OREGON AIR AMBULANCE SERVICES

by

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CHAPTER 1

INTRODUCTION

Medical care is reaching for the clouds with the increasing use of aircraft as ambulances. Rapid air evacuation, initially proven successful during the Korean and Vietnam conflicts, received enthusiastic civilian support when a prospective study by Baxt and Moody (1983) cited a reduction in predicted mortality rates of 52%. Such enthusiasm has resulted in a rapid growth of both hospital-based and privately operated air ambulance services. At present, there are 90 hospital-based air ambulance services ("Helicopters," 1984) and over 583 services offered by the air taxi operators in the United States (Thomas, Clemmer, Orme, Menlove, & Gibbons, 1985). In a recent nationwide survey of 39 states, the average number of air ambulance services reported per state was 3 (The Council for State Governments, 1986). In Oregon, there are 2 hospital-based services and 16 air taxi operators licensed to transport patients by air.

Such rapid growth in this unique form of health care delivery might be expected to result in many problems with quality of care. The absence of any comprehensive set of federally mandated and enforced standards, and the relegation of responsibility to the

individual states for regulating air ambulances result in great differences in the quality of care provided by those services. Potential problem areas identified to date include inappropriate patient selection, inadequate aircraft and accompanying medical equipment, insufficient training of medical personnel, and lack of regulations and enforcement (Bare, 1982a). For example, patients with various ailments may be safely air transported if the aircraft is suitable and adequately equipped, and if personnel are knowledgeable about the effects of altitude on the patients' conditions (Department of the Air Force, 1983). Failing such provisions, patients in moderate distress at sea level may become severely compromised at higher elevations because of the physiologic hazards associated with flight. The extent to which such problems have indeed materialized is not known inasmuch as little research has been conducted which describes and evaluates existing services.

In Oregon, responsibility for oversight of air ambulance services rests with the State Health Division. The present transport protocol does not require validation as to the appropriateness of patients for airlift, nor does it provide protection for patients with conditions for which air transport

entails danger and is contraindicated. As a result, expensive air transports may be unwisely undertaken, subjecting vulnerable patients to such life-threatening physiologic insults as dehydration, hypoxia, and pneumothorax.

In addition to the potential problems of inappropriate patient selection, transport aboard unsuitable aircraft, and lack of necessary medical equipment, there is the possibility of inadequate inflight attendant training. The Oregon State Health Division is not sufficiently staffed to enforce appropriate training. Furthermore, educational requirements for inflight attendants are minimally addressed by specifying only that "medical personnel will be trained in the effects that altitude may have on patients and how to cope with these effects" (Oregon State Health Division, 1981). The quantity or type of training, minimal knowledge level of each inflight attendant, and instructor qualifications are not indicated. Further, volunteer air ambulance services are exempt from meeting even these minimal standards (Oregon Revised Statutes, 1981). Consequently, within Oregon, inflight attendants' knowledge of altitude physiology may vary greatly.

The appropriate selection of patients, the proper

design of the aircraft, the provision of necessary equipment, adequacy of training, and the enforcement of standards, all have impact on the condition of the patient upon mission termination. Patients who place faith in state licensed agencies may find false comfort in a system poorly prepared to meet their inflight needs. It is because of such concerns that investigation and evaluation of air ambulance systems is urgently needed. The purpose of this study is to provide such an investigation of the air ambulance system in Oregon.

Review of the Literature

The civilian sector, while quick to adopt the military model of patient air transport, apparently has not mimicked this model in terms of appropriate patient selection, physical structure of the aircraft and equipment, personnel training, regulation, and enforcement of these essential standards of practice. In my recent conversation with Dr. B. Yules, Chairman of the Air Ambulance Committee for the Aerospace Medical Association, he expressed the opinion that these remain significant problems in civilian air ambulance services.

The existing information on these topics is very limited, and is for the most part derived from

governmental sources underscoring this relatively new civilian endeavor. In this literature review, first the topic of patient selection is explored, with the emphasis on the role qualified consultations play in determining the appropriateness for airlift. Secondly, the suitability of aircraft and equipment for safely transporting the patient is discussed. The third theme, concerns the recognition of specialized inflight attendant training as essential to safe care. The role of regulations for the protection of the patient's health and well-being is the fourth topic of the literature review. Finally, a historical perspective on the delegation to the states of responsibility for air ambulance regulation and enforcement is presented.

Patient Selection

A handbook published by the National Highway Safety Administration of the U.S. Department of Transportation in association with the Commission on Emergency Medical Services of the American Medical Association (USDT & AMA, 1981) lists medical consultation to ensure appropriate patient selection as one essential element for safe patient air transport in the civilian sector. This consultation should be provided to an air ambulance service by a qualified Flight Surgeon (an MD knowledgeable in the effects flight has on specific

patient conditions). It is the responsibility of the air taxi operator to request this consultation. Unfortunately, this responsibility is rarely fulfilled, and consultation is virtually non-existent in most air ambulance services according to North American Air Ambulance (NAAA) of New Jersey. That organization, which privately certifies air ambulance services nationwide that meet its high standards of care, also lists as an essential component of any patient air transport the determination by a trained aeromedical consultant (RN or MD) of the appropriateness of the patient's condition for airlift (Bleiler, 1982).

One comprehensive study on air ambulance services was conducted through the University of Alberta by Connors (1975). In this study, Connors found that even in the Canadian government funded program, patients were transported by air for inappropriate reasons, the result of system abuse on the part of air ambulance operators eager to receive reimbursement. On several occasions, patients were unnecessarily jeopardized by failure to obtain aeromedical consultation.

More recently, a survey of 154 civilian air ambulance services was completed in the United States (Thomas et al., 1985). This study was initiated because of a growing concern over poorly operated

aeromedical transport services. Items examined were aircraft ownership, aircraft availability, type of aircraft used, type of patients transported, medical personnel and equipment, major aircraft accidents, and operators' attitudes regarding aeromedical regulations. The data indicated that medical directors oversee the transport operations of 92% of the hospital-based programs in contrast to 55% of the hospital-affiliated operations and 28% of the private air ambulance programs. As a result, only two-thirds of the air ambulance services medically assess the suitability of patient transports. Private air ambulance services rely heavily on the judgement of the referring physician that they are capable of meeting the patient's inflight needs both in terms of personnel competency and required medical equipment. Without close screening of each patient, the use of sophisticated air transport services is not cost effective in the movement of patients who need less care. Also, using these services for non-emergency transports temporarily prevents their availabily for evacuating the more critically ill.

Aircraft and Equipment

Boyd (1984) claims that in the United States aircraft are being used that are far from suitable for

the safe transport of the sick and injured. He suggests that the label "air ambulance" fosters the mistaken assumption that the service possesses the same sophistication in equipment and personnel as the modern intensive care ground ambulance. Dr. Willis Wingert, Chairman of the American Medical Association's Commission on Emergency Medical Services recently expressed the opinion that "A physician who would never dream of releasing a patient from the hospital to the care of a cab driver for an unsupervised drive across town to another hospital may inadvertently do the same thing when ordering an air taxi vehicle which happens to have removable seats and is free of passengers at the moment" (USDT & AMA, 1981, p. viii). According to a recent survey (Bleiler, 1982), most of the taxi services advertised as ambulances had no facilities for stretchers, much less hooks for hanging IVs. Connors (1975) found that most aircraft were not adequate for an air ambulance role in terms of space, power sources, pressurization, sound proofing, or heating. Thomas et al. (1985) found the percentage of ambulance-configured aircraft having compressed air, built-in oxygen and suction, and appropriate electrical outlets was greatest for hospital-based programs, than for hospital-affiliated, and least for the private

services. It followed that hospital aircraft were better equipped to treat the critically ill patient. Ninety percent of the hospital programs used helicopters while hospital-affiliated services and private programs used helicopters to a lesser degree (39% and 15% respectively). Pressurized aircraft, while advocated as essential for safe airlift (McNeil, 1983), were available from only 64% of all air ambulance services.

In addition to problems with aircraft suitability, problems with medical equipment have been identified. The Department of the Air Force (1983) has determined that medical equipment suitable for ground operation within the hospital performed unsatisfactorily aboard the aircraft. Unsuitable equipment can cause interference with aircraft navigational equipment and possible malfunction during flight. Medical equipment used inflight must be equipped with visual as well as audible alarms and must not be susceptible to malfunction due to vibration. The Oregon State Health Division follows national guidelines in its designation of essential supplies which must be carried aboard aircraft. However, the only requirement the transporting aircraft must meet pertains to interior compartment size with no minimum standards of doorway

size, range, pressurization, or medical equipment (Oregon State Health Division, 1981).

Training

Specialized training of aeromedical attendants for patients has been recognized as an essential ingredient for high quality patient care by the military aeromedical evacuation system since the 1940s (Armstrong, 1952). Training in the physiological stresses of flight can be easily accomplished using a format developed by Bare (1982b). This training enables the inflight attendant to control the impact of the eight stresses of flight on him or herself as well as the patient. Without such training, the attendant risks subjecting the patient to further disability or even death (Saletta, Behler, & Chamings, 1984).

Presently, little information is available on the adequacy of training of inflight attendants. Many authors have described the effects of altitude and how to minimize these effects (Johnson, 1981; Rhoberg, 1981). Only a few have recognized that the medical attendants providing care lack this vital knowledge. In 1983, McNeil concluded that medical personnel are inadequately trained to care for patients. Bare (1982a) came to the same conclusion. In Canada, Connors (1975) found no quality control on inflight

care nor training programs available for inflight "medical attendants". Finally, Thomas et al. (1985) found that overall, only 30% of civilian medical directors had training in aviation physiology. It was reported in that study that nurses were extensively used by all air ambulance services, and those associated with a hospital-based program generally had more advanced clinical skills and expertise to manage complex procedures and equipment than nurses associated with private services. Unfortunately, that study did not attempt to assess the knowledge level of aviation physiology in the aeromedical attendants.

Regulation

From earliest times our government has had an interest in the health of its communities. Over the years, as health care became more sophisticated, it became unrealistic to expect consumers to recognize good versus poor levels of care and treatment. As a result, responsibility to protect the health, safety, and welfare of the community fell to the government. Thus government was given regulatory power to exercise control over health matters and ensure basic standards of practice, in spite of possible infringements on an individual's liberty or privacy.

To protect the health and welfare of its members,

governments usually resort to one of three bases of power: legitimate, reward, and/or coercion (Wieland & Ullrick, 1976). In the United States, the local, state, and federal governments derive legitimate authority and power from the people to require that the health care delivered meets some reasonable, professional standards. Care falling short of this goal may result in coercion (negative sanctions) whereas care exceeding this goal may be rewarded (positive sanctions).

Policies guide the development of regulations which govern specific standards and activities of practice (Kalisch & Kalisch, 1982). As a result, licensure, an assurance mechanism which establishes the "minimum standards to protect the health and safety of the public", may be required (U.S. Department of Health, Education, and Welfare, 1971, p. 28). Although the purpose of licensure is to protect the public safety, such licensure also serves as a means of 1) public recognition of the practitioner's right to practice, 2) protection of practitioners from competition by the relatively untrained, and 3) establishment of a professional group's pre-emptive jurisdiction over services that may in fact be in considerable and justifiable jurisdictional dispute (Moore, 1970).

Means established to recognize excellence in the field of patient care have been developed through certification and accreditation procedures (Williams & Torrens, 1984). Certification goes one step beyond licensure by recognizing excellence in performance, training, and knowledge (LoGerfo & Brook, 1980). Similarly, accreditation serves as a voluntary mechanism to recognize institutional adherence to standards. Accreditation and certification mechanisms are usually achieved through voluntary participation in professional programs and are not the primary means governments use to ensure minimal levels of care.

Governmental agencies regulating health care must be committed to their task. This entails firmly administering both rewards and punishments. Once a precedent has been set and the subject of power recognizes that the holder of power can use force, a show of force may not be necessary (Kalisch & Kalisch, 1982). Potential deviations from regulated practice are prevented by fear of reprisal. Without the development of regulatory standards, and a commitment to the enforcement of these regulations, public safety may be in jeopardy. Regulation without enforcement renders the agency a "toothless tiger", destined to

fail in its assigned social mandate of protecting the public.

Enforcement

The Federal Aviation Administration (FAA) does not regulate the operation of air ambulance services in this nation. Following intense lobbying by air taxi operators, the FAA stated in 1978 "the economic costs of levying the proposed regulations on an entire industry outweigh the public benefit" (p. 1360). These regulations, proposed by professionals in the field, were to insure that the medical needs of patients aboard air ambulances would be met without compromising safety. The justification given for the FAA's position was that existing statutes proscribing "deceptive practice" in "air transportation or the sale thereof" were sufficient to ensure appropriate care. However, opponents of this decision argued the need to enact additional regulations because many air taxi operators in the United States apparently lack adequate equipment or personnel to provide medically relevant services for ill patients. Support for regulation of this industry has increased according to a recent study in which 69% of the surveyed air ambulance operators favored stricter regulations (Thomas et al., 1985).

One brief story (Bleiler, 1982) highlights the

results of non-regulation. A 42-year old woman, hospitalized with cardiovascular disease in Charleston, S.C., chartered an air ambulance to fly her home to Chicago. Before takeoff, her doctor neglected to ask at what altitude the plane would fly, whether it carried oxygen, or if a medical attendant would accompany the patient. In fact there existed no requirements that the air ambulance operator provide any of the above, nor was an agency responsible to ensure such minimal precautions. In this instance, no oxygen was available, and the only other person aboard besides the patient was the pilot. When the aircraft reached Chicago, the woman was dead. The pilot said he was responsible for providing transportation, not for patient care.

By FAA's decision, jurisdiction over the setting and enforcement of standards is left to the individual states which are ill-prepared to meet these demands because of lack of funding, limited staff, and/or lack of expertise. According to officials at the Oregon State Health Division, Emergency Medical Services Section, most states are hard-pressed even to meet the demands of monitoring and enforcing the practice standards of the more numerous ground ambulance operators. Therefore, air ambulance monitoring

receives little attention and enforcement appears sporadic. This appears to be true in areas other than Oregon. For example, Connors (1975) found the Canadian government was not enforcing mimimal practice standards because of inadequate numbers of investigative personnel, and this led to wide-spread system abuse. However, the conclusions derived from that study may be unique to Alberta's province-funded program.

Summary

The literature review has highlighted several themes. First, lack of consistent aeromedical consultation and unrestrained access to services permit inappropriate transports of patients, including those with conditions contraindicated for airlift. Secondly, aircraft and equipment fall far short of expectations held by laypersons and health care providers alike. A recent survey found air ambulances ill-equipped for their role. Equipment suitable for hospital use may malfunction inflight and interfere with aircraft operations. Oregon regulations place few requirements on aircraft configurations. Thirdly, specialized aeromedical attendant training is widely advocated for safe practice. Unfortunately, leading authorities have found this training non-existent or inadequate. Many attendants lack a sound knowledge of the unique factors

associated with the air transport of patients. Finally, regulations governing practice are rarely successful unless the agency given the responsibility of enforcement is committed to its task. Air ambulance operators are not regulated federally and state enforcement is handicapped by lack of funds, staff, and expertise. Meanwhile, patients may be needlessly jeopardized by the practices of a few air ambulance operators. Research is needed to determine the condition and quality of Oregon's air ambulance system.

Relevance to Nursing

The competent care and treatment of the sick and injured is the moral obligation of all those entrusted with patient care. This holds true in the aeromedical setting, where nurses play a major role (Thomas et al., 1985). In such a role, they have the opportunity to influence practice positively by advocating strict compliance to acceptable standards of practice.

Knowledge is an essential ingredient for safe practice (Orem, 1980). The American Nurses' Association's Code for Nurses (1976) clearly mandates nurses to be knowledgeable in their practice arena so as to protect the health and well-being of their patients. Yet, a substantial number of nurses engaged in the aeromedical transport of patients, may have

insufficient knowledge of the physiological effects of altitude. Furthermore, nurses may be attempting to deliver competent care to patients unsuitable for transport aboard aircraft. Finally, poorly equipped and ill suited aircraft may hamper the flight nurse's interventions. The first step towards problem resolution is clear delineation of the problem. This research represents such a step, by assessing the extent of the problem in Oregon.

Conceptual Framework

The conceptual framework for this study is guided by systems theory. All systems exist to serve some function or reach some goal. The goal of the air ambulance transport system is the safe and rapid transport of the sick and injured (McNeil, 1983). No system can achieve its goal without energy expenditure. Thus, the air ambulance transport system (an open system) continuously takes in energy from various sources as inputs, then processes these inputs and returns to the environment one or more outputs.

A useful output is essential to any given system (Lancaster & Lancaster, 1982). If products (outputs) are undesirable to the suprasystem, then these outputs must either be changed or the system supplying them will no longer be needed and will be terminated.

Modifications to the system are achieved through a feedback loop.

The systems model for patient air transport resides within a larger supra-system, the environment. This environment can be divided in two parts. The first is the large community systems environment within which the air ambulance system operates. The second environmental system is that which exists within the airborne aircraft. Each of these environmental forms will be discussed separately.

Air ambulance services exist within the local community. These communities, to greatly varying degrees, meet the needs of the residents. Large metropolitan communities are more capable of providing for the wide spectrum of community health care needs than small rural areas. Similarly, in the case of health care, while relatively routine ailments (ex. gastroenteritis) could easily be treated in a 50 bed community hospital, a patient in need of an organ transplant would most likely require transport outside of that community environment to a large metropolitan medical center for treatment. Often the characteristics and capabilities (the environment) of the community health care system determine services required of the air ambulance service. Therefore, the

residents living near a 500 bed teaching hospital seldom require air transport. Yet a remote community of 5000, serviced only by two general practitioners and no local hospital, might keep an air ambulance service quite busy.

While the environment within the surrounding community impacts the air ambulance service, conversely, the capabilities of the air ambulance service determines services it may need from the community. In this instance, some air ambulances may require support or assistance from subcontractors. In one case an air ambulance operator may have aircraft, medical supplies and equipment, and pilots on hand to meet the call for transport. However, this operator may be unwilling to employ full-time medical crews but would rather subcontract for these support services through the local hospital. Likewise, some hospital-based air ambulance services may choose to supply the medical crews, equipment and supplies, yet seek from the community subcontractors willing to provide the pilots and aircraft for on-call use (Flexer, 1980). In short, air ambulance systems reside in larger environmental systems that impact and are impacted by the ambulance service.

While the air ambulance system exists within a

larger environmental system there also exists a micro-environmental system which has a significant effect upon the patient's condition. Everyone traveling in aircraft above 2000 feet is subjected to an unique environment within the aircraft. Most "healthy" individuals can readily compensate for this environment. However, the sick and injured patient patient incurs an additional risk based on the nature and severity of the medical problem (Cowan, 1979). For example, altitude can adversely affect patients with known cardiac problems by changing arterial oxygen pressure and saturation. The simple acceleration at take-off is another environmental stressor which can increase cerebral edema for the head injury patient (Johnson, 1981).

Several stressors aboard the aircraft have been identified by physiologists (Department of the Air Force, 1976, 1983; McNeil, 1983). These eight physiologic stressors of flight are listed below:

1. Decreased Partial Pressure of Oxygen. With increased altitude, the pressure of all gases including oxygen, is decreased and leads to a condition known as hypoxia or lowered partial pressure of oxygen in the tissues. Altitude can adversely affect many critically ill or injured patients by its effect on arterial

oxygen pressure and saturation. This effect has resulted in a recommendation by the American College of Chest Physicians for limiting altitude at which various types of patients are transported. The effects of altitude can be compensated through the proper use of oxygen and pressurization.

2. Barometric Pressure Changes. The volume of gases increases with altitude. Therefore, trapped or partially trapped gases within certain body cavities (G.I. tract, lungs, skull, middle ear, sinuses) expand in direct proportion to the decrease in pressure. The best method to transport patients with suspected trapped gases is to maintain a sea level cabin altitude which will increase travel time, turbulence, and fuel consumption.

3. Thermal Stresses. Aircraft cabin temperature fluctuations alter patient body temperature increasing energy needs and therefore oxygen consumption. The medical crew member must continually monitor cabin temperature and its relation to patient temperature and comfort during transport.

4. Decreased Humidity. Air at altitude is cold, possessing little moisture. Patients with respiratory problems can experience severe respiratory distress particularly if they are receiving oxygen (itself a

drying agent). Medical crews can minimize problems caused by decreased humidity by monitoring fluid intake and providing humidified oxygen.

5. Noise. Unprotected exposure to aircraft noise can produce temporary or even permanent auditory threshhold shifts. Medical crews must be trained in assessment skills based on the absence of one valuable assessment tool: hearing. This stressor also contributes to sensory overload on the patient.

6. G Forces. Rapid acceleration and deceleration for take-offs and landings can cause major fluid shifts within the body and alter cardiac output. Head, cardiac, and vascular injury patients must be placed within the aircraft cabin so these effects are minimized.

7. Vibration. Severe aircraft vibration can produce adverse physical and emotional stress in patients besides affecting the performance of many critically needed medical equipment items. Attendants must take action to minimize this environmental stressor.

8. Fatigue. Fatigue is the end product of all stressors of flight. Medical crews must be familiar with the effects of altitude on the human body. Implementation of correct nursing principles is an

essential responsibility of each aeromedical attendant in order to minimize the effects of altitude.

With this understanding of the environmental conditions affecting the air ambulance system, a presentation will now be given of the structure of the conceptual framework.

Any system has two major categories of inputs: human and other resources. Referring to Figure 1, the major human inputs into the air ambulance system are the patients and the non-medical escorts. Regulations, funding, aircraft, personnel training, equipment, and non-medical transports are the other resource inputs.

The combining of the inputs within the structure and by the processes of the organization enables the patients to be delivered to referral agencies. In addition, one output (the condition of the patient upon arrival) is determined by the processing of inputs within the structure of the organization. Finally, a third output, information, provides feedback which has the potential to modify inputs as well as structure and process. An essential feedback loop will make alterations in activities and operations on the basis of information received from the system outputs (Duncan, 1978, p.78). In this model, within the structure of the agency, inputs are processed with the

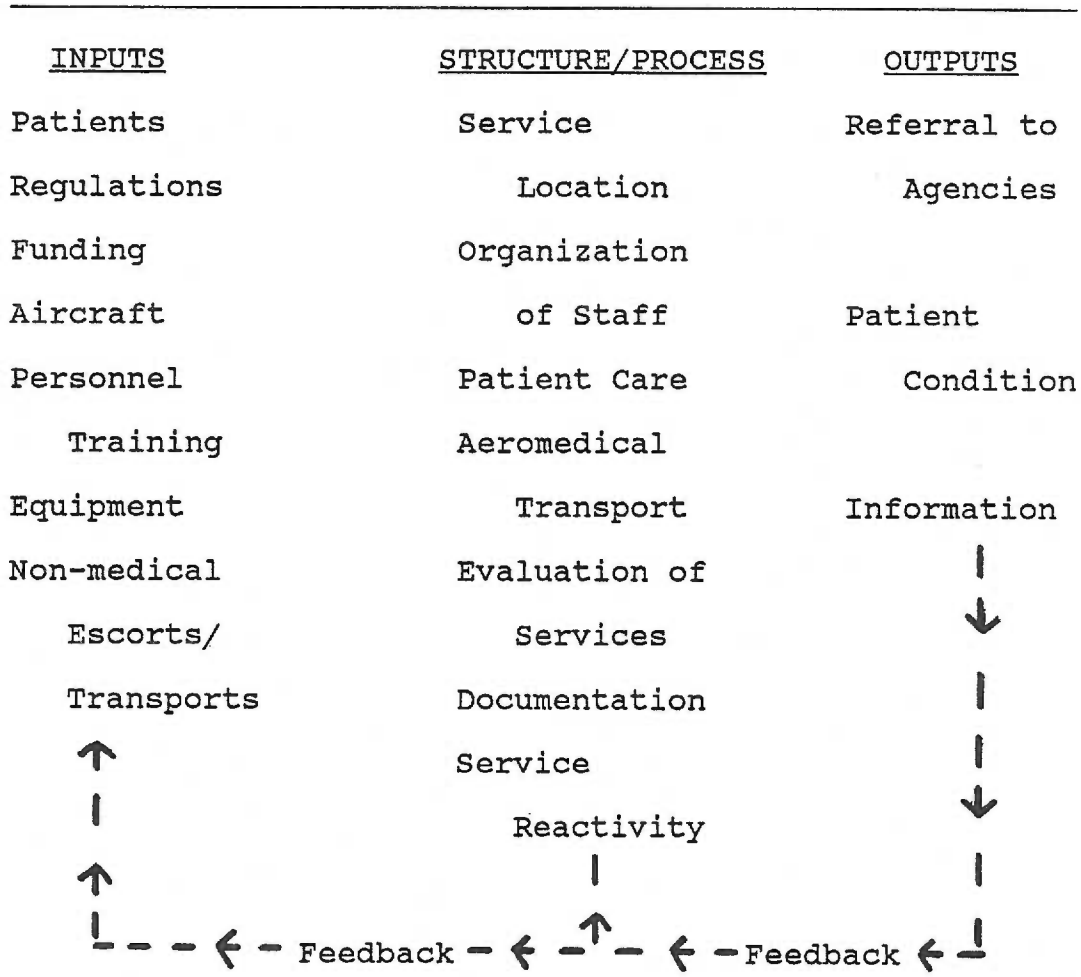


Figure 1 System Model of Patient Air Transport

aim of performing safe air transport, delivering quality emergency care, and producing information on the success or failure in achieving these goals. The produced information may identify limitations in any one input or structure/process element which may be offset by strengths in another. Thus corrections can be made to the system to improve the quality of services delivered. For example, the receiving agency may provide feedback that certain types of patients (Acute MI) do poorly when transported by air. Thus, the air ambulance may thereafter exclude the acute MI patient as inappropriate for airlift to prevent further patient compromise caused by air transport. Thus a modification has been made in the system process.

Designating key elements of the air ambulance system as inputs, structure, process, and outcomes provides a framework for analysis, and emphasizes the interrelationships among these elements. The inputs interact with the structure/process component of the air ambulance system to determine patient outcome. An alteration of any input or structure/process element may ultimately affect the patient condition upon arrival. Poor equipment, insufficient staff training, or unsuitable aircraft will have a negative patient impact. Appropriate patient selection, a highly

reactive service, and/or firm guidance of practice by governing bodies facilitates a favorable patient outcome. This study will adopt a systems approach, emphasizing the interactions of all components in order to arrive at a better understanding of the Oregon air ambulance service as a whole.

Research Questions

As a step towards identifying and ultimately solving problems associated with the air transport of patients in the State of Oregon, the following research questions are presented. First, to determine transport patterns and utilization of services, the question is posed, "Is the use of air transport in Oregon appropriate, considering both the types and the location of patients flown?" Second, to estimate compliance of air ambulance operators with existing standards, information will be gathered to answer the question, "To what degree are the aircraft and equipment of air ambulance services in compliance with State Emergency Medical Service Section requirements and suggested federal guidelines?" The third question seeks to evaluate the present training levels of inflight medical attendants: "Are inflight medical attendants receiving adequate training on unique features of care needed by the air transported

patient?" The last question ascertains the level of activity of the enforcement agencies in enhancing the existing standards: "To what degree are regulating agencies involved in the enforcement of standards for air ambulance services?"

CHAPTER II

METHODS

Study Units and Setting

The purpose of this study was to describe and evaluate the Oregon Air Ambulance System. Therefore, an attempt was made to examine the nature and scope of the services delivered by all 18 agencies which operate air ambulances in the State of Oregon (see Appendix A for a list of agencies). Prior to this study, little was known regarding the extent of involvement of each of these companies in providing air ambulance services. It was suspected that some agencies transported patients exclusively, whereas others were primarily involved in passenger charter operations. These latter would seldom move the sick or injured. Therefore, information obtained from such agencies would be limited.

While Oregon's population is primarily clustered in the western and northern parts of the State, a significant rural population remains scattered throughout the territory east of the Cascade Mountain Range. This population is somewhat isolated by country roads and great distances. Similarly, this population remains isolated from sophisticated levels of health care taken for granted by the inhabitants of the

State's metropolitan areas. Because of this lack of health care facilities, air ambulance services have become widely scattered throughout the State.

Design and Procedure

This research was basically descriptive. The data were collected in two phases. The first involved the collection of information through a mailed questionnaire. A cover letter (see Appendix B) accompanying a questionnaire provided information as to the purpose of the study, and requested the director or designated representative of the agency to participate. Return of the questionnaire in the pre-addressed envelope was interpreted as consent to participate.

Upon receipt of the questionnaire, the second phase of the research was initiated. Specific patient information was obtained either during an on-site visit by this researcher or through a follow-up phone interview when an on-site visit could not be arranged. During these follow-up contacts, the researcher reviewed the agency's records for all patients transported during a 1-month period. The records selected for the study were those of patients airlifted during September, the month prior to the mailing of the questionnaire. Selection of this month enhanced data

retrieval and prevented a review of records that might reflect agency changes subsequent to the date of completing the questionnaire.

Data-Gathering Instruments

In developing the 72-item questionnaire (see Appendix C) and 17-item record review schedule (see Appendix D), six major sources of information were employed. The first was a questionnaire used by the Association of the North American Air Ambulances (Bare, 1982a) to assess air ambulance services throughout the United States. The second source, published by that same association, consisted of guidelines for patient selection, aircraft and associated equipment, and air crew training. The third resource was the comprehensive document constructed by the Department of the Air Force (1976, 1983) to guide appropriate selection of patients for air transport, to describe proper nursing care for the patient, to list medical equipment suitable for aircraft use, and to provide inflight attendant training recommendations. The Oregon Administrative Rules (Oregon State Health Division, 1981) regarding the proper operation of air ambulance services comprised the fourth source for tool development. Finally, two comprehensive works covering the full gamut of air ambulance operations ranging

from patient selection to aircraft emergencies have been published, one by McNeil (1983) and the other by the National Highway Safety Administration of the U.S. Department of Transportation in conjunction with the Commission on Emergency Medical Services of the American Medical Associaton (USDT & AMA, 1981).

Using these sources, the questionnaire and record review schedules were developed. Preliminary versions were reviewed for clarity and comprehensiveness by the Flight Coordinator of one agency who has been involved for several years in all aspects of air ambulance operations.

In accord with the conceptual framework adopted for this research, the data collected included information not only on the structure and process of the agency, but on the inputs into the agency and the outputs produced by the agency. A description of each element of the conceptual framework follows, together with a listing of the items on the questionnaire (Q) and Record Review (RR) which provided information regarding that element.

Inputs

1. Patients. Considered under this heading was the diagnosis and physical condition of patients transported via air ambulances and the types of

patients accepted or rejected for airlift. Also considered was the referral sources such as health care professionals, public safety officers, or private parties who request patient air transport. Finally, the characteristics of the community from which the patient was transported and the reason for the transport was investigated.

Items: Q - 6,7,8,9,10,18,19

RR - 1,2,3,7,8,14,16,

2. Regulations. Information was solicited from each agency regarding the extent of their surveillance by local, state, and federal regulatory bodies, and the impact of such bodies on their service delivery.

Items: Q - 1,2,3,24,25,

3. Funding. The sources of payment (private pay, third party reimbursement, membership program) for services rendered by the air ambulance were determined.

Items: Q - 4,5,6

4. Aircraft. The number and type of aircraft used by the air ambulance operator were identified together with their capabilities for patient air transport in terms of existing recommendations.

Items: Q - 40,41,42,43,44,45,46,47,48,49,50

5. Personnel Training. The training of inflight medical attendants was evaluated both in terms of the

basic skills necessary for meeting the medical and nursing needs of transport patients, and in terms of the specialized knowledge essential for alleviating altitude effects on themselves and on their patients.

Items: Q - 35,36,37,38,39

6. Equipment. Certain equipment has been declared necessary by both governmental and private authorities as essential to the proper care of air evacuated patients (ex. oxygen mask, stretchers, etc.). The extent to which the agency provided such equipment was ascertained.

Items: Q - 50,51,52,53,54

7. Non-medical Escorts/Transports. Individuals other than medical escorts sometimes may accompany the patient during the airlift process. Airlift missions may also be requested for the purpose of delivering medical supplies and equipment, medicines, medical personnel, etc. to locations throughout the State. The agency was asked to report the extent to which it responds to such service requests.

Items: Q - 17

RR - 9,10

Structure-Process

1. Service Location. The location of the air ambulance service was identified. Many times location

determines the types of patients carried and subsequent care which must be provided. Thus, the remoteness of the served population from medical care dictates which patients must be transported to receive further care unavailable at their present locale.

Items: Q - 9,10

2. Organization of Staff. The number and the composition of personnel who provided patient service within the organization were ascertained. Included were the pilots, EMTs, RNs, MDs, as well as the director or administrator of the air ambulance service and support clerical staff.

Items: Q - 26,27,28,29,30,31,32,33,34

RR - 10,11

3. Patient Care. Actions which could be and were taken by properly trained and equipped staff to meet the medical and nursing care of the patient and to reduce the impact of the stresses of flight on the patient were assessed.

Items: Q - 51,52,53

RR - 12,13

4. Aeromedical Transport. Here distance and routes of moving the patient via aircraft from the originating station (pick-up point) to the destination

station were determined.

Items: Q - 11,12,13,14,15

RR - 4,5,15,16,17

5. Evaluation of Services. Inquiry was made into the methods employed by the agency to evaluate the impact of their services on the well-being of their transported patients.

Items: Q - 60,61,62,63

6. Documentation. The agency was questioned regarding its maintenance of factual and written reports of care delivered to the patient and of events surrounding the patient airlift, as required by law.

Items: Q - 55,56,57,58,59

7. Service Reactivity. The promptness of the service system in responding to the needs of the patient requiring transport was investigated. Also requested was information regarding the equipment and services provided to air ambulance operators who leased or rented their aircraft and/or flight personnel from an air service since these items may impact the responsiveness of the service to meet the requirements of the client.

Items: Q - 16,20,21,22,23,64,65,66,67,68,69,
70,71,72

Outputs

1. Referral to Agencies. The institutions and private parties that received the patient following aeromedical transport were identified (ex. hospital, extended care facility, private home, etc.).

Items: RR - 17

2. Patient Condition. The proportion of patients who were alive or dead on arrival at their destination were estimated for each agency.

Items: RR - 6

3. Information. The feedback given to the air ambulance service regarding its delivery of care to the clients was examined.

Items: Q - 60,61,62,63

Analysis of Data

Much of the information gathered in this study was descriptive in nature, and intended to convey a sense of the state of the air ambulance service system presently operating in Oregon. Some evaluation of the services was attempted, by comparing aspects of the existing services to available standards and recommended practice. Thus, some standards exist for patient selection, patient care, aircraft capabilities, medical supplies and equipment, and aeromedical attendant training. Table 1 lists those aspects and

Table 1

Existing Standards That Relate to Conceptual Framework Items

Standards	Conceptual Framework Components
Aeromedical Attendant Training (see Appendix E)	Personnel Training
Aircraft Specifications (see Appendix F)	Aircraft
Aircraft Equipment and Supplies (see Appendix G)	Equipment
Patient Selection Guidelines (see Appendix H)	Patients
Aeromedical Evacuation Nursing (1976,1983)	Patient Care

components of air ambulance service for which some standards exist. The lack of standards for the remaining components of air ambulance services as identified in the conceptual framework precludes a comprehensive evaluation. The data collected on those components were, therefore, useful only for achieving a better understanding of the state of affairs among air ambulance services.

Answers to the research questions required a careful analysis of all data gathered. Data on each item in the conceptual framework were viewed separately. Additionally, the interaction of items was considered to properly evaluate the system. Table 2 lists each research question with the corresponding conceptual framework components which directly relate to that question. The data collected on each of these components provided in large part the answers to each research question. In some instances, data collected on other conceptual framework elements indirectly influenced an answer to a question. Viewing the air ambulance services within a systems perspective implies an appreciation for the interaction of the components. Therefore, elements found to be relevant to the answer to each research question, either directly or indirectly, were considered. Taken altogether, these

Table 2

Conceptual Framework Components That Address The Research Questions

Research Question	Conceptual Framework Components
1. Is the use of air transport in Oregon appropriate, considering both the types and location of patients flown?	....Patients Aeromedical Transports
2. To what degree are the aircraft and equipment of air ambulance services in compliance with State Emergency Medical Services Section requirements and suggested federal guidelines?	....Regulations Aircraft Equipment
3. Are inflight medical attendants receiving adequate training on unique features of care needed by the air transported patient?	....Personnel Training
4. To what degree are regulating agencies involved in the enforcement of standards for air ambulance services?	....Regulations

data may provide a clearer picture of the capabilities of the Oregon Air Ambulance System as it presently exists, and answers to the research questions may identify important areas for further study.

CHAPTER 3

RESULTS

Questionnaires were mailed to the 18 Oregon services during the last week in October 1985. Following distribution of the questionnaires, phone contacts were made with the service directors. The purpose of these phone contacts was threefold: to enhance questionnaire return by personalizing the request for participation; to clarify any requested information and allay any fears regarding the confidentiality of the study; and to request specific patient information. Over the 2-month data collection period, 16 services returned the completed forms and agreed to provide information on all patients transported during September, 1985. Two other services stated that they did not transport many patients and therefore chose not to participate in the study.

Information from patient records was obtained through on-site visits by this researcher to two agencies. For two other services, patient information was available through affiliated ground ambulance services. A local hospital maintained patient transport information on patients transported by a fifth ambulance service. A sixth agency failed to provide patient information by the deadline for

inclusion in this study. A seventh service kept no patient records in spite of having transported 13 patients. The remaining nine services provided patient information by phone. By the end of the collection period, data on 128 patients had been collected from 14 services. Thus patient data were obtained for 84% of the 152 patients transported by the participating 16 agencies in the month selected for review. Since the month of September historically represents an "average number of monthly transports" (down from the number in the busy summer months yet above the number for the slow winter months) these figures suggest that approximately 1800 patients were transported during the past year within the State of Oregon.

In the following pages, the data obtained from the questionnaires and from the review of patient records will be presented, using the categories listed in the conceptual framework of this study.

Inputs

1. Patients. Oregon air ambulance services were divided on the question of restricting the types of patients they accepted for airlift. Half accepted any patient that requested air transport. Seven services considered the condition of patients prior to accepting them for transport. If the patient's needs exceeded

the capabilities of their equipment and medical crews, these agencies might defer to other air ambulances better equipped and trained. Three services specifically refused to transport violent, psychiatric patients who might become uncontrollable inflight. In the words of one operator, "A violent patient could spell disaster for all the occupants of the aircraft". Other types of patients refused by at least one service were neonates, obstetric, or pediatric patients on the view they might be better transported by ground ambulances.

Safety also was a factor for refusing to transport a patient. If the weather was "below minimums", the pilot made the final decision to remain on the ground without fear of reprisal. No service was willing to risk the well-being of all aboard to fly in unsafe weather.

Some reasons for moving patients to a different location were advanced more frequently than others. All services reported transporting patients because of the lack of essential medical services at the pick-up point, and the need to transport the patient to a major medical center. A less common reason was the financial benefit to the patient by being treated at a different location (i.e. Veterans Hospital, military hospital,

Shriner's Hospital, etc.). The convenience of air transportation for moving the patient nearer home and family was also mentioned.

Air transport was selected in preference to ground transport because of the time saved by using this high-speed means of travel. Ten of those surveyed believed this was the primary reason for selecting air. Two other important reasons given for choosing air were: the level of care provided by the air ambulance was superior to that provided by ground ambulance, and the site of patient pick-up was inaccessible by ground means. In some instances, air transport was promoted as cheaper than ground transport. Aircraft travel in a straight line to their destination and this can substantially reduce patient transport miles over ground services which must follow roads. Since air and ground services charge by the mile, the air service sometimes has a lower cost per transport.

As stated earlier the 16 services transported 152 patients both within and outside the State's boundaries during the month of September 1985. Of the 128 patients for whom data were available, 82 (64%) were males and 45 (35%) were female. The sex of one patient was not identified. Mean age was 43 years, with the

age range extending from a neonate only hours old to a 93-year-old male.

By place of residence, patients were scattered throughout the State. Larger numbers of patients required air transport from counties with larger populations and from counties with limited available medical care.

Fifty-five percent of the persons transported were hospital patients requiring transfer to a facility capable of successfully treating their condition. The scene of a accident or illness accounted for the preflight location of another 36% of the patients. Three percent of the patient transfers originated at an Extended Care Facility (ECF) and 2% at patients' homes. The preflight locations of the remaining patients were unspecified.

Requests for patient transports came primarily from two sources - medical doctors and ground ambulance attendants. They initiated 71 and 45 transport requests, respectively. Most air ambulance operators insisted that a physician approve the patient airlift prior to accepting the case. However, hospital-based air transport services, heavily involved in air lifting trauma patients, responded to the large number of requests by ambulance attendants. Inasmuch as medical

doctors were seldom at the site of an accident, the ranking medical authority on the scene was the ambulance attendant who determined the appropriateness of air transport. Registered nurses, employers, and families directly requested patient air transports in four instances. Five patients were transported at the request of policemen, firemen, or laymen. Finally, the source of transport request was not listed for three patients.

Seven transports were listed as "routine" transports meaning there was no need to hurry and that the patient could be transported anytime. Nineteen patients were "priority" cases, who were critically ill but could tolerate a few hours' delay in transport for proper planning of aircraft, equipment, and crew. By far the largest number of transports (77 or 60%) fell into the "urgent" category. These patients required immediate transport to prevent loss of life, limb, eyesight, or major complications of a serious illness. Lack of sufficient data precluded classification of the last 25 patients as routine, priority, or urgent.

The single largest category of patients transported by air was comprised of trauma cases (see Table 3). They had been involved in motor vehicle accidents, falls, industrial accidents, recreational injuries, or

Table 3

Patient Volumes by Selected Categories Transported by Oregon Air Ambulance Services During September 1985.

Category	Number of Patients Transported	Percent of Total Transported
Trauma	64	50%
Medical (other than cardiac)	37	29%
Cardiac	11	9%
Obstetrics	4	3%
Burns	4	3%
Pediatrics[a]	3	2%
Surgical (other than trauma)	3	2%
Psychiatric	0	0%
Not listed	2	2%
Total	128	100%

[a]"Pediatrics" category was limited to infants under one year of age.

injuries at home. Medical patients (other than cardiac) and cardiac patients comprised 29% and 9% of the total, respectively. No psychiatric patients were transported. This was not unexpected in that some operators had specifically stated they would refuse to serve such patients because of their unpredictable behavior.

2. Regulations. Each service was certified under Federal Aviation Regulation (FAR) Part 135. The FAA had conducted an on-site inspection of 13 of the air ambulance services that responded to this survey. Three services reported they had never been inspected by any regulatory agency including the FAA. The FAA does not evaluate the quality of air ambulance service, but only evaluates compliance of the aircraft and flight crew to air charter regulations, as listed under FAR Part 135.

Each service maintained licensure by the Oregon State Health Division. The air ambulance operators were nearly unanimous in responding that the impact of the Oregon State Health Division on their air ambulance service was negligible. Not one service replied in the affirmative when asked if it had ever been inspected by the Oregon State Health Division. In the words of one operator, "Once a year they collect their license fee

and that's the last we hear from them". However, he added that the Emergency Medical Services Section was insufficiently staffed and budgeted to conduct on-site inspections.

3. Funding. Funding sources varied greatly among the services. Hospital-based air ambulance services transporting many trauma patients generated revenues from insurance companies, Workman's Compensation, and Medicare. Two charter air ambulance operators who provided fixed-wing backup support to major air trauma services received reimbursement directly from those services. Eight services, transporting fewer patients, relied less on insurance companies and more on reimbursement by private individual. Many times these smaller services were engaged in elective transports for family convenience for which insurance companies would not pay. In such cases, the ambulance operators required cash up front.

Primary sources of operating revenues again varied with each service. All services relied to varying degrees upon third party reimbursement (insurance, Medicare, Welfare, etc.). However, some services were uniquely funded. In one case, members paid a yearly fee entitling them to "free" transport within a prescribed distance as medically required. For another

service, county tax levies ensured a reliable source of monies throughout the year. The smaller services that provided convenience transports relied on private funds to finance the air ambulance portion of their charter operations. Third party reimbursement played a much smaller role in their financial picture than was evident in the large, predominantly trauma-transport services. It was evident they were serving a different clientele.

Lack of financial resources was a reason listed by six services for refusing to accept a patient. This was especially true for the smaller services transporting patients for reasons of convenience. Every service was quick to add that life and death cases were transported regardless of the financial resources of the patient.

4. Aircraft. Aircraft used by the 16 operators responding to the questionnaire varied greatly. Some smaller services operated single engine aircraft (unpressurized) capable of carrying one litter patient and one attendant. Other larger services had as many as 17 aircraft capable of transporting litter patients. Jet aircraft were not uncommon. One service featured a 3-engine jet aircraft capable of transporting up to three litter patients and three

attendants on long international flights.

Pressurized aircraft is essential for the transport of patients with gas trapped in body cavities (pneumothorax, gas gangrene, penetrating head injuries) or requiring medical equipment using trapped gases (orthopedic air splints, MASK trousers, balloon cuffs on endotracheal equipment). Such aircraft were available in eight services. The other eight services either operated helicopters (unpressurized) exclusively, or unpressurized aircraft.

All but one service believed their aircraft had adequate heating, radio communications, attendant access to the patient, and vertical clearance above the patient. Twelve services reported that patients were able to be loaded through the doors of their aircraft without excessively tilting the patient on the stretcher. To accomplish this, services first loaded the patient on a small scoop stretcher, and then transferred the patient onto the litter already onboard the aircraft. Three services did not have aircraft suitable for the safe enplaning of the patients. Some respondents commented that interior space was very crowded once the patient, equipment, and one or two attendants were on-board. Lighting also was mentioned occasionally as being much less adequate than was

customary in the hospital setting.

5. Personnel Training. Fourteen of the 16 agencies responding indicated that their medical attendants had undergone some specialized training for functioning within the airborne environment. Eleven provided this training through lectures by persons who had training and experience in the subject matter to be presented. Seven air ambulances combined lectures with self-study or relied on previous military training to ensure adequate knowledge of content. One busy hospital-based service reported that its flight nurses presented specialized training to groups interested in the airlift of patients and care of the traumatized patient.

Busier services generally provided more extensive training of their personnel. However, one exception was noted in a service that ranked second in numbers of patients carried per month and operated exclusively non-pressurized aircraft. This service did not train attendants to identify and care for patients requiring special consideration in the airborne environment, nor even to recognize the basic effects of altitude on aircraft occupants in general. Patients transported in unpressurized aircraft by this service would be at high risk for the stresses of flight, and should require

close attention by knowledgeable inflight attendants. Unless the service is strictly a volunteer air ambulance service, failure to provide specialized training on altitude physiology and its impact on patients is a violation of the Oregon Administrative Rules (Oregon State Health Division, 1981). Plans were underway to institute such training for this service's personnel in the near future.

Recurrent annual training of the personnel was required by only 50% of the services. The other 50% considered one-time initial training to be adequate.

6. Equipment. Supplies and equipment were evaluated against requirements listed in the Oregon Administrative Rules (Oregon State Health Division, 1981). More stringent requirements have been advocated by several sources (Bare, 1982b; McNeil, 1983; National Highway Safety Administration of the U.S. Department of Transportation and the Commission on Emergency Medical Services of the American Medical Association, 1981). Whereas many services meet these more stringent criteria, they were accountable only for the Oregon standards. A summary of findings is listed on Table 4.

All agencies for which data were available met Basic Life Support (BLS) standards as set forth by the

Table 4

Oregon Air Ambulance Supply and Equipment Availability by Agency

Agency Number	Equipment Source	BLS[a] Equipment	ALS[b] Equipment	Oxygen Available	Suction Available	Humidification Available
01	Own	yes	yes	yes	yes	yes
02	Hospital	yes	yes	yes	yes	not listed
03	Own/ Hospital	yes	yes	yes	yes	yes
04	Hospital	yes	yes	yes	yes	yes
05	NA	NA	NA	NA	NA	NA
06	Hospital	yes	yes	yes	yes	yes
07	Own	yes	no	yes	yes	no
08	NA	NA	NA	no	no	no
09	Ambulance/ Fire Dept.	yes	no	yes	yes	yes
10	Own	yes	yes	yes	yes	yes
11	Own	yes	yes	yes	yes	yes
12	Hospital	yes	yes	yes	yes	yes
13	Ground Ambulance	yes	yes	yes	yes	yes
14	Own/ Hospital	yes	yes	yes	no	no
15	Own/ Hospital	yes	yes	yes	no	no
16	Own	yes	yes	yes	yes	yes

Note. NA = Data not available

[a]Basic Life Support Equipment by Oregon State Health Division Standards (see Appendix G).

[b]Advanced Life Support Equipment by Oregon State Health Division Standards (see Appendix G).

Oregon State Health Division. In fact, 75% of the agencies met the more demanding Advanced Life Support (ALS) requirements. Many agencies indicated they were able to meet these equipment requirements (which represent a considerable outlay in capital expenditures) by establishing cooperative arrangements with local fire departments, ground ambulance companies, or hospitals. Only 25% of the services had sufficient resources to own such costly equipment as defibrillators and ventilators outright. These services tended to carry high patient volumes, thereby justifying the expenditure.

Oxygen, a basic requirement to combat hypoxia when transporting patients, was available in all but one service. Facilities for suctioning, again important to maintain airways, were aboard the aircraft in 75% of the instances. Finally, humidification capabilities were present on 67% of the transports.

7. Non-medical Escorts/Transports. Services seldom were requested to participate in medically related airlift missions, other than for the transport of patients. Ten services reported that they had on rare occasions transported blood, organs, medical personnel, medicines, or specimens (listed in order of decreasing frequency of request). By no means did any

service rely on such transports for significant income.

Immediate family members were transported on less than 5% of the airlift missions. In no instance did someone other than a blood relative accompany a patient. Several services commented that there just wasn't enough room aboard the cramped aircraft to accommodate family members in addition to the stretcher patient, medical crew member(s), and pilot. Two services even confided that family members get in the way of the treatment of the patient. This reluctance to transport "significant others" is reflected in the data.

Structure-Process

1. Service Location. The 18 air ambulance services in Oregon are widely scattered throughout the State. Figure 2 displays their geographic location. All areas of the State can be quickly reached by one or more of these agencies.

One-hundred percent of the services are located within 10 miles of the nearest medical facility. Ten services are as close as five miles to the nearest hospital (see Table 5). One service, located within 5 miles of a 104 bed hospital, still reported that 80% of its transports were flown to a larger medical facility 75 miles away. These were usually interhospital

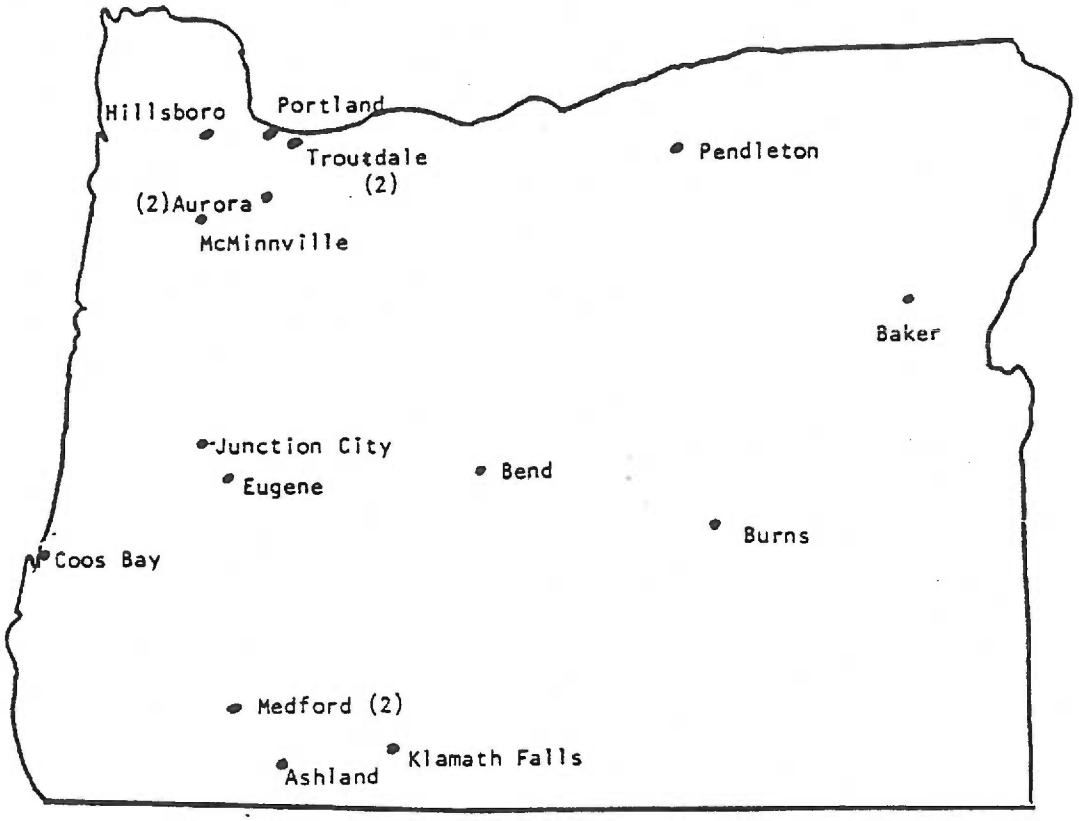


Figure 2 Geographic Location of Oregon Air Ambulance Services (Numbers in parentheses indicate more than one service at that location.)

Table 5

Proximity to Hospital and Transport Patterns of Oregon Air Ambulances

Agency Number	Distance From Nearest Hospital	Nearest Hospital Bed Capacity	Percentage of Patient Transports	
			Into Agency Area	Out of Agency Area
01	↓5 miles	164	50	50
02	↓5 miles	49	0	100
03	↓5 miles	99	90	10
04	6-10 miles	111	80	20
05	↓5 miles	73	NA	NA
06	6-10 miles	451	100	0
07	↓5 miles	172	2	98
08	6-10 miles	99	70	30
09	↓5 miles	44	0	100
10	↓5 miles	104	20	80
11	↓5 miles	451	99	1
12	↓5 miles	111	30	70
13	↓5 miles	168	10	10[a]
14	6-10 miles	194	10	90
15	6-10 miles	446	25	75
16	6-10 miles	298	80	20

Note. NA = Data not available

[a]Total percentage for agency 13 does not equal 100% since 80% of their patients are transported from points outside their immediate area to points outside their immediate area.

transports ordered for patients who needed more specialized care than was available locally. Also, air transport is frequently required by persons in that area because of extremely hazardous winter driving conditions.

Eleven services are closely located to hospitals with over 100 bed capacity. This proximity did not appear to be a major determinant of direction of transport (into the area versus out of the area). Some services, such as No. 03 located near a 99-bed hospital, brought 90% of its patients into the local area while agency No. 07, near a 172-bed hospital, transported 98% of its patients to other regions. The geographic location of the air ambulance service proved to be a key factor determining direction of travel of patient transports. Those ambulances operating out of major population centers, such as Medford, Bend, and Portland usually flew patients into those areas. Ambulances located in more sparsely populated areas flew patients out of their areas and into larger population centers.

2. Organization of Staff. It was difficult to arrive at any pattern for the personnel composition of Oregon Air Ambulance Services. The methods of obtaining personnel for use by each agency were

varied. Only three services employed their own full-time medical crews (EMTs, RNs, or a combination of both). They were the services with a greater patient volume (14-61 patients per month). A cooperative arrangement established between an air ambulance service and a hospital or ground ambulance company was more usual. In these cases, the licensed air ambulance operator provided the aircraft, pilots, and mechanics while the hospital or ground ambulance service supplied the medical crews (usually RNs or EMTs), supplies, and medical equipment. Ten services maintained a signed formal agreement, as required by Oregon law (Oregon State Health Division, 1981), between the air ambulance service and the agency supplying the personnel and/or equipment. Four services did not maintain any signed, formal agreement. Such agreements are economically desirable in that they ensure operators access to adequate personnel and equipment, without requiring them to hire permanent personnel who may sit idle for days waiting for a patient transport request.

Air ambulance staff size varied. In one agency, staff consisted of a husband (pilot) and wife (secretary) team. In another service, available staff included 39 EMTs, 40 RNs, 12 pilots, and 3 secretaries. Patient volumes dictated staff size.

Most operators tried to be very prudent with personnel expenditures.

Medical directors oversaw the operation of all but one small air ambulance service. These directors usually volunteered their services or were consulted part-time. Flight surgeons (physicians knowledgeable in the effects of flight on patient conditions) were available to clear patients for transport for only 7 of the 16 surveyed air ambulance services. Even when available, flight surgeons were not routinely consulted prior to accepting patients for airlift. Most services believed that the patient's physician could adequately determine the appropriateness of airlifting the patient. Unfortunately, most physicians lack adequate training to make such an informed decision.

Contact persons were available 24 hours per day for all the services. This ensured that patient transport requests could be responded to quickly. All services recognized that patient air transport was not an 8 to 5 job.

Table 6 documents the categories of ambulance attendants used by each agency. By far the most prevalent category is the Critical Care Registered Nurse. In fact, registered nurses accompanied patients

Table 6

Oregon Air Ambulance Attendant Utilization by Agency for September 1985

Agency Number	Number of Flights	No Attendant	Missing Data	LPN	RN	CCRN	EMT 1	EMT 2	EMT 3	EMT 4	MD	2 Attendant
01	14	-	-	-	-	14 100%	-	-	-	14 100%	-	14 100%
02	1	-	-	-	1 100%	-	-	-	-	-	-	-
03	3	-	-	-	-	3 100%	-	-	-	-	-	-
05	0	-	-	-	-	-	-	-	-	-	-	-
08	0	-	-	-	-	-	-	-	-	-	-	-
09	0	-	-	-	-	-	-	-	-	-	-	-
10	18	-	-	-	-	-	4 22%	3 17%	9 50%	15 84%	-	18 100%
11	57[a]	-	-	-	-	57 100%	-	-	-	-	3 5%	4 7%
12	3	-	1 34%	-	1 34%	-	-	-	-	1 34%	-	-
13	6	-	-	-	-	1 17%	1 17%	-	-	5 84%	2 34%	4 67%
14	4	2 50%	-	-	2 50%	-	-	-	-	-	-	-
15	0	-	-	-	-	-	-	-	-	-	-	-
16	22	-	-	6 27%	7 32%	2 9%	-	-	3 14%	4 18%	1 5%	1 5%
Oregon Totals	128	2 1.5%	1 1%	6 5%	11 9%	77 63%	5 4%	3 2%	12 10%	39 32%	6 5%	41 34%

Note. Upper number represents total number of flights with designated attendant on board. Lower number represents percentage of agency flights with that designated attendant on board. Total percentage per agency may exceed 100% due to presence of more than one attendant on some of the flights. Attendant data were not available for agencies 04, 06, and 07.

[a]Attendant data available for only 57 of total 61 agency airlifts.

on 72% of the flights during September. EMT IVs were also frequently utilized as attendants. Not reflected in the chart are data that indicated EMT Is and IIs never accompanied patients unless an EMT III or IV was also in attendance. One service utilized LPNs sporadically. One service (No.14) transported 2 of 4 patients unattended. When asked for clarification, the service representative stated that the patients were fully recovered and merely being transferred to their place of residence in Southern California.

Two services (No. 01 and No. 10) were able to ensure that two attendants were present on each of the flights. These services found an extra pair of hands very valuable when involved in the transport of severely sick or injured patients. However, most other services found this to be economically unfeasible or medically not justified, and therefore used a second medical attendant only sporadically.

3. Patient Care. The care and equipment requirements of the patients are presented in Table 7. Eighty-seven percent of air transported patients required some type of inflight care or use of specialized medical equipment. Administration of intravenous fluids ranked first as the most frequently required inflight treatment. Oxygen was needed by 56%

Table 7

Care and Equipment Needed by 107 Air Ambulance Patients in September 1985

Type of Care/Equipment Needed	Number	Percent
Intravenous Fluids	75	70%
Oxygen	60	56%
Cardiac Monitor	53	50%
Medications	37	35%
Neurologic Checks	29	27%
Traction	17	16%
Military Anti-Shock Trousers	17	16%
Ventilator/Bag-Mask Resuscitator	16	15%
Intubation	15	14%
Nasogastric Tube	12	11%
Foley	10	9%
Tracheostomy Care	10	9%
Immobilization	8	7%
Incubator	3	2%
Other	11	10%
Total Patients Needing Special Care/Equipment	93	87%

of the patients. Cardiac monitors, available through ALS air ambulance services, also were frequently requested. As the figure reflects, only 13% of the patients required no inflight care.

If inflight difficulties did occur which were related to physiologic stresses of flight, they were rarely documented in the patient's chart. Of the 128 patients transported, apparently 62% experienced no inflight difficulties caused by the physiologic effects of high altitude. Hypoxia, increased gas expansion in body cavities, temperature variations, etc., were mentioned in only 5 patient records. Inasmuch as 34% of the records made no mention of the patient's response to inflight stressors, any conclusions regarding patient reactions to flight must be guarded.

4. Aeromedical Transport. A breakdown of the 152 patients transported by agency is presented on Table 8. Agency No. 11 led with 61 patient air transports during September 1985. Five other air ambulance services fell in the 12-24 patients per month range. Ten services transported 7 or fewer patients, with 4 services carrying none during the month.

Most of the flights by fixed-wing transports varied between 100 and 400 miles. While the average air transport flight was 195 miles, it was not uncommon for

Table 8

Oregon Air Ambulance Patient Transports by Agency for September 1985

Service Agency Number	Number of Patients Transported	Percent of Total Transported
11	61	40%
16	22	14%
6[a]	(20)	(13%)
10	18	12%
1	14	9%
4	13	8%
7	7	5%
13	6	4%
14	4	3%
12	3	2%
3	3	2%
2	1	1%
5	0	0%
8	0	0%
9	0	0%
15	0	0%
Total	152	100%

[a]These 20 patients were actually cared for by Agency No. 11 and are included in the total numbers for that agency. In these cases, Agency No. 6 provided fixed-wing aircraft and pilots to enable Agency No. 11 to make long-distance airlifts.

flights to exceed 600 miles. One service made flights in September to such distant locations as Tucson, Arizona, to Vancouver, British Columbia, and to Allentown, Pennsylvania. Helicopter transports generally flew less than 100 miles and seldom exceeded 150 miles. Busy services logged close to 5000 patient air miles per month.

Services located in remote areas of the State transported nearly 100% of their patients out of their immediate area, usually to major metropolitan areas. Larger services, (transporting over 20 patients per month) generally located near large metropolitan areas and major medical centers, brought from 80% to 100% of their patients back into these regions. Figure 3 reflects these major transport routes with obvious hubs of activity being Portland, Bend, and Medford. A comparison of county origins and destinations of patients is possible through inspection of Figures 4 and 5. Thus it may be noted that only 9 patient transports (7%) originated in the Portland area, but 60 (or 46%) terminated there. Similarly, 6 patient transports originated near Bend while 11 transports terminated there. Medford had a net increase into the region of one patient. Medford serviced by Providence Hospital and Rogue Valley Medical Center, Bend by St.

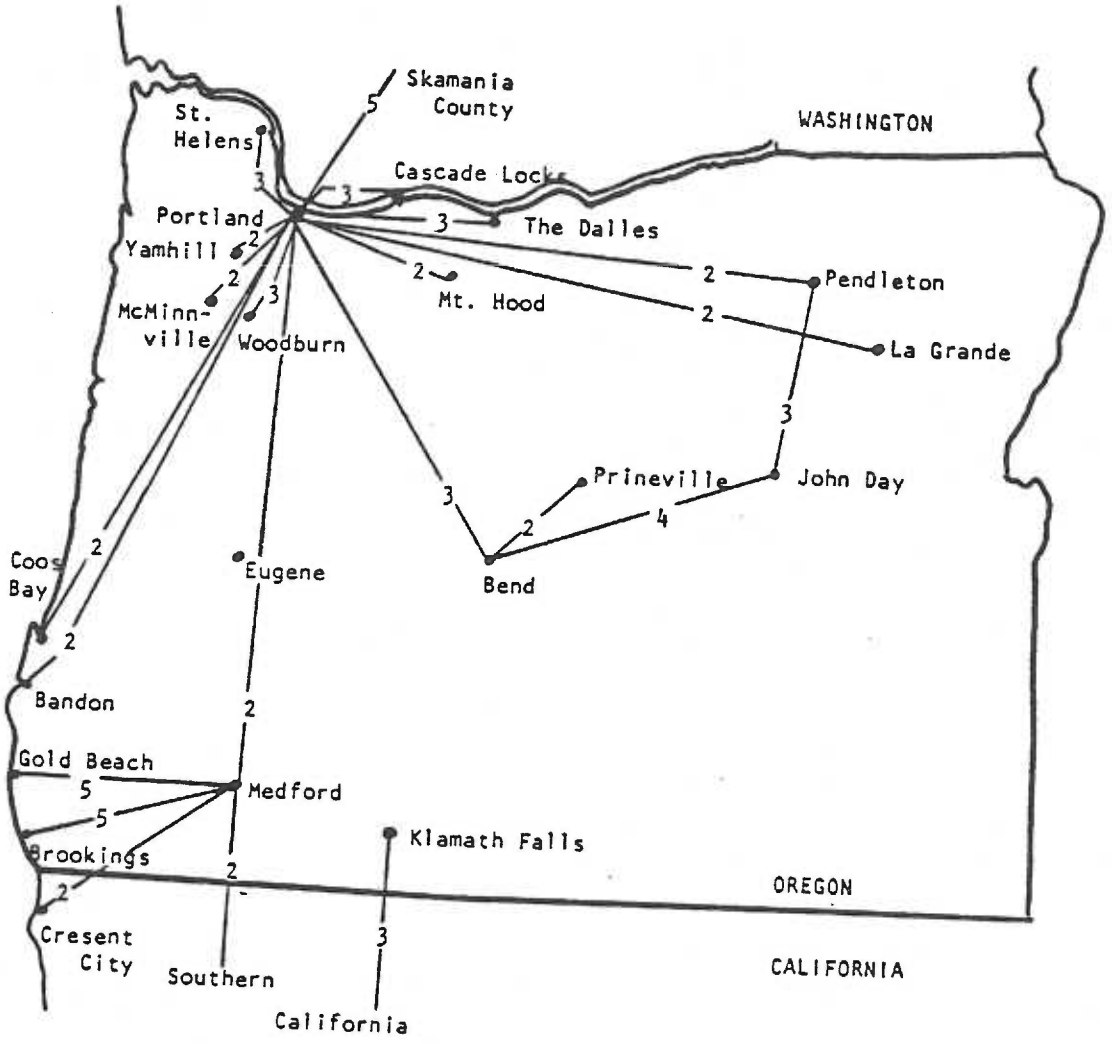


Figure 3 Oregon Air Transport Routes for September 1985. (Numbers refer to number of patients flown on the designated route. If only one patient was transported between two points during the period, no route is displayed.)

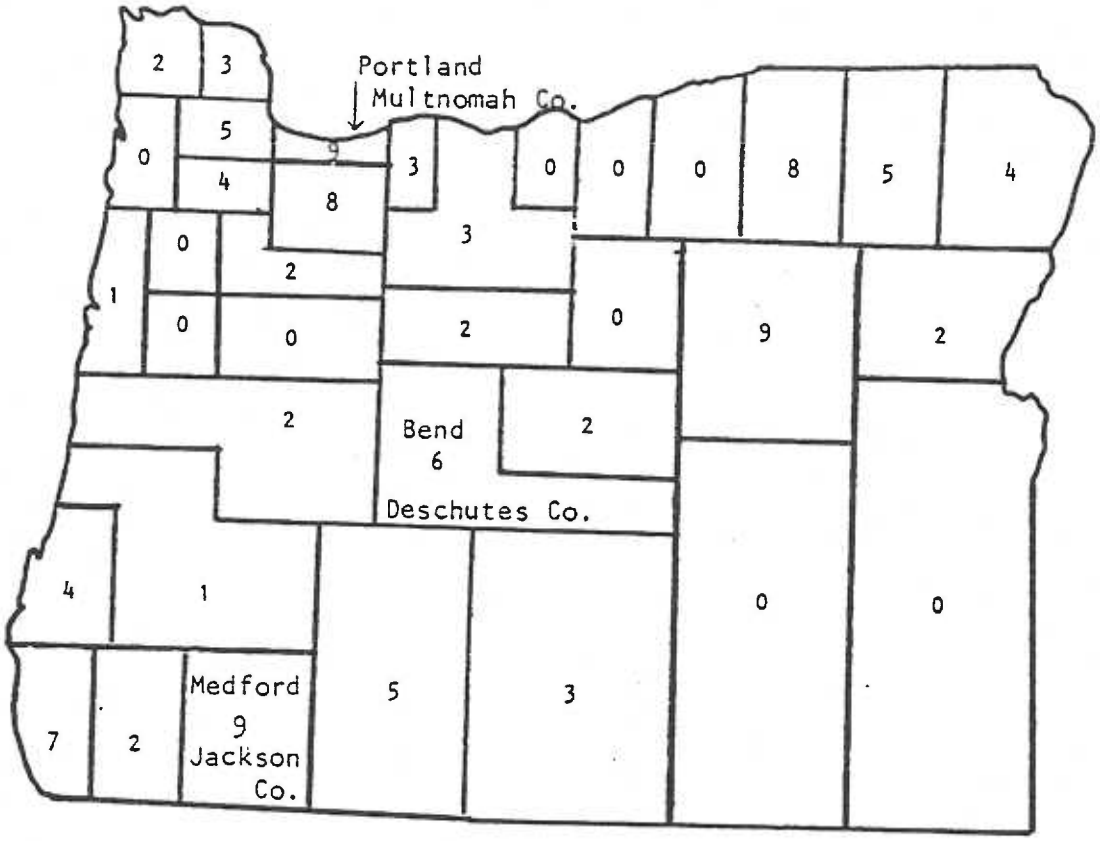


Figure 4 County of Origin of Patients Transported by Oregon Air Ambulance Services for September 1985 (Map does not present the points of origin of patients from out of state.)

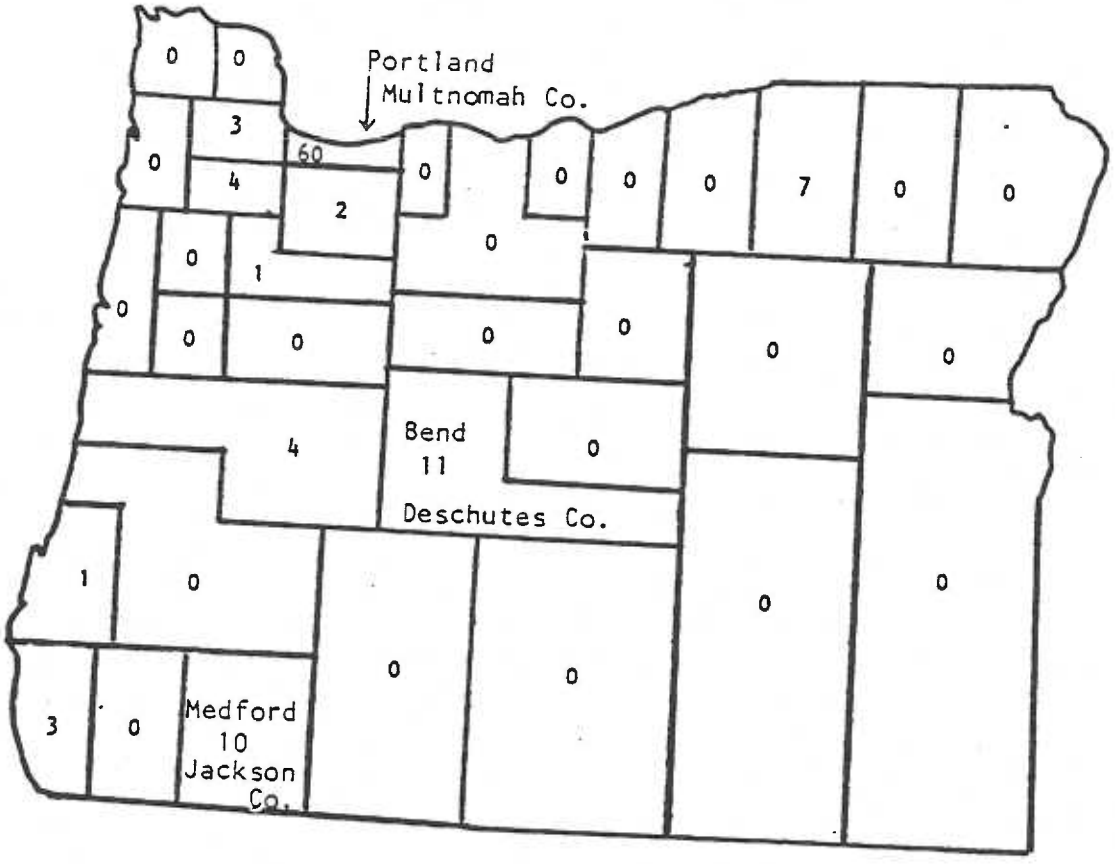


Figure 5 County of Destination of Patients Transported by Oregon Air Ambulance Services for September 1985 (Map does not present destination of 23 patients who were transported outside the state.)

Charles Medical Center, and Portland by numerous medical centers, function as regional hubs for medical care.

The pattern of airlifting patients to major medical centers is again displayed in Table 9. Data available on 122 airlifted patients indicated the usual points of origin of patient airlift were the scene of an accident or illness, small hospitals, and to a lesser extent, hospitals with over 100 beds and some specialties. Nearly 100% of these patients were transported to large medical centers capable of providing even more specialized care than was available locally. These data clearly demonstrate the trend of transporting patients from remote areas with limited medical capabilities to metropolitan areas capable of providing specialized care.

5. Evaluation of Services. Responses to the survey revealed that 50% of the services had no method to evaluate how well their agency was able to care for the patients. Most of these services transported fewer than 4 patients during September 1985 although one agency moved 20 patients. The remaining 50% of the services promoted quality assurance by several methods. Most popular was a post-flight audit of the patient's chart and a careful assessment of the

Table 9

Oregon Air Ambulance Patient Origin and Destination for September 1985

Facility or Site	Site of Origin		Site of Destination	
	Number	%	Number	%
Scene of Accident/Illness	47	37.0	0	0.0
Private Residence	0	0.0	3	2.5
Hospital, under 100 beds	45	35.0	0	0.0
Hospital, over 100 beds limited specialties	6	4.5	0	0.0
Hospital, over 100 beds numerous specialties	25	20.0	122	95.0
Other	2	1.0	0	0.0
Not Listed	3	2.5	3	2.5
TOTAL	128	100.0	128	100.0

patient. Oregon's two hospital-based services conducted Flight Review Meetings whereby they openly discussed and critiqued the inflight care provided by their own crews. One of these services even sought feedback from post flight reports, the accepting physician, receiving facility, family, and the patient.

The inflight competence of medical attendants was not specifically assessed by five of the services. These services usually relied on the agency providing the personnel (ground ambulance/hospital) to judge inflight competence. Nine services used one or a combination of inflight performance evaluations, written evaluations, state licensure, patient comments, or pilot comments. Performance demonstrations, the actually inflight observation of the attendant's competence by a qualified supervisor, were utilized by two services. These services believed this was the best method to ensure safe practice by the medical attendant. The remaining two services did not provide data in answer to this question.

6. Documentation. The manner that patient care documentation was accomplished varied among Oregon Air Ambulance Services. Oregon requires services to maintain copies of "patient care report" forms (Oregon State Health Division, 1981). Of the 15 services

responding to this question, 6 indicated they maintained no patient records. These services indicated that inflight patient records either accompanied the patient, were maintained at the hospital, or stored at an affiliated ground ambulance service. Due to the difficulty in retrieving such information, patient data were not available for 24 of the 152 patient transports conducted during the survey period.

Medical doctors with specialized altitude physiologic training (flight surgeons) were rarely consulted by any of the services to approve patients for airlift. Therefore, forms documenting such approval were universally absent. Flight manifests, indicating point of patient origin, destination, crew members, and patient names were retained by all services. Respiratory therapists and, consequently, specialized respiratory therapy forms were rarely used. Again, six agencies did not retain copies of the physician's orders specifying the care the patients under their charge were to receive. In these instances, the orders accompanied the patient to the destination facility.

7. Service Reactivity. Wide variations among services were evident when evaluating how long it takes

Oregon Air Ambulances to prepare an aircraft with pilots, medical crews, and equipment necessary for patient air transport. Oregon's three helicopter air ambulance services with aircraft, pilots, medical crews, and equipment on 24-hour immediate standby could lift-off within 2 to 5 minutes of receiving a transport request. Fixed wing operators, who in no instance had pilots, crews, and equipment on constant alert, cannot come close to this figure. Of 12 services who responded to this question, 10 were able to launch within 1 hour of receiving an airlift request. One service claimed a 15 minute response time; however figures exceeding 30 minutes were more usual. Another service listed 2 hours as their minimum response time, while a final service believed 5 hours to be a realistic estimate of the time needed to prepare the aircraft and locate the necessary pilots and medical crews to commence the mission.

Eighty percent of the services admitted they experienced delays which exceeded their original estimated departure time. The major reason for delay was identified as failure of the patient to arrive at the airport at the promised time. Many operators found that when the patient arrived, often he or she was not properly prepared for the air transport, that promised

equipment did not accompany the patient, or medications were absent, etc. Occasionally, delays were caused by aircraft failure, the unavailability of medical escorts, or arrival of patients without medical records.

Delays in transporting the patient from the destination flightline to the receiving facility were less common but were experienced by 60% of the services. The most frequent reason for delay was failure of ground transportation (ambulance) to be waiting for the patient at the flightline upon arrival. Additionally, some operators complained that their air ambulance aircraft was sometimes parked in remote or inaccessible locations on the flightline, making it difficult for the ground vehicle to locate the patient.

All air ambulance services operated through some arrangement with a subcontractor. The most common arrangements were for the aircraft, pilots, and mechanics to be furnished by the service licensed as an air ambulance whereas the medical equipment, supplies, and crewmembers were provided by a separate agency. Cooperative agreements with ground ambulance services or with hospitals were frequent as previously mentioned. Four services leased (or hired by the hour)

additional aircraft and pilots as air transport requests exceeded their standing capabilites. In order to maintain a viable operation, 53% of the air ambulances obtained services from more than one contractor. Six operators preferred to pay hourly for services provided by a subcontractor rather than be committed to long term leases.

All services indicated that their dependence on a subcontractor did not negatively impact their ability to respond to calls for transport. Aircraft from other airports could quickly be made available. Medical crews, equipment, and necessary supplies often arrived hand-in-hand with the patient. Services found such methods of operation exceedingly prudent from an economic standpoint. The data reflect the popularity of such methods of operation.

Outputs

1. Referral to Agencies. Major hubs of air transport activity centered around Medford, Bend, and Portland. While patients originated from practically every county in the State (see Figure 4), patient destinations (see Figure 5) centered on the Portland area (with 46% of the airlifts), the Bend area (with 8% of the airlifts), and Medford (with 8% of the airlifts). Eighteen percent of the patients were

transported to locations outside of Oregon.

Hospitals over 100 beds with numerous specialties were the destination of 122 patients transported by air in Oregon during September. Three patients were transported to their private residences. The destinations for the remaining three patients were not listed.

2. Patient Condition. It is difficult to determine quality of care by patient condition when assessing agencies which use different forms and methods of documenting the condition of the patient during air transport. While some charting was very indepth, other charting was brief with little elaboration beyond vital signs and IV flow rates. In this study the only measure of outcome was a crude measure of mortality (patient arriving at the destination alive or dead). Even this measure proved difficult to ascertain since at least 10 patients were undergoing cardiopulmonary resuscitation throughout the airlift mission and upon arrival at the hospital. Unless clearly stated in the patient's record, mortality could not be assumed even in these cases. Several services stated that, "Patients never died inflight". To pronounce a patient dead inflight would present problems of pin-pointing the exact geographic

location of the patient's death and possibility of initiating jurisdictional disputes among counties.

One-hundred and eleven patients arrived at their destination alive. In 15, the condition of the patient upon arrival was unclear. Two patients were Dead-On-Arrival (DOA). Both had received resuscitation at the scene of the accident and inflight.

3. Information. The most commonly used methods of ascertaining the quality of service delivered to the patient were the post-flight audit of the patients's chart and a careful physical assessment of the patient. One-half of the services surveyed relied on these methods. Another means to evaluating quality of care was the Flight Nurse Review Meetings whereby medical staff openly critiqued the inflight care provided by their own crews. Post flight reports from the accepting physician, receiving facility, family, or the patient also aided services in determining how well they were doing their job.

Inflight performance evaluations, written evaluations, state licensure, patient comments, pilot comments, and/or monthly performance demonstrations were used by 60% of the services to evaluate the inflight competence of medical attendants. The remaining 40% used no means to assess the inflight

competence of attendants. These services believed that inflight attendant competence was not their direct responsibility.

CHAPTER 4

DISCUSSION

The results presented in the previous chapter provide a general description of the air ambulance services presently operating in Oregon. In this chapter, only those results are discussed which address the four major research questions posed at the beginning of this study. These answers were obtained from data pertaining to the conceptual framework components listed in Table 2 as relevant to each question. On the basis of these answers, an initial and limited evaluation of Oregon's air ambulance system is presented.

Question 1: Is the use of air transport in Oregon appropriate, considering both the types and location of the patients flown?

Trauma is the predominant diagnosis of patients transported within our State boundaries. Often these patients are suffering from severe injuries and time is a critical factor. Aircraft, with speed as their forte, decrease transport time (Cleveland & Miller, 1980; Flexer, 1980). This is the most clear-cut advantage of air transport over ground transport (Flint & Flint, 1985).

It has been shown that delays in the movement of

high risk trauma patients into trauma centers adversely affect morbidity and mortality (Boyd, 1980). Prompt transportation by medically appropriate transport services to specialized treatment centers enhances patient recovery (Muller & Goldberg, 1977; West, Trunkey, & Cim, 1979). Inasmuch as every ambulance director reported that air ambulance services were chosen because of their speed, the Oregon experience follows national trends.

Whereas hospital-based helicopter air ambulances predominantly transported severely traumatized patients, the private fixed-wing operators transported predominantly patients with cardiac or other medical conditions. A similar finding was reported by researchers in a recent nationwide survey of air ambulance services (Thomas et al., 1985). In Oregon, private physicians usually request these transports because needed medical services are not locally available and because speed is required by the patient's condition. Requesting physicians seldom possess specialized knowledge of altitude physiology and its effect on patients (Bare, 1982a). However, many operators accept the attending physician's judgement and do not additionally consult with a specially trained flight surgeon or flight nurse prior

to accepting a patient for airlift. In Canada, when the Alberta Government removed a restriction prohibiting patient airlift without prior flight surgeon or flight nurse approval, the number of patient air transports during the following year increased threefold (Connors, 1975). Many of these airlifts were found to be inappropriate, in that patients should not have travelled by air because of their medical condition, or could have been moved with no adverse affect and more cheaply by ground.

The Canadian experience fuels concern over inappropriate airlifts in Oregon. The extent to which Oregon air ambulances are used appropriately may be estimated by examining the condition or diagnosis of each patient relative to existing patient selection criteria (see Appendix H). In 71% of the cases examined in this study, air transport of the patient appeared appropriate in that the physiologic condition of the patient would not be aggravated by the stresses of flight. A determination of the appropriateness of airlift could not be made for 27% of the patients because medical information was lacking or the diagnosis of the patient was too vague (i.e. Trauma versus Trauma resulting in pneumothorax). Two patients had conditions specifically contraindicated for airlift

aboard unpressurized aircraft. These two patients, both of whom suffered from a bowel obstruction, were transported aboard unpressurized aircraft by the same agency. Patients with such conditions may experience gas expansion with possible fatal consequences. In such instances as these, the advantage of transport speed does not offset the danger to the patient. To prevent such occurrences, services which do not employ specially trained flight surgeons or flight nurses, should obtain competent aeromedical consultation prior to accepting the patient for airlift (Bare, 1982b; Department of the Air Force, 1983).

From the standpoint of the patient's physical condition, helicopters do provide an advantage over fixed-wing aircraft. Helicopter services can safely transport patients with conditions (i.e. bowel obstruction, facial fractures, pneumothorax, intracranial air) which are clearly contraindicated for airlift above 2000 feet cabin altitude . Since helicopters can maintain flight altitudes below this elevation, these patients may be safely moved. Additionally, helicopters with a flight radius of only 150 miles (Johnson, 1981; McNeil, 1983) have the patient onboard for only minutes as opposed to hours for long distance fixed-wing transports. Also, because

fixed-wing aircraft generally fly above 5000 feet elevation (McNeil, 1983) the patients experience increased physiologic stressors. Even pressurized fixed-wing aircraft which can maintain lower cabin altitudes, run the risk of a rapid decompression which will cause the cabin altitude to quickly exceed the physiologic limits of the patient.

Five percent of the patients transported in Oregon were considered "routine" patients (no need to hurry and the patient could be transported at any time). Dr. Michael Krentz, former chairman of the emergency medical services committee of the American College of Emergency Physicians claims that sending routine patients by ground ambulance would not necessarily be bad medicine. Decisions must be made as to whether the potentially greater cost of the air transport can be justified on the basis of saved time, comfort, lack of other acceptable modes of transport, and the patient's wishes.

It was not surprising to find patient transport hubs focusing on the Medford, Bend, and Portland areas. Major routes followed the Willamette Valley, Columbia River Gorge, and the Pendleton-John Day-Bend triangle. Nearly all patients were being transported to facilities capable of providing more specialized

care. With its vast medical resources and capabilities, the Portland (Multnomah County) area served as the airlift destination for nearly one-half of all the patients airlifted in our State. What limited comparison data exist, show transport routes from less populated to metropolitan areas as typical (Connors, 1975; Cooper, Klippel, & Seymour, 1980).

The choice of air transport in the State of Oregon appears to be for the appropriate reasons. Patients must be moved because the services they need for recovery are not available locally. Air ambulance operators report speed as the primary reason they are selected to move the patient. It could be argued that patients might have been transported more cheaply by ground means, with no deterioration in condition at delivery. However, without a more complex study, similar to that conducted in California by Baxt and Moody (1982), this assertion cannot be validated for Oregon.

Patient selection does present an area of concern. Clearly some patients are being transported who should be moved by other means. Some services fail to document adequately the patient's condition or care received enroute, or maintain patient records at their site of operations. In many cases, these omissions

precluded a determination of the appropriateness of patient transport by air. Unrestricted patient access to air transport has permitted system abuse and needlessly endangered patient well-being. Controls to ensure knowledgeable pre-flight patient assessment may prevent such abuses in the future.

Question 2: To what degree are the aircraft and equipment of air ambulance services in compliance with State Emergency Medical Services Section requirements and suggested federal guidelines?

Previous studies have suggested that some air ambulance operators use aircraft and equipment that fall far short of the minimum required to safely airlift patients (Bare, 1982a; Bleiler, 1982; Boyd, 1984; Connors, 1975). Briefly, these authors assert that aircraft are poorly configured and equipped for their air ambulance role. Some ambulance aircraft have no facilities for even stretchers, much less hooks for hanging IVs. Generally operators fly small utility aircraft, with small interior dimensions, excessive noise, inadequate heat and light, and lacking power hook-ups for portable medical equipment.

This did not prove to be the case in Oregon. Most Oregon operators used multi-purpose aircraft (passenger charter and air ambulance), which could be quickly

configured to air ambulance operations. Communications equipment, heat, light, and interior size were generally acceptable.

Pressurized aircraft, while not mandatory for transporting patients, are desirable and enhance airlift capabilities (Bare, 1982a). It has been recommended that except for the transport of patients with musculoskeletal injuries who are otherwise in good health, unpressurized aircraft should not be used for aeromedical flights over any significant distance (McNeil, 1984, p. 35; USDT & AMA, 1981). Unfortunately, unpressurized fixed-wing aircraft are not uncommon in our State. Four operators use such aircraft exclusively and six operators use both pressurized and unpressurized aircraft. Only two fixed-wing operators insist on pressurized aircraft for their air ambulance operations. While the situation in Oregon is no worse than in the rest of the nation, it falls far short of meeting suggested federal guidelines. Since Oregon does not require the use of pressurized aircraft (see Appendix F), these operators may continue to practice with State sanction.

Oregon ambulances rate better in meeting equipment and supply requirements. Most aircraft had oxygen and suction capabilities readily available to maintain the

patient's airway patency. All operators met Oregon's Basic Life Support requirements and most met the more demanding Advanced Life Support requirements. These requirements closely parallel federal guidelines and have been deemed adequate to meet patient inflight needs (Bare, 1982b; McNeil, 1984).

Most operators use aircraft not specifically designed to accommodate the enplaning and deplaning of litter patients. Aircraft equipped with large cargo doors to ease patient loading are rare. Most operators report that "safe" enplaning can be accomplished through narrow aircraft doors using scoop stretchers and transferring the patient once onboard to the aircraft stretcher. However, this procedure can be stressful to the patient and time consuming for the crew. Additionally, in the event rapid evacuation should be necessary (i.e. aircraft fire), it is very difficult to get the litter-bound patient out of the aircraft.

McNeil (1984) recognizes this limitation of aircraft presently in use, and suggests that operators replace older aircraft with ones more practically designed for the air ambulance role. Operators should purchase aircraft less for their esthetic appearance than for their functional ability. Only recently have

we seen sleek, shiny, hearse-like ground ambulances replaced by box-like units mounted on truck chassis to improve patient access. Oregon places no restriction on aircraft other than with regard to interior size. All aircraft evaluated met these requirements.

Oregon air ambulance services are well equipped in accordance with both Oregon requirements and federal recommendations. Aircraft do not up measure as well. Unpressurized aircraft, widely considered unsuitable for patient airlift, are common among the State's operators. There are many multi-purpose aircraft with narrow doorways which necessitate potentially unsafe manipulation of the litter patient and which prevent rapid patient evacuation in case of an emergency. More suitable patient airlift aircraft, such as the 201 Arava or Beech Baron 58P, are not in general use in Oregon.

Question 3: Are inflight medical attendants receiving adequate training on unique features of care needed by the air transported patient?

Some specialized aircrew training was provided to 87.5% of the air ambulance patient attendants. Oregon requires attendants to be "trained in the effects altitude may have on patients and how to cope with these effects" (Oregon State Health Division, 1981).

The vagueness of this rule makes for wide interpretation and difficult enforcement. One busy service, transporting 22 patients aboard unpressurized aircraft during September 1985, neither provided specialized training for its inflight attendants nor required that attendants had received previous airlift training. Patients flying in these unpressurized aircraft were subjected to unchecked physiologic stresses of flight. In such cases, knowledgeable intervention is imperative.

An indepth, objective assessment of the knowledge level of each of Oregon's inflight medical attendants was not possible in this study. Assessment of specific knowledge levels, while addressed by each responding service, was not uniform and susceptible to subjective interpretations. What one service judged to be adequate training on environmental factors affecting patient care may have been deemed insufficient by a second service. Many agencies provide training to their attendants by self-proclaimed "authorities" on the subject matter. Again, no specific criteria have been developed by which to recognize competent instructors.

Inadequate aircrew training is not a problem unique to Oregon. A Canadian study recognized similar

problems (Connors, 1975). Many other authors have underscored this fact (Bare, 1982b; Bleiler, 1982; Boyd, 1984; McNeil, 1984). Yet training is available to Oregon ambulance crews through a variety of sources. Dr. Bare, executive director of the Association of North American Air Ambulances, has published a training manual for aeromedical attendants. In addition, he has highly skilled instructors capable of providing specialized training for aeromedical attendants. Closer to home, one Oregon hospital-based air ambulance service employs flight nurses with extensive knowledge of patient care inflight. These nurses have received 300+ hours of training in altitude physiology, inflight patient assessment and care, and aircraft emergencies, in addition to valuable practical flight experience. These nurses have made available audiovisual and printed materials, and they do regularly present programs to interested persons or groups. With such readily accessible training, it is not unrealistic to expect all inflight attendants to possess adequate knowledge of the environment in which they operate.

Question 4: To what degree are regulating agencies involved in the enforcement of standards for air ambulance services?

The only agency actively involved in regulating aspects of air ambulance operations appears to be the FAA. As it now exists, the FAA is primarily concerned with the airworthiness of the aircraft and the proficiency of the pilots. This leaves a huge gap in accountability for developing and enforcing air ambulance standards. Therefore, as concern grows for protecting patients from poorly operated aeromedical transport services, the individual states have been compelled to formulate air ambulance regulations and guidelines. Although no federal regulations exist, the American Medical Association, the Aerospace Medical Association, and the National Highway Traffic and Safety Administration have recently begun to rewrite federal air ambulance guidelines first put forth in 1981 (Thomas et al., 1985).

The Oregon State Health Division is not actively monitoring air ambulance operators at present. Not one of the 16 services responding to the survey had been inspected for rule and statute compliance by this agency's Emergency Medical Services Section. The impact of this Section on air ambulance operations in this state is negligible. Other than yearly licensure, the contact between this agency and the operators is minimal. "Voluntary Cooperation" is a term which best

describes the relationship between the service providers and the agency mandated with ensuring that standards are maintained.

For the most part the private entrepreneurs are complying with the State's requirements. By their own admission, violations do occur such as no inflight attendant training, no signed agreement with an agency providing personnel, no patient care report forms. Connors (1975) found similar violations occurred in Canada, when Alberta's Emergency Air Ambulance Service relinquished control of air ambulances to users. Some sources have even reported needless patient deaths as a result of permitting ill-prepared air ambulance services to operate without regulation or enforcement of standards (Bleiler, 1982; Thomas et al., 1985). Inflight patient deaths are difficult to document in Oregon since many operators insist that the patient "never dies inflight".

Oregon air ambulance services claim they are generally meeting State aircraft and equipment requirements, and providing adequate training of inflight attendants. In actuality, this may not be the case. Individuals are seldom eager to highlight the shortcomings of their own operations. Accentuating the positive might be a more common response. Perhaps

Oregon's air ambulance services are better than most. Objective evaluation by a government body given the authority and commitment to conduct appraisals of operations and performance offers the best chance of producing accurate results.

CHAPTER V

SUMMARY, RECOMMENDATIONS, LIMITATIONS, AND IMPLICATIONS FOR NURSING

This chapter will present a summary of the study, include recommendations, discuss study limitations, and list recommendations for future research. The implications of the study for nursing will conclude the chapter.

Summary and Recommendations

In the relatively new field of civilian air ambulance services, leading nationwide authorities have expressed concern over the ability of these services to provide good quality inflight care. A review of the literature revealed concerns over the appropriateness of patients selected for aeromedical transport. These concerns stemmed from the lack of competent, objective aeromedical consultation prior to the acceptance of patients for airlift by civilian services. Additionally, aircraft and inflight medical equipment had been found through observation to be inadequate for the role to which they were assigned. Many aircraft lacked pressurization, advocated as essential for safe patient airlift, and even such rudimentary medical equipment as is found in most ground ambulances.

Another area of concern focussed on the lack of specialized aeromedical attendant training, which had been recommended by authorities, but opposed strongly by the civilian air ambulance community. Inflight medical attendants were being recruited from ground ambulance and hospital staffs who did not understand the hazards of the inflight physiologic environment in which they were expected to operate. The condition of patients was being jeopardized because staff did not know how to reduce the physiologic stressors on the patient.

Finally, federal regulations are lacking governing the operation of the nation's more than 675 air ambulance services, as a consequence of strong anti-government sentiment expressed by air ambulance operators in the early 1970's. It has been left to individual states to draft and enforce such regulations. This has resulted in no or grossly inadequate control of these services by states lacking funds or adequate staff for monitoring.

What little research has been conducted regarding air ambulance services has supported these conclusions. However, prior to the present study, the status of air ambulance services in Oregon was unknown. Therefore this investigation was undertaken to describe

and evaluate Oregon's air ambulance system. The study sought to determine the extent to which the air transport of patients is appropriate; the degree to which the air ambulance services comply with State Emergency Medical Services Section standards; the level of specialized training for inflight medical attendants; and the degree to which regulatory agencies have an impact on Oregon's aeromedical transport system.

Data were collected by questionnaires mailed to Oregon's 18 air ambulance operators. Sixteen agencies responded. These agencies were then contacted a second time to obtain information regarding all patients transported in the month of September, 1985. The predominant category for patients airlifted in Oregon was trauma. Airlift supplied the rapid transport of these patients to specialized treatment centers. Hospital-based air ambulance services were heavily involved in those trauma transport cases. Private fixed-wing operators predominantly moved patients suffering from cardiac or other medical conditions. The main hubs of airlift activity were in the Medford, Bend, and Portland areas. Portland served as the destination for nearly one-half of all the airlifted patients.

In Oregon, private physicians usually initiated transport requests except at accident or injury scenes which were initiated mainly by ground ambulance attendants. Air ambulance operators generally accepted the physician's judgment as to the appropriateness of airlift for the patient. Rarely were qualified aeromedical consultants contacted to approve patient airlift.

Lack of clear inflight documentation hampered a determination of the patients' suitability for airlift based on their physical condition and the operator's service capabilities. In cases where adequate information existed, 97% of the patients were suitable airlift candidates, whereas 3% had conditions clearly contraindicated for flight. Airlift for this latter group could have resulted in an aggravation of their condition and/or possible death. Fortunately, this did not occur. Competent aeromedical consultation could have advised against such airlift and prevented system misuse.

Since the initiating physician rarely has the expertise to determine airlift appropriateness, it is recommended that competent aeromedical preflight assessment (either by a flight surgeon or flight nurse) be required on all patients accepted for airlift.

Obtaining such advice should be the responsibility of the air ambulance service. Consultation would not only serve to protect the patient from hazardous air travel but would also protect the operator from accepting a patient whose treatment might later prove to be beyond the capabilities of the crew, aircraft, and equipment. The air ambulance operator and the practicing physician should be advised of the restrictions and medical requirements necessary to transport the patient safely in an airborne environment.

Secondly, each air ambulance operator should maintain, for a period of not less than five years, a record of each air ambulance operation, including but not limited to:

1. patient's name
2. date of flight
3. diagnosis
4. originating and terminating points, and patient's condition upon departure and arrival
5. record of aeromedical preflight assessment or consultation
6. an inflight medical attendant's report of the patient's status, including vital signs, level of consciousness, drugs administered, and details of therapeutic intervention

7. aircraft and cabin altitude on patients requiring oxygen

8. unusual circumstances encountered inflight, including adverse responses to air travel, excessively high aircraft and cabin altitudes, turbulence, times associated with these abnormal conditions, etc.

Such a report form is presently required by the Emergency Medical Services Section of the Oregon State Health Division (Oregon State Health Division, 1981). As reported, this requirement is not presently being enforced.

Air ambulances in Oregon appeared to be well-equipped and met State Basic Life Support configurations. Oftentimes, services even exceeded Advanced Life Support configuration requirements. However, unpressurized aircraft were widely used in Oregon. While this situation is not unlike the situation nationwide, it falls far short of what is widely advocated for safety.

Most operators used multi-purpose aircraft not specifically constructed with patient airlift in mind. Cabin interior space was severely restricted, making the transport of patients requiring bulky medical equipment difficult. Patient safety aboard aircraft with narrow doorways was repeatedly compromised during

complex enplaning and deplaning procedures. Should an aircraft emergency develop requiring rapid cabin evacuation, the litter patient could not quickly be removed.

It is further recommended that operators be encouraged to purchase pressurized fixed-wing aircraft suitably configured for air ambulance operations. Pressurization would greatly enhance the capabilities of air ambulance operations and reduce the physiologic stress placed upon the ill patient. Such a requirement may limit the number of services able to operate because of increased purchase and operating costs. However, this is a legitimate requirement in order to ensure high quality air ambulance services.

The amount of specialized training given aircrews varied greatly among the air ambulance services. This variability is attributable in part to the vagueness of the training requirement as formulated by the Oregon State Health Division. Services operating unpressurized aircraft were found to be using aircrew members with no specialized aeromedical attendant training. Extent of training and determination of instructor competency were left totally to the discretion of the operator.

This situation should be rectified, and criteria to

standardize aircrew training should be developed and enforced. Authorities on patient air transport are readily accessible in this state. Their expertise could be solicited through appointment to a task force mandated to develop a curriculum which would encompass topics essential for patient air transport. Furthermore, this task force could develop criteria specifying minimum instructor qualifications. Certification which recognizes individual excellence in performance, training, and knowledge, and modification of existing regulations would be a logical result of these efforts.

Air ambulance operators in Oregon complied with State air ambulance regulations to varying degrees. No service had ever received a compliance inspection by the agency assigned to monitor air ambulance operations. Generally, the resulting "voluntary cooperation" by services was only marginally successful. Several air ambulance services are currently operating in violation of the law, and the other agencies may have somewhat exaggerated the extent of their compliance. Clearly, Oregon needs a greater commitment to enforcement, and the Oregon State Health Division should allocate funds and expert personnel to police existing services.

The number of air ambulance services in Oregon is 18, exceeding by 15 the mean of 3 for all states (The Council for State Governments, 1986). Several of these services transport no patients for months at a time, which has a negative impact on their level of proficiency. A restriction on the number of air ambulance services might increase patient volumes for the remaining agencies and serve as an incentive to increase expenditures for aircraft, equipment, and aircrew training.

A final recommendation is to subject non-profit agencies to the same requirements as all other air ambulance services in the State of Oregon. The public health and well-being can be upheld only if standards are universally applied and enforced.

Study Limitations and Recommendations for Future Research

This study had several limitations. Perhaps the most serious was the assessment tool used to solicit data from the 16 air ambulance operators. Attempts were made to validate the instrument through its review by practitioners in the field. However, the absence of previous research in this subject area forced the author to base the tool exclusively on the literature and on the author's personal experience as an

aeromedical attendant. Some specific assessment areas of air ambulance operations may have been omitted, so its entire domain may not be sufficiently represented

Time and monetary restraints precluded the conduct of on-site inspections of each air ambulance operation in Oregon, so this researcher relied mainly on the subjective reports of the operators themselves. This was less than ideal since some operators might have made socially desirable responses.

An indepth assessment of the knowledge level of all inflight medical attendants was not possible in this study. Such a study would seem to be a logical extension of the present investigation. Prior to completion of this basic descriptive research, it would have been premature.

The regulations as they exist in Oregon limited the type of data available for study. These regulations focus attention on areas of air ambulance operations such as equipment, supplies, aircraft, and training. As a result, operators generally were able to provide more information in these areas about their available services. Less information was available about operational areas not addressed by the regulations.

Finally, patient data were collected for a one month period only. Ideally, a longer sample period

would have served to increase the confidence in the extrapolation of patient data.

Additional recommendations for future research include the following. First, the data reported here should be validated through a repeat study of Oregon's air ambulance services using observational techniques. The investigator of such a study would probably need authority from a government agency. Secondly, a correlational or, preferably, an experimental study should be initiated to evaluate the effect of advanced aeromedical attendant training on inflight patient care performance. Finally, Oregon's system of air ambulance services might be compared with the systems of other West Coast states. Presently, information on other states is virtually non-existant.

Implications for Nursing

The airlift of patients within our state offers a unique opportunity for nurses. As reported earlier, more than two of every three patients transported by air in Oregon are accompanied by a Registered Nurse. Nurses far exceed any other category of aeromedical attendant. Therefore, nurses have the legitimate responsibility to guide this relatively new scope of practice, and they can exert a positive influence by advocating changes to enhance the delivery of care.

Nationwide interest in the air transport of patients is increasing. A few years ago, reports of patient airlift were the focus of community excitement. Now headlines such as "Patient Life Flighted to Regional Medical Center" are commonplace. As the number of airlifts increase so too will the problems unless an organized effort is made to guide practice. Nurses have the knowledge, the power, the responsibility, and the opportunity to meet this challenge. Let us heed the call.

References

American Nurses' Association. (1976). Code for nurses with interpretive statements. Kansas City: Author.

Armstrong, H. G. (1952). Principles and practice of aviation medicine. Baltimore: Williams and Wilkins.

Bare, W. W. (1982a). Protect your patient in the air: Air ambulance standards for the Association of North American Air Ambulances. New Jersey: North American Air Ambulance.

Bare, W. W. (1982b). Training manual for the aeromedical attendant. New Jersey: North American Air Ambulance.

Baxt, W. G., & Moody, R. (1983). The impact of rotorcraft aeromedical service on trauma mortality. Journal of the American Medical Association, 249, 3047-3051.

Bleiler, E. (1982). How safe are air ambulances? Medical Economics, 59(10), 142.

Boyd, D. R. (1980). Trauma - a controllable disease in the 1980s. Trauma, 20, 14-24.

Boyd, D. R. (1984). Foreword - Airborne care of the sick and injured. New York: Springler-Verlag.

Cleveland, H. C., & Miller, J. A. (1980). An air emergency service: The extension of the emergency

department. Topics in Emergency Medicine, 1(4), 47-54.

Connors, J. G. (1975). Alberta's emergency air ambulance service. Unpublished master's thesis, The University of Alberta, Alberta, Canada.

Cooper, M. A., Klippel, A. P., & Seymour, J. A. (1980). A hospital-based helicopter service. Will it fly? Annals of Emergency Medicine, 9(9), 451-455.

Cowan, M. N. (1979). Transporting patients by air. Consultant, 15(7), 67-73.

Department of the Air Force. (1976). Aeromedical evacuation nursing (AF Pamphlet 164-2). Washington, DC: U.S. Government Printing Office.

Department of the Air Force. (1983). Aeromedical evacuation nursing (AF Pamphlet 164-2). Washington, DC: U.S. Government Printing Office.

Duncan, W. J. (1981). Organizational behavior (2nd ed.). Boston: Houghton-Mifflin.

FAA publishes withdrawal notice on proposed air ambulance regulations. Aviation, Space, and Environmental Medicine, 49, 1360.

Flexer, M. (1980, May). The helicopter ambulance: essential medical service. Hospital Progress, 66-71.

Flint, L. M., & Flint, C. B. (1985). Evolution, design, and implementation of trauma systems. In G. D. Zuidema, R. B. Rutherford, & W. F. Ballinger (Eds.), The management of trauma (4th ed.). Philadelphia: Saunders.

Helicopters: a costly way to fill beds? (1984, September 21). American Medical News, pp. 1.

Johnson, J. C. (1981). Medical care in the air. Annals of Emergency Medicine, 10(6), 325.

Kalisch, B. J., & Kalisch, P. A. (1982). Politics of nursing. Philadelphia: J. B. Lippincott.

Lancaster, J., & Lancaster, W. (1982). The nurse as a change agent. St. Louis: C. V. Mosby.

LoFerto, J. P., & Brook, R. H. (1980). Evaluation of health services and quality of care. In S. J. Williams & P. R. Torrens (Eds.), Introduction to Health Services (pp. 355-387). New York: Wiley.

McNeil, R. L. (1983). Airborne care of the sick and injured. New York: Springler-Verlag.

Moore, W. E. (1970). The professions: roles and rules. New York: Russell Sage Foundation.

Muller, R., & Goldberg, J. (1977). The Illnois trauma system: Change in patient survival patterns following vehicular injuries. Journal of the American College of Emergency Physicians, 6, 393-397.

National Highway Safety Administration of the U.S. Department of Transportation and the Commission of Emergency Medical Services of the American Medical Association (USDT & AMA). (1981). Air Ambulance Guidelines (DOT Publication No. HS 805-703). Washington, DC: U.S. Government Printing Office.

Oregon Revised Statutes, ss 485.577 (1981).

Oregon State Health Division. (1981). Oregon Administrative Rules (Chapter 333, Division 28). Portland, OR.

Orem, D. E. (1980). Nursing: concepts of practice (2nd ed.). New York: McGraw-Hill.

Rhoberg, R. L. (1982). Preparation of the trauma patient for air transport. Emergency Medical Services, 11(5), 43-47.

Saletta, A. C., Behler, D. M., & Chamings, P. A. (1984). Fit to fly. American Journal of Nursing, 4, 462-5.

The Council for State Governments. (1986). State emergency medical services transport systems. Lexington, Kentucky: Author.

Thomas, F., Clemmer, T. P., Orme, J. F., Menlove, R. L., & Gibbons, H. L. (1985). Nationwide survey of civilian air ambulance services. Aviation, Space, and Environmental Medicine, 56, 547-52.

U.S. Department of Health, Education, and Welfare. (1971). Report on licensure and related health personnel credentialing. Washington, DC: U.S. Government Printing Office.

West, J. G., Trunkey, D. D., & Cim, R. C. (1979). Systems of trauma care: A study of two counties. Archives of Surgery, 114, 455-60.

Wieland, G. F. & Ullrich, R. A. (1976). Organizations: behavior, design, and change. Homewood, Ill: Richard D. Irwin.

Williams, S. J. & Torrens, P. R. (Eds.). (1984). Introduction to health services. New York: Wiley.

Appendix A

Air Ambulance Operators - State of Oregon

AAR Western Skyways, Inc
Portland-Troutdale Airport
Troutdale, OR 97060

Airlife
c/o St. Charles Medical Center
2500 NE Neff Rd.
Bend, OR 97701

Aurora Aviation
P.O. Box 127
Aurora, OR 97002

Baker Aircraft
Rt 2 Box 15
Baker, OR 97814

Coos Aviation, Inc.
1210 Airport Way
North Bend, OR 97459

Eugene Flight Center, Inc.
90454 Boeing Dr.
Eugene, OR 97402

Evergreen Helicopters, Inc.
3850 Threemile Lane
McMinnville, OR 97128

Henderson Aviation Co.
29484 Meadowview Rd.
Junction City, OR 97448

High Desert Aviation
P.O. Burns Aviation
Burns, OR 97720

Hospital Airtransport Systems
P.O. Box 849
Hillsboro, OR 97123

Klamath Aircraft, Inc.
Municipal Airport, Hanger 2
Klamath Falls, OR 97603

Lifeguard Medical Transport
P.O. Box 1331
Pendleton, OR 97801

Life Flight
c/o Emanuel Hospital
2801 N Gantenbein
Portland, OR 97227

Mercy Flights Inc.
P.O. Box 522
Medford, OR 97504

Pacific Flights
3650 Biddle Rd.
Medford, OR 97504

Pacific Gamble Robinson, Co.
P.O. Box 116
Troutdale, OR 97060

Pacific-Horizon Aviation, Inc.
P.O. Box 509
Aurora, OR 97002

Southern Oregon Skyways, Inc.
Dead Indian Rd.
Ashland, OR 97520

Appendix B

Cover Letter Accompanying Questionnaire

THE OREGON HEALTH SCIENCES UNIVERSITY

School of Nursing
Community Health Care Systems

3181 S.W. Sam Jackson Park Road Portland, Oregon 97201 (503) 225-7709

October 24, 1985

Dear Mr. :

I am a Registered Nurse graduate student at the Oregon Health Sciences University in Portland. I am conducting a survey of the Oregon Air Ambulance System under the supervision of Julia Brown, Ph.D. Much has been written about air ambulance services throughout the nation but very little in Oregon. Since these services vary greatly across states and even across air ambulance services, I felt it necessary to find out the scope of these services within our state.

You can help in this study by providing some information about your service. Please be frank since there are no right or wrong answers. So as not to use too much of your time, I have a list of questions with common responses that services in other states have given. Please respond in the manner indicated for each question. It should take approximately 20 minutes to complete the questionnaire. If you have any ideas which you feel should or should not be included, please feel free to add your comments. I would appreciate having them. All responses and comments will be strictly confidential.

Following the return of this questionnaire, I may contact you for some brief additional information on the types of patients you transport and the routes along which they are transported. Again, since your time is valuable, I will ensure that these requests are brief and the burden upon you and your staff is minimal.

Upon completion of this study, I will provide you with a report of the findings. It is my hope that you will find this information useful and helpful in understanding how your service contributes to the care of patients within our State. I would be happy to answer any questions you might have. You may write or call me at (503) 244-1605.

Your contribution to the success of this study is greatly appreciated.

Sincerely,

Farley J. Howell, R.N.
Graduate student
School of Nursing

Julia Brown, Ph.D.
Professor of Sociology
Community Health Care Systems

Appendix C

Air Ambulance Service Questionnaire

_____
(Agency Name)

_____
(Mailing Address)

_____
(City) (State) (Zip)

Please answer each of the following questions. As indicated, there may be more than one answer necessary.

First, could you please list any air ambulance services within the State of Oregon with which you have frequent contact:

_____No Contacts

_____ _____

_____ _____

1. Which agency/agencies have conducted on-site inspections of your aircraft, equipment, and/or operations as an air ambulance operator:

2. When was this inspection last conducted (mo/yr)?

3. What impact does this agency have on your air ambulance service?

		Great Deal	Some	None
_____Federal Aviation Administration.....	_____	____	____	____
_____Civil Aeronautics Board.....	_____	____	____	____
_____U.S. Department of Transportation.....	_____	____	____	____
_____Oregon State Health Division.....	_____	____	____	____
_____Insurance Companies.....	_____	____	____	____
_____Other_____..... (please specify)	_____	____	____	____

_____No agency has inspected this air ambulance service

4 - What are your sources of reimbursement for patient air transport (please indicate as a percent of total reimbursements)?

_____Direct patient pay
_____Private insurance (Blue Cross, etc.)
_____Medicare
_____Motor Vehicle Insurance
_____Workman's Compensation
_____Welfare
_____Membership program participant
_____Health Maintenance Organization (Kaiser, etc)
_____Other (please specify)
_____

5 - What is the primary source of operating revenues for your air ambulance service (Please rank these sources of revenue with "1" being the greatest source, "2" being the next greatest source, and so forth)?

_____3rd party reimbursement (insurance, Medicare, etc.)
_____Private pay
_____Donations
_____Membership dues
_____Other (please specify)
_____

6 - For what reasons might you refuse to transport a patient?

_____We never refuse to transport a patient
_____We are unable to pick-up or deliver the patient to the required location by air
_____The lack of financial resources of the patient
_____The condition of the patient
_____Our lack of equipment or trained personnel to meet patient requirements
_____The requested distance to air transport the patient is too far
_____Other (please specify)
_____

7 - Do you restrict the type of patients you will accept for air transport?

_____Yes
_____No

8 - If yes: What types of patients will you not transport?

_____Trauma
_____Cardiac
_____Medical
_____Obstetrics
_____Pediatrics
_____Burns
_____Surgical
_____Psychiatric
_____Other (please specify)
_____

9 - What is the name of the hospital nearest your air ambulance operation?

_____

10 - How far away is this hospital from your air ambulance service?

_____under 5 miles
_____6-10 miles
_____11-20 miles
_____21-40 miles
_____41-75 miles
_____+ 75 miles

11 - What percentage of patients do you transport -

_____into your local area
_____out of your local area

12 - What would you say is the distance in patient miles (patient aboard) of your average air transport?

_____under 50 miles
_____51-100 miles
_____101-200 miles
_____201-400 miles
_____over 400 miles

13 - What would you say is the longest distance you have transported a patient by air?

_____under 100 miles
_____101-200 miles
_____201-400 miles
_____401-600 miles
_____over 600 miles

14 - How many patients did you air transport last month (Sept. 85)?

_____

15 - What is the total number of patient miles you logged last month (Sept. 85)?

_____

16 - How long does it usually take to generate an aircraft equipped with pilots, medical crew, and equipment necessary for a patient air transport?

_____hours, _____mins.

17 - If your air ambulance service at times does not transport a patient but rather conducts a humanitarian mission, please indicate the type of service that you have provided: (Please rank with "1" being the most common, "2" being the next most common, and so forth)

_____Transport blood
_____Transport medicines
_____Transport a specimen
_____Transport medical equipment
_____Transport medical personnel
_____Other (please specify)
_____
_____

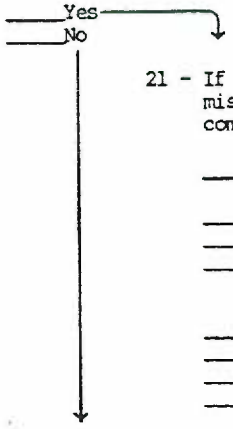
18 - What are the usual reasons given for transporting the patient?(Please list "1" as the most common, "2" as the next most common, and so forth)

_____No reason listed
_____Convenience (closer to family, closer to patient's residence, etc.)
_____Monetary benefit to the patient (e.g.to Veteran's Hospital, Military Hospital, HMO-Kaiser, Crippled Children's Hospital, etc.)
_____Medically necessary services not available at patient's present location
_____Other (please specify)
_____

19 - What are the common reasons given for selecting air transport?

_____No reason given
_____Less costly than ground transportation
_____Time critical for airlift
_____Level of care provided by the air ambulance service is greater than available by ground ambulance transport
_____Site of transport pick-up inaccessible by ground means
_____Other (please specify)
_____

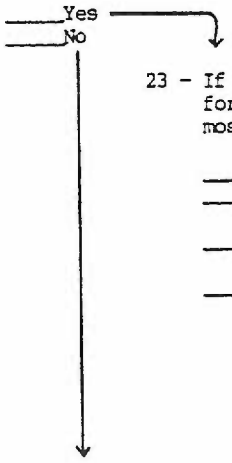
20 - Delays in patient transport pick-up (mission delays) are common occurrences with air transport. Does your service ever encounter such delays?



21 - If yes: Please prioritize these common reasons for mission delays. ("1" means most common, "2" next most common, and so on)

_____Patient not transported rapidly to airport by ground means
_____Aircraft failure
_____Medical equipment failure
_____Patient not properly prepared for air transport (promised equipment does not come with patient, medication missing, etc.)
_____Patient medical records missing
_____Medical escorts difficult to locate or unavailable
_____Pilots unavailable
_____Other (please specify)
_____

22 - Delays in patient transport from the destination flightline are common occurances. Does your agency ever experience such delays?



23 - If yes: Please prioritize the following common reasons for post-mission patient transport delays. ("1" means most common, "2" means next most common, and so forth)

_____Ground ambulance not at flightline upon arrival
_____Aircraft parked in remote or inaccessible location on flightline
_____Patient physically unstable for further transport upon arrival
_____Other (please specify)
_____

24 - Is your air ambulance service certified under Federal Aviation Regulation Part 135?

_____Yes
_____No

25 - Are you licensed in the State of Oregon as an air ambulance service?

_____Yes
_____No

26 - Do you have a medical director for your air ambulance operation?

_____Yes
_____No

27 - If an agency provides either medical personnel and/or medical equipment to be used on board the air ambulance, does your air ambulance service have on file a signed agreement with that agency?

_____Yes
_____No

28 - Are contact persons for your air ambulance service available 24 hours/day to respond to a patient air transport request?

_____Yes
_____No

29 - Do you have access to a flight surgeon who is knowledgeable in the effects of flight on patient conditions to clear all patients for air transport?

_____Yes
_____No

30 - If yes: Do you routinely consult with this physician prior to accepting any patient for airlift?

_____Yes
_____No

31 - Do medical personnel (MDs, RNs, EMTs, etc) routinely accompany the patients you transport?

_____Yes
_____No

32 - If yes: Please indicate the type of personnel who routinely accompany the patients you transport:

_____Nurse aides
_____Licensed Practical Nurses
_____Registered Nurses
_____Critical Care/Emergency Room Registered Nurses
_____EMT I
_____EMT II
_____EMT III
_____EMT IV
_____Medical Doctor
_____Other (please specify)
_____

33 - Please indicate the number of employees in each category on your staff:

_____Nurse aides
_____Licensed Practical Nurses
_____EMTs
_____Registered Nurses
_____Medical Doctors
_____Pilots
_____Mechanics
_____Communications Specialists
_____Secretaries
_____Managers
_____Other (please specify)
_____

34 - In what capacity are these personnel associated with your air ambulance service?

	Employed Full Time	Employed Part Time	Volunteers	Agency Personnel
Nurse aides				
Licensed Practical Nurses				
EMTs				
Registered Nurses				
Medical Doctors				
Pilots				
Mechanics				
Communications Specialists				
Secretaries				
Managers				
Other ( )				

35 - Are your medical personnel (nurse aides, LPNs, EMTs, RNs, MDs, etc.) trained in the physiologic effects that altitude may have on patients and how to cope with these effects?

_____Yes
_____No

36 - If yes: How is this training accomplished?

_____Lecture from an instructor who has had training and experience in this subject matter
_____Self study
_____Previous military training
_____Other (please specify)
_____

37 - Please indicate areas in which medical personnel are trained:

_____Responsibilities during the preflight, inflight, postflight phases of an air ambulance mission
_____Legal considerations of air ambulance service
_____Recordkeeping of an air ambulance service
_____Lifting and moving patients
_____General patient care inflight
_____Medications, including the times that medications are administered prior to ascent and descent
_____Medical equipment used aboard the aircraft
_____Changes in barometric pressure, decompression sickness, and air embolism
_____Other environmental factors affecting patient care such as humidity, temperature, ventilation, noise, etc.
_____Aircraft systems: electrical, pressurization, lighting, ventilation, etc.
_____Principles of survival
_____Care of patients who require special consideration in the airborne environment
_____Aircraft emergencies: proper procedures and actions (Rapid Decompression, Fire, Crash, and Ditching)

38 - Do you require medical flight attendants to receive at least 8 hours of refresher training annually in the areas cited above?

_____Yes
_____No

39 - Do you have any plans underway to conduct such training?

_____Yes
_____No

40 - Please indicate the number of each type of aircraft you have available:

_____Single-engine piston _____Single-engine turbo-prop _____Helicopter
_____Multi-engine turbo-prop _____Multi-engine piston _____Jet

41 - Do you have aircraft that can transport more that one stretcher patient?

_____Yes, please indicate the number of such aircraft _____
_____No

42 - Please complete the following regarding the aircraft you use for air ambulance service:

Manufacturer	Type-Model	Number of Such Aircraft	# of Seats + Stretcher*	Pressurized? Yes	No

*Indicate number of passenger seats excluding area set aside for two pilots and areas set aside for stretcher.

43 - Are your aircraft of sufficient size to accommodate at the minimum, required personnel, one patient, medical equipment, and still allow full access to the patient?

_____Yes
_____No

44 - Do the aircraft have a heating system capable of maintaining the cabin temperature at about 75 degrees during all phases of operations?

_____Yes
_____No

45 - Are the aircraft equipped with a radio capable of communicating air to ground and air to air?

_____Yes
_____No

46 - Are the interior lighting systems adequate for patient observations and care under all circumstances?

_____Yes
_____No

47 - Are the aircraft doors large enough to allow a stretcher or litter to be loaded without rotating it more than 30 degrees about the longitudinal (roll) axis or 45 degrees about the lateral (pitch) axis?

_____Yes
_____No

48 - Is the stretcher or litter positioned aboard the aircraft so as to allow the attendant a clear view of and access to any part of the patient's body that may require attention?

_____Yes
_____No

49 - Is the upper surface of the litter at least 30 inches from the ceiling of the aircraft or the under surface of another litter?

_____Yes
_____No

50 - Are litters installed laterally in the aircraft to provide better restraint against forces which may be encountered in flight?

_____Yes
_____No

51 - Are your aircraft routinely equipped with oxygen for the patient?

_____Yes
_____No

52 - Are your aircraft routinely equipped with patient suction devices?

_____Yes
_____No

53 - Do your aircraft have aboard a means of providing patient humidification?

_____Yes
_____No

54 - Please indicate which of the following items you routinely have available for patient air transport:

_____Stretcher/Litter
_____Means of hanging intravenous solutions
_____Emergency drug kit
_____Bag/mask ventilation device
_____Oxygen masks/cannulas
_____Oropharyngeal airways
_____Fracture equipment (traction splints and splints for the upper and lower extremities)
_____Dressings
_____Anti-shock trousers (MAST)
_____Cardiac massage board
_____Misc equipment (BP cuff, stethoscope, emesis bags, urinal, etc.)
_____Linen supplies
_____Drug kit (with a copy of current standing orders, medication list, and IV fluids and adjunct equipment list signed by the physician advisor)
_____Monitor/defibrillator
_____Airway management kit (laryngealscope, endotracheal tubes, etc.)
_____Pneumothorax kit (heimlich valve)
_____Doppler (for BP auscultation)
_____Respirator/ventilator
_____Burn kit
_____Poison drug overdose kit
_____Obstetric kit
_____Pediatric kit
_____Incubator

DOES YOUR AMBULANCE SERVICE MAINTAIN A :

55 - Patient Care Report Form for describing the patient's condition and care received during the air transport?

_____Yes
_____No

56 - Physician Aeromedical Consultation Form on all patients transported? (indicates that a qualified Flight Surgeon with knowledge on the effects flight may have on patients has approved the patient for airlift)

_____Yes
_____No

57 - Flight Manifest describing the transport location, time of pickup/arrival, and destination hospital?

_____Yes
_____No

58 - Respiratory Therapy Consultation Form documenting ventilator settings and operation on appropriate patients?

_____Yes
_____No

59 - Physician's Orders copy describing required care the patient is to receive enroute?

_____Yes
_____No

60 - Do you have an evaluation method whereby you determine how well your agency was able to care for the patient inflight?

_____Yes
_____No

61 - If yes: What type of method do you use?

_____Chart audit
_____Postflight patient assessment
_____Reports from accepting Medical Doctor
_____Reports from the patient
_____Reports from the family
_____Reports from the receiving facility
_____Other (please specify)
_____

62 - Do you have a method of evaluating inflight medical attendant competence?

_____Yes
_____No

63 - If yes: How is this accomplished?

_____Inflight performance evaluation
_____Written evaluation
_____State licensure
_____Patient comments
_____Pilot comments
_____Other (please specify)
_____

If you subcontract out for some of your services (aircraft, medical personnel, equipment), please answer the remaining questions on the following pages. If you do not subcontract out for additional services then you have completed all of this questionnaire that is necessary. Thank you very much for your time and cooperation.

The following questions are for air ambulance services which subcontract for some of the aircraft, personnel, or equipment that they utilize in providing the air ambulance services.

64 - Under what type of agreement do you obtain services from the subcontractor?

_____Lease
_____Rent
_____Hire by the hour
_____Other (please specify)
_____

65 - Do you obtain services from more than one subcontractor?

_____Yes, if so, how many different subcontractors _____
_____No

66 - Please specify which type/types of services your air ambulance service subcontracts for:

_____Pilots
_____Mechanics
_____Medical equipment (stretcher, cardiac monitor, suction, etc.)
_____Medical supplies (bandages, IV fluids, medications, etc.)
_____Medical crewmembers
_____Aircraft (please answer questions 67-72)
_____Other (please specify)
_____

IF YOUR AGENCY SUBCONTRACTS OUT FOR AIRCRAFT, PLEASE ANSWER THE REMAINING QUESTIONS.

67 - What type of aircraft do you receive through the subcontractor?

_____Airplane
_____Helicopter

68 - Is the aircraft you utilize from the subcontractor reserved solely for your air ambulance service?

_____Yes
_____No

69 - Is the aircraft solely configured for the transport of patients?

_____Yes
_____No

70 - Are the aircraft you obtain from the subcontractor available for immediate use 24hours/day?

_____Yes
_____No

71 - How long on the average does it take the subcontractor to make an aircraft available for your use?

_____0-15 mins
_____16-30 mins
_____31-60 mins
_____over 1 hour - 2 hours
_____over 2 hours - 4 hours
_____over 4 hours

72 - Where are the aircraft which the subcontractor provides to you located?

_____At the hospital
_____At the site of the air ambulance operator (my service)
_____At the subcontractor's base of operations
_____At the airport nearest the air ambulance operator
_____Other (please specify)
_____

Thank you again for you time and cooperation in this project. Please return the questionnaire in the stamped envelope that is provided.

Appendix D

Air Ambulance Service Records Review Schedule

PATIENT TRANSPORT

Date of Review:_____ Agency Number:_____
(01 to 18)

1 - SEX _____MALE _____FEMALE

2 - DATE OF BIRTH _____

3 - DIAGNOSIS _____

4 - PICK-UP POINT _____

5 - DESTINATION _____

6 - PATIENT'S CONDITION FOLLOWING TRANSPORT _____VIABLE _____DOA

7 - MOVEMENT PRECEDENCE:
_____"Routine" (no need to hurry - patient could be transported anytime)
_____"Priority" (critically ill patient, but one in which there was a few hours available to prepare the aircraft and team)
_____"Urgent" (emergency transport: patient had to be transported immediately to prevent loss of life, limb, eyesight, or prevent complications of a serious illness)

8 - PATIENT'S PLACE OF RESIDENCE:_____
(closest town or city)

9 - WAS A NON-MEDICAL ESCORT ACCOMPANYING THE PATIENT?
_____YES → 10 - IF YES: WHAT TYPE OF PERSON ACCOMPANIED THE PATIENT?
_____FAMILY MEMBER
_____FRIEND
_____OTHER (please specify)
_____
_____NO ↓

11 - TYPE OF MEDICAL ATTENDANT ACCOMPANYING THE PATIENT INFLIGHT:
_____Nurse Aide
_____Licensed Practical Nurse
_____Registered Nurse
_____Critical Care/Emergency Room Registered Nurse
_____EMT I
_____EMT II
_____EMT III
_____EMT IV
_____Medical Doctor
_____Other (please specify)
_____

12 - SPECIAL CARE OR EQUIPMENT THIS PATIENT REQUIRED INFLIGHT:

_____None
_____Neurologic checks
_____Administration of medications
_____Intravenous fluids
_____Nasogastric fluids
_____Tracheostomy care
_____Cardiac Monitor
_____Incubator
_____Traction
_____Other (please specify)
_____
_____

13 - DIFFICULTIES THE PATIENT MAY HAVE ENCOUNTERED INFLIGHT:

_____None
_____Hypoxia (reacted to lack of oxygen)
_____Increased gas expansion in body cavities
_____Temperature variations
_____Hearing impairment
_____Extreme fatigue
_____Airway problems due to decreased humidity
_____Cardiac or neurologic impairment due to acceleration/deceleration forces
_____Other (please specify)
_____
_____

14 - WHO INITIATED THE PATIENT AIR TRANSPORT REQUEST?

_____Medical Doctor
_____Registered Nurse
_____Ambulance Attendant
_____Employer
_____Family
_____Other (please specify)
_____

15 - PATIENT'S LOCATION PRIOR TO AIR TRANSPORT:

_____Hospital
_____Extended Care Facilty (Nursing Home)
_____Scene of accident
_____Private residence
_____Other (please specify)
_____

16 - WHAT WAS THE LEVEL OF HEALTH SERVICES AVAILABLE AT THE PICK-UP SITE?

_____Scene of accident - no hospital or doctor available
_____Medical Doctor available by no inpatient facilities
_____Hospital available - rural - under 100 beds - limited specialities
_____Hospital available - metropolitan - under 100 beds - limited specialities
_____Hospital - metropolitan - over 100 beds
_____Other (please specify)
_____

17 - TO WHAT TYPE OF FACILITY WAS THE PATIENT TRANSPORTED?

_____Private residence
_____Extended Care Facility (Nursing Home)
_____Hospital - rural - under 100 beds
_____Hospital - metropolitan - under 100 beds
_____Hospital - metropolitan - over 100 beds
_____Other (please specify)
_____

Appendix E

Recommended Aeromedical Attendant Training

Recommended Aeromedical Attendant Training

Item	Federal[a]	State[b]	NAAA[c]	McNeil[d]
Recommends Medical Flight Attendant (EMT,RN,MD,etc) be in attendance on each air ambulance flight	X	X	X	X
Training Recommendations				
For medical personnel other that RNs and MDs (e.g. nurse aides, LPNs) complete a course in emergency medical care in accordance with the Department of Transportation requirements (e.g. EMT course)	X	X	X	X
Trained in the effects that altitude may have on patients and how to cope with these effects		X		
Trained in:				
Responsibilities during the preflight, inflight, and postflight phases of an air ambulance missions	X		X	X
Legal considerations of air ambulance service	X		X	X
Recordkeeping of air ambulance service	X		X	X
Lifting and moving patients	X		X	X
General patient care inflight	X		X	X
Medications, including the times that medications are administered and the adjustments that are required when changes are made in time zones	X		X	X
Medical equipment used aboard aircraft	X		X	X
Changes in barometric pressure, decompression sickness; and air embolism	X		X	X
Other environmental factors affecting patient care such as humidity, temperature, ventilation, noise, etc	X		X	X
Aircraft systems: electrical, pressurization, lighting, ventilation, etc	X		X	X
Aircraft emegercies such as electrical failure, rapid decompression and emergency landings	X		X	X
Principles of survival	X		X	X
Care of patients who require special consideration in the airborne environment	X		X	X
Recurrent Recommended Training:				
Medical flight attendants should receive at least 8 hours of recurrent training annually in the areas cited above	X		X	X

a - National Highway Safety Administration of the U.S. Department of Transportation and the Commission on Emergency Medical Services of the American Medical Association. (1981). Air Ambulance Guidelines. (DOT Publication No. HS 805-703). Washington D.C.: U.S. Government Printing Office.

b - Oregon Administrative Rules, Chapter 333, Division 28, (1981). Oregon State Health Division.

c - Bare, W.W. (1982). Protect your patient in the air: Air ambulance standards for the Association of North American Air Ambulances. New Jersey: North American Air Ambulance.

d - MeNeil, R.L. (1983). Airborne care of the sick and injured. New York: Springer-Verlag.

Appendix F

Recommended Aircraft Specifications

AIRCRAFT SPECIFICATIONS

ITEM	Federal[a]	State[b]	NAAA[c]	McNeil[d]
Aircraft must meet all the requirements of the Federal Aviation Administration of Civil Aeronautics Boards regs. pertaining to air taxi and air ambulance operation.		X		
Aircraft interior must be sufficient size to accommodate at the minimum, required personnel, one patient, medical equipment, and still allow full access to the patient (aircraft purchased after 1 Oct '74)		X		
Heating System				
The heating system should have the capability of maintaining the cabin temperature at about 75° during all phases of operations.	X		X	
Communications Systems				
The aircraft must have a radio capability to communicate air to ground and air to air. This system should include two-way communications with physicians who are responsible for directing patient care in transit, and with ground personnel who coordinate the transfer of the patient to surface transportation.	X		X	X
Lighting System				
Interior lighting should be adequate for patient observations and care under all circumstances. During night operations a curtain should be used if necessary, to protect the cockpit from lights in the patient section.	X		X	
Pressurization				
Normally, fixed wing air ambulances should be pressurized, In an emergency, it may be necessary to use an unpressurized aircraft. However, in the interests of proper patient care, pressurized fixed wing air ambulances should be used on flights that can be planned.	X			X
Ideal Aircraft Configuration				
Very few, if any, of the small fixed and rotary wing aircraft built				

ITEM	Federal	State	NAAA	McNeil
today have adequate space in the passenger section to accommodate the functions associated with good emergency medical care. Therefore, the following sections simply describe desired conditions with expectations for the future:	X		X	X
Loading Stretchers and Litters Aircraft doors should be large enough to allow a stretcher or litter to be loaded without rotating it more than 30 degrees about the longitudinal (roll) axis or 45 degrees about the lateral (pitch) axis. Some patients cannot even tolerate these movements and professional medical judgment must be used to decide whether an air ambulance should be used at all if loading is a problem .				
Positioning the Stretcher or Litter The stretcher or litter should be positioned so as to allow the medical attendant a clear view of and access to any part of the patient's body that may require attention. The attendant should always have access to the patient's head and upper body. The upper surface of the litter should be not less than 30 inches from the ceiling of the aircraft or the under surface of another litter. To conduct CPR, as much as 40 inches may be desired. A conventional stretcher or litter will be at least 19 inches wide and 73 inches long. Between 12 and 18 inches of clear aisle at the head and on one side of the litter is desirable. When possible, litters should be installed laterally in the aircraft to provide better restraint against forces which may be encountered in flight.				

a - National Highway Safety Administration of the U.S. Department of Transportation and the Commission on Emergency Medical Services of the American Medical Assocaition. (1981). Air Ambulance Guidelines. (DOT Publication No. HS 805-703). Washington D.C.:U.S. Government Printing Office.

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Appendix G

Recommended Standards for Aircraft Equipment and Supplies

SUGGESTED STANDARDS FOR AIRCRAFT EQUIPMENT AND SUPPLIES

ITEM	Federal[a]	State[b]	NCAA[c]	McNeil[d]
Basic Medical Equipment Recommended for Each Flight:				
1/patient - litter or stretcher w/approved restraints	X			
2/patient - Sheets		72" X 19"	X	
2/patient - Blankets	X	X	X	
2/patient - Pillow s/cover impervious to moisture	X	X	X	
1/patient - Pillowcase	X	X	X	
1 set - Spare sheets and pillowcase (if Wt. and space allow)	X	X	X	
1 unit - Medical oxygen w/manual control; adjustable flowmeter w/gauge (0 to 15 LPM); attachment for humidification (Note;The oxygen must be attached to the aircraft in an approved manner).	X	X		
Note:The amount of oxygen to be carried is determined by multiplying the prescribed flow rate times the length of time the patient must be on oxygen and adding a 45-minute reserve. The minimum amount of oxygen carried should be enough to supply one patient for one hour at 10 LPM. It may be necessary to carry a portable oxygen unit if oxygen is not available for patient transfer at some point in the flight)		2 hour supply at 10 LPM	4L/min for flight duration plus 1 hr.	
2 each - Oxygen masks in adult, child, and infant sizes	X			
6 - Connecting tubes	X	Adult & peds	X	
1 - O_2 key	X			
1 unit - Portable suction w/connecting tubes	X			
		X With 50cc syringe backup	X Battery Operated	X
2 each - Suction catheters (various sizes)	X			
2 - Tonsil suction tips	X			X
1 unit - Squeeze bag-valve-mask unit capable of delivering 80-100% oxygen through the mask; w/masks in adult, child, and infant sizes. (Bags in adult and small child/infant sizes).	X	X	X	
1 unit - Partial rebreathing mask with tubing				X
1 unit - Non-rebreathing mask with tubing				X
1 unit - Venturi mask with adapters				X
1 unit - Laerdal pocket mask with O_2 inlet				X
1 unit -Oxygen-powered, manually triggered breathing device (100 LPM flow rate)				
1 - BP cuff, sphygmomanometer	X			
	X	Adult/ pediatric	X	X

ITEM		Federal	State	NAAA	McNeil
1	- Stethoscope	X	X	X	X
2 each	- Oropharygeal airways in adult, child, and infant sizes	X	X	X	X
1	- Emesis basin	X		X	
1	- Nasopharyngeal airways				X
1	- Emesis bags		X		
1	- Urinal	X		X	
1/patient	- Sound suppressors	X			
1	- Pneumatic antishock trousers w/pressure relief valve	X	X		
2	- Cervical collars	X	X		
1	- Neuro hammer				X
2	- 20-gallon trash bags	X			
1 box	- Ziplock plastic bags or similar product	X		X	
1	- Flashlight, 2 D batteries or equivalent w/spare batteries	X		X	
1	- Penlight flashlight w/spare batteries and bulb	X			X
2	- Locking hooks (or other positive lodking device for I.V. fluid containers)	X		X	
1 qt.	- Drinking water	X		X	
12	- Paper cups	X		X	
Dressings and Supplies Kit -Designed to be Carried on Each Flight					
1	- Rain cover			X	
4	- Cardboard or air splints or equivalent in arm and leg sizes	X	X		
12	- Tongue depressors	X			
2	- Mouth gags or padded tongue depressors	X	X	X	
1	- Bandage scissors	X		X	
4	- Tourniquets	X			
1 each	- Rolls of adhesive tape, ½", 1", 2", 3"	X	1", 2"	X	X
1 each	- Rolls of paper tape, various sizes	X	X	X	X
1 each	- Scalp vein needles, 19G, 21G, 23G, 25G	X		X	X
1 each	- Needles (assorted sizes)	X		X	X
1 each	- Intracaths (16G, 18G, 20G)			X	X
2 each	- Syringes, 3cc, 5cc, and 10cc, (TB and insulin)			X	X
2 each	- Microfilters			X	
2	- Surgical dressings	X	X		X

ITEM		Federal	State	NAAA	McNeil
24	- Sterile gauze pads	X	X	X	X
6	- Nonsterile gauze pads	X			
2	- Triangle bandages	X			X
4	- Kling bandages or equivalent	X	X	X	X
1	- 3" elastic bandage	X	X		
1	- 4" elastic bandage	X	X		
2 pairs	- Sterile gloves	X	X	X	
3	- Petrolatun gauze	X	X		
1 box	- Adhesive gandages	X			
6	- Disposable surgical face masks	X		X	
2	- Wrist Restraints	X			
2	- Eye covers	X	X	X	
1 roll	- Aluminum foil, sterilized and wrapped	X	X		
1	- Large safety pin	X			
2	- Clinical thermometers	X			
4	- Airsick bags	X	X		
12	- towelettes	X		X	
1 box	- Tissues	X		X	
Medication/I.V. Kit - Designed to be Carried on Each Flight					
2	-Epinephrine HCL, 1;1000, 1ml, prefilled syringe	X	As	X	X
2	-Epinephrine HCL, 1:10,000, 10 ml prefilled syringe w/intracardiac needle	X	Determined by Medical Advisor	X	X
1	-Amytal 10cc ampule for IM or IV			X	
2	-Aminophylline Inj., IM, 500mg/2ml ampules	X			X
6	-Aromatic Spirits of ammonia			X	
4	-Atropine Sulfate , 0.5mg in 5ml, prefilled syringe	X			X
1	-Bretylium 500mg in 10 ml				X
1	-Dexamethosone 4mg/ml in 5ml vial			X	X
2	-Diphenhydramine HCL, 50mg/ml in prefilled syringe	X		X	
2	-Calcium Chloride Inj., 1gm/10ml, prefilled syringe	X		X	
1	-Calcium Gluconate 2-1cc ampules, 1-10cc ampule			X	
1	-Caffeine Sodium Benzoate			X	
2	-Dextrose, 25gm/50ml, prefilled syringe	X			X
1	-Dopamine 200mg/5ml				X
2	-Isoproterenol HCL, 1:5,000 1ml ampules	X			X
2	-Lidocaine HCL, 2gm/10ml, prefilled syringe	X		X	X
2	-Demerol 50mg/ml			X	X
6	-Naloxone HCL, 0.4mg/ml, 1ml ampules	X			
1	-Nitroglycerine, 0.4mg, Sublingual tablets, 100's	X			
2	-Digoxin Inj.,, 0.5mg/2ml ampules	X		X	X

	ITEM	Federal	State	NAAA	McNeil
4	-Furosemide, 10mg.ml, 2ml ampules	X			X
2	-Chlorpromazine HCL, 25mg/ml, 1 ml ampules	X			
6	-Sodium Bicarbonate Inj., 3.75 gm/50ml prefilled syringe	X		X	
2	-Morphine Sulfate, 15mg./ml, 1ml prefilled syringe	X		X	
2	-Solucortef 2cc mix-o-vial	X		X	
2	-Solumedrol 1cc Mix-o-vial	X		X	
1	-Hydroxyzine HCL 50mg/ml			X	
4	-Valium 1cc ampules	X		X	X
3	-Vasoxyl 1cc ampules			X	
2	-Phenobarbitol 65mg/ml in 1ml amps				X
2	-Dilantin 50mg/ml				X
2	-Compazine 10mg in 2ml				X
2	-Inderal 1 mg in 1 ml amp				X
2	-Verapamil 5mg in 2 ml amp				X
2	-Sterile Normal Saline for Inj. 20 ml	X			
2	-Sterile Water for Inj. 20 ml	X			
	Oral Drugs				
50	-Asprin 5gr tablets			X	X
50	-Tylenol 5gr tablets			X	X
50	-Dramamine 50mg			X	
100	-NTG 1/150gr	X		X	X
1 bottle	-Mylanta			X	
20	-Valium tablets 10 mg			X	
20	-Vistaril tablets 50mg			X	
20	-Tylenol #3			X	
	Medicaments				
1	-Afrin Nasal Spray	X		X	X
10	-Ammonia Inhalants				X
1	-Hydrocortisone cream				X
1	-Bacitracin Oint				X
5	-Betadine swabs				X
1	-Betadine Oint				
	Misc.				
6	-Alcohol Swabs	X			
1	-Phenylephrine HCL, ¼% Nasal Spray	X			
3	-Needles, 15 gauge, 1½"	X			

	ITEM	Federal	State	NAAA	McNeil
1	-Tourniquet	X			
1	-0.9% Sodium Chloride Inj., 500ml bag	X			
1	-0.9% Sodium Chloride Inj., 250ml bag	X			
1	-Lactated Ringers Inj.bag	X		X	
1	-Lactated Ringers Inj, 500ml bag	X		X	
2	-Lactated Ringers Inj 1000ml bag	X		X	
1	-Dextrose, 5% in water, 250ml	X			
1	-Dextrose, 5% in water, 500ml	X			
1	-Dextrose, 5% in normal saline, 250ml	X			
1	-Dextrose, 5% in normal saline, 500ml	X			
1	-Pressure pack or infusion pump	X			
1 each	-Drip tubing, reg. and ped.	X		X	X
2	-Arm boards	X			
1	-Clean hemostat	X		X	
6	-Alcohol wipes	X		X	X
1 each	-Sterile hemostat, curved and straight	X		X	
1	-Nasogastric tube	X			X
1	-Plasma Protein Fraction, 250 ml w/infusion set	X			
2 pair	-Sterile gloves	X		X	X
1	-Knife handle	X		X	
1	-Subclavian Set	X			
1	-#15 blade	X		X	
1	-Stylet			X	
1	-Forceps			X	
1	-IV infusion cuff	X			
1 each	-Tape, 1' and 2"	X			
	Airway Management Kit - Designed to be Carried on Each Flight				
1	-Laryngoscope, w/curved and straight blades in various sizes; spare batteries and bulb	X	X	X	X
As required	-Adapters for attaching endotracheal tubes to O2, etc.	X	X	X	
2 each	-Assorted sizes, intubation tubes		X	X	X
1	-Rubber shod forceps	X			
1	-Magill forceps	X			
1	-Esophageal Obturator airway w/gastric suction capability	X			
1	-McSwain dart or Heimlich valve	X	X		X
1	-Syringe, 60cc	X			X
1	-Needle, 14 gauge	X			

ITEM		Federal	State	NAAA	McNeil
1	-Syringe, 10cc	X			
1 each	-Adhesive Tape, 1" and 2"	X			
1	-Viscous Lidocaine HCL, 2% 100ml	X			
1 tube	-Surgical Lubricant	X			
Burn Kit - To be Carried When Required					
3	-Normal Saline, 1,000 cc in plastic container	X		X	"Burn Kit"
1	-57" X 80" burn sheet	X	X		
1	-IV Administration Set			X	
5 packs	- Xeroform gauze, 5" X 9"	X		X	
1	-Irrigating syringe, 50cc	X	X	X	
2 pairs	-Sterile gloves	X		X	
4	-Kerlix rolls	X		X	
2 packs	-Fluffy gauze	X		X	
Poison Drug Overdose Kit - To be Carried When Required					
1	-Irrigation Tray	X		X	
2	-French stomach tubes, #14, #16, #18	X		X	
1	-Surgical stomach tube			X	
1	-PH specimen bottle			X	
1	-Rubber stomach tube #20	X			
1 box	-Glucagon	X			
1 tube	-Lubricant	X		X	
2	-Ipecac syrup, 30 ml	X		X	
1	-Physostigmine solicylate, 1mg/1ml, 2ml ampules	X			
1	-Pralidoxime Chloride, 1 gm kit	X		X	
1	-Activated charcoal, 10 gms				
Obstetric Kit - To be Carried When Required					
1	-Disposable obstetrical pack w/sheets, cord clamps, DeLee suction, plastic bag, silver swaddler, sterile gloves	X		X	
2	-Oxytocin, 10 units/ml, 1 ml ampule	X		X	
1	-Ergonovine maleate (Ergotrate) ampules 1cc/mg			X	
1	-Episiotomy Scissors	X		X	
1	-Ring Forceps	X		X	
Pediatric Kit - To be Carried When Required and Always with OB Kit					
1	-Pediatric laryngoscope handle w/blades	X		X	

ITEM		Federal	State	NAAA	McNeil
1 each	-Pediatric endotracheal tubes w/stylette, 2.5, 3.0, 3.5, 4,0	X		X	
1	-Pediatric McGill forceps	X			
2	-Bulb syringes	X			
2	-DeLee Suction	X			
2	-Pediatric drip IV tubing	X			
1 each	-Feeding tubes, 3½, 5, 8 Fr.	X		X	
1	-Pediatric BP cuff, sphygmomanometer	X			
Additional Equipment for Trauma Patients - To be Carried When Required					
1	-Scoop stretcher	X			Orthopedic Kit
1	-Long backboard	X		X	
1	-Foley catheter set	X			X
1	-Femur traction splint	X	X		
1	-Suture Kit	X			
1	-Chest tube tray				X
2	-Litter straps			X	
4	-Sandbags		X	X	
1	-Peritoneal Dialysis Tray				X
1	-Suture set				X
Additional Equipment for Cardiac Patient - To be Carried When Required					
1 unit	-Cardiac monitor w/strip-chart recorder	X	ALS	X	"Cardiac Kit"
1 each	-Spare ECG electrode for each lead	X	ALS	X	X
1 unit	-Defibrillator w/four pads and conductive gel	X	ALS	X	X
1	-Rubber mat or other means of electrically isolating the patient from the aircraft	X		X	X
1	-Cardiac board	X	X	X	
Additional Equipment for Specific Patients - To be Carried					
1 unit	-Respirator capable of continuous ventilation w/ventilator tubing, exhaled volume measuring divice, set of tracheostomy and endotracheal adaptors	X		X	
1 unit	-Incubator, w/all equipment suitable for neonatal care	X			

No medical device should be used which produces electromagnetic interference on aircraft navigation or communications equipment

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Appendix H

Patient Selection Guidelines

STANDARDS FOR AIRLIFTING PATIENTS WITH SPECIFIC DIAGNOSES

CONDITION	FEDERAL[a]	STATE[b]	NAAA[c]	McNEIL[d]
1. Patients with intestinal malfunction (obstruction, ileus, diverticulitis, perforation, fresh surgery)	Transport only when urgently necessary-aircraft pressurization required. Keep under 5000ft if no O_2 available	No guidelines given-left to MD discretion	Absolutely requires aircraft pressurization	Aircraft Pressurization required
2. Emphysematous blebs or bullae in the lungs, or with non-pulmonary air in thorax, such as pneumothorax pneumomediastinum, pneumopericardium, or recent thoracostomy or tracheostomy with S.Q. emphysema.	Delay transport. Pressurized aircraft only. Keep under 5000ft if no O_2 available.		Absolutely requires aircraft pressurization	Delay Transport Pressurization Required.
3. Patients with intraocular or intracranial air from surgery, scuba diving, penetrating injuries & fractures, diagnostic procedures such as pneumoencephalography.	Delay transport as long as possible. Pressurized aircraft only. Keep under 5000 ft if no O_2 available.		Absolutely requires aircraft pressurization	Pressurization required.
4. Barosinusitis	Teach patient to Valsalva		Absolutely requires aircraft pressurization	
5. Aerodontalgia	Sea level cabin altitude		Absolutely requires pressurization	Pressurization required
6. Facial or mandibular fractures with retention wires	Requires quick release mechanism.		Requires quick release mech.	Requires quick release mech.
7. Diseases of the middle ear			Absolutely requires pressurization	
8. Air Splints			Requires pressurization	

CONDITION	FEDERAL	STATE	NAAA	MCNEIL
9. Respiratory disease with vital capacity of less that 900 ml (adult)	8,000 ft max. cabin altitude with O2			
10. Recent myocardial infarction	8,000 ft max. cabin altitude with O2.		Pressurization preferred. Delay transport 1 week.	
11. Cardiac valve defects	8,000 ft max. cabin altitude with O2.			
12. Space occupying lung lesions	8,000 ft. Max. cabin altitude with O2.			
13. Anemia -less than 3,000,000 rbc's per mm^3 -less than 8.5 % hemoglobin -Hct less than 25%	8,000 ft max. cabin altitude with O2		6,000 ft max cabin altitude Pressurization preferred.	
14. CHF	8,000 ft max. cabin altitude with O2		Pressurization preferred.	
15. Altitude limits for patients with Cardio-respiratory diseases without supplemental O_2 available.				
-Any suspected asymptomatic cardiorespiratory disease	10,000 ft max cabin altitude			
-More than mildly symptomatic Marked ventilatory restriction	8,000 ft max cabin altitude			
-Recent MI (8-24 weeks) Angina pectoris Sickle cell crises Alveolar block with cyanosis Clinical cyanosis or cor pulmonale or respiratory acidosis	6,000 ft max cabin altitude		Pressurization preferred	

CONDITION	FEDERAL	STATE	NAAA	McNEIL
16. Strokes, CVA, and or paralysis			Pressurization preferred	
17. Fractures, especially of the spine			Pressurization preferred	
18. Aneurysm, especially cerebral			Pressurization preferred	
19. Patients with terminal cancer			Pressurization preferred	
20. A condition which may be aggravated by turbulent weather at low altitudes.			Pressurization preferred	
21. Patients with chest tubes in place			Pressurization preferred	
22. Most trauma			Pressurization optional	Pressurization preferred
23. Burn patients			Pressurization optional	
24. Obstetric patients			Pressurization optional	
25. Newborn infants			Pressurization optional	
26. Patients who are medically stable and are being transferred for convenience			Pressurization optional	
27. Psychiatric patients			Pressurization optional	
28. Medical equipment utilizing trapped gases -Orthopedic air splints -Balloon cuffs on trach equip. -MAST trousers -Pressure cuffs -Air in IV fliud reservioirs -Medical suction bottles				Transport with caution

a - National Highway Safety Administration of the U.S. Department of Transportation and the Commission on Emergency Medical Services of the American Medical Association. (1981). Air Ambulance Guidelines. (DOT Publication No. HS 805-703). Washington D.C.: U.S. Government Printing Office.

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AN ABSTRACT OF THE THESIS OF

FARLEY J. HOWELL

For the degree of MASTER OF SCIENCE

Date of receiving this degree: June 13, 1986

Title: OREGON AIR AMBULANCE SERVICES

APPROVED: [redacted]

Julia S. Brown, PhD, Thesis Advisor

A descriptive study of air ambulance services licensed and operating within the State of Oregon was undertaken to determine the extent to which (1) the use of air transport for patients in Oregon is appropriate; (2) air ambulance aircraft and equipment comply with State Emergency Medical Services Section requirements and suggested federal guidelines; (3) inflight medical attendants receive adequate training on features of care unique to the air transported patient; and (4) regulating agencies are involved in the enforcement of standards for air ambulance services. A questionnaire and records review schedule were developed to address the above concerns as well as gather basic descriptive data useful for achieving a better understanding of the state of affairs among the State's air ambulance

services. After repeated mail, phone, and face-to-face contacts, usable responses were received from 16 of the 18 services in existence.

The data revealed that aeromedical activity centered around the Medford, Bend, and Portland areas. Nearly one-half of all patient airlift missions terminated in Portland. The main categories of patients requiring airlift were patients with trauma, followed by patients with cardiac conditions, and medical conditions other than cardiac. Qualified aeromedical consultants rarely evaluated the appropriateness of the patient for airlift based on condition. Private physicians or ambulance attendants made this decision. Poor inflight documentation and record maintenance hampered a determination of the suitability for airlift of all 128 patients transported during September 1985. For the 93 patients for whom sufficient data existed, 97% had conditions suitable for airlift while 3% had conditions for which air transport was clearly contraindicated. Air ambulance aircraft in Oregon were well-equipped but lacked adequate doorway size and were frequently unpressurized. Specialized aeromedical attendant training varied greatly among services ranging from no training to over 300 hours of patient air transport instruction. The method and amount of

instruction, and the matter of instructor competency were left to the operators' discretion. The services demonstrated a moderate compliance with State air ambulance regulations, despite the failure of the state regulatory agency to conduct on-site inspections.

Based on the results of this study it is recommended that only pressurized (excluding helicopters) and specially designed air ambulance aircraft be used which can accommodate the safe transport and rapid enplaning and deplaning of patients. Secondly, it is recommended that all operators be required by law to obtain competent aeromedical preflight patient assessment (either by flight surgeon or flight nurse) prior to accepting patients for airlift. Third, operators should also be required to maintain patient airlift records. Fourth, criteria should be developed to standardize aeromedical attendant training and specify minimum instructor qualifications. Fifth, existing regulations should be enforced. Sixth, both for profit and non-profit services should be held to the same standards. Finally, the number of air ambulance operators in the State should be limited.

In recognition of the limitations of this study the following recommendations are made for future research.

First, the questionnaire and records review schedules need further refinement. Second, an objective on-site inspection of each air ambulance service should be conducted. Finally, the specialized knowledge level of inflight medical attendants should be assessed objectively.

The implications of this research for nursing are discussed, including the degree to which nurses are presently involved in Oregon patient air transport and the legitimate responsibility nurses have to guide this relatively new scope of practice.