AN INVESTIGATION OF THE EDUCATIONAL PREPARATION OF NURSES PRIOR TO WORKING IN LAND-BASED MULTIPLACE HYPERBARIC CHAMBERS IN CANADA

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An Investigation Of
The Educational Preparation Of Nurses
Prior To Working
In Land-based Multiplace Hyperbaric Chambers In Canada

BY

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Abstract

An Investigation Of The Educational Preparation Of Nurses Prior To Working In Land-based Multiplace Hyperbaric Chambers In Canada

The purpose of this study was to describe the hyperbaric nurses working in clinical multiplace hyperbaric chambers in Canada, to determine their age, sex, marital status and educational preparation, and to identify the topics that they perceive should be included in an introductory educational program offered prior to working in multiplace hyperbaric chambers.

Data for this descriptive study were gathered by means of author-constructed questionnaires and personal interviews. The questionnaires identified eight demographic variables, and asked participants to rate the importance of 37 topics for inclusion in a hyperbaric nursing course. The personal interview lasted approximately thirty minutes and was guided by five open-ended questions. The interview tapes were scrutinized, and content analysis was used to extract common themes which were organized into five categories.

The sample was made up of 32 of the 33 English-speaking nurses who worked full-time, part-time or on an

on-call basis in the three Canadian Hyperbaric units which were operational during January/February, 1990. These nurses were found to share many similar demographic characteristics. The interview data showed that the number of factors contributing to job satisfaction far exceeded those contributing to job dissatisfaction.

The most frequently cited concern mentioned spontaneously by 12/32 nurses in the category of personal and lifestyle adaptations was the occurrence of significant fatigue after a hyperbaric treatment. It was noteworthy and warrants attention because this sensation has not been reported previously by hyperbaric caregivers in the literature and it is known to be associated with decompression sickness.

Other findings were obtained in relationship to educational and professional concerns and focused on the challenges of infrequent dives and communication. The discussion includes the design of an Introductory Hyperbaric Nursing Course. At the conclusion of the study a number of recommendations related to nursing practice, education and research were made.

Acknowledgements

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Table of Contents

List of Tables

List of Figures

CHAPTER 1

RESEARCH PROBLEM

Introduction To The Problem

The enthusiasm surrounding the clinical use of hyperbaric oxygen therapy (HBO) has fluctuated over the last several decades but has now stabilized. The increased interest in hyperbarics was in response to a broad range of clinical research supporting its effectiveness, and the need for emergency treatment by an escalating number of individuals involved in diving activities for work and leisure.

Hyperbaric oxygen therapy requires the expertise of a multidisciplinary team, which includes nursing personnel, physicians and other staff who have a variety of technical backgrounds. The complex technology and the wide variety of conditions treated with hyperbaric pressure means that comprehensive introductory education as well as on-going educational programs are essential for all members of the clinical treatment team.

Problem Statement

Certified programs that address the purely nursing issues of hyperbaric oxygen therapy do not presently exist. McKiel, Lockyer and Pechiulis (1988), acknowledge the value of conjoint education, but caution that multidisciplinary programs may not specifically meet the

needs of one discipline. This fact, as well as the absence of research on learning needs of hyperbaric nursing personnel, indicates that research in this area is required. It follows as a logical step that the learning needs of nurses be surveyed, based on the assumption that continuing education programs designed to meet the perceived needs of the learners could be more effective than programs whose content was dictated by others (Craytor, Brown & Morrow, 1978). Therefore, this study will focus on determining the educational needs that nurses who are working in Canadian multiplace hyperbaric chambers perceive to be important. Although the research will focus on the experiences of Canadian nurses, it is expected that the findings will be of interest to hyperbaric nursing personnel in other countries as well as in Canada.

Rationale

The clinical value of this study is that it will provide a detailed analysis of the previously unresearched educational needs of the hyperbaric nurse. This information is not currently available in the North American literature and it would be beneficial not only to guide future research but to assist in the development of improved educational programs to enhance the safety of patient care.

Literature Review

Hyperbaric medicine arose from the need to treat decompression sickness. Hyperbaric oxygen therapy is administered in hyperbaric chambers which have been used for 80 years to treat diving casualties and for 25 years to treat altitude decompression casualties (Myers, Baker & Cowley, 1982). There are two types of chambers (monoplace and multiplace units), which vary in size and capabilities.

Monoplace Hyperbaric Chambers

The monoplace chamber is usually a clear acrylic cylinder approximately 8 feet long and 3 feet in diameter which normally accommodates one reclining patient. Although it has not been mentioned in the literature, hyperbaric nurses have reported to the investigator that occasionally an unsettled infant may be treated with his mother or a hyperbaric nurse in the monoplace unit. In this unit, the patient does not require a mask to receive oxygen as the chamber itself is pressurized with oxygen. Since no hands-on care is possible, patients who are treated in the monoplace chamber are usually those that are orientated, alert and able to follow instructions communicated through a two way intercom. If necessary,

unconscious critically ill patients, such as those described by Krings (1987), can be treated in the monoplace chamber since it can be equipped with mechanical ventilation, cardiac and hemodynamic monitoring equipment (Glowacki & Chew, 1988; Krings, 1987; Norkool, 1985).

Multiplace Hyperbaric Chambers

Multiplace hyperbaric chambers are pressure vessels constructed of aluminum or steel that can be sealed gas-tight. They have the structural integrity to contain the internal pressure to which they will be exposed, which, for most clinical chambers, is a pressure less than or equal to 6 atm. abs. (atmospheres, absolute). This is the pressure experienced at a depth of 165 feet under the sea (Poulton, 1981).

The chambers have specially constructed doors that seal with pressure to prevent accidental opening. There are entry locks or pass-through locks that vary according to size and that can be pressurized independently from the main chamber. The pressure in the locks must be equalized to the internal pressure of the main chamber before accessing the lock (Harrington & Carter, 1966).

The service lock can accommodate small pieces of equipment, while the personnel lock will allow the movement of personnel and larger equipment in and out of the main chamber while it is in use, thus providing an important safety advantage. "A network of closed-circuit television cameras and several small window ports provide visual access to the chamber" (Norkool, 1979, p. 729). Communication is ensured through multiple systems including two-way intercom, telephone and/or headphone.

Multiplace units can accommodate two or more patients seated, and up to several medical and nursing personnel, equipment and an intubated patient. Because these chambers are pressurized with air the patient(s) receive 100% oxygen via mask, head hood or endotrocheal tube. To prevent oxygen toxicity during long hyperbaric treatments, the patient breathes chamber air for regular short "air breaks" and usually during decompression. The nursing personnel, on the other hand, breathe chamber air most of the time, except upon decompression when they may be provided with 100% oxygen. This therapeutic use of a pressurized, oxygenated environment within a limited space presents a number of issues which must be considered as they relate to patients, personnel and

equipment.

A review of the medical literature provided an impressive list of research projects, using both human and animal subjects, and it appears that many significant developments in this field have taken place in the last decade. One of the consequences of this research has been the identification of conditions for which HBO therapy is accepted as the adjunct or primary treatment. Ross (1986) identified the following 12 diagnostic categories as benefiting from HBO therapy:

- radiation necrosis,
- carbon monoxide poisoning,
- refractory osteomyelitis,
- burns,
- compromised skin grafts,
- decompression sickness,
- gas embolism,
- crush injuries,
- cyanide poisoning,
- soft tissue infections,
- selected problem wounds and
- selected refractory mycoses.

The last diagnosis is the only one that was not addressed extensively in the literature.

The nursing literature during the same period is limited, with no attention given to research and only minimal attention focused on nursing staff or educational preparation. This is surprising since the small number of papers written on personnel, emphasize the importance of proper education and selection of staff, as well as the need to be aware of the importance of certain environmental variables. Bond (1966) comments that, even under routine operating conditions, working in a pressure chamber is hazardous, physically demanding and produces physiological and psychological stress.

The following review of the literature will be divided into two sections. First, nursing issues related to hyperbaric oxygen therapy will be presented so that educational topics may be identified. Then related literature on surveying educational needs will be examined.

A: Nursing Issues in Hyperbaric Oxygen Therapy

Issues important to HBO nursing identified from the literature can be classified into four general categories:

1. the physical and psychological factors hyperbaric staff may encounter,
2. the environmental hazards, in particular, the risk of fire,
3. the alterations to equipment that are required for use in a pressurized environment, and
4. patient education.

1. Physical and Psychological Factors

There are a number of physical factors that put nursing and medical personnel at risk as they care for a patient in a hyperbaric chamber. They encounter the same physiological effects experienced by divers (Glowacki & Chew, 1988) and are therefore at risk, particularly during the deeper exposures required to treat diving accidents. Workman (1966) wrote, "the effects of pressure on a man may be divided into two main categories: 1) those that are direct and mechanical, and 2) those that come because of changes in the partial

pressure of respired gases" (p. 110).

The first category of conditions resulting from the direct effects of pressure can occur during descent or ascent in the hyperbaric process. Glowacki and Chew (1988) warned that barotrauma, the damage that results from changes in the volume of air-containing cavities in the body, occurs when pressure outside the body space differs from that within it. The consequences of these pressure changes are usually confined to damage and pain in the ears or sinuses, and to a lesser extent, pain in the teeth. However, serious damage can be caused to the lungs if breathholding occurs during depressurization (Workman, 1966). Meijne (1970) cautioned that the process of ascent can be life-threatening if expanding air is not vented continuously. Bond (1966) noted that even without having problems during descent, personnel working in air compressed to 7 atmospheres absolute pressure (ATA) will inevitably encounter increased effort in the work of breathing, and staff must, therefore, be in good pulmonary health.

The second category suggested by Workman (1966) focused on conditions that would be attributable to pressure indirectly, as a result of changes to partial

pressure of gases in the pressurized environment. The most important of these problems, experienced during hyperbaric pressurization, are nitrogen narcosis, oxygen toxicity and decompression sickness.

Nitrogen narcosis is due to the weak anesthetic effect of nitrogen upon the central nervous system occurring at levels probably beginning at about 2 ATA (33 feet under water) with its' typical symptoms becoming obvious between 50 and 100 feet (Workman, 1966). The sensation is similar to alcohol intoxication, as the dissolved nitrogen gas affects the brain. In view of this effect,Lanphier (1966) noted that for deep exposures to approximately 165 feet (6 ATA), details of the procedure or examination of the patient must be communicated continually to personnel outside the chamber to confirm the findings/diagnosis and to check the mental status of the chamber personnel. It is also required, in this situation, that the inside tenders adhere to the orders and decisions of the surface personnel. Workman (1966) recommended that beginning at a depth of 3 ATA personnel performing procedures that require clear thinking and manual dexterity, such as operative procedures, should be maintained on a helium-oxygen

mixture.

Oxygen toxicity occurs when oxygen at a high partial pressure is inhaled for long periods of time. It can affect the brain, causing seizures, and can affect the lungs, causing cumulative and ultimately irreversible damage. Seizures can be prevented and lung damage can be ameliorated by providing air breaks, reducing the percentage of oxygen in the air or by limiting total exposure time and/or chamber pressure.

Decompression Sickness or the "bends" is caused by formation of gas bubbles in the tissues and blood during the ascent phase of under water diving, flying or hyperbaric treatment where inert gases, usually nitrogen, are inhaled under pressure. Thom (1992) writes that this phenomenon occurs "... when the speed of decompression exceeds the ability of the saturated tissues to vent the gases by simple diffusion" (p. 25). Hyperbaric oxygen therapy is the primary treatment for this disorder, which has a wide range of clinical manifestations beginning with mild symptoms of joint pain moving to severe symptoms of cerebral, spinal or cardiac trauma possibly resulting in death. Although it is almost exclusively associated with underwater diving it is a concern for

hyperbaric personnel and the reason staff are committed to specific treatments protocols for certain depths of pressure.

In considering the effects of elevated partial pressures of nitrogen, pregnancy is a crucial factor. Jennings, in his 1987 article on women in hazardous environments, discussed the very important problem of pregnancy when working in a hyperbaric chamber. While further research needs to be pursued, Jennings suggested that exposure to pressures greater than normal pose a considerable risk to the developing fetus. Several nursing papers pointed to the need for restrictions on diving during pregnancy because of the possibility of birth defects, especially in the first trimester (Corry & Montoya, 1989; Greenberg, Messina, Reichow & MacLean, 1979). H. Manson (personal communication, April, 1992) said, "The placenta appears to be a likely site for bubble growth during decompression. Since the fetus will also be exposed to increased partial pressures of nitrogen, bubbles could form on the fetal side of the placenta and thence access the fetal circulation. Developing limb buds, etc. are likely vulnerable to such emboli. Hence there is a fear of causing damage to the

fetus". In light of the sensitivity of fetal development to medication, alcohol and cigarette smoke, adhering to precautions seems to be a wise suggestion.

In the literature apart from pregnancy, women were not found to be at greater risk of experiencing more untoward effects than men. Meijne (1970) did report that one argument used against women working under pressure was that women tend to have more adipose tissue in the upper arms and buttocks and that because adipose tissue absorbs greater quantities of nitrogen it could increase their risk for decompression problems. In reality, additional problems have not occurred and a similar argument could be made for men who tend to have more adipose tissue around the abdominal area. Bond in an 1966 publication stated that, "With nursing personnel, an added and poorly evaluated factor of sex is introduced" (p.146), because a large percentage of nurses are female. However, evidence suggests that concerns reported by Meijne and those of Bond are not justified in brief hyperbaric exposures.

As opposed to the physiological effects, the psychological impact of working in a hyperbaric chamber is related to the way mental activity and functioning are

altered in a pressurized environment. Emotional strain may also be associated with the intense demands and responsibilities created by the environment and the confined quarters of the chamber. Bond (1966) states that claustrophobic tendencies and overt reactions to confined spaces are significant factors to be considered in selecting personnel to work in this area. "An individual normally unaffected by closed environments may react severely to the situation in a hyperbaric chamber where the sense of complete incarceration is very real" (Bond, 1966, p. 144). Even if, after one or two exposures, the novice nurse is shown to be able to work in such an environment, there still remains the increased tension of working in a limited space. Both physical and psychological closeness of patient and staff can be a problem, since it is heightened as they encounter similar risks in a confined space.

2. Environmental Hazards

Of the hazards of working in a multiplace hyperbaric chamber, fire is by far the main safety concern. Ross (1986) noted that in an oxygen-charged environment there is a greater risk for sparks to cause fire or explosion.

Poulton (1981) stressed that the rate at which substances burn is considerably increased with higher oxygen pressure. The potential sources of fire in a chamber are numerous, including sparks from electrical equipment or even static electricity. Petroleum products, such as lubricants, grease, hair spray, nail polish, body lotions, as well as petroleum-based cosmetics and dressing preparations, can cause spontaneous explosion in the presence of high partial pressures of oxygen (Bolton, 1981; Gaul & Hart, 1975; Glowacki & Chew, 1988; Poulton, 1981; Ross, 1986). In an oxygen charged chamber, fires are fatal because of the confined space, limited access to exits, and the increased toxic effects of combustion gases under pressure. As a result, safety precautions, such as monitoring and removing excess oxygen in the chamber and reducing oxygen in proportion to the depth, are taken to decrease the fire hazard. Safety considerations, cautioned Poulton (1981), must be of primary importance and fire regulations must be strictly enforced. Providing these precautions are adhered to the potential risk of fire in a multiplace chambers is far less than the risk in monoplace chambers which unlike multiplace units, are pressurized with 100% oxygen.

3. Modifications to Equipment

Another area of concern to nursing and medical personnel carrying out HBO therapy is the safe and accurate monitoring of patient status in the chamber, especially the critically ill patient. A mercury spill in a multiplace chamber, either from a standard thermometer or sphygmomanometer, exposes patients and staff to toxic mercury vapour, which maybe especially dangerous at high pressures. Mercury can also damage the metal of the chamber itself. Poulton (1981) suggested measuring arterial blood pressure using an aneroid manometer is preferred over the sphygmomanometer because it works without mercury. Another problem of using a standard sphygmomanometer in the chamber is that as pressure changes, the amount of time required to inflate and deflate the cuff also changes.

Ross (1986) recommended that in order to accommodate pressure alterations, medical devices with air filled balloons, such as endotracheal tubes and catheters, need to have their air pressure constantly monitored or have the air replaced with water. Glass intravenous bottles/bags should be replaced by plastic or great care must be taken with placement of their vent-tubes.

Ampules and syringes also need to be properly vented.

Similarly, measurement of arterial blood gases presents a challenge, since upon decompression, blood samples lose their oxygen saturation. In the test tube, arterial blood appears to boil as the gas content is decreased. Poulton (1981) noted that the blood sample is still adequate for measuring other blood gases but not oxygen content. However, in this situation measurement of oxygen content is not necessary since "hyperbaric oxygen therapy ensures adequate tissue oxygenation for virtually all patients-including those with severe respiratory failure" (p. 84).

4. Patient Education in Hyperbaric Oxygen Therapy

A last area of concern identified in the literature is patient education. This has not been addressed directly in published papers but is included in nursing articles under the topics of patient preparation or risk factors. Ross (1986) recommended close attention to fire prevention by repeatedly reinforcing to the patient that there be no smoking, lighters, cigarettes or electronic equipment. Fire-retardant clothing and approved footwear as well as non-petroleum based lotions are required to be

worn in the chamber. Glowacki and Chew (1988) support these recommendations, in particular the meticulous attention to prevention of fire. Ross also suggests that the nurse should teach the patient about voice changes during treatment, use of oxygen masks and methods for relieving ear pressure.

Norkool (1979, 1985) emphasizes the importance of explaining the details of the treatment procedure to the patient and the family. Anxiety, especially fear of claustrophobia, may be significantly alleviated by explanation and reassurance from nursing staff. Norkool stressed the importance of education and support for the disorientated or semicomatosed patient and Krings, in her 1987 article on treating the critically burned patient with HBO, also emphasized the need of patient education: "One of the most overwhelming challenges in this world of critical care nursing is explaining pressure change sensations on eardrums to a semi-comatosed, intubated patient who is unable to see through edematous eyes" (p. 80-H).

B. Educational Needs of Hyperbaric Nursing Personnel

The factors to be included when designing an educational program for hyperbaric nurses can best be

identified by considering the challenges that they face, such as the pressure-related alterations to the environment and equipment, the physiological and psychological adaptations for both the patient and nurse, education and awareness about hyperbarics, and finally, the uniqueness of the environment as well as the hazards. When considering these challenges, it is natural to look at the educational preparation for nursing staff in this specialty. In 1966 Workman commented that there were no formal courses available at that time but he saw education as essential. Glowacki and Chew (1988) later commented that the beginning development of clinical training courses in the United States had opened the door to the development of another specialty in the nursing and medical profession. They suggested that educational programs need to continue to develop in the hyperbaric field. However, in North America no courses specifically designed for nursing personnel have yet been developed and no detailed educational needs assessment of hyperbaric nurses has been carried out.

In a more general context, Matthews and Schumacher (1979) stated that no one really challenged the necessity of continuing education in nursing and the belief in the

importance of ongoing education continues to be accepted today. However, these authors also noted that the controversy persists as to how these courses should be developed, i.e. should the content be determined by knowledgeable specialists, or be identified by conducting a needs assessment survey of the opinions of nurses working in hyperbaric units? Farley and Fay (1988) concluded from their research that a comprehensive needs assessment is a vital part of continuing education program planning and the primary source of data to begin the planning process, because it facilitates the development of programs that meet existing needs and utilizes limited health care resources efficiently .

Chesney and Beck (1985) classified needs assessment surveys in nursing continuing education into three different types:

1. need assessments which focus on the features of continuing education programs that make them more attractive to nurses. These surveys, such as the work of Matthews and Schumacher (1979), did not request information on content areas but on length of programs, number of major topics to be presented

as well as other items.

2. needs assessment that aim for general assessment of preferred educational topics for a large group of nurses. Chesney and Beck (1985), were one of a small number of researchers to choose this approach. They collected data on educational needs for nurses in 12 counties of the Coastal Bend Area of Texas. Farley and Fay (1988) also identified the educational needs of 2,949 nurses in the state of New Hampshire.
3. needs assessment of nurses dealing with a particular topic, for example cancer, or a particular setting, for example, nursing homes. The salient points of the articles that have used this third approach seem the most appropriate for this study and they will be reviewed here.

Craytor, et al. (1978) completed three studies that aimed at determining nurses' learning needs in relationship to cancer, which was the most frequently occurring topic in the literature on learning needs assessment. Their findings indicated "that increasing knowledge and skills decreased feelings of helplessness and that learning takes place when learners are anxious,

because of inability to meet perceived demands..." (Craytor, et al., 1978, p. 219). Fernsler (1987), in a series of articles on program development in cancer nursing, lent support to this finding by stating that "adults are amenable to learning when they perceive a need to learn and are given the opportunity to participate in the planning ..." (p. 59). Seto, Ong, Ching, Liu and Yau (1988) similarly stated that "the adult learner is a demanding student and the educational process may be superfluous if it is not tailored to his or her needs" (p. 24).

The wide variety of topics selected by the nurses and the unpredictable nature of their choices supports the necessity to assess the learner's needs and involve them in planning educational programs. For example, Pittman, Stevens, Fulp and House (1988) evaluated the continuing education needs of public health nurses in North Carolina. Their findings showed the top five needs to be: 1) legal aspects/risk management, 2) obtaining continued compliance by patents, 3) counselling skills, 4) sexual abuse of children, and 5) leadership skills. All of these areas are of importance to public health nurses and the high ranking of these topics provided

valuable information.

Bye (1988) surveyed the needs of nurses in nursing homes and found that the five most requested topics included: 1) drug therapy, 2) how to motivate staff to perform well, 3) techniques to handle behavioural problems of residents, 4) how to handle a performance problem with staff, and 5) how to manage a crisis situation. This author also stated that there was a significant difference in the topics selected by younger nurses compared to older nurses, and between nurses with different educational backgrounds. Conedera and Schoessler (1985) did not examine the effect of age but like the previous authors proposed that the responses of experienced nurses differed from neophyte nurses.

Mazonson, Wu & Scaltrito (1981), in a well organized study of nurses educational needs in relationship to patients diagnosed with cancer, found the five most requested topics included: 1) nursing interventions in helping patients and families cope with cancer, 2) psycho-social needs of cancer patients and their families, 3) nursing interventions in complications/side effects resulting from chemotherapy, 4) stress reduction for nurses, and 5) current uses of chemotherapy in

cancer.

In a survey of a paediatric nursing group, Bowman, Wolkenheim, Beck, O'Donnell and Schneider (1985) found that the five educational topics perceived to be the most needed were: 1) emergency intervention, 2) emergency nursing, 3) dealing with children and families, 4) pathophysiology of common diseases, and 5) interpretation of lab values.

The uniqueness of each list of priorized education topics for the settings discussed reflects the variation of each nursing specialty and reinforces the suggestion that a thorough comprehensive needs assessment is required for each specific nursing setting.

Summary

A review of the literature revealed that a comprehensive assessment of educational needs specific to each nursing setting is important. It can also be seen that, although desirable, there are no courses that target only nursing personnel for nurses working in highly complex hyperbaric units. Most of the present day courses offered at facilities outside of Canada are aimed at the medical profession. While in individual cases

hyperbaric nurses may have been asked to indicate what they perceive to be important content for an introductory hyperbaric course, no indication of this is present in the literature, and yet this information is an essential prerequisite to designing courses specifically for HBO nursing personnel. There are no articles that report the knowledge required of the daily experiences of nurses working in hyperbaric units, although this is an area of nursing that differs considerably from general nursing practice. This is an important area requiring further study.

Conceptual Framework

This study uses the work of Fernsler (1987) and Seto et al. (1988) who state that adults are amenable to learning when they perceive a need to learn and are given the opportunity to participate in the planning; and also an adaptation of Urbano & Jahns' model of participation in continuing education. This framework has been expanded to specifically address nursing issues related to working in hyperbaric units (See Figure 1, page 26).

The framework highlights intrinsic factors and extrinsic factors that must be considered by those planning a continuing education program because they are crucial in determining whether or not an individual participates and succeeds in the program. The intrinsic factors include: 1) basic human needs, 2) attitudes, values, beliefs, expectations and perceptions, and 3) motivational orientations, and are represented in the model by the concentric circles.

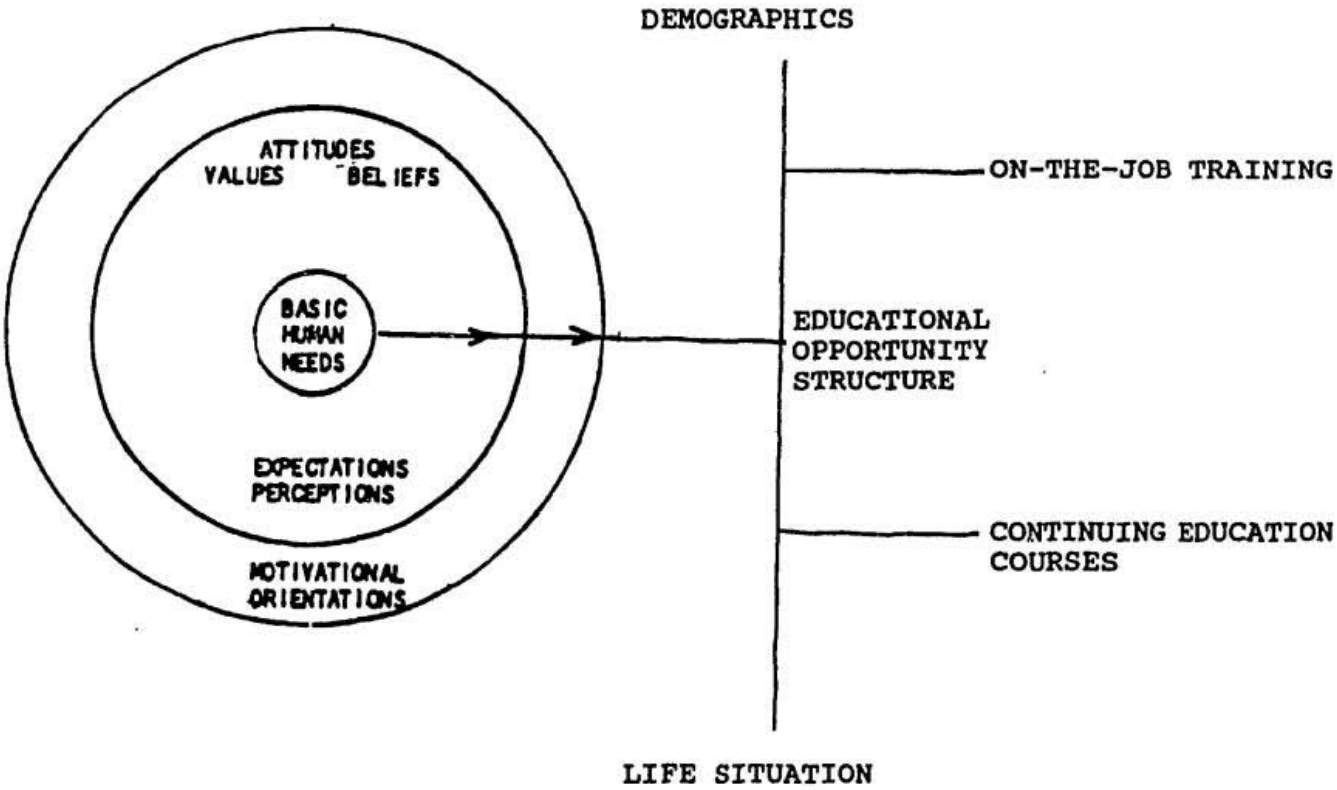

FIGURE 1: Framework for conceptualizing educational programs in Hyperbaric Nursing adapted from the framework of Urbano & Jahns (1988).

Basic human needs were organized into a general theory by Maslow (1970), who looked at human needs in a progressive hierarchy. The needs began with physical survival moving through safety, love, esteem and finally self-actualization (a sense of having achieved one's fullest potential). He believed that there needed to be some satisfaction of each need before the person could move on to concentrate on the next higher level, and that an unmet need was motivation for the person to pursue activities that would satisfy this need.

Another component of the intrinsic or personal variables is the person's attitudes, values or beliefs which can either hinder or facilitate educational involvement depending on person's expectations. If the end result of the educational program is expected to be relevant and need fulfilling for the student then this has a positive effect upon the student's belief system and subsequently upon participation (Urbano & Jahns, 1988).

The final personal variable labelled "motivational orientations" are grouped by Urbano & Jahns into six categories: external expectations, professional advancement, social relationships, social welfare,

escape-stimulation and cognitive interest (Morstain & Smart, as cited by Urbano, 1988). These social-psychological characteristics which were only briefly mentioned by the authors are the primary motivators for professional participation in continuing education.

These intrinsic factors are impacted upon by extrinsic or societal forces which are divided into three categories: 1) demographic characteristics, 2) life situation variables, and 3) educational opportunity structure characteristics. Urbano & Jahns classify as demographic characteristics, factors such as age, sex, education level and marital status because these factors have been associated with motivation and participation in educational programs. They influence, among other things, the attitudes and expectations of the participants, as well as their financial status, time availability and health, and consequently effect the quality of success or failure of the educational experience.

The Life Situation variables of the framework include the sociological influences of adult growth and development, and the effect of the significant people in the learner's family, personal, and/or professional life.

The learner may be influenced by their own attitudes and beliefs as well as those of others. For example, a person's attitude toward their job, the support of colleagues and family members toward continuing education, their career goals, and their stage of personal or professional development can all effect the quality of the educational experience. These life situation variables need to be considered when selecting target groups for recruitment, publicity and planning continuing education programs.

Educational opportunity structure represents the varying availability of programs which will affect participation. Availability of programs considers such factors as location, timing, cost, and course content that must be addressed by those planning the continuing education program. Urbano and Jahns model has been expanded to include on-the-job training and continuing education courses (see Figure 1).

At present, on-the-job training in hyperbaric units is the main avenue by which nurses in Canada are introduced to this specialty and through which their knowledge is kept current. In most facilities, this on-the-job orientation is supplemented by reading relevant

materials, and a few units also provide study guides and/or films. Practical supervision in the chamber is provided by the senior nurse or physician as time and work load permit.

Because no courses specifically designed for hyperbaric nursing exist an educational needs assessment should be carried out as an important initial step in designing a program for hyperbaric nursing. Consequently, this study will determine Canadian hyperbaric nurses perception of the educational needs to be addressed in a hyperbaric course. It is not the intention to test the conceptual framework modified from Urbano & Jahns' work but consideration will be given to analyzing components that are relevant to this research.

The following assumptions have been made in this investigation:

1. Hyperbaric nurses interviewed will be able to recall accurately the education and training they were given prior to working in a hyperbaric chamber.
2. They will be able to recall their most significant early work experiences in an hyperbaric chamber accurately.

3. They will be able to identify information that they did not have that would be useful to them.
4. This information will be useful to those responsible for designing educational courses for hyperbaric nurses.

Limitations of the Study

1. Only the three Canadian English - speaking clinical hyperbaric units were sampled.
2. With the exception of the pilot study, the questionnaires used in the study were not previously tested.
3. Information obtained by asking nurses to recall their introductory hyperbaric educational experience may not provide an accurate picture of that experience.

Despite these limitations, it is expected that the nurses will recall the most significant details. This study is expected to produce useful information, and provide a starting point for further research and for developing continuing educational programs for hyperbaric

nurses.

Purpose

The immediate purpose of this study is to describe the hyperbaric nurses working in clinical multiplace hyperbaric chambers in Canada, to determine their age, sex, marital status and educational preparation, and to identify the topics that they perceive should be included in an introductory educational program offered prior to working in multiplace hyperbaric chambers. The ultimate purpose is to supply basic information for those planning an introductory hyperbaric education course specifically for nurses and also to provide a foundation for further research into hyperbaric nursing practice.

Research Questions

1. What are the demographic and professional characteristics of nurses who are working in hyperbaric chambers providing clinical treatment in Canada?
2. What educational preparation was provided to nurses before they began to work in a multiplace hyperbaric chamber?

3. What additional information would these nurse have found useful for their hyperbaric work?

Definition of Concepts

Hyperbaric oxygen therapy (HBO) is the administration of 100% oxygen by inhalation in a chamber at greater than atmospheric pressure. It functions on two principles: 1. that in a pressurized hyperoxygenated environment the amount of oxygen is increased in the plasma, tissues and cells and 2. that gas bubbles decrease in size and are reabsorbed as pressure in the chamber increases.

Hyperbaric chambers are vessels that can be sealed gas-tight and maintain increased internal pressure. They can be either a monoplace chamber, which is a unit only large enough for one person, or a multiplace unit which is large enough to accommodate two or more people.

Hyperbaric nurse is a registered nurse who has been specifically educated to care for patients in a multiplace hyperbaric chamber.

An introductory program is a formal continuing education program, including classroom and clinical experiences, designed for nurses beginning to work in

hyperbaric unit.

Continuing education program are courses offered to registered nurses after their basic nursing program for the purpose of introducing new knowledge or updating existing knowledge.

Learning needs are those educational needs perceived by the learner to be important as opposed to ascribed needs which are educational needs identified by someone other than the learner (Volker, 1987).

CHAPTER II

METHODOLOGY

Research Design

In view of the limited information in the literature on hyperbaric nursing, it was decided to do a descriptive study. This study was conducted to determine certain personal and professional characteristics of English-speaking nurses working in clinical multiplace hyperbaric chambers in Canada, as well as their perceptions regarding the content of an introductory educational program in hyperbaric oxygen therapy.

Setting

The setting for this study was the three hyperbaric multiplace units in Canada who employ nurses, that are located in 1. Toronto General Hospital, 2. Vancouver General Hospital and 3. Victoria General Hospital. Taped interviews were conducted in privacy, with only the subject and the investigator present, either in the hyperbaric unit or at a location selected by the subject.

Sample Selection

A telephone survey of the nine multiplace units in Canada revealed that English-speaking nurses were employed in three of the facilities: 1) Toronto General Hospital, Toronto, Ontario, 2) Victoria General Hospital, Halifax, Nova Scotia, and 3) Vancouver General Hospital, Vancouver, British Columbia.

After approval to conduct the study had been obtained from the appropriate administrative and research personnel of these institutions (see Appendix C), the initial explanation of the study to the nurses was made by the senior hyperbaric nurse or supervisor, and a memo was sent to the nursing staff prior to the researcher visiting the unit. Upon arriving at the unit the researcher's first phone contact with the participants focused on explaining the purpose of the research project, the role of the researcher, expectations of the nursing participants and the requirements for informed consent (see Consent Form in Appendix E). An appointment was also scheduled for an interview and arrangements were made for each participant to receive a package of information about the research prior to the interview.

This package included a consent form, information

about the study and the research questionnaires. The subjects were asked to complete Part 1, The Information Sheet and Part 2, Educational Needs Assessment Questionnaire and bring them to the interview. Thirty-two of the 33 English-speaking nurses who work full-time, part-time or on an on-call basis in these three units in January/February, 1990 agreed to participate. One nurse was not asked because of hospitalization due to illness. None of the participants were coerced into participating. The high participation rate was probably related to the good rapport between the participants and the nursing leaders of the units (who made the initial contact), and also the high level of motivation in this particular nursing specialty.

Ethical Considerations

The proposal for this research received approval from the Human Investigation Committee of the Faculty of Medicine, Memorial University and the Research Committees of all hospitals involved in the study. The policies for protection of human subjects were followed and measures were taken to ensure that informed consent was understood beginning with a discussion with the participants

concerning the nature of the study (see Appendix D), their rights regarding participation, the scope of their involvement, and assurances of the anonymity and the confidentiality of their information.

Subjects were presumed to have given their consent to have the questionnaire data used after they brought the completed documents to the interview and consent to use interview data was obtained by completion of a written consent form (see Appendix E) prior to the taped interview. A numerical code was used so that questionnaires did not include the subjects' names and thus ensured anonymity. Data was locked in a secure place by the researcher until it was entered into the computer at which time the original questionnaire was destroyed. Individuals' responses were not discussed with the employer and they were grouped for analysis so that individuals cannot be identified from their responses.

As far as could be determined, there were no risks to the health or safety of participants in this investigation. The researcher utilized the following safe guards to minimize risk:

1. To allay anxiety, the researcher attempted to provide a comfortable, relaxed setting using a non-judgemental approach.
2. Appointments were scheduled at a time and place most convenient for participants, with flexibility for subjects who worked in the evening or at night.
3. Appointments were rescheduled upon request of subjects even at short notice.
4. The subject was reassured that she may refuse to answer any question.

Subjects may not directly benefit from involvement in the study, but long-range benefits could be derived from using results to design better educational programs focused on the needs of hyperbaric nurses. Most subjects were pleased to have the opportunity to talk about their concerns and their achievements in this clinical specialty.

Data Collection

Data collection took place from January 22, 1990 to February 10, 1990. The investigator visited the hyperbaric units in Halifax, Nova Scotia; Toronto, Ontario and Vancouver, British Columbia and spent one

week at each institution. Data were gathered by means of a questionnaire consisting of two instruments developed by the writer (see Appendix A), and a personal interview (see Appendix B).

The first part of Instrument number 1, the Information Sheet (see Appendix A) listed eight demographic variables which have been included in similar tools focusing on nurses working in other clinical settings (Bye, 1988; Conedera & Schoessler, 1985, Craytor, et al., 1978; Mazonson, et al., 1981; Pittman, et al., 1988). Four of these variables (age, marital status, # of children and advance courses taken prior to working in hyperbaric units) were included for descriptive purposes while it was hoped that the remaining items could be examined for a correlation with the nurse's perceived educational needs (Bye, 1988; Conedera & Schoessler, 1985). The second part of this instrument, the Educational Needs Assessment Questionnaire (see Appendix A), provided a list of 37 topics related to hyperbaric nursing. The topics were obtained from the literature on hyperbarics, the researcher's clinical experience in this area and the outline of the Hyperbaric Medicine Course offered by St.

Luke's Hospital in Wisconsin. The participants were asked to rate how essential these topics would be in an introductory course for beginning hyperbaric nurses using categories labelled as 'having a great need', 'having some need', or 'having no need', and to indicate if they 'did' or 'did not' have this information in their introductory program. A final column allowed room for comments. The second instrument titled Interview Questionnaire (see Appendix B) was a series of open-ended questions used as an interview guide to address educational concerns of the participants. In using these questions the interviewer was careful not to lead the questioning in any way.

Pilot Study

The questionnaires were pre-tested to determine if they were readable and sufficiently easy to understand, and to allow the content to be assessed for completeness. In the pilot study, a sample of experienced hyperbaric nurses working in the Hyperbaric Medicine Department of St. Luke's Hospital, Milwaukee, Wisconsin, were asked to review the questionnaires and give suggestions for revision. Only minor grammatical changes were needed as

a result of this test. All these nurses indicated that the questionnaires were readable and understandable.

Data Analysis

A general description of the nurses working in hyperbaric units was obtained from examining the frequencies of each demographic variable. Topics in the Educational Needs Assessment Questionnaire were ranked in order of decreasing perceived educational need, based on the overall mean rank values assigned to each topic by all respondents. Where numbers in the various demographic categories allowed, the rank ordering of learning needs was examined to determine if any relationships existed with the demographic variables (sex, education, hours worked per week in hyperbaric unit, and length of time working in hyperbaric unit).

Using the process outlined by Wilson (1985), content analysis was carried out on the qualitative data obtained from the taped interviews with participants. After the tapes were transcribed, the interviewer read and reread them searching for common themes to describe nurses' experiences in hyperbaric chambers. During the interviews predetermined open-ended questions were used

to guide the participants (Appendix B) and numerous themes emerged from the interview data. These themes were organized into five thematic categories which described the nurses educational needs, and their experiences of working in hyperbaric chambers. An experienced nurse educator read a sample of the transcribed interviews to check on the validity of the categories chosen by the researcher.

CHAPTER III

RESULTS

The results are presented in three sections: 1. Description of the demographic characteristics of the nurses; 2. Analysis of Educational Needs Assessment Questionnaire and 3. Analysis of the data obtained from interview tapes.

Characteristics of the Sample

Table 1 shows the personal characteristics of the 32/33 Canadian English-speaking hyperbaric nurses as obtained from the Information Sheet (Appendix A). The majority of the subjects are in the age range of 30-39 years while the second largest age group is 40-49 years. Overall these two age groups comprise 81% of the sample. Twenty-nine of the thirty-two participants were female. Slightly more than a half of the nurses were married or living with a significant other. Twenty-three (71.9%) of the group had no children.

Table 1

Personal Characteristics Of Canadian Hyperbaric Nurses (N = 32)

VARIABLE	CATEGORY	FREQUENCY	PERCENTAGE
Age	20 - 29 years	5	15.6
	30 - 39 years	17	53.1
	40 - 49 years	9	28.1
	50 + years	1	3.1
Sex	Female	29	90.6
	Male	3	9.4
Marital Status	Single	14	43.8
	Paired	17	53.1
	Separated/Divorced/Widowed	1	3.1
Number of Nurses with Children	No Children	23	71.9
	1 Child	4	12.5
	2 Children	4	12.5
	3 Children	1	3.1

The nurses' professional characteristics are displayed in Table 2. The educational level for 29 of the nurses was Registered Nurse (R.N.) while only 3 participants held a bachelors degree in either nursing or a related field, such as science. Most of the nurses worked in the hyperbaric unit as on-call personnel. Only a small number (N=6) worked full-time and only one part-time. There was at least one full-time nurse in each of the three hyperbaric units surveyed.

The length of time working in hyperbaric units that was most frequently recorded on the questionnaire by 28.1% of the respondents was 2-5 years. However, the majority of nurses (62.5%) had been working in this area for longer than 2 years, and as was learned during the interviews, the senior nurse of each hyperbaric unit had been working in the area of hyperbarics for 15 - 20 years having been the senior nurse since each unit was opened.

Almost all of the nurses had worked at one time or another in Intensive Care or Coronary Care Units and 28 of them had taken an advanced course in ICU or CCU. Three respondents had been involved in a course on Wound

Table 2

Professional Characteristics Of Canadian Hyperbaric Nurses (N = 32)

Variable	Categories	Frequency N	Percentage %
Education	R.N.	29	90.6
	B.N./B.Sc.	3	9.4
	M.N./Ph.D.	0	-
Employment Status in Unit	Full-Time	6	18.8
	Part-Time	1	3.1
	On-Call Basis	25	78.1
Length of Time Working in Hyperbarics	0 - 6 months	3	9.4
	> 6 months - 1 year	4	12.5
	> 1 year - 2 years	5	15.6
	> 2 years - 5 years	9	28.1
	> 5 years - 10 years	3	9.4
	>10 years	8	25.0
Advanced Courses Taken Prior to Working in Hyperbaric Units[a] N = 47	ICU/CCU	28	87.5
	Wound Care	3	9.4
	Respiratory Therapy	0	-
	Hyperbaric Oxygen Therapy	5	15.6
	Other	11	34.4

[a] Several nurses have taken more than one course.

Care while none of the subjects had taken a course in Respiratory Therapy. Five participants indicated in the questionnaire that they had completed a Hyperbaric Oxygen Therapy course prior to working in this area. Since there are no hyperbaric courses available in Canada, this was followed up during the interviews and it was learned that the subjects were referring to the on-the-job orientation that they had received while being introduced to the hyperbaric unit or a hyperbaric course taken in the United States after commencing work in the unit. Eleven nurses indicated that they have completed other courses, some of those mentioned were programs in Aeromedical Nursing, Physical Assessment, Neurosurgical Nursing, Nursing Management or Certified Scuba Diving.

Analysis of Educational Needs Questionnaire

In the Educational Needs Assessment Questionnaire, completed by hyperbaric nurses (see Appendix A), the subjects were asked to indicate which of 37 educational topics listed were of most importance in an introductory hyperbaric program.

The topics of perceived educational need were then rank ordered according to mean rating (Bowman et al.,

1985; Bye, 1988; Mazonson et al., 1981; Pittman et al., 1988). Table 3 shows the ten most needed topics as perceived by this nursing group. "Handling patient emergencies in the chamber" was ranked by all of the nurses as the most important topic to be addressed in an introductory course to hyperbarics. Three topics with a mean of 2.97 were tied as the second most important topic: "Teaching patients about HBO complications and the importance of compliance"; "Nursing interventions for oxygen toxicity" and "Preparation of patient for hyperbaric oxygen therapy". Three topics with a mean of 2.94 were selected as the fifth most important group of topics, they included "Nursing care for the patient with carbon monoxide poisoning"; "Contraindications, complications and potential hazards of this work for nursing personnel" and "Handling pressure generated emergencies". In this group, "Contraindications, complications and potential hazards of working in the chamber for the nurse" was the first and only item in the ten 'Most Needed Topics' which related to the nurse's health as opposed to patient concerns. Finally, the topics of "Patient assessment", "Nursing interventions for anxiety disorders" and "Fire safety and control"

ranked 7-10 respectively and completed the list of the 10 most needed topics, all with a median value of 2.91.

Table 3

Overall Ranking Of Educational Needs For Canadian Hyperbaric Nurses - Most Needed Topics (N = 32)

MOST NEEDED TOPIC	MEAN	% OF 32 NURSES WHO RECEIVED TOPIC IN INTRODUCTION TO HBO
Handling patient emergencies in the chamber, e.g. cardiac arrest. (30)	3.00	71.9
Teaching patients about HBO complications, and the importance of compliance to treatment regimen. (11)	2.97	78.1
Nursing interventions for oxygen toxicity. (13)	2.97	84.4
Preparation of patient for hyperbaric oxygen therapy. (15)	2.97	81.3
Nursing care for the patient diagnosed with carbon monoxide poisoning/smoke inhalation. (3)	2.94	71.9
Contraindications, complications and potential hazards of working in the chamber for the nurse. (26)	2.94	81.3
Handling pressure generated emergencies, such as pneumothorax, gas embolism. (29)	2.94	71.9
Psychological and physical assessment of patient prior to and during hyperbaric oxygen therapy. (14)	2.91	78.1
Nursing interventions for anxiety related to confinement in HBO chamber. (17)	2.91	71.9
Fire safety and control. (24)	2.91	84.4

NOTE Numbers in brackets refer to the order of questions in the Educational Needs Assessment Questionnaire (Appendix A).

Table 4 lists the five least needed topics in order of decreasing need as perceived by all the respondents in this study. "Decompression diving tables" and "Nursing Care for the patient diagnosed with crush injuries" were at the top of least popular choices with a mean of 2.38, while the topic of "Nursing Care of patients diagnosed with burns" was ranked third (median 2.19). Interestingly, "Stress reduction for nurses" with a median value of 2.06 was chosen by the nurses surveyed to be the least important topic of all 37 items in the questionnaire, even rating lower that "Evolution of hyperbaric oxygen therapy" which was ranked second last.

Table 4

Overall Ranking Of Educational Needs For Canadian Hyperbaric Nurses - Least Needed Topics (N = 32)

LEAST NEEDED TOPIC	MEAN	% OF 32 NURSES WHO RECEIVED TOPIC IN INTRODUCTION TO HBO
Decompression diving tables. (33)	2.38	62.5
Nursing care for the patient diagnosed with crush injuries. (4)	2.38	34.4
Nursing care for the patient diagnosed with burns (5)	2.19	37.5
Evolution of hyperbaric oxygen therapy. (23)	2.13	56.3
Stress reduction for nurses. (35)	2.06	12.5

NOTE Numbers in brackets refer to the order of questions in the Educational Needs Assessment Questionnaire (Appendix A).

Analysis of Interview Data

The data discussed in this section was obtained from transcriptions of the 32 taped interviews with the participants. The following five thematic categories were identified and named:

1. Nurses' Perception of their Educational Needs: the education and experience obtained prior to working in the unit, the additional knowledge and skills the nurses need to have upon commencing work in the unit, and the personal characteristics that are related to commitment and satisfaction with hyperbaric nursing.
2. Job Satisfaction: the pleasant feelings and challenges provided by working in a hyperbaric unit.
3. Job Dissatisfaction: the unpleasant feelings and events that were experienced when working in a hyperbaric unit.
4. Personal & Lifestyle Adaptations: the changes the nurses noted to themselves or their lifestyles experienced as a result of working in a hyperbaric multiplace chamber.

5. Administrative & Professional Suggestions: issues related to continuing education for experienced hyperbaric nurses and other non-educational issues of administrative or professional concern to the hyperbaric nurses.

Although it does not totally relate to introductory nursing education, the last category was included because it may be of value to the unit administrators or other professionals reading this thesis.

Nurses' Perception of their Educational Needs

This category can be defined as the education and experience obtained prior to working in the unit, the additional knowledge and skills the nurses need to have upon commencing work in the unit, and the personal characteristics and competencies associated with commitment and satisfaction with hyperbaric nursing. Each of the components of the definition will be discussed beginning with the nurses' perception of the preparation that should be brought to this specialty area by a beginning practitioner.

Prior Education and Experience Required

All the participants suggested that registration as a nurse and having a strong basic knowledge base in that area was essential. Twenty-eight of the 32 nurses said that previous work in an Intensive Care Unit (ICU) was vital to have developed the skills and knowledge needed to handle the critically ill patients treated by HBO. The rationale for this belief was reflected in the following comments.

> ICU skills are needed so that you feel competent if an emergency occurs.
>
> You need to be able to handle every crisis that comes up, therefore you must have highly trained critical care nurses for these [HBO] patients.
>
> I think it's almost essential to have an ICU background, because of a lot of the emergency cases that come in, particularly [patients diagnosed with] gas gangrene are really sick and you have to know how to use the equipment, just to be able to look at the monitor and identify something unusual and know when to call someone for action.
>
> I think having the critical care background - you need to have that ... because you are in the tank quite often by yourself, you do not get a lot of backup support.

An experienced HBO nurse explained why the nurse's clinical expertise is so crucial in relationship to the timing and temporary inaccessibility.

> The patient rely [SIC] on you alot. You are the only one in the chamber with him, although we can send help in, it takes time - that's why you're judgement and response [are vital]. If you've got the knowledge then your patient will benefit.

One nurse explained that critical care education brought with it not only a change in the skill level of the nurse but an important adjustment in attitude, she said, "I had been indoctrinated in ICU that there really are no emergencies because you are prepared for everything. I think this attitude helped me in an area like hyperbarics."

Some participants emphasized that ICU training was necessary to care for the critically ill patient, but also felt that extensive experience in the ICU field was important.

> At least a couple of years of ICU experience is essential.
>
> Critical experience is important and having that down well because if you run into any kinks you have to solve them and you can not have just learned.
>
> I think that experience in critical care nursing is a must. ... You need people who do this [head to toe assessment] on a daily basis, that can assess and zoom in on the problem right away ....
>
> If you are a very young ICU nurse or one with limited skills and people say, 'Oh no, we are

> not going to have that, we are going to have this.' It's just going to throw you.

Only one participant directly stated that an ICU nurse was not needed. This may be related to her length of time working in the hyperbaric unit which was reported as between six months and one year as well as the fact that this nurse had no formal education in ICU although she had worked in the area for a number of years. She did say that "the ICU personality is a prerequisite." She described the ICU personality as the type of nurse who would have enough confidence to interrupt patients that "don't want you interfering with them" to check that they are all right. This respondent felt that the patients who are very experienced with HBO often do not want you to interrupt them and many have difficulties because they are over confident.

Previous scuba diving knowledge and experience was mentioned by ten of the 32 nurses. Seven of these ten participants considered this type of knowledge and experience to be most important.

> Becoming a certified scuba diver and developing that knowledge helps.

> Scuba diving was most important for the nurse's own adjustment to [clinical] diving.

> Diver training helps a lot. You don't get bombarded so much if you've got basic knowledge ... of scuba diving and physiology. I knew about the Diving Tables and clearing your ears.

One nurse responded enthusiastically on this subject, saying that, "For me the biggest thing is diving experience, absolutely nothing is better than that." (304) She described at length the content of a diving course and the benefits of each component to the HBO nurse. She stressed that this course makes many aspects of hyperbarics 'second nature', including the physiology, principals of diving and what to do if something goes wrong.

Involvement in diving for leisure was for two of the nurses the reason they became interested in hyperbarics. The following comments reflect this view:

> I think that [being a diver] was my most useful knowledge initially. Actually that's what gave me the interest to pursue getting into the hyperbarics.

> I had the added advantage of being a scuba diver.... That's why I got into hyperbaric medicine - I figured at one time I might need the service so therefore I should probably take part in it.

Only three of the 32 respondents stated that a scuba diving course was not essential. However at least two of these nurses went on to comment that, "if people did recreational diving that would be an asset." It seemed that they were able to acknowledge the importance of learning the content of a diving course but did not feel comfortable personally with sport diving. When the investigator asked one nurse if she was a sport diver, she responded, "Not on your life!" The other participant expressed similar reservations. She stated that she had only attended a course because she was with another hyperbaric nurse whom she trusted. She found that it was interesting "to listen to their [other divers'] explanations as to what happens, to see some of the practices that go on with experienced divers. It was ... surprising to hear some of the things that these divers say they would do."

Personal Characteristics and Competencies

A number of personal characteristics and competencies were identified by the nurses as being associated with commitment and satisfaction with hyperbaric nursing. The personal characteristics, which

will be discussed first, include: 1. feeling confident; 2. being able to handle change; 3. being able to work in small places and 4. being physically fit.

Feeling confident was the most frequently mentioned quality, identified by ten respondents and ranged from simply having self-confidence to feeling assured in more specific skills and knowledge. The following statements discuss the importance of confidence for beginning nurses:

> Old age helps! I believe very strongly that one develops a confidence that time alone can give you ...
>
> You have to have confidence in yourself because you're in there by yourself, so you have to be comfortable in being by yourself and making decisions.
>
> You can't really call on any one else for help, I guess you have to have a lot of confidence in yourself.
>
> I always felt confident in myself if an emergency occurred.

The ability to handle change was identified by six participants as a desirable quality in hyperbaric nurses. Because of the many problems that can occur with complex machinery as well as changes in patient or personal status, the nurse must not only be adaptable but able to deal with problems calmly.

> You have got to be prepared for all kinds of things changing - there is nothing set about it. The hallmark of hyperbarics is 'Hurry up and wait' and 'Things are going to change'. The patient that you thought you had is going to be a different patient, the time you thought you were going to start is going to be different and something is going to have to be [adapted] to suit the occasion.

Another participant responding to a request to describe her most useful qualities answers in a similar way:

> I think [having] adaptability and being able to keep a cool head (because anything can go wrong in there) and not being claustrophobic.

To emphasize this point, she told of a patient who had great difficulty getting to depth because of a problem with ear clearing. While at depth another unusual physical problem presented in this patient thus extending the time in the chamber even longer and challenging the nurse to deal with a clinical situation that was not anticipated.

It was important according to another nurse to be "prepared for anything while in the chamber, like something comes apart." Another respondent concurred with this feeling in this straight-forward statement.

> I think it's really important to be a calm person, to look at things matter of factly.

These comments seem to indicate that a beginning nurse

needs to not only have the clinical skills required to deal with a multitude of experiences but would benefit also from being adaptable enough to calmly accept the many situations she may encounter.

Four nurses recommended two qualities, the ability to work in small places and being physically fit, as being important. Because of the limited space in the chamber, it was considered to be beneficial if nurses had the ability to work in small places without becoming claustrophobic.

> You need to be a specific type of person to work in the chamber. You have to not mind the confines of the space nor the claustrophobia the mask can give you as well....
>
> You have to be able to work in a small area - that's just a very individualized thing.

One nurse describes her initial feelings related to the confinement, in the following statement:

> ... it's a small chamber and with four other people sitting there, it was really close quarters. It was too crowded, especially with people you really don't know.

Another nurse anticipated feeling claustrophobic prior to going in the chamber and makes this comment:

> I thought I would be really claustrophobic in there. I thought I'd be really scared.

She went on to elaborate that she may not have experienced these feeling's because she had never had a patient who became aggressive or encountered an emergency situation, such as a cardiac arrest.

It would seem that feelings of claustrophobia related to confinement need to be addressed by individuals coming to work in this area and in fact it may exclude some nurses from actually becoming involved in this type of nursing. Factors such as the number of people in the chamber, the level of agitation and/or illness of patients, and the use of masks may also play a part in the intensity of claustrophobic feelings.

The final personal characteristic recommended by four nurses is being physically fit. This characteristic was discussed in several different ways. One nurse stated that it was initially very reassuring to be physically fit.

> I am physically healthy and didn't have any problems with my ears or clearing like other people have.

While other participants pointed to the reasons that physical fitness is beneficial.

> You have to be healthy to dive so you have to keep yourself in good shape and do all those stress relievers, in terms of diet and exercise, to keep yourself a healthy candidate

> or you're going to get yourself bent [decompression sickness].
>
> And the only other thing I would suggest is ... that they [nurses] be in good health and reasonably fit because it is an effort to breath that thicker gas down there....

These recommendations were supported by Bond (1966) who emphasized the need for personnel to maintain good health, especially pulmonary fitness.

The participants not only identified these personal characteristics but also suggested that nurses coming to work in HBO should have certain competencies. The most frequently recommended skills were effective communication and the ability to establish relationships, however, being organized and having good assessment, listening and observations skills were also considered to be necessary.

Nine of the participants commented that being an effective communicator was a vital requirement to work in this area, and the majority felt that communication was especially important with the anxious patient.

> You need a personality like _____ or _____ [names of two senior HBO nurses] where you can relate to people well, so they feel at ease with you, because a lot of nursing care is dealing with the fear that people have with these chambers. You want them to feel comfortable and easy, that they can talk to you easily. That's a great asset.

> I think communication skills - people seem to trust me when I'm speaking to them - I think that really helps.
>
> ...alot of it was helping you reassure people. Some people need an extra little bit of attention going down, and we do dives sometimes with two or three patients in the chamber .... They're frightened, but they don't want to be frightened because it's their fifth or sixth or tenth dive .... Tell them, 'it's alright', no matter if it's their 50th, 'that you can stop us on the way down if you're having a hard time clearing your ears' ....

Being able to communicate empathy for patients was considered necessary as noted in the following responses to the request to describe the most important HBO nursing qualities.

> Empathy with patients when we are compressing - sometimes you need alot of patience because they just want to give up, they can't swallow or can't keep the mask on - and kids [are a challenge].

Two other respondents commented on the importance of communication in decreasing the anxiety related to the oxygen apparatus. As is reflected in the following statements both methods of administering oxygen - either with the more popular Scott face mask or an inflated plastic bag placed over the head - can be uncomfortable and confining in their own unique way.

> You have to have alot of patience with these people because they don't want to keep their

> masks on - they want to take it off or they don't think they can breath. So you have to have a calming, soothing voice in there. You have to be ready for people who don't like masks [or] the confinement.
>
> [It is important] really being able to support patients through that period when they have a bag over their head - because it's not pleasant. And as nursing staff you have to make it tight around the neck, you can't let any oxygen escape.

One participant focused on the link between patient education and anxiety reduction, she listed these two competencies as being valuable:

> Having a good enough understanding of what was going on to be able to relate it back to the patient, and doing some teaching with them. Being able to keep the spirits going in the chamber .... .

One senior hyperbaric nurse felt that there was a difference in communicating with the critically ill patient in an ICU setting and the ambulatory patient often treated in hyperbaric chambers.

> The thing about critical care is that often you can work a long time without even having to talk to a patient. The 'bread and butter' of the [HBO] unit is people that come in off the street and if you're dealing with things like claustrophobia it's really important that you're also able to talk to them and deal abit with that anxiety - give them credit for what they are saying ..... You have to be able to talk well with people and relate to people.

The importance of the nurse's ability to communicate

effectively and establish relationships was not only mentioned with regard to calming the anxious patient but identified by twelve nurses as a valuable skill to use generally in hyperbaric nursing. More than half of these 12 nurses suggested that it was beneficial to establish trusting relationships with patients, while the remainder of the group felt that relationships with other members of the clinical team were more vital.

Relationships with patients were deemed to be essential by the nurses because of the need they saw to support and counsel patients with painful, long-term illnesses.

> They are usually dealing with some difficult diagnoses - the oncology patient or the chronic care patient - they have been in pain for years and years. So you really need to have some good social skills, to be able to bond quickly with these people, to have a therapeutic relationship in less than two hours [usual treatment session] that benefits both people.

> Because of the kind of patients that you will treat - for longterm patients there must be an empathy, there must be a willingness to spend time with them, to be more than just clinically orientated to the clinical problem or the medical/surgical problem. The other people that work here have alot of liveliness and warmth that they bring to the patients. I am very glad for that.

Two respondents mentioned briefly that "dealing with

people and trying to put them at ease" was important and to be more specific it was felt that "interviewing skills, personal relations [skills] are certainly of benefit."

One individual commented at length about the importance of relationships with the patient as well as the team.

> I find working in a small unit, some sort of preparation in human relations is important because you have very close contact with people all the time.... It's very important ... if you are in the chamber with patients, you have to deal with patients inside - it's very close. At the same time you have to be confident with who ever works with you from the outside because to me safety is very important - you have to trust the other people that operate the whole thing.

This nurse similarly suggested that skills in interpersonal relationships are needed because the clinical team is usually small and "you work closely together."

Having confidence in and trusting the other team members, especially the chamber operators, emerged as the common thread throughout all the references to this issue. The nurses needed to know that they could rely on the team's knowledge and quick action during an emergency.

> You need absolute confidence in the team taking you down [because] there's danger to the job.
>
> When you run into oxygen toxicity or problems in the chamber... You need to trust the people outside to get you to the surface and tell you exactly what you need to know in order to do it.

Another nurse supported this by stating that she "always felt confident in the controllers, [that they] knew what they were doing", while her colleague felt that controllers played a valuable role in that "reminders are important from people outside." This nurse went on to say that "relying on others for guidance" meant that the nurse needed to be "able to take guidance or suggestions from others and be able to perform under watchful eyes."

Being organized, possessing highly effective listening and observation skills, and having quick assessment abilities for patient as well as mechanical problems were competencies also mentioned by the research participants.

Organization skills were considered by three nurses to be beneficial skills to have for a beginning nurse. One respondent mentioned organization as just one of several abilities that she found useful, while another

individual believed that "being organized and coordinated [was crucial] because I was by myself." The next participant stated that her abilities to be organized helped her especially when she was in the chamber with several patients and she need to "get all the patients masks on after the [air] break." It can be a challenge to assist all the patients at varying levels of awareness to replace their masks at the same time.

Four respondents commented on the need for effective listening and observation skills. Though some of this group commented briefly about this, two nurses suggested that the reason this ability was important is so that problems could be anticipated and hopefully prevented, as was evident in the following comment. The necessary skills are "observation and just being able to anticipate any problems that may occur." The final rather graphic comment on observation skills denotes the nurses strong emphasis on this ability, she said:

> Any idiot knows when someone is dead, hopefully you'll know ten minutes before they're dead.

Superior health assessment skills allow the nurse to anticipate potential problems and avert them. Therefore having keen observation skills is closely related to the

last of the recommended nursing skills, that of thorough nursing assessment of the patient. Four people who deemed this competency invaluable also felt that the hyperbaric nurse should possess superior abilities acquired through much practice.

> Certainly patient assessment skills [are important] - just watching how the patient is tolerating the whole dive plus all your IV maintenance, taking blood pressure, etc.
>
> If I need to know something about [hyperbaric] pressures then I can ask, but my assessment skills are most important.
>
> I think that assessment is your number one key. I think that it is necessary to have very sharp assessment skills to be able to pick up these problems, because you are the only one often in there, or there's yourself and an RT [Respiratory Therapist] and they are not trained to do head to toe assessment. It's up to you to pick these problems out and relay it outside the chamber so the physician can diagnose the condition and prescribe treatment. I know that people who come out of nursing school, either from a diploma or a baccalaureate program, are prepared, they know how to do an head to toe assessment, but in these situations, especially if you're doing emergency dives... often you go to deeper depths, there's more risk of nitrogen narcosis, and you really have to keep your wits about yourself. It's good to have somebody there who does these types of assessment on an on-going, daily basis, so that it's automatic for them to pull this information out and zoom in on it and find the problem.
>
> You need a lot of assessment skills... beyond the assessment skills that one needs for

> normal physiology. [For example], how do you assess all of these changes [related to abnormal pathology] most of the time without a stethoscope because you just can't hear? Are you going to recognize [major lung trauma] in a noisy chamber when you can't hear lung sounds and you are going to be looking at purely clinical parameters?

As is evident the majority of the comments focused on patient assessment, however, one senior nurse stressed also the need for knowledge of mechanical assessment of the equipment and chamber itself. She stated that

> walking into a chamber and assessing the situation and immediately seeing what was missing .. and watching the patient [was equally important].

Additional Knowledge and Skills Required

The previous section has identified the personal qualities and competencies that a nurse should bring to hyperbaric nursing. This section identifies additional knowledge and skills that must be initially learned to work successfully in this area. The knowledge and skills which are related to understanding the hyperbaric chamber, the process of compression and decompression, and any modifications required to Intensive Care equipment for HBO use are detailed and comprehensive, so

much so that the suggestions offered by this group of nurses are enough to comprise the core curriculum of an introductory course for hyperbaric nurses. The knowledge and skills identified are divided into two main categories: the largest is course content, however suggestions with regard to course format form a small but important category.

Course Content

The most frequently identified topic that needed to be addressed in an introductory course was the kinds of patient conditions treated in the chamber. The next most frequently suggested topic was the need to understand human physiology and the changes that occur during a hyperbaric treatment. Most of the sixteen comments on patient conditions reflected the need to be very familiar with all of the diagnoses for which patients would be treated with hyperbarics, as is evident in the following statements.

> You need to learn about all the disease syndromes, such as gas gangrene and embolisms, etc.... and the important signs and symptoms to be looking for.

> With regard to designing a clinical training program for nurses, I really think you need a basic rundown of the type of patient you are

> going to see, why they are in that state, what the purpose of the treatment is and what the expectations are.
>
> I think you do have ... to know the signs and symptoms of what you are dealing with, whether it's gas gangrene, air embolus or carbon monoxide poisoning - what ever you are going to dive.
>
> I would really get into the kind of patients you have there and why you treat them....

Some respondents identified specific conditions that they would want to have taught, as presented in the following comments:

> Recently a number of our patients are in the category of radiation influences [necrosis] and I know I don't have any background in radiation, except X-rays - I would like to have some background in that.

This nurse also went on to mention the need for information on patients with gas gangrene, stating that "basic principles are mandatory but it would be helpful to have more detailed information."

> If I were designing my own program [I would include] the more frequently treated conditions such as osteomyelitis, carbon monoxide.... I think I would also go through a lot of emergency care - typical emergency care .... I would include what's expected in emergency care, signs and symptoms of carbon monoxide and carbon monoxide extended, and gas gangrene - what you can expect and what your nursing duties will be.

This nurse suggested that she would also include minor to severe cases of decompression sickness. The next statement stresses the importance of teaching about emergency treatment as well as elective patients.

> It is important to go over the diseases that can be treated ..... like burns and skin grafts (they're not difficult) but when you're dealing with poisonous gas inhalation, then you've got a whole new 'ball of wax' because in addition to the fact that the patient is all ready in a foreign environment, you throw in another gas which [complicates the situation] even more.

One respondent suggested the following method of organizing and teaching the disorders that are treated with hyperbaric oxygen therapy. She recommended that, if time is limited in the course it would be ideal "to have exposure or experience with the different types of illness that you'll see - the emergency ones as well as the day-to-day cases ... and perhaps cover the types of cases you'd see more in your area."

In the previous comments the need to address the nursing interventions likely to be used for each of the patient diagnoses was implied, however these two final comments emphasis the value of specifically teaching the relevant nursing care.

> I think you have to go into hyperbaric medicine. There must be specific nursing interventions in hyperbaric medicine that have to be spelled out for each condition.
>
> The majority of the program I would really focus on specific disease entities and the nursing approaches for those.

This nurse went on to say that nursing care plans need to be devised for all of the diagnostic categories for which HBO is utilized, and the complications of this treatment such as oxygen toxicity and anxiety related to confinement.

It was felt by fourteen nurses that a good understanding of physiology was a necessary component of an educational program. Most of those who mentioned this topic listed it with other components of the course context, however some participants did elaborate on the subject.

> You certainly need to have a good understanding of the physiology.... so I would work my way through the systems [of the body] with some lectures, learning material and reading material. Obviously pulmonary physiology would be very important .... Cardiac physiology [needs to be addressed] - you get some significant changes there. We dive alot of [patients with] carbon monoxide and the potential for both brain and heart ischemia is there.... So I think I would explain the basic physiology, then take them through what is normal physiology in pressure-related situations and then the abnormal.

> I think it would be nice to have... a background in anatomy and rudimentary physiology that would focus on ears, eyes, skin, lungs, musculature, gas exchange, responses to pain and blood gases.
>
> Well obviously I'd go into the physiology - the gas laws....
>
> It's good to have a good understanding of what is happening - the reasoning behind it.
>
> Topics for classroom teaching would include alot of the physics and physiology because then most of the disease processes fit in, they follow from that.
>
> I would include everything on the Checklist [Educational Needs Assessment Questionnaire] - absolutely everything with emphasis on physiology and what to do in an emergency.

Two individuals similarly suggested that physiology be the first and only subject taught to course participants prior to them going into the chamber for pressure testing. This is a standard component of most if not all courses in hyperbaric medicine, in which novice nurses with supervision are put under pressure in the chamber. This dive serves as a test to ensure that individuals who have problems with ear clearing or confinement are identified and disqualified from working in the HBO unit. Two nurses suggested that this test should be done early in the hyperbaric course to save time.

> If you give a bit of information about the physiology then do the test dives not as much time and energy of both parties is invested.
>
> You'd have to start with the physiology and then you need to test whether they can tolerate it themselves - to be pressure tested.

Educating nurses about the physiological changes is seen then as not only a crucial part of an educational program but a topic that should be introduced at the beginning since many other subjects would follow from it.

Suggestions to include information on a variety of mechanical and technical equipment was made by thirteen nurses. Several general comments focused on pressure-induced changes to equipment.

> In a course you need to include what changes in the actual equipment, IV apparatus, etc. when you go down. .
>
> I would probably go through quite an indepth orientation to the equipment and ventilators.

Two other respondents suggested that nurses needed to know specific equipment alterations in particular, "volume changes in fluid" and how pressure effects intravenous therapy .

Nurses new to the area need to understand that certain equipment or electrical components of apparatus, such as the controls, have an increased risk of igniting

a fire or may be sensitive to pressure and are not placed in the chamber, as is mentioned in the following comments.

> I can't think of any procedures that were unfamiliar, maybe the fact that you defibrilate and someone from the outside charges for you.
>
> Occasionally ... you're in the tank dealing with controls that are outside like ECG and BP controls.

Although it is essential for fire safety, there are inherent disadvantages to this arrangement since nurses inside the chamber may not be able to directly view or control the apparatus.

Other participants recommended attention be given to the type of oxygen delivery system used, including ventilators, and how they may need to be adapted to the patients condition.

> I was kind of surprised about the plastic bags used for hoods.
>
> The manner in which oxygen is delivered to different patients depending on the patient's needs (ie. if they could tolerate a face mask, being hooked up to the ventilator and thing's like that) should be addressed in a course.
>
> Nurses need to learn how to deal with the intensive care patient in the chamber as far as working with a ventilator and the various lines that they would have.
>
> You need to learn about handling a respirator

> and the different kinds of masks - the hood and the mask itself.
>
> I think the biggest frustration was working with the Bird ventilator. It was almost impossible to get the thing regulated. You really couldn't when you were going down and coming back up. You had to just bag [manually ventilate] the patient.... Once you were settled, it wasn't too bad but that did definitely tied up your hands. You needed somebody in there going up and coming down simply because one person had to bag....

Enclosed systems, such IV tubing, or catheters with balloons, require special attention so that they do not suffer volume changes as ambient pressure changes.

> Well, some small things should be included like IV tubing, what happens to IV bags and closed things like catheter bags.
>
> If you have tubes you have to know what's going to happen to the cuffs and all that.
>
> I was with patients that were intubated and trying to be aware of the cuff in which you put saline you don't put air. That was a totally different type of nursing for me.

The final comment on this issue vividly describes a situation which speaks to the technological and organizational demands which the nurse must learn to manage in this restrictive environment.

> You are in a small chamber, especially with two ventilated patients and an R.T., you are bagging [manually ventilating] one patient, trying to keep all data clear on two clipboards, trying to move around to check a B/P that you can't hear; there's no method of

> monitoring the arterial pressure; you have an inotrope controlling the patient's blood pressure but you can't count the drops because the IV chamber is filled up.

The fourth most recommended topic for an introductory course in hyperbarics is the effects of pressure which was identified by ten respondents. Two other topics - the basic principles of hyperbarics and barotrauma - were recommended by a smaller number of respondents (4 and 5 individuals respectively) but are closely related to the effects of pressure and will therefore be discussed in this segment.

The impact of increased atmospheric pressure is partially responsible for the therapeutic effect of hyperbaric oxygen therapy but also results in consequences that are unwanted and need to be prevented, as reflected in the following comments:

> The whole effect of hyperbaric pressure on your physiology is very different than anything else on systems. It is essential to understand [these effects] for your own safety as well as for patients and [for] carrying out patient care.

> It is important to understand the effects of pressure itself - not only on the patient but on the equipment.

> I think that they should have some theory, even the gas laws and physics because you will need to know what changes will occur to equipment.

One of the major concerns about the effect of pressure in hyperbaric nursing is preventing barotrauma, that is, the pain or damage that can occur when pressure outside a body space (such as the ears, lungs or sinuses) differs from within the cavity and is unable to be equalized.

> You certainly need to have a good understanding of the physiology and the range of barotrauma that can occur, the effects that pressure can have on people and the side effects of pressure - what can happen with breathholding, etc.
>
> You need to know techniques for assessing if the non-verbal patient is having pain due to pressure and helping a person who at one foot [depth] is experiencing ear pain.

Another nurse similarly emphasized the importance of being able to detect non-verbal signs that a patient is unable to clear his ears. This person stated, "I actually witnessed an eardrum rupture because of inability to clear the ears." The patient did not ask to stop the increasing pressure and in that case it would be the nurse's responsibility to intervene. She went on to say, "I learned very quickly that this is an important type of assessment."

The final suggestion related to barotrauma stresses that it is the responsibility of the nurse to not only

convey to the patient a variety of methods for ear clearing but she must also understand how to adapt her teaching to the needs of the patient such as children of various ages.

> It's nursing who goes into all of the support to get a small child to depth and to support them during that dive, especially the ones that are awake enough to know what's going on. It's all the pediatric skills that you use in terms of identifying what developmental level is this child at and what are they likely to be entertained by. How can you divert them? How can you teach them to Valsalva? It's not easy to teach a three year old how to clear their ears? Or how do you do a three week old infant?

The behaviour of gases under pressure are explained by theories of physics called the gas laws. It is therefore vital to know these principles so that one can understand how hyperbaric oxygen therapy has a therapeutic as well as a negative effect.

> Since hyperbarics is based on the gas laws, I think they [nurses] should have a better knowledge so that they can accumulate and build on this basic knowledge and so that they understand how things behave under pressure and how to make changes.

> I would definitely include the actual mechanism of action of the hyperbaric chamber... How does it work? Why does it promote healing? Why would you use if for gas gangrene? How does it improve the oxygen [supply]? Why does the blood plasma (not only the hemoglobin) become supersaturated with oxygen?

> Knowing the gas laws [is important] and understanding where you encounter it and what to do about it.
>
> The gas laws would be a really important part of it [a hyperbaric course].

Three participants felt that the basic theory was important enough to be taught at the beginning of the course, as was recommended previously for the topic of physiology, followed by pressure testing in the chamber.

> The basic theory such as compression and decompression, should be well taught at the beginning before nursing care and [you should also include] the different ways that hyperbaric helps the different diseases.
>
> Probably I would go the first day with an introduction to the basics - physics and safety ....
>
> If I were designing a program myself, the first things that I would go over are the actual theories... Henry's, Boyle's and Dalton's Laws.

This nurse went on to say that she found these theories "difficult to grasp" and practical demonstrations were important aids to learning such as "filling a glove with air" and bring it in the chamber during the test dive.

One individual elaborated on the influence teaching these basic principles may have on the attitude of the nurse being introduced to hyperbaric nursing.

> The thing about hyperbaric medicine is that it seems to help somethings that you can't help any other way, but the other thing is the miracle that happens when you treat divers when there is no other treatment for it. When do you even see something like that - so that the nurse has some kind of real inspiration for what she's doing? That whole attitude will open the nurse's mind so that she will really be receptive to the whole program. That seems to be what makes or breaks a nurse in this area - her strong belief in the value of this treatment.

Having a knowledge of operating the multiplace chamber and emergency care were topics suggested by ten nurses as being necessary to include as a course component. It was believed to be an advantage to at least know rudimentary knowledge about the chamber.

> You need basic information on how the chamber runs using a diagram.

> There is a need for the nurse to have at least some knowledge of running the multiplace chamber from the outside and the inside.

Several respondents offered a rationale for including this topic in the course content.

> I would probably go through... the actual diving manoeuvres of the chamber - now nurses don't handle those, respiratory technicians do - but personally, I would love to get my hands on that machinery and start to do some of that.

> I'd like to see more of that [the operation of the chamber] included in my area. There isn't an actual need because of the number of respiratory therapists that are trained.... I

> think it would enhance the nurse's feeling of being a complete part of the team.
>
> Certainly I think people need to understand the chamber ... you need to know the basics of how that chamber works and you need to know the basics of how to work it yourself, because it decreases anxiety alot if you know you can get out by yourself. If anything were to happen to both controllers or something malfunction on the panel, you want to know that you can take control of the chamber for yourself.
>
> It would be a nice feature to know something about controlling the chamber. I know in this unit we are heading in the direction of being functional at that level but even at a rudimentary [level] you should at least know, what is normal and the variation from normal,... how to diagnose problems - that could prevent an accident from happening.

It would seem that teaching this topic in a hyperbaric course may satisfy a wide range of needs from simply acquiring new competencies to enhancing the nurse's feelings of being a part of the team to, most importantly, accident prevention and safety precautions.

The majority of the ten nurses who recommended teaching about emergency care were focusing on unexpected changes to patient's health status occurring in the chamber, as seen in the following statements.

> You need to have emergency training in recognizing pneumothorax, especially with ventilated patients - dealing with pneumothorax, cardiac arrest and seizures.

> You need to know all the things that can go wrong, like tension pneumothorax and to treat ... all the emergencies.
>
> You also have to know ... what you are going to do in certain situations - run through an arrest - how to deal with an algorithm - what are you going to do with someone with oxygen toxicity ...?

Sometimes very practical considerations in an emergency need to be addressed, especially in a restrictive environment.

> One time we had a very large man in the chamber, and he had had several dives, I had the side rails down on the stretcher.... Well, this patient had a seizure with no warning at all. I had valuim drawn up but I couldn't reach anything. I was simply trying to keep him on the stretcher and get his hood off. So I learned my lesson, when I have someone on stretcher I always have the sides up.

Comments from other nurses suggested that factors, such as timing and being isolated increased the demands placed on nurses during emergencies in the chamber.

> When you work in this kind of nursing, in the chamber with the patient, the time element is very important. You have a certain time frame to complete all these tasks and if the patient condition changes you have to do specific things in a very short time and also rely on your own judgement to deal with the emergency.
>
> I think I would also go through a lot of emergency care - typical emergency care. During emergencies you are the only one here besides the doctor....

> You're by yourself so it's important that you are able to handle emergency situations.

The factors of having a limited time frame and often being the only nurse in the chamber are usual occurrences in hyperbaric therapy and strengthen the recommendation that nurses be taught in a hyperbaric course to anticipate and intervene when the patient's health status worsens during treatment.

Treatment profiles or tables are the protocols which dictate the length of time and amount of pressure used in hyperbaric oxygen therapy that are specific to each diagnosis. The nine participants who felt this educational component was needed for a hyperbaric course seemed to closely link this topic to the patient's medical diagnosis, as seen in these comments:

> I would list each disease entity and what we need to know about it, for example, the depth and length of dive, the important signs and symptoms, what to be doing at certain times in the dive and the dive chart [treatment table].

> There are different approaches to the treatment, for example, for someone who has gas gangrene with radical surgeries and with carbon monoxide poisoning, I would just try to cover all of those things....

> After the background information and a test dive if the nurse is comfortable with that then go on to the various treatments that are

> done, why they are done - go through the protocols.
>
> What illnesses would be treated by it, why those illnesses seem to improve with it, what each illness requires from hyperbarics, how much oxygen, how much depth, how much pressure, why the [air] breaks, how long you keep people on 100% [oxygen] ....

It would seem, then, that the medical conditions for which HBO is used could be taught initially, followed by the treatment profiles and the nursing interventions for each diagnosis, as the following comment emphasizes.

> The majority of the program I would really focus on specific disease entities and the nursing approaches for those.

Most of the eight nurses who proposed patient education as a topic listed in point-form a variety of issues that needed to be addressed. The following list reflects their suggestions:

> Patients often do not realize that they will not get wet especially when it is referred to as a 'dive'. The fogging [inside the chamber] especially in the summer time is alarming to patients. Patients who are claustrophobic may be 'set off' by unexplained or unexpected noises. Voice changes are humorous.
>
> Things that patients shouldn't do going down and coming up. How it's going to feel for the patient at the bottom.
>
> Why [patients and personnel] can't cough or sneeze when travelling up and down [when pressure is decreasing or increasing in the chamber].

One nurse stated that "the main problem she encountered was educating people so that they would not react to the closeness - the idea that you are in there and can't get out", but other issues to address with the patients are "the coolness, the heat, the mist, the feeling of pressure on the ears... and briefly how the chamber is controlled."

An experienced hyperbaric nurse reported that she had encountered several situations where either the patient was semi-conscious throughout the treatment dive or an unconscious person (most often with carbon monoxide poisoning) woke up in the middle of the treatment and was very challenging to educate and orientate.

The final comments emphasize the value of patient education and need for explanations that are easy to understand. It is especially important that nurses can explain to the patients in a simple way how hyperbarics impacts on the different diseases.

> Patient education is important but it must be done in a simple way.

> The nurse role is important in this area, ... with children - considering how to divert them and how to teach children of varying ages to valsalva (a technique to equalizing pressure in the ears).

These statements reflect the value of patient

education generally about hyperbaric oxygen therapy and point to two central themes, firstly, that of explaining what is expected of the patient when the pressure in the chamber is being increased and decreased, and secondly what environmental changes the patient can expect during treatment in the chamber.

The need to teach nurses about the topic of wound healing was identified by six participants. The first of the statements about this issue addresses the need to educate nurses about the stages of wound and bone healing.

"I would probably go through quite an indepth teaching in wound care." This nurse then elaborated at length about the abrasive qualities that she and other staff members have observed with regard to some wound cleansing solutions and the importance of addressing these issues. You need "to get a better understanding of processes like new bone growth with osteoradionecrosis or osteomylitis."

Several of the nurses comments spoke to the value of addressing not only wound healing but also drawing attention to the emotional impact of problem wounds for the patients and nurses.

> One thing comes to my mind about clinical teaching would be to really get in tune with wound healing stages as well as how to measure and document changes in wounds. I found that patients are very focused on their wound - how is it doing today? Because [healing] is very very slow... You have to keep supporting the fact that the wound is getting better.
>
> I would suggest that you spend a day on a variety of units to see wounds that the nurse may encounter in the chamber. In the Surgical Intensive Care Unit, the [patients] sometimes have major abdominal wounds - some people have no abdominal wall at all - [for nurses] who have never seen that it might not do a lot for them in the chamber, if something went wrong.

The final statements recommended the inclusion of infection control along with wound healing.

> The third [most needed topic in a hyperbaric course] would be infection control and how important that is, because you are dealing with high oxygen concentrations.
>
> Infection control is another area of concern, as is wound care with gangrene patients - basic principles are mandatory but it would be helpful to have more detailed information. With wound healing - [you need to include] what is actually going on here on a cellular level and how you can influence that with chemicals you put on it, such as saline, duoderm; the wrap you use and the pressure you use. They are all important variables and they play a role.

Most of the statements made by seven participants addressing the issue of safety in a hyperbarics course specifically focused on the nurse's health and

precautions she must take.

> The other part [to include] is safety - the way it is set up here is very safe and [the nursing supervisor] emphasizes that you try to avoid repetitive dives and not dive again for another twelve hours or longer.
>
> You need to know What are you doing to yourself when you go down in [the chamber]? A lot of that isn't talked about - pregnancy was mentioned....
>
> You have to spend a lot of time on safety precautions.

This nurse went on to elaborate on educating the novice nurse about risks to the patient's and the nurse's health, such as diving when the nurse is tired.

> I think sometimes people underestimate the damage that they can do because of the pressure in the situation - 'We need you to dive. There's just nobody else.' I admit I've dove tired - I've dove after 24 hours with no sleep when we just had no one else to dive and you are putting yourself very much at risk. You're putting your patient very much at risk because your judgement isn't bad enough as it is at 60 feet let alone adding fatigue on top of that.
>
> Risk factors should be covered in more detail [than in the orientation, because] I couldn't think of many. Risk factors for the nurse, in particular [should be addressed] but also for the patient.
>
> Some of the things that I learned that were happening while I was down there made me sort of say, 'Do I want to be down here?'... I think you have to be aware what's happening to your body as well as to the patients, that way you are better able to understand the

> precautions... and it makes people easier to comply when they know why.
>
> Do the complete physical to make sure that you're physically fit and [cover topics such as] using fire retardant material and no makeup... and checking for oxygen leaks.

The educational issues related to safety for the nurse would include ensuring that the nursing personnel are physically fit to dive, emphasizing the precautions that must be taken when going into the chamber with regard to personnel and equipment, and establishing policies that stress safety on issues, for example, like repetitive diving. One nurse ranked the topic of safety in general high in priority, she made this comment.

> The second [most needed topic to be taught] would be fire and safety within the hyperbaric chamber itself.

Course Format

The information on the course format begins with twenty recommendations, from the nursing group studied, which relate to timing and organizational issues of the course. Suggestions from two of the twenty nurses identified the importance of being consistent with the principles of learning, such as "start off with something simple, and then move to the higher technologies.... You

don't have to be so technical in the beginning." The majority of respondents (n = 11) who commented on organizational issues emphasized the need for both a theoretical component followed by clinical experience.

> Initially, I think it would be nice to have all the lecture material at the beginning, then you've got the full background knowledge for when you go to do some hands on - you are applying the knowledge that you've gained.
>
> I think the theory will have to be combined with the clinical - it couldn't just be all clinical.
>
> I feel that the orientation should include two components - one is the theory - based ... and the second part is the clinical component so that the nurse will have the hands-on experience with the type of patient and environment they will be working in. So in combination with these two parts you can prepare a nurse better.

Several interesting comments were made that support the development of a hyperbaric course rather than on-the-job training.

> I am a firm believer in formal lecture, because if you are relying on a one-to-one on-the-moment type of orientation, I think you are more apt to miss things, whereas if you have a formal lecture you are more apt to get all of the points.
>
> You need to have more training than what I got. I was self-motivated and read a lot but some nurses don't do that.
>
> Teaching in hyperbarics is [limited]. The hyperbaric nurse is very good in teaching, and

> supporting new nurses by diving with them the first several times. There is a real need for this hyperbaric course so please set it up soon.

This very experienced hyperbaric nurse suggested that certain topics be taught in the classroom because

> If I am with patients in the chamber with the nurses [new to hyperbarics] ... it is not very wise spending alot of time discussing gas gangrene when they [the nurses] are getting over their fears of clearing their ears and watching patients for breathholding.... There is so much to be taught and I can only do it if there is not too much going on at the same time.

Five of the 20 nurses proposed that a test dive, where the nurses under supervision are introduced to the experience of pressure in the chamber, be another course component along with theoretical concepts and clinical experience.

> Probably I would go the first day with an introduction to the basics - physics and safety, and a tour, and probably a dive the next day to be able to relate the information and bring things back to the classroom.

This next nurse commented at length about the value of theory and practice in a hyperbaric course and then recommended that the test dive be conducted in a similar way to her first chamber experience in which "they let you have an opportunity to play around with the chamber and they got you to relax and feel the experience of

thick air and what it does to the brain." This last reference to test dives offers a rationale as well as a suggestion.

> I think you have to understand your own feelings of what's going on while in the chamber so that you can put that on the back burner when you are with the patient and attend to them. I think you should first have a dive alone with the doctor, then a dive with another nurse and then alone with an elective patient.

The final suggestion about the course format concerns the issue of the length of the course, which five participants addressed. Four of the five nurses agreed that a one week course would be beneficial but would not be long enough to give attention to all issues.

> I didn't have a training program and I think that I could have gained a lot more from that .... I think a structured, probably week long program [is needed].

> I think it's a pretty comprehensive thing, I think you could do it in one week and then as your go on do more because you can't have information overload....

> The time frame for the course (because of the budget constraints and time constraints) you should try to complete the course in one week. One week is not quite enough... but I think most centers try to include everything condensed in a week.

One respondent felt the course should be longer and less concentrated in one short time period. She

suggested a two week period or "even if you stretched it over a month... like few hours at a time because it's a lot of information and it's quite a heavy load on people's minds."

Three participants suggested these methods of facilitating classroom teaching.

> A basic pamphlet, probably would take twenty pages and would be beneficial.
>
> I think I would include [in a course] alot of reading and research material.... I would go through several simulated case studies of patient conditions.
>
> Using tapes, either audio or visual tapes, slides, diagrams, pictures of equipment are unimportant. Movies, hands-on demonstrations - that's what I would benefit from in a course.

Summary

Beyond the basic nurse education it would seem that having taken an Intensive Care Nursing Course with experience working in an ICU setting are strongly recommended by this nursing group as pre-requisites for working in a hyperbaric unit. Furthermore, this education and experience is considered to be more important than diving courses or diving experience, although course work and experience in diving did draw a

number of nurses to this clinical specialty as well as provide them with relevant education and an awareness of some of the more risky behaviours practiced by some divers. Twenty-eight of the 32 nurses had taken an ICU course and this may have biased their opinion on the issue of ICU education and experience. However, it seems likely that in as much as hyperbaric nurses must be able to deal with critically ill patients and the unforeseen emergencies that can occur in HBO chambers, the conclusion that ICU knowledge and experience is required in hyperbaric nursing is valid, not only for the clinical expertise it provides but also for the self-confidence that it fosters.

It is also the opinion of this group that nurses bring to hyperbarics a combination of adaptive personal characteristics which are essential to buffer the strain experienced by the patient as well as the nurse, and to allow them to assist patients to deal with their illnesses. The personal characteristics for hyperbaric nurses suggested by this nursing group are not surprising in view of the physical, environmental and professional demands of the pressurized environment. Confidence, seen as the most important quality, may not only enhance

success in hyperbaric nursing but may also be linked to the very reasons nurses are attracted to this unique setting. It is understandable, that the need for confidence and the ability to handle change is identified as valuable in this study, because of the level of independence and isolation associated with hyperbaric nursing.

Other characteristics suggested, such as being able to work in small places, handling change calmly, and being physically fit, may also contribute to successful performance in this area by enhancing the physical or emotional comfort of the hyperbaric nurses.

Communication stood out as the most important of the advanced clinical competencies, especially for the anxious patient. It was also proposed that anxiety may be increased by many different cumulative factors: such as fear of mechanical apparatus or even the chamber itself, concerns about the process of pressurization, such as ear clearing; difficulty in expressing needs, for example with children; and the nurse's own adjustment from the non-communicative to the communicative patient.

The importance of establishing close relationships, has been introduced in this section. However, most of

the other participants, although they did not identifying it as a needed skill, discuss close relationships with patients in many positive contexts in other parts of the study.

Because the patients health can change rapidly and serious problem can develop the nurses' observation and assessment skills need to be above average and she needs to use them almost instinctively. Organizational skills were considered to be necessary to attend to the many tasks the nurse may have to complete at a given time. In general it was felt that several factors including the level of patient acuity, the complexity of the chamber and the isolation seems to necessitate that the beginning hyperbaric nurse possess advanced skills and qualities that enhance success and ensure optimum patient care.

The additional knowledge and skills deemed to be essential by these Canadian nurses was extensive and would need to comprise the majority of an introductory course content. Understandably the highest ranking topics concerned the kinds of patient diagnoses that nurses would encounter, followed by the physiological alterations induced by hyperbarics and the mechanism of action. The effects of pressure was a topic that was

highly recommended for inclusion in a course not only the physiological effects of pressure such as barotrauma but it's impact on equipment. Chamber operations were also considered highly essential, most probably because the topic is not usually addressed in the introduction to hyperbarics since it is mainly the domain of Respiratory Technologists. Nurses did express an interest, however, in having some knowledge in the event of an accident. These topics were considered to be even more essential than emergency care and safety precautions possibly because these highly experienced nurses may not consider challenging situations to be threatening or because they appreciate the importance of preventing accidents through education and awareness. Finally, treatment profiles, patient education and wound healing were recommended as necessary components of an introductory course in hyperbarics reflecting the need for detail in both educating nurses as well as patients because of the technical complexity and uniqueness of this specialty.

Recommendations in the smaller category of course format centered around the length of the course and most importantly, the organization of the course components. It was felt by the majority that there was a need for a

theoretical component followed by a test dive and clinical experience. Most of the nurses who commented on the length of the course agreed that one week would be most practical.

Job Satisfaction

For this category of responses job satisfaction is defined as the pleasant feelings and challenges associated with working in a hyperbaric unit. The positive aspects of hyperbaric nursing outweighed the disadvantages, and the satisfying factors that the nurses viewed as 'challenges' were regarded as desired stimulation rather than threatening events. The word challenging also meant different things to different nurses at different stages in their career, as this nurse indicated.

> The word challenging varies according to what stage you're at. It might be challenging to get through the day or through your first dive by yourself.... There are many things to challenge you in this area....

The most popular quality attracting nurses to hyperbarics was identified by 15 respondents as it's uniqueness and difference from other areas of nursing. This quality is reflected in statements such as.

> I like all the diversity, the different patients.... It's so different, it's brand new.
>
> I think it's just the challenge, it's something different.

Three participants offer separate reasons as to why this clinical specialty attracts nurses and keeps them involved for long periods of time.

> Nurses that are attracted to specialty areas are sort of a kin group, they're always looking for something that's very different. There's certainly a uniqueness in doing [hyperbaric nursing].
>
> You're called in to work with a whole different group of people, and [staff] are so easy going here, ... it's fun.
>
> It seems like a lot of fun when I come here; it seems so different and refreshing than ICU, even taking an ICU patient in [the chamber] is different. The psychological pressures are only on when you're in the chamber, when you're in ICU the pressure is on the whole shift.

The second most frequently mentioned factor contributing to job satisfaction was the relationship with the patients. Most of the 14 nurses who drew attention to this topic spoke at length, making very strong statements about their experiences.

> I find it interesting talking to patients. The kind of patients coming in here are dealing with conditions that are life-threatening [or chronic].

> I really enjoy talking to patients and developing my communication skills, ... this is one unit where I have the time to talk to them.

> I really enjoy getting to know the patients.... For me the biggest challenge is for them to learn to trust me.... [Because] most of the patients ... are patients that have dealt with hospitals for years, they don't have a trust for staff... because everybody tells them something different. [The patient contact in this unit] is definitely more intense. We are less than two feet away for more than two hours during the day so there's a lot of touching.

This nurse then elaborated with several examples of the warmth and trust that had developed in relationships with patients and nursing staff.

From the previous comments, it is apparent that the most important component of the relationship with patients is the ability of the patient and the nurse to talk. This may be particularly important for ICU nurses who may have had limited verbal communication with patients because they are intubated or have altered levels of consciousness, as can be seen in the following statements:

> It's a total change from the critical care setting - often the patients are more stable in the chamber than the patients I have on the floor. So, it's nice to be able to have patients often that you can talk to. So, I enjoy the people aspect of it. I think providing emotional support is something I

really enjoy doing.

> ...it's a real change but a nice treat when you get the patients that talk to you. They're not really critically ill but you still have to know what you are doing.
>
> You notice in ICU that staff babble all the time but if someone answers you, you jump.

Another participant initially presented an opposing view - stating that communicative patients may in fact threaten some nurses who are new and inexperienced.

> I think the elective patients are very knowledgeable and are sometimes a threat to people who ... come as backup from ICU, where you're not used to people talking and suddenly you have people talking to you and not only talking to you they are telling you what to do....

However this nurse went on to discuss at length the immense value of the nurse-patient relationship.

> You develop much more of a rapport than I've ever been able to develop in any other area I've worked in.... You are locked in the chamber for 2 hours at a time, with four other people, sometimes it's a group discussion that goes on and sometimes it's more of a one-to-one, or you get out [of the chamber] and go on with a one-to-one [interaction].

On a similar note the following participant expressed her observation that the close proximity of the people within the chamber enhances the rapport that develops.

> The physical closeness facilitates a warmer

> relationship because you are in such a confined area. I'm sure that contributes. If you're in there two or three hours with a person, you do develop a closeness.

Beyond the importance of communicating with patients, three nurses felt that the relationship with the patient afforded them the opportunity not only to talk to patients but to be able to use a holistic approach to patient care which is very rewarding.

> You tend to get a lot more involved in their total care and are more aware of what's going on [with the patient. You need to contact] other services to see what is available. You need to find alot of community resources. Actually it's a satisfying experience in that respect.

> I also find the very sick patient [challenging] where I can be involved with both the family and other agencies, such as Pastoral Care, Social Work. Other modalities that will add dimension... to a very rounded care for the patient.

The other satisfying aspects of working in hyperbaric nursing is the rapid response of patients to this treatment identified by eleven of the research participants. Several nurses made general statements about this issue.

> The rewards of patient's improvement and their acknowledgement is encouraging.

> It may not be challenging but it is rewarding seeing people healing.

Other respondents recalled their experiences of rapid improvement with specific diagnoses or patients.

> We did a carbon monoxide dive and it was an overdose (I see a lot of overdoses) and I like the fact that this man went from unconscious - a non-communicator to very communicative. Most overdoses don't have that quick response time.

> We had a patient that it [HBO] was his only possible route... We were absolutely astounded that this person responded so well, so magnificently.

> I saw a diver go in paralysed and come out walking. When do you ever see something like that ...?

This following comment is also related to having treated a person after a diving accident.

> It's very beneficial that when you're finished your dive the patient is getting better.

Three of the eleven individuals who remarked on the patient's rapid response to treatment also emphasized that hyperbarics may be used as a last resort often because of lack of information or reluctance on the part of medical staff. In this situation the patient's response is even more rewarding.

> ... very often the other medical services think that they have done everything they can for the patient, it seems hyperbarics will be the last resort... gradually the patient recovers - benefits from it [hyperbarics] so there is something right in front of your eyes that gives you a lot of satisfaction.... It's

like you are doing the impossible.

In discussing the challenges of treating people with chronic problem healing wounds, this nurse said,

> this is usually their last course. The [patients] have come here and said, 'I don't think you can do anything, but let's see you do it.' So it becomes a real challenge in the beginning to say, 'OK, I know where you're coming from, and that's alright. You will trust me, I hope.' and it's nice to see a couple of weeks later when they come in and say, 'Hey, look it did something!' and when they go out singing our praises, it's very nice to see.

The interest in new knowledge or a sense of independence that knowledge brings were the components that drew another eleven nurses to hyperbarics and was a sources of satisfaction for them.

> It seems really interesting to me and I've enjoyed learning something new.

> The reason why I wanted to go into hyperbarics was just for increasing knowledge - just an inquisitive mind.

> To be honest it was new - I started there when [the hyperbaric unit] was initially there and I just found it very interesting.

Beyond the interest in new learning some nurses seemed to have a stronger drive to expand their knowledge.

> It is interesting ... and gives you that much more experience.

> I was searching for a maximum knowledge gain in an area of nursing and it did meet my expectations to learn about hyperbarics.
>
> I like the fact that I have to go home and look up disease processes again. Sometimes if you have been doing something for a long time you don't have to look very much up. And it's nice that you have to go home and look it up.

Three of these eleven nurses specifically stated that one of the reasons they were attracted to hyperbaric nursing was because it satisfied their intense need to increase their independence or care for the most critically ill patients in ICU.

> I thought it might be a way of getting some of the sick patients [in ICU]. I like the added responsibility because you're in the chamber by yourself.... You're in charge down there... and that's nice. You don't have a lot of authority telling you what to do.
>
> I'm free to do what I want, I've got a lot of latitude and I think that's gone a long way to keeping people stimulated to work here.

The following enthusiastic comment, the nurse explained, was made in response to a colleague's negative comment about hyperbaric nursing:

> Well, it's neat because you're inside this chamber, although you can see everybody outside, you know that you can not just open the door and yell, 'Help!' It's just you and the patient there, if you run into trouble you really have to know what you're doing and be knowledgeable in what to do and what not to do.

The last comments suggest that there may be mixed feelings about the level of independence in the chamber. As previously stated some nurses found being in the chamber alone to be at times an unwelcome demand, unlike the individuals making the above statements.

Ten participants described hyperbaric nursing as unpredictable and exciting and therefore as an attractive area of nursing for them.

> It's exciting and non-routine.
>
> It's like magic, it really was.

Several respondents found the emergencies particularly exciting and described their feelings in this way:

> I love coming in for the emergencies.
>
> It's nice to come in on an emergency - you're in a whole different field, sometimes you're in the unknown. It's sort of an adrenalin rush.... Of course, I'm an ICU nurse I enjoy the adrenalin.
>
> I like the calls in the middle of the night - I really like those.

On the other hand two participants explained that even the daily treatments with elective patients can be just as exciting when you consider, as the following statement reflects, all the possible complications that may occur.

> On a routine day it's very routine ... but it's all the potential that can happen and that's very exciting.

It would appear that the excitement associated with working in hyperbarics occurs as a result of the type of patient treated, as well as the hyperbaric environment itself.

Five nurses indicated that there was a special attraction to this clinical specialty because it was rather elite, not only in terms of the advanced technological and clinical knowledge needed but also because there is a very small group involved in this treatment modality. The following sample of comments focuses on this issue:

> I like the opportunity to do something only a limited number of nurses can do.

> It's nice to be a little bit different as part of a small select group.

The term elite came up frequently in conversations with participants, however when the researcher used it during an interview one nurse responded negatively and stated, "It's not like that, dear." Another nurse suggested that wearing the Durette uniforms, which are fire retardant material and a unique gold color, made nurses who work in hyperbaric chambers stand out in the hospital

environment.

> Wearing Durette was a little unexpected.... We are identified any where in the hospital because of the color - it's like a trade mark almost.

Finally, the relationship between nurse's full-time employment and their on-call involvement with the hyperbaric unit was a source of satisfaction for five respondents. Four of the five nurses felt it was a welcome change from their regular job to be able to work overtime in a different environment.

> The reason I went into hyperbarics was that it was another option for making overtime, I can come in and just do three or four hours at a time.
>
> It's a great way to do overtime without burning yourself out in your own unit...
>
> I think it's nice to have an alternative part to your work, to be called in and not to have to go to the same place.

One nurse felt it wasn't so much the change that attracted her to hyperbarics but it was the natural blending of her personal interest in sport diving and her professional involvement in ICU nursing.

> I think initially it was just a natural extension of both my private life and my professional life [that drew me to hyperbarics].

The Challenging Patient

When asked to describe their most challenging hyperbaric patient, thirty of the thirty-two nurses interviewed responded, usually presenting more than one example (for clarity this material is presented in Table 5). Whether these experiences were a challenge in a positive or negative sense is included in the appropriate segment under Job Satisfaction or Job Dissatisfaction. Thirty-one of the thirty-eight comments on the challenging patient described emergencies. They were separated into two major categories: 1. those critical conditions occurring before treatment for which hyperbaric oxygen therapy is used (N = 20), and 2. emergencies occurring in the chamber during the treatment period (N = 11).

Most of the twenty comments relating to patients who were critically ill before treatment concentrated on the difficulties of caring for the unstable critically ill patient who would have one or several monitoring or treatments devises, including respirators, multiple intravenous (IV) or intraarterial lines and IV medications. A limited number of respondents spoke more than briefly about these issues as the following

statements reflect.

> The most challenging are the rather sick cases were you're titrating dopamine going down and coming up. It's difficult to do it properly and keep the blood pressure stable.
>
> A challenge would be a seriously ill patient normally straight from recovery or ICU, has hemodynamic monitoring. They are really sick, on inotropes and support drugs.
>
> Patients on inotropes [are challenging] and you tend to find with the pressure even though we use IVACs, you get a lot of fluctuation with the vital signs until you actually get to the bottom.... You can set it [the IVAC administration system] but it does seem that with compression the patient is getting a little bolus (with changes in fluid levels the fluid is pushed in). I don't think there's anyway you can control it, maybe you could just turn things off depending on how long it takes to get down - sometimes - most times the decent is slow.

Table 5

Types Of Challenging Patients (N = 30)

Category	Frequency[a]
Critical Conditions Occurring Prior To Treatment	
Critically ill patients with several support devices	7
Critically ill patients with multiple intravascular lines and inotropes	6
Critically ill patients with mechanical ventilation	3
Specific diagnoses	3
Unconscious patient	1
Total	20
Emergencies Developing During Treatment	
Oxygen toxicity	4
Complications in patients with carbon monoxide	3
Cardiac arrest	3
Something goes wrong	1
Total	11
Other Challenging Patients	
Treatment at deeper pressures	2
Several patients in the chamber	2
All treatments because of the potential for emergencies	2
Introducing a new patient to the chamber	1
Total	7

[a] Some nurses mentioned more than one challenging patient

> A challenge dive would be with probably the more complicated ICU patient. I know recently we had a man who was on three different inotropic - type drugs, Swan-ganz art [arterial] line - in total he had about seven or eight IV or arterial lines. He was leaking out blood as fast as we could put it in. That was sort of a challenge.

In the previous statements, six of the nurses commenting on the critically ill patient mentioned the challenge of dealing with multiple intravascular lines and the administration of inotropic drugs of which Dopamine is the most commonly used. These medications are used to treat unstable low blood pressure which is indicative of shock. Patients receiving these vasoactive drugs require meticulous monitoring of not only their physical status but of the rate of drug administration.

Along with monitoring the intravenous therapies of critical ill patients three other respondents also pointed out the need to attend to patients who may also have mechanical ventilation.

> A challenging dive would be somebody who came in through emerg [Emergency Department] who is intubated and ventilated, like carbon monoxide poisoning or crush injury, perhaps unstable, requiring fluid bolusing in the chamber, where you have to monitor them closely and you have to pick up and identify the cues of what's happening first, so you can relay it to the physician on the outside of the chamber and initiate the treatments that are prescribed. To be able to be the eyes and the hands - that's my challenge.

Several specific diagnoses were briefly listed by three nurses as challenging to bring into the chamber, in particular carbon monoxide poisoning, the 'bends', air embolus, crush injuries and gas gangrene.

Finally, of the references to the critical ill patient going into the chamber for treatment one person made this statement about the unconscious patient.

> Well, there's no doubt that the unconscious patient to me is the most challenging because they can't tell you at all what's going on and you've got very little resources for assessment.

The majority of the eleven remarks about in-chamber emergencies drew attention to specific complications about which nurses were concerned. One participant made a general comment that "the most challenging is always when something goes wrong in there". Four respondents identified oxygen toxicity and the resulting seizures as a concern in the chamber. One of the four nurses only briefly mentioned this issue, however three people made the following statements:

> If you're in there all alone with the patient then it can be quite nerve-wrecking especially if the patient gets in oxygen toxicity or seizing [seizuring]

> A challenge, would be someone who has a seizure....

> Some of the problems would be baseline medical problems, like cardiac problems or a patient who seizured because she was on steroids.

The final two emergency situations raised were each referred to by three nurses. The first of these emergencies was the complications in patients with carbon monoxide poisoning. One nurse pointed to her challenging experience of dealing with "increasing cardiac symptoms in two patients with carbon monoxide", while another person spoke of the "carbon monoxide patient who had some alcohol and drugs on board [in his system] who needed inotrope support and the IV was [problematic]" . The last comment described the difficulty of making a diagnoses and identifying the etiology of the problem.

> I've had three patients with carbon monoxide and when people start vomiting - now, is it oxygen toxicity or is it because they swallowed so much air...?

The three references to cardiac arrest in the chamber suggested that this familiar scenario for an ICU nurse would be more of a challenge because of the isolation of the nurse, the unfamiliarity of treating an arrested patient in the chamber and the limitations of space.

> A challenging dive would be having an arrest, because you are working in a small place.
>
> The worst thing that could happen is that somebody arrested in there. You know the basics and what's going to happen, but until you are in an arrest situation in a particular area it's not automatic.
>
> Just imagining a worse case scenario ... if

> you are in there on your own and the patient arrests. It would be difficult to conduct CPR in that environment... you have a large patient on a narrow stretcher; or another situation would be to have three or four outpatients and one have an arrest or pneumo [pneumothorax].

The nurse went on to describe the difficulty she anticipated with placing the latter patient in a supine position in a crowded chamber and caring for the seriously ill patient while attending to the anxiety of the other patients who would be observing this situation.

Finally, the last category of challenging patients was labelled as 'other' because of the variation in the seven comments included. There were three separate issues that two different participants mentioned as being challenging - the deeper dives, several people in the chamber and all treatments in the chamber.

The treatments requiring compression to deeper pressures were mentioned because of the strain of dealing with the effects of nitrogen or nitrogen narcosis.

> The challenging dive is the longer one ... that makes you giddy. I think it would be challenging because ... the dive is effecting you as well.

> The treatment of an air embolism where you go deep, that would be a challenge.

When referring to several people in the chamber the respondents briefly drew attention to the challenge of treating "five people in the chamber at once" and caring

for "a family with an infant and children". Although treating a family including children occurs less frequently (usually when a house fire is the cause of carbon monoxide poisoning), being with four or five people in the chamber at once may be a daily event when treating elective patients.

Interestingly, two individuals with quite extensive experience in hyperbaric nursing stated that 'all treatments in the chamber are challenging', most likely because of the potential for unanticipated emergencies.

> They are all challenging - everyone of them.

> In one way or another, they're all challenging.... Most divers [patients] even elective ones that look mundane sometimes are mundane, but there's always that third eye, or part of you that's watching for the oxygen toxicity seizure or watching for changes.

The final statement in the 'other' category revealed the challenge of introducing a new patient to the chamber including addressing his anxiety and doing indepth patient teaching.

> I think the most challenging dive would be introducing a new patient to the chamber and taking them on their initial dive or initial few dives, and helping them work through their anxiety, and helping them with their understanding of the treatment and the effect it will have for them.

Summary

The in-depth list of factors that attract nurses to this highly technical and clinically challenging specialty begins with the two highest ranking components which are the uniqueness of hyperbarics and the relationship with the patients. Both of these factors provide a change for the nurse and an opportunity to use different clinical skills. Satisfying the need for new experiences and close patient interaction is followed next by obtaining a sense of satisfaction from the rapid response of the patient to treatment. Eleven nurses focused on this topic ranking it third and interestingly, it is similar to the previously mentioned factors in that the rapid response of the patient to hyperbarics is different than in the ICU setting where patients are critically ill for lengthy periods and may be slower in their response to treatment.

The opportunity for new learning experiences and a sense of independence was the fourth component attracting nurses to hyperbarics, followed by the feeling of satisfaction that working in an exciting area of nursing brings. These job satisfiers were considered to be more important that the last two components identified which were the elitism of hyperbarics and its attraction as an alternative workplace. All of these identified sources

of job satisfaction share a central theme, the fact that hyperbaric nursing is different or a change from the nurses' usual place of work (in most cases the Intensive Care Unit). That difference satisfies a vast array of needs including a opportunity to work in a uniquely different environment with different patients and staff, which gives the nurse the occasion to use other clinical skills and receive acknowledgement from colleagues. Most nurses are able to feel this satisfaction without moving from the full time intensive care environment.

It is not unexpected that the type of patient experience that most nurses consider challenging are the emergencies either occurring prior to or during treatment. Although several specific diagnoses and in-chamber emergencies were deemed to be demanding, by far the most challenging experience was the critical ill patient with various monitoring or treatment devices.

Job Dissatisfaction

Job dissatisfaction is defined as the unpleasant feelings and events that were experienced by nurses while working in a hyperbaric unit, not including personal or lifestyle alterations. The central theme in the most frequently mentioned issues is the unpredictability and seriousness of patient illnesses.

Eleven of the research participants stated that the variation in the severity of patients illnesses was unexpected and therefore challenging to deal with. A number of comments focused on the extreme critical condition of the acutely ill patients. The surprise related to "how sick patients can be" including "ICU patients with all the paraphernalia around them."

> I guess I would say the unexpected about these patients... is that they were actually going to be so sick as they were ... and then the unexpected again was how quickly it reversed itself in the chamber.

Severity of the illness of patients with gas gangrene in particular was noted to be unexpected by two participants. Only one of these nurses had an Intensive Care background, however many other respondents did acknowledge the challenge of working with patients diagnosed with gas gangrene.

Individuals in other diagnostic categories, such as osteoradionecrosis and carbon monoxide, were also unexpected most probably because patients such as these would not traditionally be seen in a critical care setting and therefore ICU nurses would have "no experience".

One nurse held an opposing view about the extent of the patients illnesses, she stated that she "expected the illnesses to be more severe." This nurse was

anticipating that she would care for critically ill patients and instead has only cared for patients with chronic problems. However, she had only been working on an on-call basis for six months to one year. Most of the respondents who commented on the seriousness of patient illnesses had been working in the unit a much longer time and so the difference in viewpoint may be related to the nurses' experience in hyperbarics.

Other respondents were surprised not so much by the acutely ill patients but by the fact that this treatment could also be used for chronic conditions in ambulatory patients.

> Since I had seen alot of the patients that had come through here [ICU] ... I was surprised when I got there [HBO unit] that they had patients other than critical patients that were elective and could walk in ....

In particular some nurses were surprised by the ambulatory patient who could talk. One nurse commented on the impact of patients conversation.

> I think the elective patients are very knowledgeable and are sometimes a threat to the people who come as back-up in the fact that a lot of our back-up comes from ICU, where you're not used to people talking to you, and they are not only talking to you - they are telling you what to do. I think nurses find that a bit threatening.

Many nurses would most likely not support this statement since they suggested that the opportunity to

talk with patients was one reason they found HBO work satisfying.

The final statements emphasized the extreme variation in the acuity of the patients being treated by hyperbaric oxygen therapy. This sentiment is reflected in the following statements:

> There is quite a difference between emergency and routine patients... for the seriously ill patients, it wasn't so unexpected since I have a long background in ICU.

> Sometimes I'm diving with four people... and we are all cramped in there, doing osteo [osteomylitis] dives and diabetic ulcer dives. And then you get the 3 o'clock in the morning dive and you've got someone who is comatosed, who tried to commit suicide or a young child who has a dopamine infiltration....

Another nurse shared this view and offered some explanation,

> Due to my lack of knowledge, I knew how it worked with diving accidents and as well with carbon monoxide poisoning, but I wasn't all that familiar with the types of infections and ischemic wounds that were treated with it as well.

The nurse's concerns about their personal safety and that of the patient was identified by ten participants. Two statements were general concerns about feeling safe.

> In order to work here you have to have a very detailed physical, so that sort of gets in your mind the emphasis on the dangerous aspect of it. It made me think twice.

> Occasionally I focus on the fire hazards and

become concerned.

Three nurses however, focused on the familiar theme of being alone and discussed the emotional impact of that experience in a crisis situation.

> It was surprising how awkward you feel in the chamber when [patients] are acutely ill, ventilated, waking up from sedation or difficult to manage (suicide attempts who are not happy to be awake).
>
> When patients are overly restless and agitated it is a bit worrisome being by yourself in there trying to priorize... you only have one pair of hands and your main concern may simply be keeping the patient on the stretcher....

Another nurse described two situations she had encountered first with an "extremely restless agitated" patient and then a patient who needed to be defibrillated. "So again that required having somebody extra in there. It went OK, but these are the things that make it hair-raising at times."

The final statement about safety in relationship to patients who are confused or agitated, stresses one of the reasons why these situations can be unsafe.

> You're trying to keep their oxygen masks on but you can't, so you are putting yourself at risk because you are increasing the O_2 level in the chamber and the patient isn't getting their therapeutic dose either.

Not being in control of the chamber or not having knowledge of chamber operations was a source of concern

about safety for two nurses.

> I was nervous. Not being in control was most anxiety-provoking. The controller outside is in charge [of the chamber operations] and that's distressing - I always like to drive!

> You are under the control of the operators while you are in there ... and say, for example, something happened to the operators, is there someone else around who can work the chamber .... It is important as a safety factor for nurses to know this. It is wrong to withhold information or provide it for a select group.

The problem of variation in the ability to communicate outside the chamber was partially related to the issue of safety, as expressed by the following statement.

> There are things I don't like about the chamber - having every word you say to the patient being broadcast outside to that everybody can hear what you say... There is no privacy between the patient and the nurse. And also difficulty in communication when you want to speak to someone outside the chamber, especially on ascent. It's very difficult to make yourself heard to people outside....

Four nurses mentioned two issues that were not satisfying, the feeling of not knowing what condition the emergency patient will be in and concerns related to care of patient with chronic illness, that is, the unpleasantness of problem healing wounds. One respondent reported that in dealing with patients with chronic illness, she had not anticipated encountering "facial disfiguration related to multiple facial surgeries and draining wounds" or the magnitude of skin breakdown or

finally she described "ulcers that had been ulcers for years and were unpleasant to look at." These feelings were also reflected in the comments of another nurse who said, "I never thought some of them, where going to be old, old wounds from years ago...." A third participant similarly expressed that she was surprised to find people who had been sick for long periods, people who had not taken care of themselves or had injured themselves and especially the "large number of elderly who had necrotic areas or amputations due to necrosis." The final respondent noted that the patient's diagnosed with gas gangrene were "very gorrie" and she was somewhat afraid of being contaminated.

Only three of the four people who mentioned the issue of not knowing the condition of the emergency patient felt that it was a disadvantage, one person actually liked the unexpectedness of the situation.

> Being on-call I didn't really know the person as well as I would like before I actually went in the chamber with them.... (If they are an ICU patient you get as much of a report as you can get). But your're discovering as you go, especially if they come from emergency with smoke inhalation.

The last area of dissatisfaction identified by three hyperbaric nurses is being called into the hospital to wait for long periods of time before the patient arrives for treatment. One nurse briefly referred to it as "the

Hurry-up-and-wait syndrome, sometimes having to wait for 1 - 8 hours." Another respondent also labelled hyperbarics as "the hurry-up-and-wait syndrome" but elaborated on the frustrating "delays in treatment, such as with gas gangrene, where the patient goes for a surgical intervention first but needs to be treated with HBO urgently." This very similar statement also reflects this frustration.

> One of the hardest aspects of it [HBO] is ... getting called at eleven at night, told that you are supposed to be there by 12 or 1 [o'clock] and waiting until 5 am and the patient is still not there because the surgeon has decided to take him to the OR first.

Summary

In this very limited category, the major source of job dissatisfaction was related mostly to the patients illness, either because of the unexpectedness of their condition or the rapid change in their level of illness. Concerns about safety, identified as a second job concern, were most probably justified in a highly technical, somewhat risky treatment in which most nurses perform independently and in isolation. Because hyperbarics may be seen as the last resort for chronic problems it is not surprising that the unpleasantness of problem healing wounds may be a source of discomfort for

some nurses. And finally, waiting for long periods for the patient to arrive at the unit was a frustration that a small number of nurses expressed.

Personal & Lifestyle Adaptations

Personal and lifestyle adaptations can be defined as those changes that nurses have experienced in themselves or their lifestyle as a result of working in a hyperbaric multiplace chamber. These adaptations seem to fall into two categories: 1. physical or psychological adjustments that are required in the chamber due to the pressurized environment, and 2. physical sensations felt or lifestyle adaptations made when a hyperbaric treatment is completed.

The adjustments required in the chamber, which is the largest category, are necessary because of the effects of increased atmospheric pressure on nursing personnel and the impact of specific features of the chamber environment.

Barotrauma was the most frequently mentioned pressure related effect, having been identified by thirteen nurses as a concern in the chamber. Preventing barotrauma to the ears as the chamber pressure increases was the most common concern for ten nurses. For some participants their anxiety was short lived and was

resolved after the initial dives.

> Once I realized that I could clear my ears, OK, then things became much better. Initially, that was the big thing, worrying about being able to clear my ears.

> Initially I remember being quite frightened. I went down on my test dive with another nurse and an anaesthetist and he said I wasn't valsaling (technique for equalizing ear pressure) enough then I got afraid that there was an air embolism building up and I wasn't keeping up, so I started valsaling more and became afraid I would swallow air and belch or get in some sort of trouble because of that. I wasn't very comfortable and thought, 'how am I going to comfort a patient in this situation'. I was worried by my past history of ear difficulties as a teenager. Later, I did a routine dive under the suggestion of the hyperbaric nurse and it was just a piece of cake [in this regard] and they all have been since.

Some respondents felt that clearing the ears was an issue to be regularly addressed each time they entered the chamber to be pressurized.

> It's necessary to feel comfortable with clearing your own ears, so that you can give more attention to the patient.

> Well, they [HBO staff] told me that you have to clear your ears - you either have to cough or yawn or blow out. I was swallowing and yawning as I was going down and it wasn't very much. I guess I hadn't opened my ears and I got this pain and it was so bad I said 'Stop!' I had tears in my eyes. [The nurses] outside the chamber said, 'Blow out! Blow hard!' and that's what I did. I kept blowing and blowing, because some people are easy to clear

> their ears with me it was very hard!
>
> What was uncomfortable? - the changes in pressure and getting used to clearing your ears and learning to time that so that it comes more automatically than scary. I'm sure it's scary for anyone going down in the chamber. Any one who has done diving before is more used to it.
>
> I was concerned about being able to keep myself calm enough to keep my ears clear. It's sort of the feeling that you can feel it [the pressure] building up. I find if I let myself get anxious - well it's usually the patients I am thinking of and I'm not concentrating on what's happening to me - it's harder for me to clear.

Attending to the needs of the often critically ill patient while trying to clear the ears can be a challenge for the nurse. Often because of the seriousness of the situation the nurse will neglect her own comfort to care for the patient or experience anxiety about being able to clear her ears. The previous statements alluded to this issue, however two nurses described quite dramatically the situation the nurse may encounter in this regard.

> I had a situation where my own need to pressurize the patient (because we were trying to do CPR while we were pressurizing an arresting child) [was more important than clearing my ears.] Barotrauma just didn't enter my head, my ears were screaming but the patient at the moment was very much more important.... Under any emergency situation your comfort takes second place.

> My biggest concern and still sometimes I get it, is that I'm not going to be able to get to depth because I'm not going to be able to clear my ears... and therefore we are going to have to abort the dive and it's going to be bad for the patient. Now after ten years I've gotten used to it. I have all my tricks - it's in my mind I have to drink water I can't clear my ears any other way.... I've got to have my two glasses of water in the chamber and if I forget to take them in with me I get a little panicky.... It's more a fear of failure. I have got to get to depth and quickly. You've got a big team, the patient is depending on you getting down, everyone else is depending on you getting down, and most people are called in in the middle of the night and everyone has to go to work in the morning, so you have that feeling, plus you have a sick patient who is getting sicker by the minute so 'stop fooling around!' and so you push your self, at least I do.... After a number of years of diving I've gotten more relaxed about it. I know I will get down and if I don't, I'll lock out and someone else will lock in, so I don't feel so anxious.

The sinuses and teeth are less often affected by changes in pressure but need to be addressed as is evident by the experiences of these for participants.

> Everything had been explained to me except sinus pain and I went several dives with tears running down my face and having nosebleeds before I realized what was happening.

> I didn't have any problems with ears... but I had alot of sinus infections and it was almost a prophylaxis for me to take Otrivan or Sudafed when I went in just to make sure that I was clear and it wasn't me that was going to hold up the procedure particularly if we were diving someone with the bends or whatever and having to go deeper than what we had

anticipated to possibly 165 feet.

> One day I had extreme pain in my teeth, well it wasn't extreme, but when we were going down I felt the pressure, then it went away and when we were coming up I felt it, so I mentioned it. They [senior staff members] told me I had to get it checked out - I couldn't dive.... The air was trapped behind my filling.

Another individual briefly mentioned that she had also experienced tooth pain.

The issues ranked as second by nine nurses were also related to the effects of a pressurized environment, they were:

1. temperature and atmospheric changes and
2. other physical sensations.

As the pressure is increased in the chamber during compression the inside temperature rises, conversely, the temperature decreases during decompression. The temperature drop also results in a build up of condensation, seen in the chamber as fogging. These changes can be rapid and therefore surprising to the people being introduced to the chamber.

> I was surprised by the great variation in heat and cold.

> One thing that happened at the beginning (although they told me it would happen) when you feel it, it certainly makes an impression, is the heat and humidity. I don't even think

about it now.

> I didn't mind the temperature changes too much, it's a wonderful room to cool down in but when it gets warm - the heat!

Depending on the mechanical capabilities of the chamber it may be difficult to finely control the environment of the pressurized chamber so that it is comfortable. Several nurses talked about their experience in this regard.

> Well, I froze in there - the chamber is quite cold.

> One thing I was surprised about and made the chamber uncomfortable, was in the summer time when it's hot and humid, the chamber is sometimes unbearable and they have to sometimes close it down. There's no cooling system.

> I usually find it cool when we dive to 65 feet, part of that was due to the ventilation that they [chamber operators] had to keep going - it's a little bit draughty in there.

This nurse described the experience of being in the chamber

> sweating buckets when I'm down sixty feet and they can't vent the system enough to cool it off.

The third issue of physical adjustments required in the chamber reported by eight nurses was in reference to the level of comfort in the chamber, in particular, respondents found that the size, confinement and

isolation of the chamber required that they make some adjustments. These first statements address the difficulty of being comfortable with the seating in the chamber.

> I don't think I have ever been comfortable in the chamber - the small size of the chamber especially with two ventilated patients and an R.T. [Respiratory Therapist].... You don't really expect to be comfortable, the goal is for the patient to be treated.
>
> ... also sitting arrangements for attendants - the way the walls are curved - it's very hard for me to sit back. Usually you are all scrunched over like this [demonstrating curved posture] and on longer dives it could get really cramped and that's hard on the back. Sometimes if there's one patient, you can get in a more comfortable position but really it's just physically uncomfortable.
>
> It was really close quarters. You couldn't get up and move around. After a while the chair is bugging you - you couldn't get comfortable.

The confinement was an issue that some nurses mentioned that they needed to address for themselves.

> Psychologically - the only thing I found when I first went in there, I had to talk to myself - it's a small place. This was basically the first dive and after that I didn't really have a problem because you have patients so you're not dwelling on yourself.
>
> The biggest eye opener for me is the confinement in the unit itself. I didn't really appreciate how confined it would be and I'm sure a lot of patients must experience that on the first time down.... As far as

> teaching pre-diving it would be a big issue - discussing how confined it was, especially when there are two or three patients in there at one time....
>
> At first, I felt isolated in the chamber but with the portholes and the earphones, you quickly got accustomed to that.

For one nurse she needed to adapt to the layout of the chamber which did not provide her with the same instruments that she normally had at her disposal.

> I've always felt that you need a lot of control over the surroundings inside the chamber and you don't have things you are accustomed to at your fingertips inside the chamber as you would in ICU.

The fourth ranking issues described were the noise in the chamber and difficulty with concentrating, which were mentioned by five nurses. Chamber noise was a source of stress requiring adaptation by both nurses and patients.

> The fact that it's so noisy - I really didn't expect that, and alot of patients when they first come in, the sound of the jets when the chamber is being pressurized really scares them. I really found that that was one of the most unexpected things....
>
> The noise is quite loud and persistent and [in a course] that can be stressed. [The temperature variations] didn't bother me as much as the noise and the confinement.
>
> Getting use to the noise is an adjustment - once you get used to that it's just a routine area. Critical Care [because of the machinery

> and alarms] is one of the noisiest areas next to this.

Interestingly, five nurses also reported difficulties with concentration associated with hyperbaric nursing and offered some rationale for this.

> I have difficulty concentrating sometimes... that may be because most of the dives are in the middle of the night, I'm sure that has something to do with it.

When asked if her level of concentration was different in the chamber than when she worked a regular night shift. She stated,

> I think that my concentration is probably worse in the chamber because: A. When I work nights at work [ICU] I'm expecting to work all night and I'll have slept during the day - I'm prepared; also B. because I haven't done that many dives (I've only done 7 or 8 dives) it's still a new situation for me and I have lots of things to occupy my mind. At work [ICU] I'm probably more relaxed.

Two nurses were surprised by the effects of nitrogen.

> In the initial dives, the unexpected for me was the nitrogen narcosis. I felt silly and found it quite funny and now I still find it's unexpected and I have to get used to it....

> I was astonished the first time I dove was down to 120 feet and the narcosis! I couldn't believe this, and I'm not much of a boozer.... I had heard about it, read about it and felt I was prepared - no way was I prepared. I couldn't do the questionnaire, I felt like I couldn't make any sense out of myself - I couldn't stop giggling. I haven't had any nitrogen effects since.

Two adjustments mentioned by four nurses were related to bladder control and breathing. Hyperbaric chambers are usually not equipped with bathroom facilities and the nurse must be able to tolerate confinement in the chamber for long periods. This problem is intensified by the perceived need to drink sometimes large amounts of water as a method of ear clearing.

> It depends on bladder control... because you have to be able to sit there comfortably for six hours and not use the facilities or require them. The other thing is they [support staff outside chamber] are very free and easy about giving you things to drink in the chamber but you have to bear it in mind, you could be in there for awhile....
>
> If you are going down for a long dive you better make sure you can keep your bladder under control for four or five hours.
>
> It took me awhile to get the hang of clearing but I used to drink gallons of water - six glasses for a 90 minute dive - and then you have to go to the bathroom!
>
> You're thirsty and you're trying not to drink so your bladder doesn't go halfway through.

Problems with breathing were mostly related to the difficulty of breathing the denser air when the chamber is pressurized.

> I would suggest that people... be in good health and reasonably fit because it is an effort to breath that thicker gas down

> there....
>
> The density of the air made my breathing a bit more difficult.
>
> On the test dive to 165 feet I was surprised by the quality of air itself.... At 165 feet the air is really thick and I didn't like it at all - it was a very uncomfortable situation.

One person did mention the difficulty of breathing when initially trying to adjust her mask.

> Once or twice I experienced not being able to get enough air with a mask on, but now I know how to adjust it.

Finally, the issue of other physical sensations that required adjustment in the chamber were also mentioned by nine participants and is a collection of various physical sensations that, although they were mentioned infrequency are still noteworthy.

Two nurses referred to their amusing experiences with voice changes.

> Voice changes are humorous - it may be easier to lip read or use hand signals.

One nurse said she was surprised when her usually deep voice sounded "like Donald Duck... when I hear it squeaking out of me I started to laugh." Another respondent remarked about discomfort from contact lens.

> The only other discomfort is that I wear hard contact lens (gas permeable) and when I would do deeper dives to fifty or sixty feet, or on rapid ascent I would get bubbles beneath my contacts and that would distort my vision.

The remaining six comments focused on physical sensations related to pressure and although not identified in the literature search they may be important.

> I noticed everytime I went in the chamber the drop of the first ten feet I would start yawning, like crazy - big yawns with tears in my eyes.... After I got below the first ten feet it would settle down - that was just the CO_2 level changing.
>
> Headaches go away when you're down and come back as soon as you come up.
>
> On an odd occasion, I would get what I call 'scrinches' - they are things in your neck when you turn your head - it's like crunching noises. I was concerned... They don't happen very frequently now....
>
> One thing I found with myself (I haven't found it documented [in the literature] or anything) was my joints crack a little bit more, particularly in my shoulders, I get a bit of crepitus. I have normally a small amount of scrunching or crepitus in my shoulder but it certainly heightens, and I can hear it more and feel it more clearly when I'm in the chamber and under pressure.
>
> One nurse explained that during short dives where you are rotating with another nurse every fifty minutes to avoid decompression..., it wouldn't be unusual to overlap a couple of minutes because you're trying to give report to the next person. The only effect that I felt from that was a tingling in my forearms - 'niggles' that lasted a half an hour and went

> away. At the time I wondered... if it was happening anywhere else that I'm not aware of ....
>
> I did a dive a couple of years ago at a point when I was starting in on a long illness. I didn't know what was going on at the time but I was feeling unwell, but I wasn't that unwell. But I got in the chamber and I was suffering from oxygen toxicity and my heart rate was really going all over the place and I was really having a rough time. I was quite surprised in the tremendous difference, it changed me from being functional outside the chamber to being very marginally functional inside....

A smaller but equally important category of adaptations for the nurse are those focused on lifestyle changes occurring after the treatment is complete.

A feeling of tiredness was the most frequently reported effect occurring after exposure to pressure, identified by twelve nurses. Some comments referred to tiredness in a general way, such as the following remarks.

> I felt tired sometimes, even to [a depth of] 45 feet and that's not terribly deep and I never like to do anything after a dive.
>
> I did find that after you dove and went home you didn't do anything. You didn't do anything major here but you were tired when you left.... Sometimes when I would be diving I would be so tired.

Other respondents, however, found that after a particular type of treatment in the chamber, they would be fatigued.

> After a long or particularly deep dive, there's no doubt about it, you're feeling a bit dragged out.
>
> Sometimes I did feel tired after a dive, but it usually was an emergency dive in the middle of the night when you would be tired anyway and it would be depths greater than 60 feet. But for an average dive that we do often at 33 or 45 feet, I usually don't have any effects.
>
> I find on emergency dives, I get very tired. It's a long [treatment] table plus unless [the patients] have had myringotomies done it could take a long time getting down [to depth]. I've had one [patient] where I did a foot per minute - we were there for an hour getting down.... I just find I'm exhausted after. I don't know if it's because those dives are usually three o'clock in the morning and you're exhausted anyway, and the adrenalin rush. I don't know what it is but there is something and everyone finds it - so tired after.

Three of the nurses who mentioned this issue stated that the tiredness occurred at a particular time in their hyperbaric career. In the case of two nurses fatigue was experienced initially and for the third nurse she found herself becoming tired as she became more frequently involved with hyperbaric treatments later in her career.

> Initially, I found I was quite tired and I had vague thoughts that I wouldn't want to write an exam after a dive.
>
> I was tired first for the first hour or two after.
>
> The fatigue has been more evident as the years

> go by because of the increased number of dives I do every week.

One nurse made this rather humorous but realistic appraisal of her fatigue.

> I'm tired all the time. I just didn't notice a difference in the degree of tiredness. I work full time and have two kids - I'm tired. I may have been more tired at that time but wouldn't even notice.

Seven participants drew attention to the fitness and lifestyle changes that were necessary after a treatment. Most people found that the limitations on physical activity were inconvenient and restrictive.

> I didn't know anything about not exercising after, so if I did an evening dive and finished around four I couldn't go to aerobics right away. At first I was deathly afraid of going in case I got the bends.... It was kind of upsetting [not to be able to go to aerobics] so I tried to do the morning dive and it was arranged so I could.

> There are lifestyle changes immediately after a dive. You can't go out and do an athletic program, you're stuck basically for the rest of that night and for someone who is very athletic it can be a pain in the neck.... Because particularly in the summer time if I wanted to go and dive I couldn't or ride horses or play tennis.

> I followed their rules and took it easy, and didn't do aerobics, or run the dog or anything after.

> I have to be reminded each and everytime I come in ... not to go home and have a hot shower. When you've punched in a long time,

> it's nice to go home and soak. So it's nice that they do remind me not to do that or not to go running to my car.
>
> Some people who were into sports and exercise after you left the chamber you couldn't do anything exertional - that was always a good excuse not to.

Two respondents mentioned the need to abstain from consuming alcohol during the period before going in the chamber.

> If you know you are going to dive you couldn't be out drinking the night before. You'd have to plan in advance... if you are going to dive. It does make an impact on your life....
>
> People should be very aware that diving tired after having a couple of drinks is asking for trouble.

The last after-effect of hyperbaric treatment relates to the interesting observation by three nurses that it brings on or intensifies colds. One nurse referred to this briefly but these two following comments address the issue more completely.

> In the initial period the unexpected for me was... how it brings on colds.... What happens is that for the two or three days break that you take from diving when you have a cold, you think you're on top of it and it's better but you come back and you take a dive... and you have a cold again.
>
> If I had a sore throat before I went in, the next day it was [worse]. Some days I just haven't felt great before I've gone in, which

> is probably the start of a cold and the next day I've got a full blown one. I don't go in when I have a sore throat at all.

Summary

The majority of the personal and lifestyle adjustments required of nurses working in this specialty were adaptations to the pressurized environment inside the chamber, however, comments on the after-effects of pressure constitute a small but important category.

Of the in-chamber adjustments, remarks about techniques to prevent barotrauma were made most often, followed by comments on the chamber environment such as the heat, cold or humidity, and the physical sensations associated with pressure. A similar concern follows in third place which addressed the level of comfort in the chamber. Of the four remaining issues only one focused on the chamber environment that of noise in the chamber. The other three factors requiring adaptation are concerned with the comfort or health of the nurse, they include: fatigue, difficulty in concentration, bladder control and difficulty in the work of breathing. The two common themes in all of these issues is adjustment to the environment of the chamber, and to the physical

sensations associated with pressure.

Administrative and Professional Suggestions

This section addresses issues related to continuing education for experienced hyperbaric nurses and administrative or professional concerns about this nursing specialty. By far the majority of this information was volunteered at the end of the personal interview when the respondents were given the opportunity to comment on anything else they wanted to say about working in hyperbaric nursing or the educational preparation provided (see Appendix B). Interestingly, all of the issues that arose were shared by nurses in each hyperbaric unit across Canada. Two issues, public relations and diving infrequently, were mentioned most frequently by thirteen nurses.

Often respondents talked about public relations in the field of hyperbarics at length or made several references to it in varying contexts. The term grew to mean not only the promotion of a positive image of hyperbaric oxygen therapy but the need to address the ignorance of health care professionals and the general public. This nurse felt that "taking the mystic away

from it and addressing the myths and misinformation would be important".

Other respondents had the following comments:

> I didn't know what HBO was about. I thought it was a Boiler Room and others [staff] made comments about the dangers. There's a lot of misinformation.
>
> A lot of the people in the department where I come from said there was no way that they would be able to do that or were not at all interested because of the claustrophobic effect. I would chuckle to myself because you would say you were diving and they would always say, "Did you get wet?" There's sort of a mystery behind it all.
>
> ... I was working in emergency and whenever they called me away from work to go in the unit my head nurse would make me literally lie down for an hour afterwards.... I think she was scared I was going to end up with an embolus or flake out on her....

It would appear that misinformation on the part of nursing staff may have some negative consequences in that they may be reluctant to work in this area or in the case of the nursing supervisor, have concerns about the nursing staff who go into the chamber.

In the process of discussing their similar observations about staff awareness, the following two nurses suggested one method of addressing the ignorance and misinformation.

> I think there are probably just a handful of the sixty or so nurses in the ICU would understand what's done in hyperbarics. I don't think they understand why it is a treatment and what's going on with it.

This nurse went on to state her concerns that information on hyperbarics is not being taught in other nursing programs.

The next respondent similarly noted that the instructors in their local ICU course do "touch a little bit on hyperbarics" but most other specialty courses as well as the diploma and bachelors programs for nurses do not include this topic.

> So a lot of people don't even know... there's a hyperbaric unit or ... a lot of people just think it's used for decompression sickness and that's one of the least that we use it for here.... They don't have to go through all the details, just the basics - how it works, the effect of oxygen - just deal with some of the diseases that you treat with it.

Incorporating an introductory lecture into the curriculum of basic and post-basic educational programs for nurses would be an effective approach to dispelling the misinformation for large groups of nurses.

Specialty inservice education is another suggested method of accomplishing this goal as reflected in the next statements.

> Nursing staff need to be involved in educating other nursing departments about hyperbarics while the physicians could educate other physicians. Specialty grand rounds in other departments and hospitals is the technique employed in one hospital to make people aware of the use of hyperbarics.
>
> I go back to what I said about the PR, [public relations] is important within the medical staff, so they have to convince each other to accept it.... Education of medical staff is important,... the educational process should include medical, nursing and clinical staff.

One senior hyperbaric nurse also emphasized that in order to increase utilization of HBO, education has to be focused on medical as well as nursing staff.

> The education has to go from one doctor to another. Education of nurses is also important, especially when it comes to suggesting appropriate patients for hyperbaric treatment.

It was also felt that education of nursing as well as medical staff is important, so that this treatment modality is not relegated as a last resort.

> Our record especially for the patients treated earlier is impressive but we mostly get the patient at the end stage when it's too late, they should come earlier.
>
> I guess something that's always puzzled me has to do with educating the medical community - the underutilization. It seems that there are still a lot of doctors who don't know about hyperbaric treatment, don't understand it and think it's 'hocus pocus', thus they put all other treatments above it and in some cases that's not appropriate.

Another result of not having accurate information may be that the medical staff will be uninformed about the treatment schedule for patients with gas gangrene and less precise in the debridement of wounds in these patients. One nurse mentioned this briefly but the following person spoke at length.

> Usually [critically ill] patients have gas gangrene or Fournie's gangrene (necrotizing fascitis of the perineal area). Usually those spread very fast, the patient is really sick and the chance of losing the patient is very high.... They have to be treated right away so they don't die but we've been fighting with the surgeons because they always think they have to have the patient in the operating room first. But they should come here first - have the problem stopped, then go to the OR and back to hyperbarics again. They could do some debridement after the first HBO treatment because the line of demarcation may be more well defined... so they can do a more thorough job.

Although education of the nursing and medical communities was deemed to be important, the next three statements incorporate the need to address other medical groups and the general public.

> I think maybe the biggest challenge that hyperbaric oxygen has is it's credibility.... I'm frustrated in this unit at times because you'll often hear through other sources that doctors wouldn't refer patients because they feel what we do is hogwash. They don't understand what it is we do so they wouldn't send a patient.

This nurse went on to comment about singer Michael Jackson who was reported by the media to sleep in a monoplace hyperbaric chamber to make himself look younger:

> Perhaps if there was a body to address that situation, that may help. As it was no one really responded to the situation.... Baby Jessica, who fell down the well, also received HBO.... They [the media] just referred to it as oxygen treatment. The only area I can clearly see the credibility is in the diving community.
>
> I think it helps to be able to convey what you do.... So some background in teaching and public relations would be an asset. Tours for the general public, school children, other nurses and orientating staff provide opportunities to present information to other people....

Another nurse who had tooth pain when she first went in the hyperbaric chamber because of air trapped behind a filling explained that her dentist had never heard of HBO. She said, "He was very intrigued and wanted to know more", but she felt that the public and even other hospital personnel know nothing about this form of treatment or are misinformed and therefore "They think you're crazy to work there." She went on to say that nurses should be instructed in a course how to address peoples concerns and misconceptions regarding hyperbarics.

Twelve nurses identified the second topic as the problem of diving infrequently. All three hyperbaric units are staffed primarily by on-call personnel who are not scheduled to work regularly, therefore, it may not be possible for staff to come to work when called. This makes it very difficult for staff to learn and retain new knowledge by repeatedly using it in the clinical setting.

> Staying current in your knowledge is a challenge, especially when you are not called all that often or are pregnant.
>
> Because of the limited amount of opportunities that one gets to dive, it's a long time before you become solid in the specialty unless you work full-time If you're on part-time or casual basis, it takes you a long time to build up that number of dives.
>
> ... if you are on an on-call basis, there is the potential there for not coming in for several months and I suppose when you are doing it for a nurber of years it's OK because you have the experience behind you but there are people who can start and not dive for three or four months.
>
> It's so easy to forget especially when you don't do it all of the time.... When it's months in between, that's a different story. To remember all the signs and symptoms, etc is impossible.
>
> I guess my only problem was that I haven't been diving for a few months. I've been saying that I've got to get back into it again because at three o'clock in the morning I may be getting cold feet, saying, 'I haven't been in there in so long I don't know if I'll know what to do' and that's a scary feeling.

> My biggest concern is that I'm not familiar with the unit. I haven't worked here full-time, and to be on an on-call basis and not called frequently enough to retain the knowledge, to reinforce the nursing - that's a bit of concern for me.

Some respondents also offered suggestions for the resolution of this problem. A rather simple but practical recommendation was that the layout inside the chamber be kept the same and that nurses take time to reorientate themselves.

> Since people dive infrequently when you set up the chamber you don't want to change the physical set-up too much because when you do come in at three in the morning it's very time consuming to find things.

> ...In order to make it safe for patient care and for the dive team you have to take a lot of responsibility for constantly reorientating yourself to the physical plant.... If you've been away from the chamber for six weeks or two months, you've got to get in early and familiarize yourself again....

It was emphasized that you must keep personnel up-to-date with regard to knowledge and policies. This could be improved by getting together on a regular basis to present nursing publications or interventions.

> You have to keep people who are not in the chamber frequently informed.

> Something has to be different, whether it's getting together a hyperbaric club or getting together once a month to go over new information, which I think would be a great

> thing just to have a journal club of sorts. I wouldn't mind getting together to present a paper.
>
> To update knowledge perhaps you could get different staff to take turns reading on something like air embolism or gas gangrene and do a mini-presentation to the other nurses within the hyperbaric unit.... They could not only have the benefits of a handout of the nursing care and interventions but they'd have verbal reinforcement.

Three people thought that a required dive or regular testing at scheduled intervals would effectively address the problem of infrequent dives.

> It will continue to be a concern unless there were some sort of required dive, like every two months you must do a dive or have a group meeting every two months to keep you in touch and keep you informed.
>
> ... if a person is not diving on a regular schedule may be there needs to be reorientation or retesting... because I know I haven't dove in probably a year. If suddenly they needed somebody, I could go in the tank and do quite well but there probably should be a bit more reorientation.

If you have not been in the chamber frequently enough to maintain your knowledge base then "I think they should have an upgrading or recertification." There should be someway to verify "that people understand what they are doing." This participant went on to suggest that the knowledge required to work in HBO be monitored "like a delegated medical act or added nursing skill."

It was felt that current literature on hyperbaric oxygen therapy needs to be made available for those who have time to read in the chamber.

> ... for people like me [who may not dive for six months] it's important just having available updated pamphlets or new information. We can always read it when we are down on the dive.

The final suggestion is related to the problems of being on-call. These nurses recommend that regular scheduling may facilitate the process and help to make more nurses frequently available to work in the unit when called.

> I think it would be nice if they had a nurse on-call... at least you know if you are possibly going to be called. Because sometimes [you may have some alcohol to drink], and you feel really bad because you think, 'If I had known I wouldn't have had that drink - I would have had that beeper with me....' They have the R.T. on-call (the two people who will run the board) but they don't have the person who's going to be in there [on-call].

> Unfortunately sometimes when the calls come in you're either working or you can't get there because it's so random - we never know when we are on-call. That's the most frustrating thing. I wish there was a night I could say that 'I'm on-call tonight.' because you want to come if you can.

A hyperbaric newsletter was proposed by ten nurses to enhance communication within units as well as across

Canada and to update their knowledge base.

> A monthly newsletter -I'd like to see this in our chamber... because people like me, who have trained four or five years ago or maybe ten years ago- you get rusty on things you haven't seen. When you're a part-time person you get called so sporadically, usually into an intensive care situation.... If you had a newsletter every month, it would be like a refresher course. A national one might be good but local would be better so we could include local protocol

> Because you don't know what the other chambers are doing, I think there should be a Canadian input - to discuss things.... I think it would be good to have a Canadian Newsletter just going between the chambers.

> I think that [a newsletter] would be a way of keeping the units in contact across Canada - so they could be on the same level of knowledge.

> A newsletter is a good idea to keep people up-to-date, review latest articles and differences in articles as well as communicate.

> A Canadian version of the newsletter, especially in terms of research, would be a valuable way to communicate.

Three other respondents suggested content for the newsletter which could include: review of recent articles especially nursing publications, brief discussions of etiology, signs and symptoms as well as nursing care of each diagnostic condition treated with HBO as well as, indicators of common problems and issues

in hyperbarics. But most importantly

> ... it would foster a sense of community between the hyperbaric nurses. Statistics might also be incorporated and circulated to enhance a sense of importance and knowledge of what's happening in the area.

Nine participants remarked on several aspects of reading and library material. It was an especially important issue for nurses because of the absence of an introductory hyperbaric course or continuing education programs. Nurses are usually given selected medical or technical readings to introduce them to the theory and treatment principles of hyperbarics or maintain currency of knowledge. The unavailability of nursing literature was seen to be a disadvantage. One nurse said that although "reading material was to be read on your own, the articles she was given were good and explained it". However some booklets, "like the airforce booklet was a little difficult to understand, and would need a lecture to explain the information". The following comment lends some support to the concerns about reading materials.

> A lot of literature is way over everybody's heads and turns people off.

Another respondent offered this possible consequence to

this situation.

> People don't pay attention to library material.

Other people presented more positive comments about the literature and reading material, and made recommendations for expanding the number of publications and making them more accessible. These respondents similarly suggested that;

> It's really an interesting area and it would be nice to see more literature come out....
>
> It would be beneficial to have a central registry where information could be shared among nurses.
>
> Have a mini-library where the nurses and other staff members and R.T.'s can feel free to go and borrow the material....

Five nurses identified research and educational conferences as being valuable. Many areas of hyperbaric research need considerable development, in particular studies need to examine many nursing techniques and the effects of pressure on chamber attendants. These three comments address this issue:

> I'd like to see some studies done on vital signs of chamber attendants but I've never seen a paper on that - I'd really like to see something like that.
>
> There isn't enough information about the physical effects on the staff that work in the chamber, and I would like to see some research

> and education just to allay fears or help with the understanding and increase the safety.
>
> It would be nice to do some research on why all of our gas gangrene cases come from [a specific geographical area]. Is it because the medical community recognizes the need for hyperbarics more or is there more gas gangrene there? It's not always a farming community that the patients come from.

Other references to hyperbaric research emphasize the importance of developing knowledge in research and sharing that information with other Canadian units.

> It would be a nice feature to have some background in research.... Some of the projects we have started, ended up being shelved - not completed. I think if we had a strong background it would go a long way towards completing projects.
>
> Having contact every six months is a good idea so that new developments and research could be shared between units.

The five nurses who made a statement about hyperbaric conferences were unanimous in their opinion that there are very few conferences available on hyperbarics and even when conferences are offered nurses do not get funding to go.

> There are very few conferences you can go to, the medical director here tries to make sure that we get some in-house inservice once a year....
>
> I think the hospital could give funding for nurses to go to hyperbaric conferences... because otherwise we're going to get so far

> behind in what we're doing.... I don't know how many millions they spent to put this [chamber] here. But how much would it cost to send a nurse to a conference - $1500 maybe - just to get upgraded, to bring home new ideas....
>
> There's no conferences or they're so far away and naturally we're not funded.

Three nurses revealed that they would like to see a certification process developed for hyperbaric nursing that would lead to the designation of this type of nursing as a clinical specialty.

> I would like to see a way that we could be recognized as a specialty - a certification process.
>
> Having an introductory program consisting of classroom and clinical components, continuing educational opportunities and a process of certification/recertification are all important.

This final category is a collection of the nurses' suggestions to solve the educational problems, in particular how supervisors of hyperbaric units may compensate for the unavailability of hyperbaric courses in Canada.

Eight of the thirteen nurses remarked that structured self-learning modules would be beneficial rather than reading material.

> The self-learning modules where you read something and answer the questions, those would be a lot more useful, or maybe one-to-one [teaching] rather than just going home with a bunch of readings.
>
> I really think there should be a structured learning guide that would be available to each unit and ... some group learning as well.
>
> This nurse recommend a study guide if it was carefully selected and updated periodically.

These participants emphasized the importance of nurses being self-directed but also remarks on the need for more continuing education.

> The person who is learning has to be very self-directed and very motivated on their own. You can put together a small program to give them the basics but after that you really have to work on your own.... You have to do alot of reading on you own.... It's a continual learning process.
>
> There should be more continuing education in hyperbarics. There really isn't alot.
>
> Rounds for hyperbaric personnel are a good way to [have interdisciplinary contact] - present cases every couple of months and work through: what was everybody's role, how did everyone meet that role, what kinds of things didn't you know and what kinds of things do you need to know for the future.

Other suggestions include an annual dive and review of procedures or a refresher course .

In the absence of formal continuing education programs nurses will often obtain their updated

information from informal, non-nursing sources, as reflected in this statement.

> I rely on controllers for new information and changes in treatment schedules for patient and nurses.

Summary

Interestingly when given the opportunity to make any comments they wanted about hyperbarics, the most important concerns for nurses were the need to utilize public relations techniques to increase awareness of hyperbaric oxygen therapy among health care professionals and the general public. Also a variety of educational issues, mainly focused on ways to accommodate to the absence of a formal hyperbaric course and continuing education programs were seen to be important. The third item mentioned was the development of a national newsletter or at least a local one, so that new policies, publications and research can be shared, knowledge could be kept current and just as important the feeling of community between hyperbaric nurses could be enhanced.

Twelve nurses emphasized a vital issue of importance for nurses, that of infrequent opportunities to dive in the chamber. Many nurses offered creative suggestions, as well as discussed the impact of this problem.

Other mechanisms of broadening their knowledge base such as using library materials, attending conferences and contributing to research studies were mentioned. A small number of nurses expressed interest in seeing hyperbaric nursing develop as a specialty in nursing.

CHAPTER IV

DISCUSSION

The immediate purpose of this study was to describe the hyperbaric nurses working in clinical multiplace hyperbaric chambers in Canada, to determine their age, sex, marital status and educational preparation, and to identify the topics that they perceive should be included in an introductory educational program offered prior to working in multiplace hyperbaric chambers. The ultimate purpose was to supply basic information for those planning an introductory hyperbaric education course specifically for nurses and also to provide a foundation for further research into hyperbaric nursing practice. Most of these objectives were met and in addition other serendipitous findings were obtained in relationship to educational and professional concerns, and the need for a means of communication between hyperbaric nurses.

The discussion will address the personal and professional characteristics of Canadian hyperbaric nurses, issues related to job satisfaction and dissatisfaction in hyperbaric nursing, and a format for an introductory course in hyperbarics, designed utilizing the findings of this study. This will be followed by a

discussion of the implications of the serendipitous findings and limitations of this study.

Demographics and Personal Characteristics of Canadian Hyperbaric Nurses

The thirty-two nurses working in hyperbaric units in Canada were found to be a group of nurses who shared many similar characteristics. All of them had a background in critical care nursing with 28 (88%) of them having taken an advanced course in ICU or CCU. This percentage exceeds by far the average since in 1990 only 18% of Canadian nurses had taken Post-basic Courses (Statistics Canada, 1990). This difference may indicate that nurses lacking this education and experience did not remain with the specialty because they felt insecure in dealing with critically ill patients ard chamber emergencies, such as oxygen toxicity seizures or cardiac arrest.

Seven nurses (all female) were scuba diving enthusiasts who had also educated themselves in the area of sport diving and who had probably been attracted to hyperbaric nursing by the knowledge that it was an essential emergency treatment for divers, or because it allowed them to combine their professional and personal

interests.

Although the hyperbaric nurses had obviously taken more advanced courses, only 3 (9.4%) of them had bachelors degree, which is less than the average (13.5%) for nurses registered in Canada. This finding may be related to the nurses' older age, or because they wanted to acquire knowledge that was more immediately applicable to their clinical setting or required a shorter time frame.

The personal characteristics identified by the group as being important qualifications for hyperbaric work included self-confidence, physical fitness and adaptability in a confined space that is prone to rapid and sometimes dramatic changes. At least two of these characteristics, feeling confident and being adaptable to change, may have been enhanced by the nurses' experience and education in critical care nursing. It would also seem that nurses lacking these qualities would either not be attracted to hyperbaric nursing or would not stay in this work very long. The finding of this study that most nurses (62.5%) had been working in hyperbaric nursing for longer than two years would appear to indicate that qualified senior nurses seem to enjoy this specialty and

are committed to it.

A higher percentage of hyperbaric nurses are male (9.4%) compared to that found in the larger nursing population (3.3%) (Statistics Canada, 1990). It is possible that more men are attracted to this area because of an interest in less traditional roles in nursing, complex technology, or because they may have a preference for working independently.

Fifty-three point one percent of the nurses in this study were in the 30-39 year age group, compared with 34.5% for all nurses registered in Canada (Statistics Canada, 1990). This difference may be due to the higher level of skills and experience required by nurses working in hyperbaric medicine which would discourage neophyte nurses from choosing to work in the area. This is supported by the fact that the percentage of hyperbaric nurses 20 - 29 years of age was only 15.6% compared with 17.5% for all nurses registered in Canada. The lower proportion of hyperbaric nurses over 50 years, 3.1% as compared with 17.7%, may indicate that there are few administrative positions available in hyperbaric units, that older nurses want more regular hours or it may reflect the difficulty of maintaining medical fitness for

diving past age 50.

An interesting finding was that only 50% of the respondents were married and only 10 (31%) had children. Perhaps it is harder for married nurses and those with children to commit themselves to a specialty with an uncertain timetable. Another factor may be that nurses who want to have children are not attracted to this specialty because pregnancy is a contraindication to diving in hyperbaric nursing. Several authors support restrictions on diving while pregnant, especially in the first trimester (Corry & Montoya, 1989; Greenberg et al., 1979), and Jennings (1987) stated that because pregnancy can occur before it is recognized it may result in exposure to pressure in the first trimester. Therefore women hoping to become pregnant would probably not be willing to work in this area.

Factors Contributing to Job Satisfaction or Dissatisfaction

The reasons why nurses were drawn to this area reflect not only the characteristics of this treatment modality but also the preferences of the nurses. Paradoxically, they were attracted to work in hyperbaric

nursing both because of its similarities to, and differences from, their usual work in critical care nursing. Hyperbaric nursing is similar to intensive care nursing in that it permits the nurse to continue to work with a challenging patient. Like ICU nursing, it is exciting because of the emergency interventions required periodically, the opportunity to acquire advanced knowledge and work independently, and because it is an elite type of nursing. Hyperbaric nursing also confers on the nurse an elite status because of the special clothing (gold Durette uniforms) noticeable as they pass through other areas of the hospital staffed by health care professionals who, in general, may see it as a mysterious area because they are poorly informed about hyperbaric oxygen therapy.

On the other hand, hyperbaric nursing is attractive to nurses in the way it differs from ICU nursing in that it provides the chance to work with patients and staff in a unique environment, and to establish warm relationships with patients many of whom, unlike most ICU patients, can talk. Most of them appreciated the increased opportunity for communication with the patient and the gratification of seeing some patients rapidly respond to HBO treatment

when no other treatment would have succeeded.

The list of factors contributing to job dissatisfaction is far shorter than the list of positive job characteristics, but none the less an important component of this study. The factors centered around the unpredictability of the patient's condition, especially the critically ill patient. Other factors contributing to job dissatisfaction included being called to work only to wait for hours while the patient is in the operating room, the unpleasantness of some chronic or extensive wounds and concerns about safety, especially with agitated patients. The nurses' concerns about feeling safe and the issue of being alone in the chamber were closely tied together since restless and confused patients increase threats to safety. These findings support the remarks of Norkool (1979), who suggested that the isolation and confinement of the environment may increase safety concerns, "The environment is confining in that the nurse and the patient are enclosed in a relatively small space, separated from the outside environment and at times are totally committed to that enclosure until certain specific decompression schedules are completed; limiting in regard to space and easy

accessibility of equipment, supplies and medical assistance that nurses are accustomed to having in the convenient hospital setting..." (p. 732).

It would appear that one major issue raised by these factors may be a lack of appropriate education. Support for skill development through education is emphasized by Greenberg et al. (1979) who notes that because of the variety of patient conditions and level of acuity, hyperbaric nurses need to possess a broad range of skills. Advance warning of problems and knowledge of required abilities such as, communication techniques for the agitated patient should be integrated into an introductory program to hyperbaric nursing. In-service for other disciplines especially medical staff should be considered to increase their awareness of issues related to the comprehensive treatment of the patient with gas gangrene, carbon monoxide poisoning and chronic wounds.

A number of concerns presented by these hyperbaric nurses, under the category of personal and lifestyle adaptations, also warrant mention here because although they were not labelled as sources of job dissatisfaction they caused the nurses to redefine their expectations of personal comfort or learn new techniques to handle

sensations created by pressurization and depressurization: barotrauma, in-chamber noise, difficulty in concentration, the increased work needed to breathe, the need to limit liquid intake for bladder control, different physical sensations, such as tingling in the arms and increased fatigue. Many of these reported sensations, though not researched, had been addressed in the literature. However, the experience of fatigue after a treatment dive, mentioned by 12/32 nurses, has not been addressed in the literature nor has the variety of physical sensations, such as tingling in the arms noted by six informants.

There are a number of possible reasons for the high frequency with which fatigue was reported. It may be related to the sometimes strenous activities performed in a pressurized environment, to the impact on sleep patterns of diving in the middle of the night or to medications taken to facilitate ear or sinus clearing. However, it has also been suggested that fatigue may indicate borderline decompression sickness (H. Manson, personal communication April, 1992), as well tingling in the arms may also be indicative of decompression problems. Whatever the causes, research and education is

needed to further explain this finding.

Introductory Hyperbaric Course Design

The educational topics to be discussed in this segment were obtained when nurses were directly asked to offer recommendations for designing an introductory course for hyperbaric nurses. The validity of this interview data was supported by the ranking of the 37 topics deemed "Most Needed Topics" in the Educational Needs Assessment Questionnaire (see Table 3). The participants' suggestions were detailed and comprehensive, so much so that the recommendations offered by this group covered the entire core curriculum of an introductory hyperbaric course. To make the most effective use of the data obtained from these nurses, the suggested content and format will be integrated into the discussion of the format for a course in hyperbaric nursing.

Pre-Selection Program

It is felt that it would be financially more responsible to offer a half day pre-selection program during which nurses would be introduced to hyperbaric

nursing and tested in the chamber, so that those not tolerating compression could be disqualified, and others might choose not to proceed with hyperbaric nursing early in the experience.

The test dive, a standard part of most orientations to hyperbarics, disqualifies individuals who may have difficulties with ear clearing or confinement. It is not only cost effective to schedule this component early in the program but it also reduces the anxiety about equalizing middle ear pressure that nurses mentioned occurs in relationship to their initial dives. It also helps administrators and faculty teaching the hyperbaric nursing course to know that they are not likely to lose participants because of the inability to equalize ear pressure or endure confinement in the chamber.

While the primary focus of the pre-selection program should be to do pressure testing, nurses also should be introduced to the basic theory of hyperbarics, the need for certain lifestyle adjustments, and they should be made aware of the drawbacks and the benefits of working in a hyperbaric unit (shift work, having to wait sometimes long periods for patients, being alone in the chamber with critically ill patients, the appearance of

some of the disfiguring wounds and for some nurses the close personal relationship that develop between them and their patients). The opportunity to work independently in a challenging and exciting environment, the need to make lifestyle adjustments, and to be adaptable to the unpredictability of patient conditions and complications should also be emphasized.

If the size of the nursing group available for the hyperbaric course is large enough, the course coordinators could select nurses during the pre-selection program who have the clinical competencies recommended in this study. If this component of the pre-screening is not done then these competencies would need to be reviewed in the hyperbaric course.

The pre-selection program could also be used to broaden the knowledge base about hyperbaric oxygen therapy. Even if nurses chose to drop out after taking the introductory component of the hyperbaric course, their time would have not been wasted, in that knowledge about hyperbaric nursing would have been disseminated throughout the nursing population. Since teaching other health professionals was seen to be extremely important by the participants of this study, this would be

beneficial.

Hyperbaric Course Content

The following sequence was suggested by the participants for an introductory program: physiology and mechanism of action; conditions to be treated; nursing care for these conditions and equipment modification; chamber operation and emergency procedures and patient education. It was recommended that a one week course would most likely allow enough time to address the important topics related to this subject.

Physiology and Mechanism of Action

Following the pre-selection test dive, educating nurses about the physiology and mechanism of action for hyperbaric oxygen therapy were seen as crucial topics that should be introduced at the beginning of the program, followed by a detailed discussion of normal and abnormal physiology under pressure. Understanding the gas laws was also recommended for inclusion in this theoretical element of the course.

Conditions to be Treated

The most frequently identified topic that nurses said should be addressed early in this course was the kinds of conditions treated in the chamber, especially life-threatening diagnoses, such as gas gangrene and carbon monoxide poisoning. Participants emphasized the importance of teaching about the less frequently seen serious conditions, as well as the large number of less critical elective patients with diagnoses, such as problem non-healing wounds.

Nursing Care and Equipment Modification

Following a discussion of the kinds of conditions treated in the chamber, the next topic should address the treatment profiles and nursing care required by these patients. Nursing care is not emphasized in the hyperbaric courses that are now available and yet it is a major part of hyperbaric medicine. It is especially important that nurses know how to give comprehensive nursing care and be able to anticipate possible complications.

Nurses in this study expressed a need to learn about the nursing care of patients with oxygen toxicity, carbon

monoxide poisoning/smoke inhalation, and anxiety related to confinement in the chamber.

Nursing care of patients with life-threatening diagnoses, such as gas gangrene, and the interventions required in other emergency situations also need to be thoroughly covered in this course. Similarly, advanced clinical skills in the area of patient assessment, which ranked fourth in the list of educational needs (Table 3), are important. Corry & Montoya (1989) agreed with the participants regarding the care of patients with gas gangrene. They wrote: "... the nature of gas gangrene requires that the critical care nurse understand the disease process. Sharp assessment skills form the cornerstone of early diagnosis and treatment..." (p. 30).

The 38 scenarios describing the most challenging patients encountered by these nurses should be used as guidelines for developing case-studies or clinical seminars for use in the course. Case studies could be developed to enhance lectures on nursing care or be used as study guides to focus on, for example, a unstable critically ill patient on a mechanical ventilator who has hemodynamic monitoring and is receiving inotropic drugs.

Suggestions for other case studies should be taken from the most needed topics in the overall ranking of Educational Needs for Hyperbaric Nurses (Table 3).

In as much as patients diagnosed with problem wounds form a large and challenging component of the hyperbaric caseload, the healing and care of problem wounds is a necessary part of the course. Several issues related to problem wounds were emphasized by the participants in this study: 1) hyperbaric oxygen therapy may erroneously be seen as a last resort for patients with chronic wounds, 2) the patient may be depressed and frustrated because of repeated treatment attempts and 3) nurses may be surprised and horrified at the extent of many chronic and unpleasant wounds. All of these points need to be discussed in the course along with an explanation of how HBO impacts on wound healing at a cellular level, the intricacies of wound care and the psychological impact of chronic illness.

In addition, attention should be given to interpersonal competencies since the most frequently recommended clinical skills that nurses in hyperbaric units should have were effective communication and an ability to establish relationships. Nurses who work in

ICU state that they often care for patients who are non-communicative. It may be that the opportunity to spend primarily uninterrupted time (during the treatment period) talking to patients may in fact attract nurses to hyperbaric nursing. Certainly the emphasis placed on communication by this nursing group and the tremendous importance of psychological care of the patient indicate that it would be beneficial to include these topics in the hyperbaric course.

Thirteen nurses indicated that they would like to see priority given to the topic of pressure-related changes to all equipment including respiratory support systems, IV administration and other enclosed systems. In particular, nurses found it challenging to deal with multiple intravascular lines and controlling the administration of intravenous vasoactive drugs. This information is not usually taught in depth in currently available hyperbaric courses and yet it was a strong recommendation of these nurses that it be thoroughly presented. It would seem most appropriate to schedule it as part of the nursing care. The importance of this topic can not be over emphasized because ignorance can cause death of the patient. Unfortunately, despite its

importance little concrete information is available in the literature.

Chamber Operations and Emergency Procedures

Chamber operations should be clearly taught so that nurses working under pressure have some knowledge of what is happening at the control panel. Emphasizing and explaining chamber operations to be used in an emergency would also help to alleviate nurses' concerns about safety and give them a sense of control.

The topic of emergency procedures included two components, emergencies related to hazards in the pressurized environment and emergencies due to changes in the patients' health status.

Two crucial topics associated with the hazards of a pressurized environment are awareness of the contraindications for nursing personnel working in the chamber and knowledge of fire safety precautions. These two aspects of safety were ranked third and fourth respectively in the ten most needed topics in an introductory hyperbaric course.

The issue of fire safety is mentioned repeatedly in all literature on hyperbarics because of the need for

caution and its devastating consequences in an oxygenated environment. It is important then that nurses know, in particular, what procedures to follow in the event of emergencies, such as an in-chamber fire or a power failure.

On the other hand, much is unknown about how hyperbaric pressure effects personnel and although there are number of precautions to be followed, nurses should not only be educated about these topics but encouraged to research them.

The second type of chamber emergency includes sudden changes in the patient's condition, such as oxygen toxicity seizures or cardiac arrest. This type of emergency care was considered an important course component because the majority of this nursing group worked in the hyperbaric unit part-time and would not have had any prior hands-on experience with these emergencies in the chambers. Handling these emergencies was identified twice in the ranking of the most needed topics in a hyperbaric course (Table 3). For example, handling patient emergencies such as cardiac arrest in the chamber was selected by <u>every</u> participant in this study and ranked first out of 37 items. While handling

pressure-generated emergencies, such as oxygen toxicity was ranked second, and pneumothorax and gas embolism were ranked third. The importance that the participants placed on these issues supports the recommendation that they should be included in the course.

Patient Education

The necessity to cover the many aspects of patient education was stressed by eight nurses, because of the uniqueness of this treatment modality and the importance of issues related to safety, especially where nurses are caring for confused, agitated or comatose patients. Teaching patients about hyperbaric complications and compliance, and preparing them for treatment ranked second in the list of most important topics. The participants felt that it was necessary to inform the patient specifically about what he could expect to happen in the hyperbaric chamber as well as how they were expected to behave. Particular consideration should also be given to special situations, such as educating the cognitively-impaired patient or children of different ages.

The hyperbaric nurses in this study identified the need to emphasize the importance of fire regulations, use of ear clearing techniques and oxygen apparatus, caution against breathholding on ascent, and explain the interventions to reduce confinement anxiety. These components of patient education were supported by Ross (1986) who made additional suggestions to teach about voice changes and establish a simple system of hand signals to ensure good communication in a noisy chamber.

Other concerns expressed by the participants included teaching patients about fire safety and caring for the anxious patient. Education would go a long way toward alleviating anxiety for both the patient and the nurse. Gaul & Hart (1975) noted that hyperbaric oxygen therapy "is initially interpreted by all patients as a threatening and frightening experience" (p. 1040). These authors agreed that patient and family education, along with effective psychological nursing interventions, were necessary to assist patients in coping with this treatment.

Despite serious safety considerations, the difficult chamber environment, odd hours and shifts, and the lifestyle changes that must be made, it was interesting

that stress reduction techniques were given the lowest priority of all 37 items on the Educational Needs Assessment Questionnaire. It may be that these hyperbaric nurses experience some of the impact of the many physical and psychological variables as eustress, that is, positive stress. Evidence to support this was found in the interview transcripts where nurses often commented that they preferred emergency dives with critical patients. That is not to say that stress management strategies should not be a part of a HBO course, since nursing interventions for patients with anxiety disorders related to confinement and dealing with emergencies were ranked in the 10 most needed topics. However, it seems that a stress management component should focus on strategies for both the patient and nurse.

Serendipitous Administrative and Professional Suggestions

A number of suggestions made during the interviews with participants did not relate to the course content for a hyperbaric program but focused on administrative and professional issues. They are included in the discussion because consideration of these recommendations

would enhance the effectiveness of programming related to HBO therapy. Thirteen nurses in the sample identified the most frequently mentioned issue in this category as the need to publicize the use and benefits of hyperbaric oxygen therapy. Education of the general public, nursing and medical communities was considered even more important than that of continuing education of hyperbaric nurses, although this issue also received considerable support. The finding that nurses ranked education of other groups higher than their own continuing education seems unexpected and may be related to the strong need to promote the maximum appropriate use of the chamber and its staff. Similarly, the main goals of education in hyperbaric nursing were seen to be two fold: 1. making people aware of the purpose of hyperbaric oxygen therapy and 2. dispelling the myths associated with this treatment, so that physicians would utilize it more frequently and appropriately, and nursing staff would promote its use as well as be attracted to the area and be recruited more easily.

With regard to the broad education of nurses, one suggestion to achieve this goal was to incorporate an introductory lecture about the benefits of hyperbaric

therapy into the curriculum of basic and post-basic educational programs for nurses. Some of the post-basic critical care courses have incorporated a short segment on Hyperbaric Oxygen Therapy but it is not taught in most programs.

Because it was stressed as a major issue for thirteen nurses, continuing education after the introductory period was recommended to be offered regularly. The knowledge and skills covered in the introductory course were seen to need continuing education to keep the practioners up to date. It was suggested that an introductory program should focus on basic skills, for example, chamber operations, which could later be developed to an advanced level in the continuing education program.

Maintaining currency of knowledge and skills seem to be a considerable challenge in hyperbaric nursing because many nurses dive infrequently due to the fact that they may be working in ICU, may not be available to work in the chamber when asked to do so, and some may be unable to work due to pregnancy. Continuing education for these nurses is vital because they are working in an extremely challenging environment, often with very seriously ill

patients. These suggestions mirror those of Norkool (1979) who also emphasized the need for maintance of clinical competencies, she states that, "Hyperbaric nursing is a demanding and challenging profession, not only requiring the nurse be proficient in the skills of caring for the acutely ill patient, but also demanding the ability to function efficiently and effectively within a confining, limiting, enduring and often adverse work environment ..." (p.732).

It was also suggested that a regular on-call list be established. This would ensure that more nurses are available to work when called, and a system of yearly certification could be devised so that nurses would be confident that their knowledge was up-to-date.

An introductory hyperbaric course was considered by the participants to be essential, but in view of it's unavailability, nurses recommended ways to accommodate to this situation until such a course is developed. Structured self-learning modules and current nursing publications that were highly readable were suggested.

Because nurses are often isolated from each other even within their own units, it was not surprising that communication was a concern. A national or local

newsletter was given considerable support by this group not only as a method of communication but as an avenue to update knowledge.

Discussion of Limitations

While it was a limitation of this study that only the three English speaking clinical hyperbaric units were studied and therefore the findings cannot be generalized to all multiplace clinical hyperbaric units, the issues and recommendations were consistent across all three of the study units and there was also agreement between quantitative data collected and the interview transcript data. Furthermore, many of the findings were also true of the Hyperbaric Unit at St. Luke's Hospital, Milwaukee, Wisconsin where the study questionnaires were pilot tested.

The fact that the questionnaires had not been used before is not seen to be a problem in that the data requested was not used for anything other than ranking topics according to importance for inclusion in a hyperbaric nursing course.

While it is possible that nurses may not have remembered their initial experiences accurately, and some

did say they could not recall some details, the majority spoke at length about their initial contact with hyperbaric nursing.

Though mechanisms were not in place to determine the accuracy of the information recalled about their education prior to working in the chamber, there was no evidence that the information provided by the participants was inaccurate, and the detailed nature of their comments supports the assumption that they were able to recall their most significant early work experiences and identify information that would have been useful to them for this study. Furthermore, the material gathered during the study was detailed and had a logical consistency that was in agreement with material obtained from a visit to the Hyperbaric Unit at St. Luke's Hospital, Milwaukee, Wisconsin and from talking with other knowledgeable people who were not part of the sample studied.

One major limitation was that several categories of demographic data were underrepresented and it was not possible to look for differences between, for example, the responses of men versus women or nurses with or without a BN. It is a strength of the study that 32 of

the 33 nurses working in the three hyperbaric units took part in the study.

It was never the intention of this study to test the appropriateness of the conceptual framework, which was modified from that of Urbano & Jahns, but two of the four components of the framework were found to be appropriate for this investigation. The first component was related to basic human needs and individuals' belief systems. For the participants in this study the need that was evident was the need for a sense of value, importance, achievement and self-actualization. This was satisfied frequently through the experiences that nurses enjoyed in hyperbaric nursing: acquiring specialized knowledge and competencies, seeing patients return from the brink of death, being totally in control, accepting personal danger for the benefit of others and viewing hyperbaric nursing as having an elite status.

These nurses also demonstrated a need for social relationships, which was reflected in the value hyperbaric nurses placed on talking to patients and establishing warm relationships with them. The need for excitement was manifested in the unpredictable nature of the work and the expressed desire for a different

experience. Hyperbaric nursing seemed to attract ICU nurses looking for a different experience.

The second component of Urbano & Jahns' framework that was relevant to this study related to the life situational variables. For example, the fact that pregnancy disqualified nurses from working in the chamber would discourage young women from working in this area if they were likely to become pregnant, while shift work might be a deterrent to older or experienced nurses.

The original framework was designed to explain why learners are attracted to continuing education courses. For this study, it was adapted to explain what attracted nurses to hyperbaric nursing and to assist in planning an introductory educational hyperbaric program. As there were no hyperbaric educational courses available in Canada, other components of the framework could not be addressed, but the framework of Urbano & Jahns provided a useful and suitable foundation for this study.

Despite these limitations, it was concluded that the following recommendations, based on the study findings, provide valuable information for anyone designing an introductory hyperbaric course for English-speaking (and perhaps French-speaking) Canadian nurses. It was also

concluded that it would be extremely desirable for such a course to be made available in Canada.

Recommendations for Education and Practice

1. Recruitment campaigns should be directed at nurses most likely to remain loyal to the specialty for long periods of time, ie nurses with qualities similar to the research participants, with extensive experience in critical care nursing, superior health assessment skills, confidence, good health and an ability to adapt quickly and calmly to change.
2. A half-day pre-selection program should proceed the introductory hyperbaric course and aim at exposing course participants to pressurization and preliminary information on hyperbaric oxygen therapy, so that they can make a more informed choice regarding more regular involvement in the hyperbaric specialty. An assessment of the nurse's clinical competencies could be completed at this time.
3. A one week introductory course should be developed to address the topics discussed and presented in

this thesis based on recommendations by the research participants.

4. Schools of Nursing should be encouraged to incorporate an introductory lecture into the curriculum of basic and post-basic educational programs for nurses in order to dispel misinformation and educate nurses about hyperbaric oxygen therapy.
5. Continuing education programs need to be developed to maintain currency of knowledge and advance clinical skills.
6. On-call schedules should be devised to take into account the need to avoid certain activities, such as drinking alcohol and diving when tired, so that nurses may be more likely to be available when called to work in the hyperbaric unit.
7. Directors of hyperbaric units should seek sources of funding to: 1. enhance the development of communication systems between hyperbaric nurses and support the development of a local newsletter thus educating and assisting hyperbaric nurses who work in small, isolated groups to keep up with the new findings and practices of hyperbaric nursing, and

2. publicize the effectiveness of hyperbaric oxygen therapy for the appropriate disorders to all health care professionals.

Recommendations for Further Research

This study raised a number of important questions that should be investigated. For example, a significant number of the participants reported experiencing fatigue after diving in a chamber. In as much as it has been suggested that this after-effect could be an early symptom of decompression sickness, it ought to be studied further.

Because many patients treated with hyperbaric oxygen therapy are diagnosed with problem healing wounds which pose challenging treatment concerns, more research into identifying optimal wound cleansing solutions and dressings for chronic as well as acute wounds is needed.

Sources of patient anxiety and methods of anxiety reduction, as well as the broader educational needs of patients and their families were other important concerns emphasized by the nurses in this study.

Research interest in hyperbaric nursing could be generated if Directors of hyperbaric units more actively

publized their specialty in Schools of Nursing, especially those with graduate programs and those with hyperbaric units in the area. This is a valuable specialty and one that has been sadly underdeveloped.

References

Bond, G. F. (1966). Safety factors in chamber operation. Fundamentals of Hyperbaric Medicine. (Publication No. 1298). Washington, D.C.: National Research Council.

Bowman, B., Wolkenheim, B.J., Beck, M.L., O'Donnell, D., & Schneider, K. (1985). Needs assessment: An information processing model. The Journal of Continuing Education in Nursing, 16 (6), 200-204.

Bye, M.G. (1988). An analysis of continuing education needs of nurses in nursing homes. The Journal of Continuing Education in Nursing, 19 (4), 174-177.

Chesney, A.P., & Beck, S. (1985). Assessing the need for continuing education for registered nurses. The Journal of Continuing Education in Nursing, 16 (2), 39-43.

Conedera, F., & Schoessler, M. (1985). Continuing education for hospice staff. Nursing Clinical of North America, 20 (2), 357-363.

Corry, M. & Montoya, L. (1989). Gas gangrene: Certain diagnosis or certain death. Critical Care Nurse, 9 (10), 30-32, 36-38.

Craytor, J.K., Brown, J.K., & Morrow, G.R. (1978, June). Assessing learning needs of nurses who care for persons with cancer. Cancer Nursing, pp. 211-220.

Farley, J.K., & Fay, P. (1988). A system for assessing the learning needs of registered nurses. The Journal of Continuing Education in Nursing, 19 (1), 13-16.

Fernsler, J. (1987). Developing continuing education programs in cancer nursing: An overview. Oncology Nursing Forum, 14 (5), 59-60.

Field, P.A. & Morse, J.M. (1985). Nursing research: the application of qualitative approaches. Rockville, Maryland: Aspen Systems Corporation.

Gaul, A.L. & Hart, G.B. (1975). Baromedical nursing combines critical, acute, chronic care. AORN Journal, 21 (6), 1038-1047.

Glowacki, M. & Chew, N. (1988). Hyperbaric oxygen therapy: A guide for the perisperative nurse. AORN Journal, 47 (6), 1370-1383.

Greenberg, D.A., Messina, V., Reichow, W. & MacLean, C. (1979, September). Hyperbaric oxygen: Exciting new clinical results. RN, 53-57.

Harrington, J.V. & Carter, J.C. (1966). The Hyperbaric facility. Fundamentals of Hyperbaric Medicine. (Publications No. 1298). Washington, D.C.: National Research Council.

Jennings, R.T. (1987). Women and the hazardous environment: When the pregnant patient requires hyperbaric oxygen therapy. Aviation, Space & Environmental Medicine, 58 (4), 370-374.

Knowles, M. (1973). The adult learner: A neglected species. Houston, Texas: Gulf Publishing Company.

Krings, J. (1987). Hyperbaric oxygen therapy and the critically burned patient. Nursing Management, 18 (9), 80A-80H.

Lanphier, E.H. (1966). Recompression: Treatment of decompression sickness and air embolism. Fundamentals of Hyperbaric Medicine. (Publication No. 1298). Washington, D.C.: National Research Council.

Matthews, A.E., & Schumacher, S. (1979). A survey of registered nurses' conceptions of and participation factors in professional continuing education. The Journal of Continuing Education in Nursing, 10 (1), 21-27.

Maslow, A. (1970). Motivation and personality. New York: Harper & Row.

Mazonson, P.D., Wu, A.H.T., & Scaltrito, S. (1981, April). Oncology grand rounds for nurses: The need for case-oriented continuing education programs in cancer nursing. Cancer Nursing, p. 107-114.

McKiel, R.E., Lockyer, J., & Pechiulis, D.D. (1988). A model of continuing education for conjoint practice. The Journal of Continuing Education in Nursing, 19 (2), 65-67.

Meijne, N.G. (1970). Hyperbaric oxygen and its clinical value. Springfield, Ill: Charles C. Thomas Publisher.

Myers, R.A.M., Baker, T. & Cowley, R.A. (1982). Hyperbaric medicine: State of the Art, 1979. The American Surgeon, 48 (9), 487-494.

Norkool, D.M. (1985). Hyperbaric oxygen therapy: High pressure nursing. Nursing Administration Quarterly, 9 (4), 57-61.

Norkool, D.M. (1979). Current concepts of hyperbaric oxygenation and its application in critical care. Heart & Lung, 8 (4), 728-735.

Pittman, K.S., Stevens, R.H., Flup, E.M., & House, R.M. (1988). Addressing continuing education needs of public health nurses in North Carolina. The Journal of Continuing Education in Nursing, 19 (4), 158-167.

Poulton, T.J. (1981). Monitoring critically ill patients in the hyperbaric environment. Medical Instrumentation, 15 (2), 81-84.

Ross, M.C. (1986). Healing under pressure. American Journal of Nursing, 10, 1118-1120.

Seto, W.H., Ong, S.G., Ching, T.Y., Liu, S.H., & Yau, T.O. (1988). Educational needs in patient care practices in Hong Kong. American Journal of Infection Control, 16 (1), 19-25.

Statistics Canada (1990). Registered nurses management data. Ottawa: Canadian Nurses Association, Research Department.

Thom, S.R. (1992). Hyperbaric oxygen therapy: A committee report. Bethesda, Maryland: Undersea & Hyperbaric Medical Society.

Urbano, M.T., & Jahns, I.R. (1988). A conceptual framework for nurse's participation in continuing education. The Journal of Continuing Education in Nursing, 19 (4), 182-186.

Volker, D.L. (1987). Learning needs assessment. Oncology Nursing Forum, 14 (5), 60-62.

Wilson, H.S. (1985). Research in nursing. California: Addison-Wesley Publishing Company.

Workman, R.D. (1966). Other medical problems associated with exposure to pressure. Fundamentals of Hyperbaric Medicine. (Publication No. 1298). Washington, D.C.: National Research Council.

Appendix A

Information Sheet

PART I

I would like to know something about you. (Please do not include your name)

AGEOF CHILDREN

_____ 20 - 29 years_____ Number
_____ 30 - 39 years_____ 0 - 2 years of age
_____ 40 - 49 years_____ 3 - 5 years of age
_____ 50 years +_____ 6 - 10 years of age
_____ 11 - 17 years of age
_____ 18 years of age and older

SEX

_____ Female_____ Male

MARITAL STATUS

_____ Single
_____ Married/Living Together
_____ Separated/Divorced/Widowed

EDUCATION (Highest Degree Attained)

_____ R.N._____ B.N._____ M.N./Ph.D.

HOURS WORKED PER WEEK IN HYPERBARIC UNIT

_____ Full-Time
_____ Part-Time
_____ On-Call Basis

LENGTH OF TIME WORKING IN HYPERBARIC UNIT

_____ 0 - 6 months
_____ Longer than 6 months to 1 year
_____ Longer than 2 years to 5 years
_____ Longer than 5 years to 10 years
_____ Longer than 10 years

ADVANCED COURSES, INCLUDING THOSE ON HBO, TAKEN PRIOR TO WORKING IN HYPERBARIC UNIT

_____ Intensive Care Nursing
_____ Wound Care
_____ Respiratory Therapy
_____ Hyperbaric Oxygen Therapy
_____ Others (please list)

_____
_____
_____

Part II Education Needs Assessment Questionnaire

Please place a check mark in one of the first three columns to indicate how essential you feel this topic is in an introductory course in hyperbaric nursing. Check Column 4 or 5 if this topic was or was not included in your program and place any comments about the topic or your response in Column 6.

	GREAT NEED	SOME NEED	NO NEED	WAS RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	NOT RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	COMMENTS
1. Nursing care for the patient diagnosed with decompression sickness/diving accidents.						
2. Nursing care for the patient diagnosed with an air embolism.						
3. Nursing care for the patient diagnosed with carbon monoxide poisoning/smoke inhalation.						
4. Nursing care for the patient diagnosed with crush injuries.						

	GREAT NEED	SOME NEED	NO NEED	WAS RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	NOT RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	COMMENTS
5. Nursing care for the patient diagnosed with burns.						
6. Nursing care of the patient diagnosed with soft tissue infections, including gas gangrene.						
7. Nursing care of the patient with chronic problem wounds.						
8. Nursing care for the patient diagnosed with refractory osteomyelitis.						
9. Nursing care for the patient diagnosed with radiation necrosis.						
10. Nursing care for the patient diagnosed with compromised skin grafts.						

	GREAT NEED	SOME NEED	NO NEED	WAS RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	NOT RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	COMMENTS
11. Teaching patients about HBO complications, and the importance of compliance to treatment regimen.						
12. Obtaining informed consent from patients.						
13. Nursing interventions for oxygen toxicity.						
14. Psychological and physical assessment of patient prior to and during hyperbaric oxygen therapy.						
15. Preparation of patient for hyperbaric oxygen therapy.						
16. Nursing interventions for middle ear barotrauma.						
17. Nursing interventions for anxiety related to confinement in HBO chamber.						

	GREAT NEED	SOME NEED	NO NEED	WAS RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	NOT RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	COMMENTS
18. Nursing implications of drug administration for the hyperbaric patient.						
19. Teaching new personnel about HBO.						
20. Impact of HBO on health and lifestyle of patient and their family.						
21. The needs of the seriously ill patient.						
22. The laws of physics related to diving/hyperbaric medicine.						
23. Evolution of hyperbaric oxygen therapy.						
24. Fire safety and control.						
25. Contraindications, complications and potential hazards of hyperbaric oxygen therapy for the patient.						

	GREAT NEED	SOME NEED	NO NEED	WAS RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	NOT RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	COMMENTS
26. Contraindications, complications and potential hazards of working in the chamber for the nurse.						
27. Indications of hyperbaric oxygen therapy.						
28. Understanding equipment and necessary modifications to equipment or procedures for use in the hyperbaric environment.						
29. Handling pressure generated emergencies, such as pneumothorax, gas embolism.						
30. Handling patient emergencies in the chamber, e.g. cardiac arrest.						

	GREAT NEED	SOME NEED	NO NEED	WAS RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	NOT RECEIVED IN INTRODUCTORY PROGRAM TO HYPERBARICS	COMMENTS
31. Special problems with the treatment of children.						
32. Handling chamber emergencies, e.g. power failure.						
33. Decompression diving tables.						
34. Infection control for HBO.						
35. Stress reduction for nurses.						
36. Lifestyle changes required of personnel while working in HBO chambers.						
37. The hazards of pregnancy while working in pressurized chambers.						

Appendix B

Interview Questionnaire

1. What was unexpected about patient conditions or procedures when you first worked in a multiplace hyperbaric chamber?

2. What was unexpected about your personal comfort or physical or psychological health when you first worked in a multiplace hyperbaric chamber?

3. What knowledge and skills were most useful to you when you started working in this unit?

4. If you were designing a clinical training program for nurses coming to work in a hyperbaric chamber, what would you include?

5. What do you find most challenging about working in hyperbaric nursing?

6. Is there anything else about your job or educational preparation that you would like to tell me?

Appendix C

7 Avalon Street
St. John's, NF
A1C 4P6

Director of Nursing
Director of Hyperbaric Unit
Director of Research

Dear

I would like to request your permission to conduct a research project as part of my Master's thesis at Memorial University of Newfoundland. The title of the study is, "An Investigation of the Educational Preparation of Nurses Prior to Working in Land-Based Multiplace Hyperbaric Chambers in Canada". I wish to ask nurses working in hyperbaric units to complete two short questionnaires and to talk with each nurse for about 30 minutes.

The enthusiasm surrounding the clinical use of hyperbaric oxygen therapy has peaked in recent years in response to clinical research supporting its efficacy in treating an increasing number of conditions. This is a particular taxing area with very specific educational needs. More nurses are beginning to work in this area and therefore require educational preparation to meet the demands of this developing specialty. Nursing literature, especially related to the educational needs of the hyperbaric nurse, is unavailable and yet we are aware that the most successful educational programs are those that begin with assessing the learner's needs. This project will focus on those special needs of hyperbaric nurses in Canada.

The ultimate goal of this study will be to use this information to design clinically based educational programs for nurses in hyperbaric units and thereby enhance quality of care administered to patients.

This study has received the approval of the Human Investigation Committee of Memorial University of

Newfoundland, Health Science Complex, and I am enclosing information about the project for your perusal. If I receive your approval, I will make arrangements to visit your hospital to collect data. Should you have any questions or comments, please feel free to contact me. Thank you for your time in considering this project.

Sincerely,

Bette Davis

Appendix D

AN INVESTIGATION OF THE EDUCATIONAL PREPARATION OF NURSES PRIOR TO WORKING IN LAND-BASED MULTIPLACE HYPERBARIC CHAMBERS IN CANADA

Thank you for giving some of your time to read about this study. I estimate that it will take approximately 15 minutes to complete Part 1 and 2 of the questionnaire. The questionnaire asks for:

1. General information about you, such as age and education.

2. Your educational interests in hyperbaric nursing.

I would also like to discuss in a brief interview with you some of the experience you have gained while working with HBO.

The purpose of this study is to assess the educational needs of nurses working in multiplace hyperbaric chambers. The literature suggests that educational programs are most successful when the participant's needs are met. Recent publications show that nursing research on the subject is limited especially in relationship to the HBO nurse's educational requirements.

Although you will not directly benefit from going through this study, the findings will be made available to you through your institution upon completion of the study. Long-range benefits could be derived from using the study results to design better educational programs more clearly focused on hyperbaric nursing.

Your participation is completely voluntary and refusal to be involved will not in any way affect your employment or evaluation of your job performance. Your information will remain anonymous, therefore do not indicate your name anywhere on this form. The data collected will remain confidential. Individual's names will not be shared with your employer or used in publication.

You may withdraw from the study or refuse to answer questions that may be distressing. If you have any

questions, comments about the questionnaire or require fu ther information about the study, please feel free to as.

Please complete Parts 1 and 2 and bring them to the interview that I will arrange with you.

Thank you.

Bette Davis
School of Nursing
Memorial University of Newfoundland

Appendix E

Informed Consent Form

Investigator:Bette Davis

Phone:(709) 737 - 6695

P r o j e c t T i t l e :
An investigation of the educational preparation of nurses prior to working in land-based multiplace hyperbaric chambers in Canada.

You have been asked to participate in a research study. Participation in this study is entirely voluntary. You may decide not to participate or may withdraw from the study at any time without penalty.

The purpose of this study is to understand the educational needs of nurses working in a multiplace hyperbaric unit. The descriptive data will be collected by the researcher through a questionnaire which can be completed in fifteen minutes and a taped interview with each nurse which will take about thirty minutes. Any information that is obtained will be held in complete confidence and will not be discussed with other personnel. All material, written or taped, will be destroyed at the end of the study. The investigator will be available during the study should you have any problems or questions.

There may be no direct benefits to the participants of this study, but research results may be used to design future educational programs. There will be no health risks to participants resulting from involvement in this research.

I hereby give my permission to be interviewed and for this interview to be tape-recorded. I understand that, at the completion of the research, the tapes will be erased. I understand that the information may be published, but my name will not be associated with the research. I understand that completion of the questionnaires implies that I consent to have the information used in this study.

I have been given the opportunity to ask whatever questions I desire, and all such questions have been answered to my satisfaction.

THIS IS TO CERTIFY THAT I, _____
(print name)

HEREBY agree to participate as a volunteer in the above name project.

_____

Participant Researcher

_____

Date

PAGINATION ERROR.

TEXT COMPLETE.

ERREUR DE PAGINATION.

LE TEXTE EST COMPLET.

UNIVERSITY OF Miami
SCHOOL OF MEDICINE

February 11, 1992

Bette Davis
130 Bond Street
St. John's, Newfoundland
A1C 1T7

Dear Ms. Davis,

Thank you for your recent letter requesting permission to use my conceptual framework re: participation in professional continuing education. I would be very honored for you to use my framework in your research and certainly give you my permission.

You may also be interested in writing to Donna L. Waddell, EdD, RN, (Rt. 4, Box 250, Dahlonega, GA 30533). She recently conducted a meta-analysis of the participation research. Her findings supported the Urbano and Jahn's conceptual framework. She currently has a manuscript under consideration by The Journal of Continuing Education in Nursing.

I'd be very interested in seeing your results after you complete your thesis. It would be fun to compare findings.

Sincerely,

Mary Theresa Urbano, ARNP, PhD
Associate Professor of Pediatrics and Nursing

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