were associated with accidental trauma, and one eye problem (central serous chorioretinopathy) occurred spontaneously with unknown cause. Only one case (open phalangeal fracture) was transferred to Korea completely; the others came back to the station after treatment. There was one emergency medevac case and another six cases were urgent evacuation. The major challenge was the arranging of an aircraft, but others such as remoteness, darkness, cold harsh weather, and runway limitation seemed to be minor because of the geographical site of the King George Island where the King Sejong Station is located.

### **Comparison with other studies**

Evacuation statistics from McMurdo Station for three years (1998–2001) indicate there were over 10,000 cases of disease and 134 evacuations for those years, with 11 cases (8.2%) of the evacuations being emergency. The main causes of medevac were fracture, head injury, acute abdominal problems, and stroke and cardiovascular problems.<sup>2</sup> Another study, in 2005, surveying 11 Antarctic stations with a total of 23 evacuations, showed a high proportion of orthopaedic problems (11 cases), and three major causes for evacuations – surgery, internal medicine, dentistry (three cases each) – and another three minor causes: neurosurgery, urology, psychiatry (one case each).<sup>3</sup> In comparison with these studies' findings, the medevacs from King Sejong Station are less



frequent and the cases less severe than those from McMurdo Station (after correction of population), and the disease distribution is similar to that of the Japanese study.

### **Discussion and conclusion**

Since the system of medevac from Antarctica is directly related to the issue of the winter-over personnel's safety and lives, it is necessary to prepare for emergencies by case-specific scenarios, followed up with guidelines for each medevac step. These include first aid, awaiting medevac, and rapid transfer, to name a few. It is useful to share the case reports of medevac among the countries, to develop a management record with archiving, and to update the archive with real-time resources. It is also necessary to keep in mind the international air operation protocols and rules of medevac. Additionally, these things must be considered along with efforts such as pre-screening, safety training, and education in order to prevent these medevac situations occurring.

### **References**

1. Korea Polar Research Institute (KOPRI), The Wintering-over Report of the Korea Antarctic Research Program at King Sejong Station, annual report, 1<sup>st</sup>~28<sup>th</sup> (1988 to 2015).
2. G. H. Mills et al., Challenges of Air Medical Evacuation from Antarctica, *Air Medical Journal*, 27:6, 281–285, 2008.
3. Y. Hasegawa and K. Watanabe, International Comparative Study of Medical Service at Antarctic wintering-over stations, *Antarctic Record*, Vol. 51, No. 3, 251–257, 2007.

# **Use of E-Communication and its Psychological Influence on Winter-Over**

Marta Barbarito and Maria Laura Naveira  
[mbarbarito@dna.gov.ar](mailto:mbarbarito@dna.gov.ar) and [fcpsico@kennedy.edu.ar](mailto:fcpsico@kennedy.edu.ar)

Dirección Nacional del Antártico (DNA)-Instituto Antártico Argentino (IAA)

The Antarctic continent will be the setting for our analysis – because it is a hostile environment for human life and there is no native population. Human presence in Antarctica varies according to the resources of the Antarctic stations of the countries with ongoing Antarctic activities.

The Antarctic Psychology Programme at the Argentine Antarctic Institute (IAA), a scientific entity of the National Antarctic Directorate (DNA), has obtained clear evidence of the stress situations that winter-over volunteers must endure because of the Antarctic environment itself, without even considering personal issues and other situations that could arise during their stay.

For a long time, expeditioners have travelled to Antarctica, challenging the harshness of this natural environment without using communication technologies. The use of e-communication devices at the Argentine Antarctic stations has both positive and negative impacts, depending on the purpose and intensity of their use.

The crew is faced with environment restrictions since they will be spending the majority of their time in confined spaces. These environments will cause a sense of confinement, monotony, and a lack of privacy, and will force the crew to share activities with other members not necessarily selected by them. These are called Isolated Confinement Environments (ICE). We consider that the people subjected to ICE conditions may see and feel themselves benefited by the use of the new communication technologies, since

they allow for "reduction" of geographic distances and help to deal with the feeling of loneliness.

E-communication in Antarctica, however, is still dependent on the weather. Heavy storms affect Internet operation, and the only Information and Communication Technologies (ICT) left in these situations are the old ones, such as radio or satellite phones in a best-case scenario. The psychological impact on a winter-over population of it losing e-communication for a certain period of time must be taken into account. The crew must have the capacity to face these technical problems without generating further stressful situations.

The progress of e-communication has been changing in such a way that winter-over crews have contact with the rest of the world, including family and friends, as well as with people with which the relationship is strictly professional. One of the aspects that create most concern for people who decide to remain during a year or more at an Antarctic station is the fact that they have to be physically away from their family and affections. Because of that, they highlight the importance of being able to communicate more easily with family and friends, through the new communication technologies: via emails, chats, or video calls.

The use of ICTs allows for communication in a private manner, different to previous systems that existed in Antarctica, such as radio communication, which didn't provide much privacy for the wintering population, as the messages were transmitted to a radio operator and not person-to-person.

The ways of overcoming the effects of the geographical isolation and loneliness are going to be different for each person undergoing wintering effects, but they follow some common traits in current society with the use of new technologies of information and communications. The Antarctic worker can establish more intimate, frequent, and real relationships with family and friends. This modality helps to reduce some of the signs of Winter-Over

Syndrome (WOS) related specially to personal psychological manifestations, particularly those that are related to depression and anxiety. The use of technologies such as Skype is a clear example of technology that assists by shortening distances using a real-time communication.

On the other hand, an intense use of new communication technologies, especially Internet and mobile phones, may create withdrawal attitudes that could negatively influence the group cohesion, without helping achieve a good co-existence among the station's crew. The well-being of the group may see itself affected, and this situation could impact on the successful achievement of goals and on the group's performance.

Other problems detected are the occurrence of work accidents produced by a lack of attention because of the inappropriate use of e-communication, as it acts as a distraction. The alterations in the psychic function of attention, brought about by the intense use of technologies could affect work performance. Therefore, the excessive or intense use of the communications is potentially dangerous for the safety and efficiency of work.

The group cohesion is a fundamental factor to be achieved and it helps the adaptation of the crew to the Antarctic environment. It has two distinctive slopes. The first one is related to the affective-emotional aspects that help develop the feeling of belonging to the station crew, and the second one is related to the aspects of fulfilment with employment goals and efficiency in the performance of assigned tasks. Therefore, attention must be given to people who prefer to dedicate more time to e-communication – which generate self-exclusion behaviours – than to face-to-face contact with other crew members.

The use of e-communication in emergency scenarios for an individual or a group event helps the resolution of a critical situation. The psychologists of the Argentine Antarctic programme are the ones in charge of intervening and providing support in such

situations, whether via communications with the Station Leader acting as a nexus, or by having direct contact with the members of the crew.

The psychologists who are specialised in Antarctic subjects will give their assistance when the circumstances require it, as they are prepared to give long-distance advice, using ICT, especially through smart phone and Internet. With these tools, they will have to assess the situations, and either by written or oral means they will need to address them.

It is extremely important for the winter-over crew to be in proper psychological conditions, in order to minimise chances that there may be circumstances that put themselves or the rest of the group at risk, as they will be exposed to an extremely confined and lonely environment.

The Antarctic Psychology Programme of the IAA has been developing an investigation project, with online and self-administered questionnaires. This allows for faster data gathering, without needing the presence of an expert. One of the investigation lines is about the relationship between e-communication and group cohesion, and e-communication's influence on adaptation to the Antarctic environment.

The use or abuse given of these types of technologies depends on the individual subjective opinion of each person, and their tendency to addictive or abusive behaviours. Similar to the rest of postmodern society, Antarctic workers are involved in a culture of speed and excess that could become deeper in this continent because of the extreme isolation.

In current societies, relationships, such as with family, co-workers, and other social groups, that demand high amounts of energy, might weaken as a result of compulsive virtual communications. This compulsion to constantly get information has been recently named by psychiatrists "Compulsive Online Disorder". The people

affected by this disorder of watching television, browsing the Internet, and checking voice messages, will suffer alterations of memory, attention, concentration, productivity, and creativity.

The arrival of the ICTs has presented, both for the winter-over crews and for the psychologists, new challenges that will influence the selection of the staff (with regard to personality profile), and will require leadership to prevent excessive employment of e-communication such that it interferes with the consolidation of the integration of the group, thereby reducing the emergence of interpersonal conflicts among crew members.

### **Bibliography**

Barbarito M., Peri A., Peri M. (2014) Consideraciones teóricas para la construcción de un cuestionario exploratorio en el manejo del tiempo en los medios ambientes extremos. *Revista Borrromeo*, 5. Facultad de Ciencias Psicológicas. Universidad Argentina John F. Kennedy.

Bauman, Z. (2000/2015) *Modernidad líquida* (15ª Reimpresión). Buenos Aires, Argentina: Ed. Fondo de la cultura económica.

DNA-IAA, Coordinación de Ciencias de la Vida. (2005) Programa de Psicología Antártica, Grupos humanos en situaciones de aislamiento: *Psicología Antártica*. Buenos Aires: Ed Talleres Gráficos Dirección Nacional del Antártico.

Naveira M., Barbarito M. (2016) Nadie sobrevive solo en la Antártida. [Nobody can survive alone in Antarctica] *Revista Borrromeo*, 7. (en prensa), Buenos Aires, Argentina: Ed. Facultad de Ciencias Psicológicas. Universidad Argentina John F. Kennedy.

Naveira, M. L. (2016) El quehacer del psicólogo y la cohesión grupal influidas por el uso de las TIC en las bases antárticas argentinas. TFI Licenciatura en Psicología, Buenos Aires Argentina: Facultad de Ciencias Psicológicas, Universidad Argentina John F. Kennedy.

Lipovetsky, G. (1993) *La era del vacío*. Buenos Aires, Argentina: Ed. Anagrama.

Palinkas, L.A., Houseal, M. (2000). Stages of change in mood and behavior during a winter in Antarctica. *Environment and Behavior* 32, 1: 128–141.

Palinkas, L. A. (2007) Los efectos psicológicos de las expediciones polares. [The psychological effects of the polar expeditions] *The Lancet*, 9607, 153–163  
Downloaded on 9 October 2015 at:  
[http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(07\)61056-3/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(07)61056-3/fulltext).



# Yoga: A New Strategy to Facilitate Human Adaptation in Antarctica

B. Ragavendrasamy<sup>a</sup>, M. N. Ramesh<sup>a</sup>, N. K. Manjunath<sup>a</sup>, and S. Saini<sup>b</sup>  
[ragavendrasamy.b@gmail.com](mailto:ragavendrasamy.b@gmail.com)

<sup>a</sup>S-VYASA University, Bangalore

<sup>b</sup>National Centre for Antarctic and Oceanic Research (NCAOR)

## Introduction

Characteristics and determinants of human response to extreme environmental conditions prevailing in the Antarctic continent have interested psychologists and physiologists. The polar work group on expeditions to Antarctica is confined to capsule-like environments with lesser availability of resources, adverse weather conditions, and altered circadian rhythms. Scientific studies and observations conducted on humans travelling to Antarctica have revealed several changes in human physiology during stay and also after returning from Antarctica. These changes range from behavioural changes such as aggression and mood swings, to psychiatric problems such as depression. However, the most common perceived challenges by the members include impaired sleep, indigestion, constipation, and fatigue.

Also, in-depth studies have shown decreased immune responsiveness accompanied by an increase in circulating insulin, thyroid hormones, testosterone, cortisol, and pro-inflammatory cytokines. These pro-inflammatory cytokines act like general alerting systems affecting various systems in the body. Presence of these pro-inflammatory cytokines for longer periods in blood circulation is associated with incidence of several metabolic disorders. These factors, along with isolation, are likely to impose a state of physical and psychological stress in the expeditioners.

States of isolation might enhance the extent of repetitive negative thinking based on the personality of the individual. The mental



health of an individual at Antarctica has been identified to be associated with four distinct characteristics: diurnal rhythm, environment, social conditions, and salutogenesis. Depressed mood is inversely associated with the severity of the physical environment of the station: depressed mood has been understood to be less perceived by individuals seeking challenging experiences.<sup>1</sup>

### **Yoga**

Yoga is an ancient Indian science well known around the world for its potential physical and mental health benefits. Physical postures (asana), voluntarily regulated breathing (pranayama), and meditation have been very commonly practised in India over thousands of years to attain functional harmony between body and mind. Yoga practices are known to be beneficial despite individuals having associated pathology of obesity,<sup>2</sup> hypertension,<sup>3,4</sup> diabetes mellitus,<sup>5</sup> or cancer.<sup>6,7</sup>

Yoga practices in the long run are shown to reduce inflammation to below levels predicted by such key risk factors as age, abdominal adiposity, cardiorespiratory fitness, and depressive symptoms. Better inflammatory status is noticed in experienced yoga practitioners when compared with novices.<sup>8</sup> However, interestingly, even short-term yoga practice is helpful in reducing IL-6 and TNF- $\alpha$  and in increasing adiponectin levels in the plasma.<sup>9</sup> Also, the regular practice of yoga has been shown to improve overall antioxidant status and to maintain the antioxidant defence system in normal healthy volunteers.<sup>10</sup>

Negative emotions that are the cause for worry and a contributor to perseveration have been shown to reduce after a week of yoga practice.<sup>11</sup>

Insulin resistance, known as the central regulator of metabolic syndrome, has been shown to be overcome with yoga practices.<sup>12</sup> A meditation technique that involves aligning breath and body movement, has been shown to regulate immunity, metabolic rate,

and cell death by transcriptional regulation at genomic levels, emphasising the need for further studies to understand the uniqueness of yoga practices.<sup>13</sup> Yoga practices increase expressions of glutathione S-transferase enzyme and glutathione peroxidase, suggesting better free radical scavenging activity. Also, yoga practices have been shown to possess influence over antiapoptotic Cox-2, HSP-70, and human telomerase reverse transcriptase activities,<sup>14</sup> suggesting a possible role of yoga practices in adaptation and ageing processes.

The associated factors of sympathetic arousal, viz., inflammation,<sup>15</sup> increased cortisol, increased cytokine production, decreased quality of life,<sup>16</sup> increased blood pressure,<sup>17</sup> and hypercholesterolemia have been shown to be reduced with regular yoga practice. Even a short practice of guided relaxation has been shown to elicit a relaxation response, lowering sympathetic arousal and increasing the para-sympathetic activity.<sup>18</sup> Studies conducted on various yoga practices, including asana,<sup>19</sup> pranayama,<sup>20,21,22</sup> concentrated focussing (dharana), and dynamic meditation<sup>23</sup> have all shown that they regulate the autonomic system, shifting it towards parasympathetic predominance, along with many other potential health benefits.

The relation between sympathetic arousal and the immediate effect of yoga practices over the inflammatory biomarkers and immune expression is still unclear in extreme environmental conditions, necessitating a need for scientific understanding of the beneficial effects. The hypothalamus and the limbic system, which are intimately concerned with emotional expressions of fear, rage, and aggressiveness,<sup>24</sup> are inhibited with yoga practices,<sup>25</sup> indicating one of the probable roles of yoga in regulation of stress resistance. Diaphragmatic breathing correlates with reduced serum cortisol levels and lower oxidative stress levels.<sup>26</sup> Reduced free radicals and malondialdehyde, and increased glutathione<sup>27</sup> and super oxide dismutase,<sup>28</sup> which aid the combating of insulin resistance and maintain better pancreatic beta cell functioning, have been documented with yoga practices.

### **Application of yoga to facilitate adaptation in Antarctica**

Findings from the previous studies conducted on yoga practices suggest the possible role of yoga practices in restoring the homeostatic condition through reduction of allostatic load. It appears that yoga practices achieve beneficial effects irrespective of an individual's health status through enhancing stress resistance and decreasing the incongruence between psychology and physiology. Unlike any other science/system of wellness that exists, yoga is more personalised; i.e., the response produced by yoga practices depends upon the psycho-physiological state of an individual. For example, slow breathing practices increase the rate of metabolism in novices, whereas they decrease the rate of metabolism in experienced practitioners. In another observation, the same set of yoga practices has been helpful in addressing states of depression and aggression. The mechanisms underlying such personalised regulatory effects of yoga practices are less explored.

In an attempt to understand the personalised regulatory effect of yoga practices, a simple slow-breathing practice with breath awareness was administered at a rate of four breaths per minute to a group of four normotensive and hypotensive individuals with an age range of  $20 \pm 1.5$ , and cardiac haemodynamics and metabolism were monitored.

The findings of the study (Figures 1 and 2) indicate, following yoga practices, an increase in blood pressure and peripheral vascular resistance, and a reduction in heart rate and stroke volume, suggesting that the body selectively increases the vascular resistance to cope with the relaxation, while at the same time decreasing the physiological demand of the body.

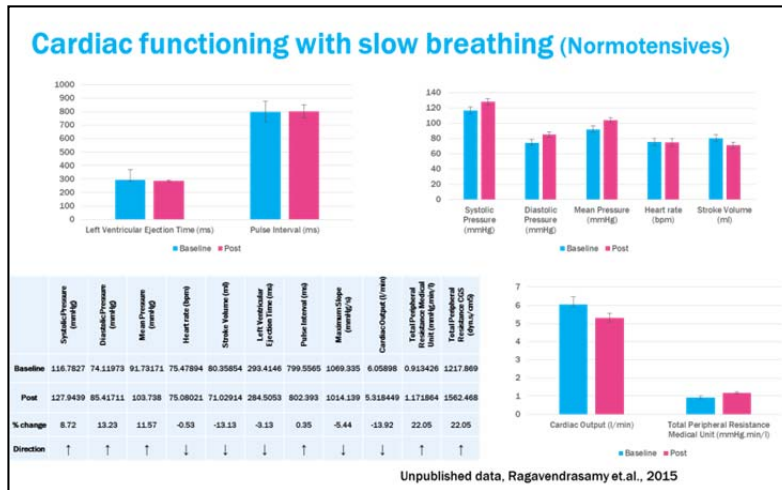


Figure 1: Cardiac functioning with slow breathing (normotensives).

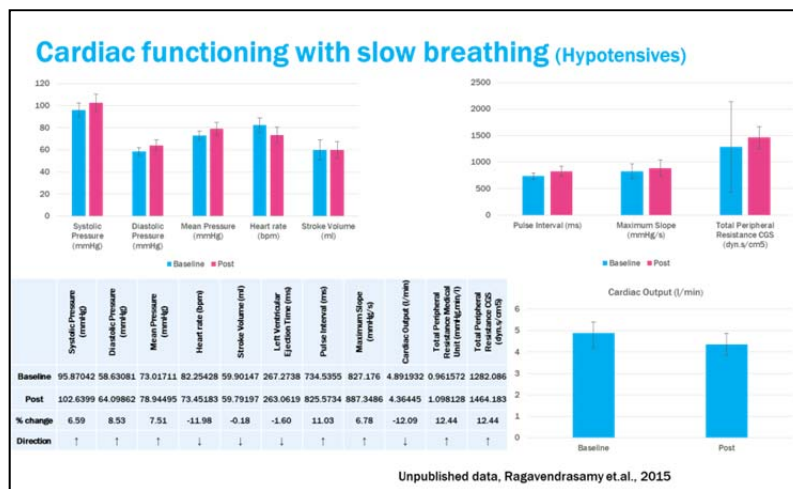
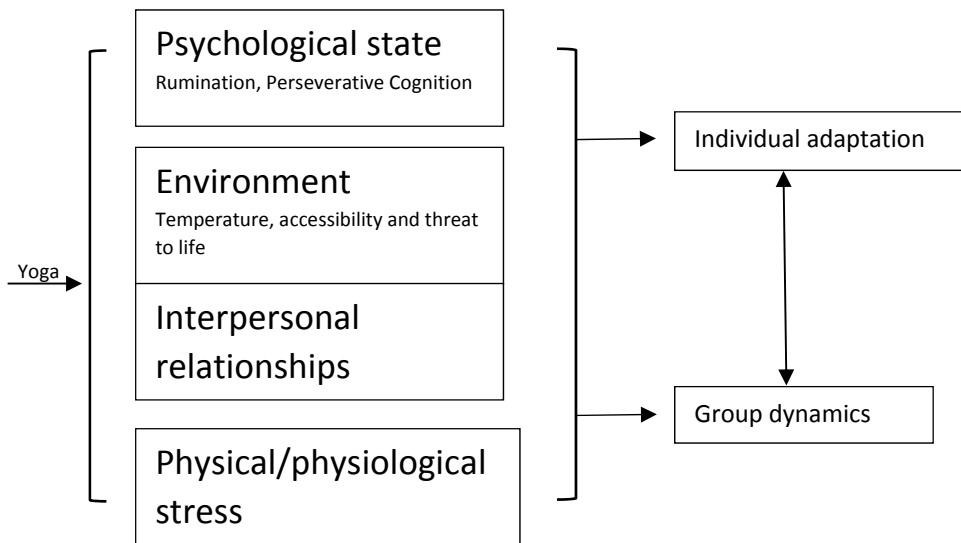


Figure 2: Cardiac functioning with slow breathing (hypotensives).

Yoga does not require high motivation, as the practice is usually done in groups. Regarding its social benefits for individuals residing in isolation, confinement, and extreme environmental conditions, yoga is expected to bring cohesiveness to the entire group and a

reduction in friction in interpersonal relationships, as a result of the regular informal interaction amongst members and the sense of perceived support due to group practice.



**Conclusion**

Yoga practices are understood to be capable of regulating both psychology and physiology, and of driving the inherent biological systems towards homeostasis. We hope that yoga practices might be a novel strategy that might be helpful in promoting cohesiveness of the expedition team, individual psychological well-being, and better physiological adaptation. Having offered the yoga intervention in the 35<sup>th</sup> Indian Scientific Expedition to Antarctica, the authors will have more information on its effects following completion of the biochemical assays.

**References**

1. Palinkas, L. A. (2003). The psychology of isolated and confined environments: Understanding human behavior in Antarctica. *American Psychologist*, 58(5), 353.
2. Jain SC; Uppal A; Bhatnagar SOD; Talukdar B, A study of response pattern of non-insulin dependent diabetics to yoga therapy. *Diabetes Research and clinical practice*, 1993, 19(1), 69–74.

3. Gokal R; Shillito L; Maharaj SR. Positive impact of yoga and pranayam on obesity, hypertension, blood sugar, and cholesterol: A pilot assessment, *The Journal of Alternative and Complementary Medicine*, 2007, 13(10); 1056–1058.
4. Patel C; North WRS, Randomised controlled trial of yoga and bio-feedback in management of hypertension, *The Lancet*, 1975, 306(7925); 93–95.
5. Bijlani RL; Vempati RP; Yadav RK; Ray RB; Gupta V; Sharma R; et al., A brief but comprehensive lifestyle education program based on yoga reduces risk factors for cardiovascular disease and diabetes mellitus, *Journal of Alternative & Complementary Medicine*, 2005, 11(2), 267–274.
6. Nicole Culos-Reed S; Carlson LE; Daroux LM; Hately-Aldous S, A pilot study of yoga for breast cancer survivors: physical and psychological benefits, *Psycho-Oncology*, 2006, 15(10); 891–897.
7. Banerjee B; Vadiraj HS; Ram A; Rao R; Jayapal M; Gopinath KS; et al., Effects of an integrated yoga program in modulating psychological stress and radiation-induced genotoxic stress in breast cancer patients undergoing radiotherapy, *Integrative cancer therapies*, 2007, 6(3); 242–250.
8. Kiecolt-Glaser, J. K., Christian, L., Preston, H., Houts, C. R., Malarkey, W. B., Emery, C. F., & Glaser, R. (2010). Stress, inflammation, and yoga practice. *Psychosomatic medicine*, 72(2), 113–121.
9. Packard, C., Bezlyak, V., McLean, J., Batty, G. D., Ford, I., Burns, H., ... & Tannahill, C. (2011). Early life socioeconomic adversity is associated in adult life with chronic inflammation, carotid atherosclerosis, poorer lung function and decreased cognitive performance: a cross-sectional, population-based study. *BMC public health*, 11(1), 42.
10. Sinha, S., Singh, S. N., Monga, Y. P., & Ray, U. S. (2007). Improvement of glutathione and total antioxidant status with yoga. *The Journal of Alternative and Complementary Medicine*, 13(10), 1085–1090.
11. Narasimhan, L., Nagarathna, R., & Nagendra, H. R. (2011). Effect of integrated yogic practices on positive and negative emotions in healthy adults. *International Journal of Yoga*, 4(1), 13.
12. NAGARATHNA, R., RAJ, T., THOMAS, T., & Plw, M. V. A. Z. (2008). Insulin sensitivity and cardiac autonomic function in young male practitioners of yoga. *National Medical Journal of India*, 21(5).
13. Li QZ; Li P; Garcia GE; Johnson RJ; Feng L, Genomic profiling of neutrophil transcripts in Asian Qigong practitioners: a pilot study in gene regulation by mind-body interaction, *Journal of Alternative and Complementary Medicine*, 2005, 11(1); 29–39.
14. Himani S; Palika D; Archana S; Sudip S; Narendra KB; Vinod K; Neeta S, Gene expression profiling in practitioners of Sudarshan Kriya, *Journal of Psychosomatic Research*, 2008, 64; 213–218.
15. Black DS, Cole SW, Irwin MR, Breen E, St Cyr NM, Nazarian N, Khalsa DS, Lavretsky H., Yogic meditation reverses NF-κB and IRF-related transcriptome dynamics in leukocytes of family dementia caregivers in a randomized controlled trial. *Psychoneuroendocrinology*. 2012 Jul 13. [Epub ahead of print].
16. Jyotsna VP, Joshi A, Ambekar S, Kumar N, Dhawan A, Sreenivas V. Comprehensive yogic breathing program improves quality of life in patients with diabetes. *Indian J Endocrinol Metab*. 2012 May;16(3):423–8.
17. Okonta NR. Does yoga therapy reduce blood pressure in patients with hypertension?: an integrative review. *Holist Nurs Pract*. 2012 May–Jun;26(3):137–41.

18. Melville GW, Chang D, Colagiuri B, Marshall PW, Cheema BS. Fifteen minutes of chair-based yoga postures or guided meditation performed in the office can elicit a relaxation response. *Evid Based Complement Alternat Med.* 2012;2012:501986. Epub 2012 Jan 16.
19. Manjunath, N. K., and Telles, S. (2003). Effect of sirsasana (head stand) practice on autonomic and respiratory variables. *Indian Journal of Physiology and Pharmacology*, 47(1): 34–42.
20. Raghuraj, P., and Telles, S. (2008). Immediate effect of specific nostril manipulating yoga breathing practices on autonomic and respiratory variables. *Applied Psychophysiology and Biofeedback*, 33(2): 65–75.
21. Raghuraj, P., and Telles, S. (2003). Effect of yoga-based and forced uninostril breathing on the autonomic nervous system. *Perceptual and Motor Skills*, 96: 79–80.
22. Telles, S., Raghuraj, P., Arankalle, D., and Naveen, K. V. (2008). Immediate effect of high-frequency yoga breathing on attention. *Indian Journal of Medical Sciences*, 62(1): 20–22.
23. Patra, S., and Telles, S. (2010). Heart rate variability during sleep following the practice of cyclic meditation and supine rest. *Applied Psychophysiology and Biofeedback*, 35(2):135–40.
24. Rothuizen J; Reul JM; Rijnberk A; Mol JA; de Kloet ER, Aging and the hypothalamus-pituitary-adrenocortical axis, with special reference to the dog, *Acta Endocrinologia (Copenhagen)*, 1991, 125 Suppl (1); 73–76.
25. Arora S, Bhattacharjee J, Modulation of immune responses in stress by Yoga, 2008, 1(2); 45–55.
26. Martarelli D; Cocchioni M; Scuri S; Pompei P, Diaphragmatic breathing reduces exercise-induced oxidative stress, *Evidence Based Complementary and Alternative Medicine*, 2011, 2011:932430.
27. Hegde SV; Adhikari P; Kotian S; Pinto VJ; D'Souza S; D'Souza V, Effect of 3-month yoga on oxidative stress in type 2 diabetes with or without complications: a controlled clinical trial, *Diabetes Care*, 2011, 34(10); 2208–2210.
28. Bhattacharya S; Pandey US; Verma NS, Improvement in oxidative status with yogic breathing in young healthy males. *Indian Journal of Physiology and Pharmacology*, 2002, 46(3); 349–354.

## **Safety Expertise Support from the Korean Government for the Winter-Over Party**

Wonjun Kim  
[wjkim@kopri.re.kr](mailto:wjkim@kopri.re.kr)

Korea Polar Research Institute (KOPRI)

The safety of personnel in Antarctica is the most critical issue for all national Antarctic programmes, as well as one of the winter-over challenges. An accident or incident during the winter-over season could cause loss of life, as well as having a negative effect on the stable operations of a research station.

In this presentation, KOPRI shared its experience and learnings from an accident in 2003 at its King Sejong Station. After the accident, a review of the safety system at the station was conducted by the Korean Government.

As a follow-up on actions as a result of the review, the Korean Government decided to deploy safety expertise under the collaboration of the Korean Navy and the Korean Coast Guard as part of the winter-over party of King Sejong Station from 2006 onwards. For the past 12 years, this safety expertise has played a key role of supporting marine-based research activities, such as diving, and related research activities, and of setting up guidelines for any marine-based activities of the winter-over party as well. This has been a successful arrangement, with many lessons learned.





# **When the Lights Go Out: Challenges, Strategies, and Management During Wintertime Incidents**

Tim Stockings, John Hall, Simon Garrod, and John Eager  
[t.stockings@bas.ac.uk](mailto:t.stockings@bas.ac.uk)

British Antarctic Survey (BAS)

On the 30 July 2014 at 13:25, Halley 6 research station lost main power. The outside air temperature was -56°C. The station was in blackout with only emergency lighting. After 19 hours, minimal power was restored; however, it took a further four days for the winter-over team to restore full power to the station. Substantial damage to heating and sanitary systems was caused as temperatures inside the main building dropped to below -20°C.

On-station and back in the United Kingdom headquarters, emergency action plans were put into action. Emergency communications were effective and they enabled technical advice to be passed from the United Kingdom-based team to those on-station.

On-station the team restored power, opened up emergency accommodation and services, and protected the station infrastructure to ensure the station's ability to produce scientific output. No personnel were injured and the morale remained high throughout.

This incident and the recovery of the station to full capacity tested every aspect of the British Antarctic Survey (BAS) and challenged concepts of infrastructure, external and internal communications, and risk management and mitigation. This required collaboration between BAS, British Antarctic Survey Medical Unit (BASMU), external stakeholders, scientific collaborators, The Department of Business Innovation and Skills, and the Antarctic Logistics Centre International (ALCI).

Perhaps the greatest challenge of this was management of the team on-station: ensuring the safety of personnel – their physical and psychological well-being – and ensuring lines of communication remained open throughout the incident and beyond.

In November 2014, Halley 6 research station was restored to full scientific and operational capacity. Infrastructure and procedures are now more robust than ever, and training and planning are more intense and targeted as a result of lessons learned.

# Concordia: The Third Continental Station

Claire Le Calvez<sup>a</sup> and Gianluca Bianchi Fasani<sup>b</sup>  
[clecalvez@ipev.fr](mailto:clecalvez@ipev.fr)

<sup>a</sup>French Polar Institute Paul-Emile Victor (IPEV)

<sup>b</sup>Italian National Agency for New Technologies, Energy and Sustainable Economic Development-Antarctic Technical Unit (ENEA-UTA)

## Location and brief station description

The French Polar Institute (IPEV) and its Italian counterpart ENEA-UTA are partners in the installation at Dome C (Figure 1) of the permanent research station Concordia.

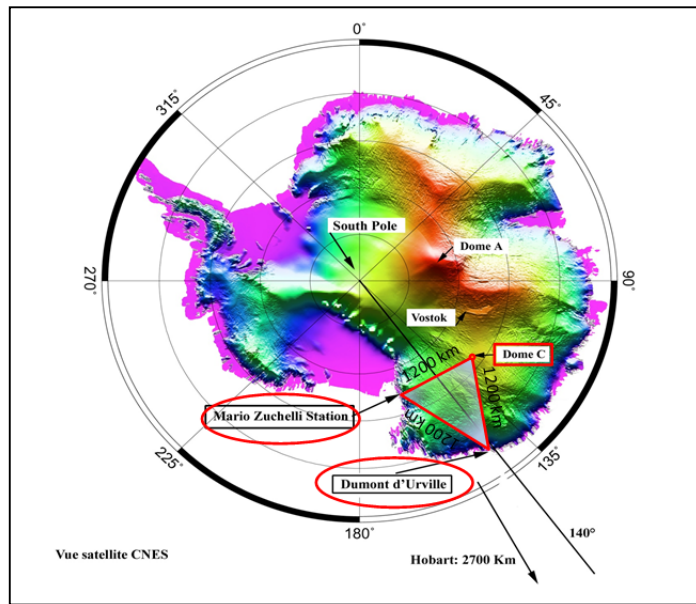


Figure 1: Map of Antarctica showing relative location of Dome C.

Dome C is located at 75° 06' S and 123° 23' E: at about 1,000 kilometres from the coast, 1,120 kilometres from France's Dumont d'Urville Station, 600 kilometres from Russia's Vostok Station, and about 1,200 kilometres from Italy's Mario Zucchelli Station. Dome C has an altitude of 3,260 metres. Meteorological conditions are characterised by low temperatures, low wind speeds, and low precipitation, with an average of 4 centimetres of snow per year. There is a permanent night from beginning of May until the beginning of August every year.

Concordia Station has an average population in summer of around 65 to 70 persons. In winter, only 13 to 15 persons stay on-site, isolated for nine months.

Figure 2 shows a top view of the station, outlining the main areas of activities: the main station; the science laboratories and shelters, which are disseminated mainly in an area 1 kilometre away from the main station in an area called the astronomy area; and the summer camp with the EPICA drilling camp.

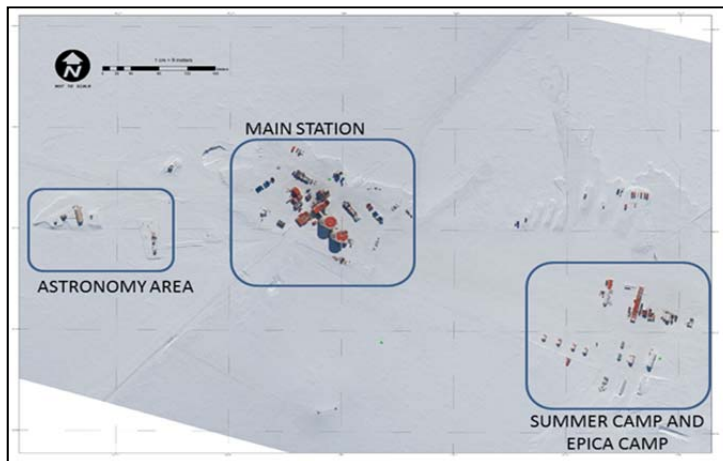


Figure 2: An aerial view of Concordia Station.

The main station is composed of three buildings (Figure 3): a technical area with the power station and water treatment; a noisy building with the restaurant, lounge, storage, and workshop; and a calm building with all the bedrooms, the hospital, and laboratories. In addition, on the technical platform there are other facilities, such as a VSAT shelter, a garage, a metal workshop, and a carpentry area.



Figure 3: Picture of the main buildings at Concordia Station.

### **Winter-over life at Concordia**

There are many external factors that will lead to constraints on organisation during the winter-over. Among them: it's high, it's very cold, it's dark, it's isolated, and it's a place of life and work for the winter crew. This will impact technical and safety matters and life and leisure organisation.

### **Technical point of view**

The heart of the station from a technical point of view is the power station, which produces electricity, heat, and water. The aim is to have a reliable power station over the winter period. There are three generators, but only one is running at a time. This allows for one generator to be on maintenance, and one ready to be started to any time. In addition to those three, there is an additional back-up generator in a separate building of the station.

It is obvious: redundancy is everywhere on all installations. For example, two boilers, by-passes everywhere, two pumps in parallel on circuit for water and fuel.

Moreover, we try to have a complete set of spare parts for everything (or almost!) because breakdowns will always happen where you did not plan for them. So you have to be very inventive and find solutions with the materials available on-site.

Water is produced from snow, which is melted thanks to the heat recovered from the generator (Figure 4). There is plenty of snow, and, if a generator is operating, there is plenty of heat, so water is not such a problem, except in the case of contamination, which has happened. The station also uses a recycling system for the grey water in order to reduce the need for producing too much “new” water.



Figure 4: The production of water from snow around Concordia Station.

The supply of the station is mainly done with the traverse from Dumont D’Urville Station on the coast to Concordia. There are three traverses in the summer period, which deliver over 500 tons of material: fuel, goods, food, and scientific material. The stocks of the station at the end of the summer, before the winter, have to be

enough for more than one year, in case problems occur the following summer.

The typical winter crew for Concordia Station is composed of 13 people (six Italian, six French, one other European), being one cook, one radio/telecom operator, six scientists, four technicians, one medical doctor. They are all specialists in their field of competences and the selection is done separately by the French and Italian organisations.

### Information and communication technologies

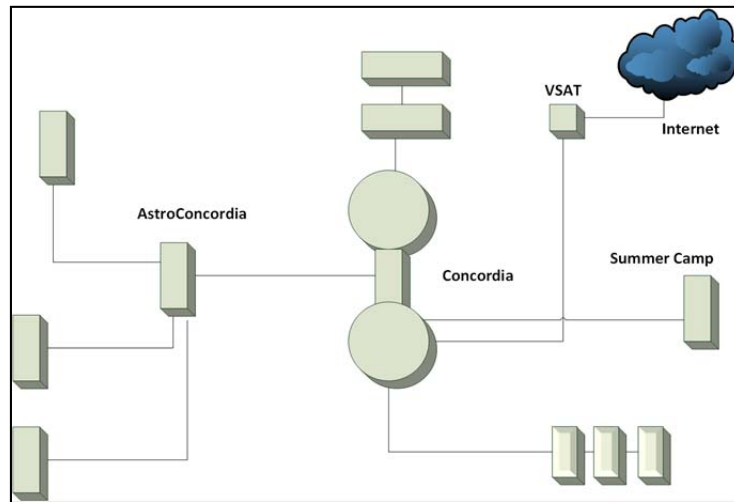


Figure 5: Schematic of LAN campus network.

Figure 5 shows a schematic of the LAN campus network. The external structures are connected to the station via fibre optic, Wi-Fi, and twisted pair cables. The VSAT is a 3.8 m diameter antenna pointing a satellite Itelsat GEO allowing a bi-directional data rate of 512 kbps. Inside the station there is a cloud system where all PC and mobile devices are connected. Various applications are available: database, storage, services to sciences, and



entertainment. Facilities available for external communications are email, VOIP, Skype and WhatsApp.

Radio communications are by way of the following:

- HF-Radio: two 150 W devices connected to two broadband antennas (8.245 MHz and 8.738 MHz). They allow communication with the other stations, in particular with Mario Zucchelli Station and Dumont d'Urville Station.
- VHF-Radio: two radio links (one analog and one digital) and a simplex channel allow connections between the station and the staff, aircraft, and vehicles in a range of 20 km. The digital channel allows for the tracking of personnel and vehicles.

Two fixed BGAN terminals are used for telephone communications and emergency if the VSAT is down. In addition, two fixed and two portable Iridium devices are available for emergency communications.

### **Health care system**

The medical area is equipped with an operating theatre, a dentist's chair, and radio facilities. In winter, there are two doctors (a doctor in charge and a research doctor), and a direct and dedicated link to the Policlinico Gemelli in Rome, Italy can be operated. A camera is installed on the scialytic lamp in the surgical area for telemedicine procedures and consultations. Psychological support is also available on request.

### **Winter-over crew**

The winter crew is selected by IPEV and ENEA-UTA from February to September in the year before the winter the crew is being chosen for. In September the crew are trained by IPEV and by ENEA-UTA, and they all meet for the first time in October, just before their departure for Antarctica. Depending on the needs of the winter-over team, each member can be trained to a specific topic, such as science experiments, water recycling, and vehicle driving.

Winter crew members arrive at various times during the summer and additional on-site training is given. The aim at the end of the summer is that each member of the winter crew is autonomous in his or her job and that all the emergency teams are operational.

One of the most important teams is the fire team. At Concordia Station, every member of the crew is in the fire team and each has a particular function. They are trained before their departure on the extinguishers and again immediately at their arrival on-site. In winter they do at least one fire exercise per month.

An emergency might require the evacuation of the station. In case the crew cannot use the standard stairs and doors, the station is equipped at each floor with a kind of "sock" or evacuation tube. By this means, it is very easy and safe to escape the station when necessary and also to evacuate any injured person from the station should the need arise. The strategy of any evacuation is to go to the summer camp, which is equipped with a power station and water distribution system. Exercises to evacuate and to open up the summer camp for use during a winter emergency are also held during wintertime.



## **Development of Telemedicine: A Substantial Contribution to Medical Safety During Winter-Over**

Eberhard Kohlberg, Christine Wesche, Uwe Nixdorf, and Dirk Mengedoht  
[eberhard.kohlberg@awi.de](mailto:eberhard.kohlberg@awi.de)

Alfred Wegener Institute (AWI) Helmholtz Centre for Polar and Marine Research

Alfred Wegener Institute (AWI) has been running a permanent research station in Antarctica for more than 35 years. From the very beginning great value has been placed on appropriate medical equipment for the hospital and optimal health care for the winter-over personnel. For a long time it has been the aim to use telemedicine in remote areas or on board vessels or on stations in Antarctica.

The hospital of the first Georg-von-Neumayer Station was very simple in comparison with today (Figure 1), but we have to consider that technology, communication technologies especially, have developed rapidly. As early as the 1980s, during the first winterings at the station, the question was raised of how to give support to the medical doctor from a hospital located in Germany in case of operations or emergency on the station. Electronic engineers developed a system that allowed the station to transmit television images in colour around the world with existing shortwave radio equipment at normal voice bandwidth or by Inmarsat.



Figure 1: Photos showing the medical facilities at the hospital originally at the Georg-von-Neumayer-Station (top) and the current hospital facilities at Neumayer Station III.

The system was called *Slow Scan Television (SSTV)* and was deployed to Neumayer Station in 1984. The existing Inmarsat connection was used for transmission. SSTV was probably the first remote diagnosis system via Inmarsat. It was also in use at the Indian Station Dakshin Gangotri.

The mode of operation was as follows: two still images were stored by the system and subsequently transmitted. During the very slow transmission no phone calls could be made. The fact that the images were not of really high resolution, and the interruptions due to technical faults during transmission, made the system not feasible for differentiated diagnosis. However, with the development of modern and fast communication technologies a practicable application became feasible. Modern and extended satellite links now enable the transfer of all vital parameters of a patient, including transmission of video and pictures.

The major question is, why establish such a complex system of telemedicine for Antarctic stations, as year-round stations normally have medical staff, including at least one medical doctor? During winter nearly all year-round stations are isolated for a long time: up to nine months. During this period, access to Antarctica is extremely limited and sometimes even impossible. Wintering-over teams are numerically small, meaning the number of medically trained staff is limited as well.

In addition to staff, from the technical point of view, the prerequisites for the medical equipment have to be in place. Various options for telemedicine require various equipment. The various options of telemedicine are *teleconsultation*, *telediagnosics*, *telemonitoring*, and *E-medicine*.

In the early days, telemedicine was limited mainly to teleconsultation via radio or phone, or telediagnosics by scans or pictures. Telemonitoring is a much more sophisticated system and requires more factors to be taken into consideration; e.g. stable communication systems, devices suitable for telemedicine, and compatible communication of the involved networks (station, institute, hospital).

For 10 years we have been running a telemedicine system between Neumayer Station and a collaborating and supporting hospital in Germany. Conditions required are availability 24 hours a day, 7

days a week, and the presence of all medical disciplines. The telemedical backup and monitoring in case of emergency and operations offer active support, in particular to younger doctors who may be less experienced.

We have two components for our real-time monitoring systems, which collect the haemodynamic, gas, and respiration data. These data are transmitted to Germany using a connection with an available bandwidth of 1–2 Mbit/s. A permanent satellite link connects Neumayer Station with AWI in Bremerhaven, and, also, with respect to medical issues it connects with the hospital there (Figure 2).

A monthly test of the telemedicine system is done between the station and the hospital's Intensive Care Unit to make sure that the system is working properly and in place for operations and emergencies.

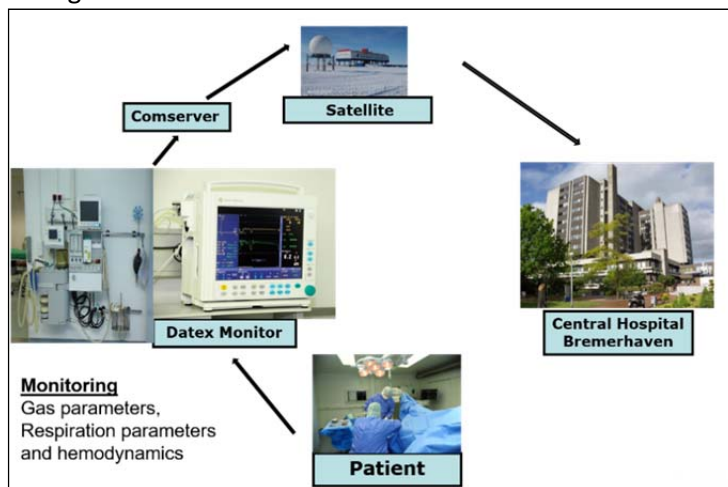


Figure 2: Schematic showing telemedicine linkages.

With expanded bandwidth becoming available at Neumayer Station, expanded expectations follow. At present, there is the ability to transmit ultrasound scans in real time to Germany to get advice from the hospital in critical cases.

In the season 2016–17 we will put into practice video laryngoscopy to get more anatomic information for the doctor on-site and to be guided during intubation by an anaesthesiologist in the hospital. The system as shown needs a bandwidth of 384 kbit/s for transmitting pictures with sufficient resolution.

Once the upgraded system is working, the main focus will be on telemonitoring and different devices for tediagnosis at summer stations and even during field activities and traverses. These different systems contribute to medical safety, in particular during the winter, assisting both the medical doctor on-site and persons responsible back in Germany.





# **Crevasse Detection for Safety Issues During the Antarctic Winter using High-Resolution Synthetic Aperture Radar (SAR) Imagery**

Christine Wesche, Eberhard Kohlberg, and Uwe Nixdorf  
[Christine.wesche@awi.de](mailto:Christine.wesche@awi.de)

Alfred Wegener Institute (AWI) Helmholtz Centre for Polar and Marine Research

## **Abstract**

The Synthetic Aperture Radar (SAR) imaging technique enables the mapping of the Earth's surface independent of weather and light conditions, which makes it a suitable instrument during Antarctic winters. Since the early 1990s, imaging radar techniques have been established in polar sciences. The imagery can be used to support Antarctic wintering staff; e.g. to detect crevasses or other surface features. To do so, the radar backscattering behaviour of homogeneous (undisturbed) and heterogeneous (crevassed) areas is used to map crevasse fields or ice edges. A semi-automatic technique of surface feature detection can help to process the data more rapidly. Nevertheless, an experienced observer is crucial in emergency cases.

## **SAR technique**

During recent decades, the SAR technique on spaceborn platforms has become increasingly available. The European Remote Sensing satellites (ERS-1 and -2) were the first satellites carrying a SAR system for semi-operational capabilities.<sup>1</sup> Since then, a variety of SAR sensors have been launched on satellites.

A SAR system belongs to the group of imaging radars and comprises a moving platform (satellite or aircraft) at a certain altitude, which carries a side-looking radar antenna. The radar antenna emits pulses of electromagnetic radiation to the Earth's surface. From the Earth's surface, the pulse is scattered back to the radar antenna,

where the residual radiation is received. The amount of backscattered radiation (backscattering coefficient) gives a first idea of the type of the Earth's surface, which was illuminated by the pulse. The big advantage of the SAR technique is the emission of microwave signals, which are unaffected by the cloud cover and the light conditions, making it a perfect tool during winter.

### SAR satellites (programmes)

Currently, five satellites (programmes) are scanning the Earth's surface (Figure 1). The German satellites TerraSAR-X and TanDEM-X are able to deliver images with a pixel size of up to 1 m; the same is true for COSMO-SkyMed (CONstellation of small Satellites for Mediterranean basin Observation), which is an Italian satellite programme consisting of four satellites. The Japan Aerospace Exploration Agency (JAXA) operates the ALOS-2 satellite, which delivers SAR images with up to 3 m pixel size. The RADARSAT-2 was launched on 14 December 2007 by the Canadian Space Agency, and it gives images with a maximum pixel size of 1 m. Within Europe's Copernicus programme of the European Space Agency (ESA) there are two radar satellites: Sentinel-1a (launched on 3 April 2014) and Sentinel-1b (launched on 25 April 2016).

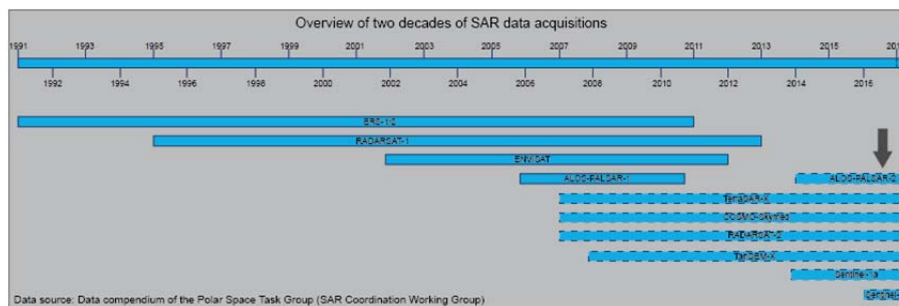


Figure 1: Overview of two decades of SAR data acquisitions. Solid bars represent completed programmes; dashed bars represent programmes in progress<sup>2</sup>.

Compared with the previously mentioned satellites, the Sentinel-1 satellites have larger pixels of a maximum 5 m, whereas in Antarctica it is limited to a maximum 20 m. All these satellites deliver information on the ice conditions throughout the year. However, their access is partly limited: only the two ESA satellites are freely available, through the ESA's Sentinels Scientific Data Hub.

### **Detection of surface features**

Surface features (e.g. crevasses or flow lines) on the Antarctic ice sheet are caused by the steady motion of the ice as a result of the gravitational force. Especially in the coastal areas, where the slopes are generally steeper than in the interior, the motion of the ice creates crevasses, which pose safety issues for overland traverses and scientific field work.

Surface features are visible in SAR imagery as rapid changes of the radar backscattering coefficient within a short distance. The spatial resolution of the used image directly influences the detectability of the features. For example, a TerraSAR-X StripMap Mode image has a pixel size of 3 m, therefore the spatial resolution can be assumed to be twice the pixel size, which means features need to be at least 6 m wide to be detected. Typically, crevasses are elongated objects, which stand out very clearly from the surroundings. For a semi-automated detection method, the differences in radar signal backscattering between, for example, crevasses and undisturbed areas, are used to map potential danger zones. The method of semi-automated feature detection is described in detail in Wesche et al. (2013).<sup>3</sup> An example of how the methods worked on ice shelves is given in Figure 2.

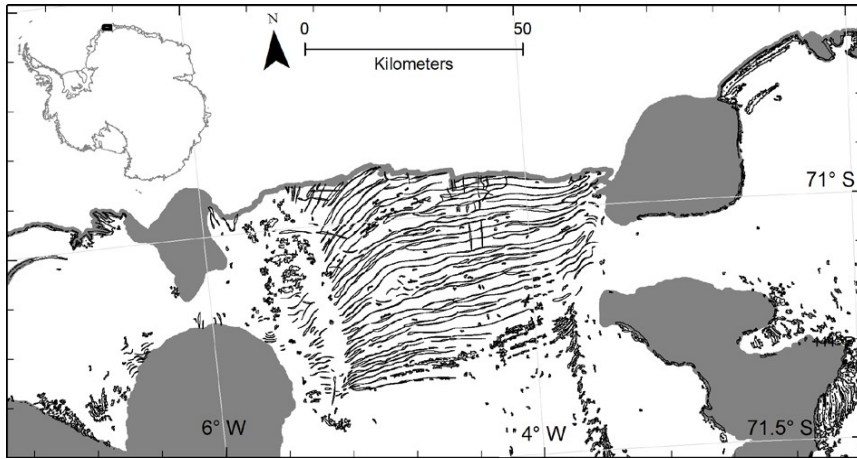


Figure 2: Surface features on the Jelbart Ice Shelf detected by the semi-automatic method<sup>3</sup>.

As the semi-automated method has some uncertainties, the visual inspection of the results is very important and should be done additionally.

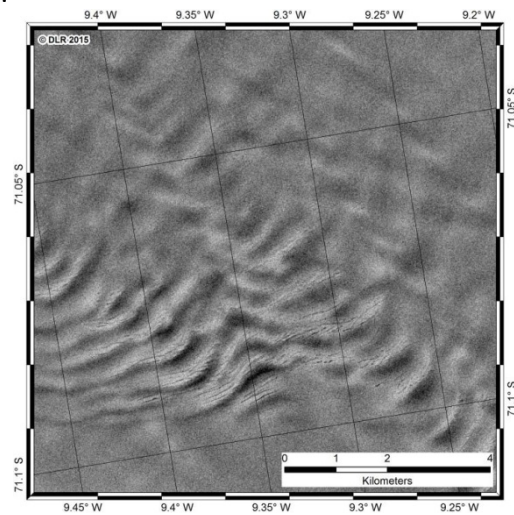


Figure 3: TerraSAR-X StripMap Mode image on the Ekström Ice Shelf.

In smaller regions, the visual inspection can be the only tool to map potential dangerous areas. An example of small scale crevasses is shown in Figure 3. High-resolution SAR imagery as in the TerraSAR-X StripMap Mode shown in Figure 3 can reveal crevasses in great detail. The pixel size of the image is 3 m and the features shown here are surface undulations superimposed on small sets of crevasses. This is an area typical of the sort that should be avoided.

### **Summary**

In the remoteness of the polar regions, the use of satellite imagery is crucial, especially in the winter months, when access is very limited. The SAR technique is an optimal tool, because it emits microwave pulses, which are independent of weather and light conditions. For two decades, different satellites have scanned the Earth's surface from space at different spatial resolutions. Using SAR imagery, surface features such as crevasses can be detected semi-automatically or by visual inspection alone. This increases the safety of scientists and field personnel during overland traverses and field studies.

### **Acknowledgements**

Thanks to the German Space Agency for the acquisition and provision of the TerraSAR-/ TanDEM-X data within the project COA3071.

### **References**

1. Oliver, C. and Quegan, S. (1998), Understanding synthetic aperture radar images. Artech House, Boston, MA.
2. Polar Space Task Group, SAR Coordination Working Group (2016), Data compendium: A summary documentation of SAR satellite data collections, plan and activities ([http://www.wmo.int/pages/prog/sat/documents/SAT-GEN\\_PSTG-SAR-CWG-DataCompendium-Apr2016.pdf](http://www.wmo.int/pages/prog/sat/documents/SAT-GEN_PSTG-SAR-CWG-DataCompendium-Apr2016.pdf)).
3. Wesche, C., Jansen, D. and Dierking W. (2013), Calving fronts of Antarctica: Mapping and classification, Remote Sensing 5, p 6305–6322.



# The Halley Relocation Project

Adam Bradley and John Eager  
[joge@bas.ac.uk](mailto:joge@bas.ac.uk)

British Antarctic Survey (BAS)

## Why move Halley VI?

In early 2015, there were changes identified in a large crevasse close to Halley VI Station. The proximity of the crevasse to the station poses a risk to the station and necessitates the station's relocation upstream on the Brunt Ice Shelf. The British Antarctic Survey commissioned an independently reviewed scientific justification to relocate the station. The Halley Relocation Project began as a result of that scientific justification report.

## Halley relocation project objectives:

- Select a new site on the Brunt Ice Shelf.
- Safely relocate all Halley VI infrastructure.
- Complete the project within the budgetary and time constraints.
- Minimise the disruption to science delivery out of Halley VI.
- Remove all accessible obsolete infrastructure from the old Halley VI site.
- Improve the station infrastructure where possible (reduce footprint, reduce costs of future relocations, remove obsolete infrastructure).
- Document the relocation procedure for future use.

## Planning

Planning began in 2015 and recruitment of personnel was undertaken for the 2016–17 season. The project will be completed in 2018.

The new-site selection process was a four-stage process:



1. Eliminate economically and logistically unviable areas.
2. Eliminate areas of glaciological high risk.
3. Apply operational site selection criteria.
4. Complete Ground Penetrating Radar survey (4,000 kms in total) of selected site and route.

Based on this process, the new site was selected in January 2016.

The summer team of 2016–17 will begin the moving process. This will require 96 people to be at Halley VI Station over the season and will see crews working round the clock (24-hour working operations). The crews will include the following:

- 16 vehicle operators and mechanics
- Eight steel fixers
- Seven electricians
- Six plumbers
- Five IT and communications specialists
- Two doctors

The winter-over team for 2017 will also increase in numbers: from 13 to 16 people. The three extra persons will be a field guide, a generator mechanic, and a vehicle mechanic, and they are required because of the increased winter travel by snowmobile, the increased fuel usage (generators will be needed at both sites), and increased personnel risks. A project risk assessment has been carried out, with strategies to mitigate or eliminate all identified risks.

In the summer of 2017–18, all science experiments will be relocated to the new site with minimal downtime of each experiment. All infrastructure will be removed from old site and the site will be left clean, except for a continuously operating GPS and weather station, which will be used to provide data on the status of the old location.

## Poster Presentations



# **Pilot Study: Winter-Over Psychological Telecare at the Korean Antarctic Station in 2010**

Eojin Yi  
[eojinkorea@gmail.com](mailto:eojinkorea@gmail.com)

Korea Polar Research Institute (KOPRI)

In the Antarctic winter period, winter-over members often need psychological support because of the harsh environmental conditions and the isolation. It is therefore important for winter-over members to have access to a means to communicate their emotional feelings and any stress by talking with others. In a small team, having such a personal discussion with other winter-over colleagues is often difficult and uncomfortable to do. With family members not near to talk to, alternative solutions must be found. If members are left without a mechanism to release emotional and stressful thoughts, depression, anxiety, and aggression may arise. This may impact the success of the winter-over experience, so it is important to prevent such maladjustment or psychological crisis.

This poster discussed a project to create awareness at an early stage of the depressed state of any member of the winter-over team at King Sejong Station in 2010, and to use telemedicine to assist when such states are discovered. In September 2010, there was a pilot test programme of remote psychological interviews (telecare) using an Internet video communication program. The entire 18 station members had already participated in the depression test (Korean Beck Depression Inventory, K-BDI) in July. Three high-scoring members (mild depression) and one applicant (minimal) were selected as subjects for consultation. They each received 30 minute, one-to-one counselling by a psychiatrist in Korea. After consultation, members assessed the telecare and gave feedback to the Antarctic doctor during an additional interview.

The satisfaction score was generally high (Likert 4 of 5), and the participants' feedback indicated that they recommended:

- a guarantee of security of the consultation content;
- extension of the counselling time;
- scheduling regular consultations; and
- consultation with a physician who was experienced in the winter-over programme.

Results assisted KOPRI in its use of telecommunications to provide a conduit for winter-over team members to talk with someone who was not part of the winter-over team in order to reduce stress and the difficulties that may arise from such stress.

The work in 2010 has shown that a remote "third party" person, usually a doctor, is able to have a positive effect on the psychological state of the winter-over member and provides a high-level of confidentiality.

# **The History, Present, and Futures of Polar Medicine in the Case of South Korea: 30 Years and Beyond**

Eojin Yi  
[eojinkorea@gmail.com](mailto:eojinkorea@gmail.com)

Korea Polar Research Institute (KOPRI)

Antarctic medical needs are greater today than in the past, as a result of the expansion in infrastructure and extension of scientific research requirements. To address this increasing need, the Antarctic medical activities of Korea also have evolved, and they took a step forward in 2014 with the establishment of the Korean Society of Polar Medicine (KSPM).

Ten years after the first Korean Antarctic krill fishery and research started, polar medicine in Korea began with the dispatch of the first medical doctor to the Antarctic King Sejong Station (1988). Through the history of 28 years, Korean Antarctic medical activities have contributed to operating the Antarctic stations and the successful winter-over programme.

With the expansion of Korean Antarctic infrastructure and facilities – examples are the icebreaker *Araon* (2009) and the Antarctic Jang Bogo Station (2014) – currently we have three residing medical doctors for the two Antarctic stations and the one icebreaker.

As society has developed, safety and health-care issues in Antarctica have become more highlighted. International co-operation and networking with other medical sectors, such as aerospace medicine, can be important cornerstones. In addition, application of developing technology to the Antarctic medical field and sustainable development of the medical system for the future generations are other ongoing issues.

In this study, we hope to share the history and current state of Korean Antarctic medical activities and to also discuss the “future scenarios” of polar medicine for the not-too-distant future.

## **Key Issues to be Solved for the Winter-Over Party of Jang Bogo Station**

Seonung Choi  
[suchoi@kopri.re.kr](mailto:suchoi@kopri.re.kr)

Korea Polar Research Institute (KOPRI)

Twenty-eight years have passed since the inauguration of Korea's King Sejong Station in 1988. Now, KOPRI operates two winter-over stations: King Sejong on King George Island and Jang Bogo at Terra Nova Bay, Northern Victoria Land.

Operating Jang Bogo Station as a year-round station since 2013 has come with big challenges for KOPRI. The station is the first Korean continental station and the only year-round station at Terra Nova Bay. With the past three years of operations experience, KOPRI presents three key issues to be shared with and considered by COMNAP members in relation to national Antarctic programmes' long-time experience and knowledge.

The key issues are: e-communication management in crisis/emergency situations, ensuring good expertise, and medical evacuation during the winter-over season.





## Using the DLR NRT Satellite Imagery Service for the Navigation of Vessels through Sea Ice

Christine Wesche<sup>a</sup>, Kathrin Höppner<sup>b</sup>, Erhard Diedrich<sup>b</sup>, Eberhard Kohlberg<sup>a</sup>, and Uwe Nixdorf<sup>a</sup>  
[christine.wesche@awi.de](mailto:christine.wesche@awi.de)

<sup>a</sup>Alfred Wegener Institute (AWI)

<sup>b</sup>German Aerospace Center (DLR)

The German research vessel *Polarstern* of the Alfred Wegener Institute (AWI) was on a cruise through the Weddell Sea to the Ronne Depot at the edge of the Filchner–Ronne Ice Shelf (cruise PS96) between December 2015 and February 2016. The main objective of this cruise was to supply a joint expedition between AWI and the British Antarctic Survey (BAS) on the ice shelf. Satellite imagery from the German satellites TerraSAR-X (TSX) and TanDEM-X (TDX) was used during the cruise to derive sea ice information at a high spatial resolution.

This was very useful, since the Weddell Sea region is characterised by a perennial sea ice cover, especially in the southern portion close to the ice shelf edge. Such conditions are challenging to vessel navigation and safety.



## **EDEN ISS: Providing Fresh Food to Winter-Over Neumayer Station III Crews and Long-Duration Missions**

Matthew T. Bamsey<sup>a</sup>, Paul Zabel<sup>a</sup>, Daniel Schubert<sup>a</sup>, Eberhard Kohlberg<sup>b</sup>, and Dirk Mengedoht<sup>b</sup>  
[eberhard.kohlberg@awi.de](mailto:eberhard.kohlberg@awi.de)

<sup>a</sup>German Aerospace Center (DLR)

<sup>b</sup>Alfred Wegener Institute (AWI)

Provision of fresh produce to winter-over Antarctic crews is a challenge. The fact that at least 46 different greenhouses or plant production systems have existed at one time or another in Antarctica<sup>1</sup> demonstrates the desire to produce food *in situ*, even in this harsh environment.

The EDEN ISS project will deploy an advanced plant growth system to Neumayer Station III. In addition to providing winter-over crews with fresh produce, the project aims to advance the technology readiness and operations techniques of space-based plant growth systems. The EDEN ISS “Mobile Test Facility” is designed to operate from two 20-foot shipping containers. These containers will be mounted upon an elevated platform situated approximately 300 metres south of Neumayer Station III. The facility will be composed of three distinct sections:

- A cold porch
- A Service Section, housing the bulk of the facility subsystems as well as a refrigerator-sized growth rack specifically designed to advance microgravity-based growth systems
- A Future Exploration Greenhouse providing the main plant production area of the facility

The greenhouse module will utilise multilevel growth systems and will employ a number of advanced technologies, such as LED lighting, aeroponic and nutrient-film technique irrigation systems, CO<sub>2</sub> enrichment, and air management equipment, so as to limit overall power use and material requirements while maximising the overall biomass output of the facility. The facility will ensure conformance to environmental protection regulations through the implementation of the lessons learned from past facilities and a number of specialised decontamination and monitoring techniques and technologies.

The Mobile Test Facility is presently under manufacture and integration of its various subsystems will commence in late 2016. Following close to a year of testing and growth trials, the facility will arrive in Antarctica in late 2017 and will undergo its first year of operations, for which a number of additional scientific goals have been set. It is expected that the facility will provide winter-over Neumayer Station III crews with a reliable source of fresh food while pushing the envelope of the use of hydroponic systems in Antarctica.

#### **Acknowledgement**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636501.

#### **Reference**

1. Bamsey, M.T., Zabel, P., Zeidler, C., Gyimesi, D., Schubert, D., Kohlberg, E., Mendedoht, D., Rae, J., Graham, T. (2015) Review of Antarctic greenhouses and plant production facilities: A historical account of food plants on the ice, 45<sup>th</sup> Int. Conference on Environmental Systems, ICES-2015-060.

## Improvement of Transportation and Construction at the Syowa Station: Future Plans and Challenges

Yutaka Katsuta, Gen Hashida, and Yoshifumi Nogi  
[ykatsuta@nipr.ac.jp](mailto:ykatsuta@nipr.ac.jp)

National Institute of Polar Research (NIPR)

Syowa Station is located in a difficult region of the Antarctic with regards to accessibility, therefore the Japanese Antarctic Research Expedition (JARE) has been struggling to establish stable resupply since the opening of the station. In order to cope with limited supplies and workforce size, various contrivances have been devised for base construction. The history of the Syowa Station, along with an account of the four Japanese icebreakers, is presented.

The first icebreaker *Soya* could not break through thick ice and therefore its capabilities were limited. The icebreaker *Fuji* was then constructed; it had better performance than *Soya* but, still, berthing at Syowa Station was not easy. *Fuji* did have capacity for two large helicopters and therefore increased the capacity to transport goods to the station. In 1983, the third icebreaker *Shirase* was used. It had improved ice-breaking capability and a larger cargo hold. When *Shirase* came into service, it became possible to berth at Syowa Station. Although goods transport was still carried out by air with helicopters, the ability to transport large machinery and materials by short-range ground traverse on sea ice was now possible. By such stable transportation of goods, Syowa Station was made larger, with increased research facilities. Since 2009, *Shirase II* has been in operation. The use of containers on board has increased the efficiency of transport of goods to the station.



# Construction of Wind Power Generation at the Japanese Antarctic Station Syowa: A Case Study using the CFD-GIS Wind Synopsis Simulator

Koui Kima<sup>b</sup>, Takanori Uchida<sup>c</sup>, Kenji Ishizawa<sup>b</sup>, Hiroyuki Fujino<sup>b</sup>,  
and Hideaki Nakamura<sup>d</sup>  
[kim.koui@fukushima-nct.ac.jp](mailto:kim.koui@fukushima-nct.ac.jp)

<sup>a</sup>National Institute of Technology, Fukushima College

<sup>b</sup>National Institute of Polar Research (NIPR)

<sup>c</sup>Kyushu University

<sup>d</sup>NIPPI Corporation

The Japanese Antarctic Research Expedition (JARE) has been testing the wind power at Syowa Station since 2015, using the blizzards (severe snow storms) during wintering. Accordingly, the effective use of wind power is attracting attention as a substantial and sustainable energy source for JARE.

Since the generated energy output from a wind turbine is proportional to the wind speed cubed, accurate site selections with favourable wind conditions are important for constructing wind turbines, even to a pinpoint level.

The topography of Syowa Station is characterised as complex terrain with many buildings. Those interactions induce flow impingement, flow separation, flow reattachment, and reverse flow. All of these need to be taken into consideration when choosing the location of the wind turbines.

With such a need and with the recent rapid advancement of computational capability, we developed a geospatial database for the Syowa Station on a GIS (Geographic Information System) environment, integrating Computational Fluid Dynamics (CFD). This meant we can successfully evaluate the best sites for wind turbines. Verification and validation were conducted using the field data.





# Challenges of PV Generation in Polar Regions

## Case Study: the Norwegian Research Station Troll in Antarctica

Stanislas Merlet<sup>a</sup>, Thomas Thiisa<sup>b</sup>, Bjørn Thorud<sup>a</sup>, Espen Olsenban<sup>d</sup>, and Jostein Nyhus<sup>c</sup>

[stam@multiconsult.no](mailto:stam@multiconsult.no)

<sup>a</sup>Multiconsult ASA

<sup>b</sup>Norwegian University of Life Sciences (NMBU)

<sup>c</sup>Nyhus Elektro Rådgiving AS

### Objectives

Design a functional “fuel-saver” Photo Voltaic (PV) system (with electricity storage) that can:

- increase energy autonomy and reduce the need for fuel logistics;
- withstand extremely low temperatures, snow loads, and polar wind blasts; and
- maximise solar harvest according to the load profile.

### System design

- Load: constant 165 kW (incl. 30 kW thermal)
- PV modules: mono-Si 18.6%
- Capacity: 762.5 kWp (4,100 m<sup>2</sup>)
- Battery capacity: 3,840 kWh

### Conclusions

- PV can provide substantial benefits in polar regions, with high specific yield due to high irradiance, low temperatures, and high albedo.
- Hourly/daily storage (battery) allows PV to meet 50% of the annual demand.
- PV energy is half the price of the station’s actual electricity.

- An option of water electrolysis + hydrogen storage + fuel cells can be considered for seasonal storage at a later stage.

## APPENDICES

## Appendix A:

### COMNAP Symposium 2016: Winter-Over Challenges Programme

<b>Day 1:</b> Time	<b>Friday 19 August 2016, Morning Session</b> Title/ <u>Speaker</u> /Organisation
<b>Session 1: The Future</b> <i>chaired by Javed Beg</i>	
0900–0910	<b>Welcome</b> <u>Javed Beg</u> , Symposium Convener
0910–0930	<b>From Leadership in Extreme Environments to Extreme Leadership: How to Shape the Future of Antarctic Operations</b> <u>Nathalie Pattyn</u> , Belgium Royal Military Academy
0930–0950	<b>Antarctic Year-Round Stations: Under-Utilised Platforms to Fill the Gap in Science Observations</b> <u>Hyoung Chul Shin</u> , Korea Polar Research Institute (KOPRI)
0950–1010	<b>How to Minimise the Risk of Field Activities During Winter-Over</b> <u>Gen Hashida</u> , National Institute of Polar Research (NIPR)
1010–1030	<b>Building Effective Wintering Communities: The Role of the 24-Hour Selection Centres</b> <u>Rob Wooding</u> , Australian Antarctic Division (AAD)
1030–1115	Coffee Break/Poster Session
<b>Session 2: The Human Element (medical)</b> <i>chaired by John Guldahl</i>	
1115–1135	<b>Health Care Planning and Delivery in Antarctica: An Analysis of Health Disorders</b> <u>Pradip Malhotra</u> <sup>1</sup> and <u>Abhijeet Bhatia</u> <sup>2</sup> <sup>1</sup> 22 <sup>nd</sup> and 28 <sup>th</sup> Indian Scientific Expeditions to Antarctica (ISEA) <sup>2</sup> North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences (NEIGRIHMS) and 27 <sup>th</sup> ISEA
1135–1155	<b>Counter Measures to Improve Quality of Life, Performance, Health, and Well-Being</b> <u>Anne Hicks</u> <sup>1</sup> , <u>Pete Marquis</u> <sup>1</sup> , and <u>Nathalie Pattyn</u> <sup>2</sup> <sup>1</sup> British Antarctic Survey Medical Unit & Plymouth Hospitals NHS Trust; <sup>2</sup> Belgium Royal Military Academy

1155–1215	<p><b>Medical Management System and Severe Cases in Japanese Winter-Over Situations: Fatal Case, Surgical Operations, and Medical Evacuations</b></p> <p><u>Giichiro Ohno</u>, Noriyasu Sekiguchi, Tsuginori Yoshida, Norio Ishizaki, Osamu Fujimoto, and Yutaka Katsuta, Japanese Antarctic Research Expedition (JARE), National Institute of Polar Research (NIPR)</p>
1215–1235	<p><b>The Role of Technology in Antarctic Medicine</b></p> <p><u>Abhijeet Bhatia</u>, NEIGRIHMS, India</p>
1235–1255	<p><b>Changes of 25-OH-Vitamin D During Winter-Over at the German Antarctic Stations Neumayer II and III</b></p> <p>Mathias Steinbach, <u>Eberhard Kohlberg</u>, Martina Anna Maggioni, Stefan Mendt, Oliver Opatz, Alexander Stahn, Josefine Tiedemann, and Hanns-Christian Gunga, Alfred Wegener Institute (AWI)</p>
1300–1400	Lunch Break/Poster Session
<p><b>Session 3: The Human Element (Personalities, training and critical situations)</b>  <i>chaired by Robb Clifton</i></p>	
1400–1420	<p><b>Personality Characteristics and Training Programmes Useful for Better Adaptation During Winter-Over Expeditions to the Antarctic in Multicultural Groups: The Results of the Last 11 Missions at Concordia Station</b></p> <p><u>Denise G. Ferravante</u><sup>1</sup> and Paul Laforet<sup>2</sup>, <sup>1</sup>Antarctic Technical Unit (ENEA-UTA); <sup>2</sup>Institute Polar Paul-Emile Victor (IPEV)/TAAF</p>
1420–1440	<p><b>Psychological Evaluation and Screening Pre-Deployment to Antarctica</b></p> <p>Marta Barbarito and <u>Maria Laura Naveira</u>, National Antarctic Directorate (DNA)-Argentine Antarctic Institute (IAA)</p>

1440–1500	<p><b>How to Face the Winter-Over Challenge in Terms of Team Building and Training? The Approach of the Alfred Wegener Institute</b></p> <p><u>Eberhard Kohlberg</u>, Christine Wesche, Uwe Nixdorf, and Dirk Mengedoht, Alfred Wegener Institute (AWI), Germany</p>
1500–1545	Coffee Break/Poster Session
1545–1605	<p><b>The Limitations of Digital Communications when Dealing with a Medical Emergency in a Remote Location: Lessons Learned from Military and Antarctic Missions</b></p> <p><u>Nathalie Pattyn</u><sup>1</sup>, P. Neirinickx<sup>2</sup>, Pete Marquis<sup>3</sup>, Simon Horne<sup>3</sup>, and Anne Hicks<sup>3</sup>, <sup>1</sup>Belgium Royal Military Academy; <sup>2</sup>Military Hospital Queen Astrid, Belgium; <sup>3</sup>British Antarctic Survey Medical Unit &amp; Plymouth Hospitals NHS Trust</p>
1605–1625	<p><b>First Aid and the Role of ICTs in Critical Incidents</b></p> <p>Marta Barbarito and <u>Maria Laura Naveira</u>, National Antarctic Directorate (DNA)-Argentine Antarctic Institute (IAA)</p>
1625–1645	<p><b>A Major Winter-Over Challenge: Medevac Case Analysis in the Korean Antarctic Station over 28 Years</b></p> <p><u>Eojin Yi</u>, Korea Polar Research Institute (KOPRI)</p>
1645–1705	<p><b>Use of E-Communication and its Psychological Influence on Winter-Over</b></p> <p>Marta Barbarito and <u>Maria Laura Naveira</u>, National Antarctic Directorate (DNA)-Argentine Antarctic Institute (IAA)</p>
1705–1715	Summation of Day/Close of Day 1 of Symposium

<b>Day 2:</b> Time	<b>Saturday 20 August 2016, Half Day</b> Title/ <u>Speaker</u> /Organisation
<b>Session 4: The Built Element chaired by Tijun Zhang</b>	
0900–0910	<b>Welcome Back</b> <u>Javed Beg</u> , Symposium Convener
0910–0940	<b>Yoga: A New Strategy to Facilitate Human Adaptation in Antarctica</b> <u>B. Ragavendrasamy</u> , Ramesh M.N., and Shailendra Saini National Centre for Antarctic and Ocean Research (NCAOR)
0940–1010	<b>Safety Expertise Support from the Korean Government for the Winter-Over Party</b> <u>Won Jun Kim</u> , Korean Polar Research Institute (KOPRI)
1010–1030	<b>When the Lights Go Out: Challenges, Strategies and Management During Wintertime Incidents</b> Tim Stockings, John Hall, Simon Garrod, and <u>John Eager</u> , British Antarctic Survey (BAS)
1030–1050	<b>Concordia: The Third Continental Station</b> <u>Claire Le Calvez</u> <sup>1</sup> and <u>Gianluca Bianchi-Fasani</u> <sup>2</sup> <sup>1</sup> Institute Polar Paul Emile Victor (IPEV); <sup>2</sup> Antarctic Technical Unit (ENEA-UTA)
1050–1120	Coffee Break/Poster Session
1120–1140	<b>Development of Telemedicine: A Substantial Contribution to Medical Safety During Winter-Over</b> <u>Eberhard Kohlberg</u> , Christine Wesche, Uwe Nixdorf, and Dirk Mengedoht, Alfred Wegener Institute (AWI)
1140–1200	<b>Crevasse Detection for Safety Issues During the Antarctic Winter using High-Resolution SAR Imagery</b> <u>Christine Wesche</u> , Eberhard Kohlberg, and Uwe Nixdorf Alfred Wegener Institute (AWI)



1200–1220	<b>The Halley Relocation Project</b> Adam Bradley and <u>John Eager</u> , British Antarctic Survey (BAS)
1220–1230	Summation of Day/Close of Symposium



## Appendix B:

### List of Posters

Poster Number	Titles/Authors/Organisation
1	<b>Pilot Study: Winter-Over Psychological Telecare at the Korean Antarctic Station in 2010</b> Eojin Yi, et. al., Korea Polar Research Institute (KOPRI)
2	<b>The History, Present, and Futures of Polar Medicine in the Case of South Korea: 30 Years and Beyond</b> Eojin Yi, et. al., Korea Polar Research Institute (KOPRI)
3	<b>Key Issues to be Solved for the Winter-Over Party of Jang Bogo Station</b> Station Support Team, Korea Polar Research Institute (KOPRI)
4	<b>Using the DLR NRT Satellite Imagery Service for the Navigation of Vessels through Sea Ice</b> Christine Wesche <sup>1</sup> , Kathrin Höppner <sup>2</sup> , Erhard Diedrich <sup>2</sup> , Eberhard Kohlberg <sup>1</sup> , and Uwe Nixdorf <sup>1</sup> <sup>1</sup> Alfred Wegener Institute (AWI); <sup>2</sup> German Aerospace Center (DLR)
5	<b>EDEN ISS: Providing Fresh Food to Winter-Over Neumayer Station III Crews and Long Duration Missions</b> Matthew T. Bamsey <sup>1</sup> , Paul Zabel <sup>1</sup> , Daniel Schubert <sup>1</sup> , Eberhard Kohlberg <sup>2</sup> , and Dirk Mengedoht <sup>2</sup> <sup>1</sup> German Aerospace Center (DLR); <sup>2</sup> Alfred Wegener Institute (AWI)
6	<b>Improvement of Transportation and Construction at the Syowa Station: Future Plans and Challenges</b> Yutaka Katsuta, Gen Hashida, and Yoshifumi Nogi, National Institute of Polar Research (NIPR)

7	<p><b>Construction of Wind Power Generation at the Japanese Antarctic Station Syowa: A Case Study using the CFD-GIS Wind Synopsis Simulator</b></p> <p>Koui Kim<sup>1,2</sup>, Takanori Uchida<sup>3</sup>, Kenji Ishizawa<sup>2</sup>, Hiroyuki Fujino<sup>2</sup>, Hideaki Nakamura<sup>4</sup></p> <p><sup>1</sup>National Institute of Technology, Fukushima College;  <sup>2</sup>National Institute of Polar Research (NIPR); <sup>3</sup>Kyushu University; <sup>4</sup>NIPPI Corporation</p>
8	<p><b>From the Shortest Day to the Longest Night: Lessons in Human Behaviour and Performance Training from Spaceflight</b></p> <p>Nathalie Pattyn, S. Buckle, and L. Bessone</p> <p>Royal Military Academy; European Space Agency; British Antarctic Survey Medical Unit</p>
9	<p><b>Challenges of PV Generation in Polar Regions Case Study: the Norwegian Research Station Troll in Antarctica</b></p> <p>Stanislas Merlet<sup>1</sup>, Thomas Thiisa<sup>2</sup>, Bjørn Thorud<sup>1</sup>, Espen Olsen<sup>2</sup> and Jostein Nyhus<sup>3</sup></p> <p><sup>1</sup>Multiconsult ASA, Norway; <sup>2</sup>Norwegian University of Life Sciences (NMBU); <sup>3</sup>Nyhus Elektro Rådgiving AS, Norway</p>