

# Transport Patterns and Complications in an Isolated Alaska Practice

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This study reviews the patterns of transport and complications that occurred in 169 cases of transporting patients over a four-year period for a small, isolated Alaskan community in which the physicians as a matter of policy attempted to avoid heroic emergency surgery. Case descriptions are included describing transport-related complications and mortality and morbidity of patients transferred. A low incidence of mortality and relatively little long-term morbidity was experienced, supporting the feasibility of transferring severely ill patients rather than attempting heroic surgery under marginal circumstances. Although the lack of comparable studies limits the usefulness of these findings in assessing the overall quality of care, appropriate utilization of transport as an extension of the physician's capabilities resulted in a low incidence of complications during the study period.

The primary care physician is often faced with cases that are beyond his capability to handle or that require skills and care better provided by physicians with more specialized capabilities. For the physician practicing in an area where such medical and surgical support is available, referral and transport of the ill patient requiring specialty care are routine and present few problems. For the non-surgical generalist practicing in an isolated setting, however, problems of referral and transport of patients become major stumbling blocks in the attempt to provide high-quality medical care. The physician isolated from support specialties often faces a disparity between the way he knows medicine should be practiced and what must be practiced in his or her setting.

Undoubtedly, there are patients whose mortality or increased morbidity could be attributed to their isolation from subspecialty, particularly surgical, care. Furthermore, there are times when a

physician will need to decide whether to attempt heroic surgery under suboptimal conditions in terms of his own skills, as well as assistants, equipment, and supportive laboratory and anesthetic help. The physician may be faced with the prospect of transporting patients in extreme weather conditions, a not uncommon situation in Alaska, where the risks for the persons involved in the attempted transports must be considered. Transport, particularly by air, has its own problems and complications for the severely ill patient.

The nonsurgical physician practicing in an isolated setting without surgical support becomes acutely aware of the limitations in his knowledge, support, and facilities. In a small Alaskan community in which the physicians, as a matter of policy, attempted to avoid heroic emergency surgery, a study was undertaken to determine the patterns of the 169 transports that took place during a four-year period. The results of this study, including transport-related complications, mortality, and morbidity of the selected patients, are described here.

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## The Community and Practice

The community involved in this study is on Mitkof Island in the Alexander Archipelago of Southeast Alaska. The population varies seasonally from 2,000 to 4,000, with isolated fishing and lumber camps included in the catchment area. Access to the community is by air or water, since there is no intercity road system. The economy centers on fishing, logging, and various federal Forest Service occupations. The population tends to be young and predominantly male.

Two physicians serve the community, which has a hospital with 13 acute-care and 12 long-term care beds. There is an average of 1,300 emergency room visits and 55 deliveries each year. The two physicians' offices in town average 40 visits per day.

Referral sites are 90 to 100 miles away for general surgery, internal medicine, orthopedics, ophthalmology, obstetrics, and plastic surgery. All other specialty referral sites are in Anchorage or Seattle, 900 to 1,000 miles (six hours) away. Air transport is complicated by a gravel runway, numerous 2,000- to 5,000-foot mountains, and north Pacific storms that bring 110 inches of precipitation per year. Weather has prevented air access to the island for up to seven consecutive days. Emergencies occurring during darkness or extreme weather can be transported out by a Coast Guard helicopter; however, since this endangers four additional lives, utilization is dependent on the situation.

## Methods

In this study all patient transfers from the hospital and emergency transfers from physicians' offices were reviewed for the years 1978 through 1981. The 169 cases reviewed in this study were grouped according to the clinical situation that resulted in transporting the patient.

*Category 1. Acute life-threatening emergencies.* Patients in this category were in the immediate life-threatening situations requiring intervention, usually surgical, beyond the capabilities of the local physician. Obstetrical and neonatal emergencies are included in a separate category.

*Category 2. Emergencies that could result in loss of life or limb.* These patients required surgi-

cal intervention or subspecialty support within 24 hours of initial physician contact.

*Category 3. Elective.* Cases not included in the other categories, primarily orthopedic.

*Category 4. Obstetrical and neonatal transfers.*

Because of the possibility that inability to transport may have contributed to patient health, all intrahospital deaths for the period of this study, 1978 through 1981, were also reviewed.

## Results

The patterns of referral by specialty for the 169 cases reviewed are itemized in Table 1.<sup>1-3</sup>

Out of approximately 12,000 outpatient visits, there were 169 transports, for a rate of transport of 1.4 percent. This rate is comparable to referral rates from previous studies (Table 2) and was expected to be somewhat lower, since elective patient self-referrals were not included in the present study. Rates of surgical referral, also compared in Table 2, were expected to be somewhat higher because of the comparison of emergency transport to office referrals and the high rate of trauma in the community.

The experience of 169 patients transported during this study is shown in Table 3. Cases involving mortality, prolonged morbidity, or intratransport complications are presented in narrative form.

### *Acute Life-Threatening Emergencies*

These cases made up 5.9 percent of total transfers attempted. There were no deaths, but three of the known complications occurred during transfer. There was a higher incidence of poor outcome in this group compared with the rest in this study. These cases included two neurosurgical, three medical, and five general surgical emergencies. One neurological case and one surgical case had prolonged morbidity.

*Case No. 1* (Hemiparesis occurring during transfer secondary to epidural bleeding): A 52-year-old man fell from a height, striking his head. By the time he was found, he had been unconscious for 2 to 4 hours. There was a laceration on his posterior cranium and bleeding from both ears. He was alert and oriented in the emergency room. X-ray examination revealed a posterior skull frac-

Specialty	Number of Referrals	Percentage of Total Referrals	Rank
Orthopedics-plastic surgery	52	32	1
General surgery	34	21	2
Obstetrics-gynecology	29	18	3-4
Medical	29	18	3-4
Psychosocial	10	6	5
Ophthalmology	6	4	6
Neurology-neurosurgery	5	3	7
Pediatrics	3	2	8
Otolaryngology	2	1	9-10
Urology	2	1	9-10

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Total referrals	1.4	1.8-3.2	2.0-2.5	1.9-2.7
Referrals to surgical specialists	79	59	72.5	70

\*This study addresses transport rather than referral rates

	Cases	Lost to Follow-Up*	Mortality	Complications in Transfer	Prolonged Morbidity
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Acute life-threatening emergencies	10 (5.9)	0 (0)	0 (0)	1 (10)	2 (20)
Possible loss of life or limb	53 (32)	6 (11.0)	0 (0)	1 (2.0)	3 (5.3)
Elective transfers	79 (47)	8 (10.0)	0 (0)	0 (0)	0 (0)
Obstetrical and neonatal emergencies	27 (17)	0 (0)	1 (3.7)	1 (3.7)	2 (7.4)
Total transfers	169 (100)	14 (8.3)	1 (0.6)	3 (1.9)	7 (4.5)

\*There were no deaths in this category; however, in computing the incidence of complications of transfer and poor outcomes, these cases were deleted from the total



ture and a fractured right clavicle. He was transferred the next morning on the first available flight and during transfer developed a right hemiparesis and became lethargic. CAT scan evaluation in Seattle revealed a fluid mass in the right parietal area, and an emergency right parieto-occipital craniotomy was done with evacuation of a large epidural hematoma. At the time of discharge two weeks later, the patient had a normal neurological examination.

*Case No. 2* (Head trauma with prolonged morbidity): A 60-year-old woman with a history of cerebral aneurysm surgery was involved in an automobile accident. She had head and chest injuries, multiple fractures, hypotension, and bronchospasm. Although she was stabilized and transferred by plane in the morning, she was left with some mild residual mental defects.

### *Emergencies That Could Possibly Result in Loss of Life or Limb*

There were 53 cases in this category, representing 32 percent of all transports. There were no deaths, one transport-related complication, and three cases with prolonged morbidity.

*Case No. 3* (Gastrointestinal bleeding recurring during transport): A 60-year-old woman was admitted to the hospital for hypotension and dizziness. During the night she had melanic stools and her hematocrit level dropped to 30 percent. The nasogastric aspirate was negative for blood. The patient was given two units of blood, her hematocrit stabilized at 35 percent with no sign of active bleeding, and transfer was attempted by public transport. During the attempted transport to Seattle, she developed profuse hematemesis, and the flight was diverted. She was rushed to the Ketchikan Hospital and received four more units of blood. Transport was again attempted to Seattle with a physician in attendance. She bled again, requiring additional transfusion. In Seattle, under gastroscopy, a duodenal ulcer was found and treated conservatively. She has done well and returned to the community.

*Case No. 4* (Prolonged morbidity secondary to ruptured appendix): A 50-year-old man with a ten-year history of Parkinson's disease severe enough to force his retirement presented to the

emergency room in the evening with a three-day history of abdominal pain. A diagnosis of acute appendicitis was made. The patient was started on gentamicin and chloramphenicol and transferred to Sitka the next morning. A ruptured appendix was found on laparotomy. The patient was slow in leaving the respirator postoperatively and had a prolonged convalescence but has otherwise done well.

*Case No. 5* (Infected bowel with prolonged morbidity): A 34-year-old woman, whose history included an emergency hysterectomy, presented to the emergency room in the evening with abdominal pain and vomiting of 12 hours' duration. Abdominal examination was normal except for mild tenderness, but an x-ray film showed some air-fluid levels. Intravenous fluids and nasogastric suction were initiated and the patient was transferred to Juneau the next morning. At surgery, she was found to have a volvulus with four feet of infarcted bowel. She did well postoperatively, except for the development of hypertension. She was evaluated in Seattle and found to have an occlusion of the anterior branch of the right renal artery. The patient is now asymptomatic, normotensive, and without medication 2.5 years later.

*Case No. 6* (Amputation secondary to vascular occlusion): A 77-year-old man with severe vascular disease had the onset of foot pain at 1 AM on the morning of admission and was heparinized at 7 AM. The patient was transferred to Seattle on an afternoon jet flight and underwent a successful embolectomy that night. Two months later, he had pain in the opposite foot, following which the same sequence of events occurred with the exception of the outcome, an above-the-knee amputation.

### *Elective Transfers*

There were no deaths and no known prolonged morbidity in this group. Almost all these patients were transported on public transport as available.

### *Obstetrical and Neonatal Transfers*

During this study, 217 obstetrical patients gave birth at Petersburg Hospital. Patients with obvious

potential for complications were referred out of the community for care and delivery. Some of the patients with obvious potential for complications refused to leave the community for their obstetrical care. Twenty-seven transfers were required perinatally, including 23 antenatally and 4 sick neonates, for a transfer rate of 12 percent with the one mortality, a mortality rate of .5 percent, and a prolonged morbidity rate of 1.4 percent. These cases are included in narrative form. Two complicated cases involving perinatal bleeding and a footling breech with prolapsed cord are not included because both mother and child did well after transfer.

*Case No. 7 (Infant mortality):* A 32-year-old, gravida 3, para 1, 306-lb woman was admitted at 6 AM at term and in early labor. The infant was at -4 station, the cervix was 2-cm dilated, and the patient had albuminuria (2+) and a blood pressure of 160/100 mmHg. An effort was made to refer the patient elsewhere, but the only physician willing to accept high-risk pre-eclamptic obstetric patients was away at a meeting. When the southbound jet arrived, the patient's labor was intensifying, the cervix was 4-cm dilated, and her blood pressure was under control. It was decided that she would be at increased risk during the 4-hour trip to Seattle. Her labor progressed slowly from that point, and the cervix was completely dilated at 4 AM. With maternal fatigue and a tight mid-pelvis, the second stage lasted 3.5 hours. The head was delivered with the aid of forceps, but because of severe shoulder dystocia, 10 minutes were required to deliver the shoulders with the help of a large episiotomy and fundal pressure. The infant had an Apgar of 0, but was resuscitated and transferred to Juneau on the morning jet. It was then transferred to Anchorage, where it died two weeks later.

*Case No. 8 (Intratravel complication):* A 28-year-old primigravida woman presented to the hospital at 11:30 PM in labor at 28 weeks' gestation. At 7 AM her cervix was 4-cm dilated. She was transferred by seaplane to Juneau, where she was placed on an early nonstop jet to Seattle. On arrival in Seattle at 2 PM, the cervix was completely dilated. She was taken by ambulance to the nearest hospital, where she was quickly delivered of a 1,000-g male infant with an Apgar of 1 to 2. A neonatal transfer team arrived soon thereafter, changed the endotracheal tube from the esophagus to the trachea, and took the child to the neonatal

center. Mother and child are doing well two years later.

*Case No. 9 (Premature infant with cerebral palsy):* A 23-year-old primigravida woman with a bicornate uterus ruptured membranes at 32 weeks' gestation just after getting off the southbound jet, returning from a visit to her obstetrician in Anchorage. She presented to the hospital as the jet departed, was put on a seaplane to Wrangell, and the jet was held for her. She proceeded to Seattle by jet and delivered the next day at the high-risk obstetrical center. The infant had cerebral palsy.

### *Deaths in Hospital*

All deaths in the hospital during the period of this study were reviewed to determine whether inability to transfer or a conscious decision by the physician involved not to transfer could be considered contributory to the patient's death. Of particular interest was the status of patients experiencing myocardial infarctions, since in most cases transport was considered to be too dangerous for such patients.

There were 33 deaths during the period of study. Patients fell into two major categories: chronically ill and debilitated (22 patients), or acutely ill on presentation to the hospital (11 patients). Except for the case reported and the one patient in intractable cardiogenic shock who died 5 hours after admission, patients who died of acute illnesses in the hospital in Petersburg were either dead on arrival or declared dead within 30 minutes of being seen in the hospital. A majority of these patients had a cardiopulmonary arrest listed as the cause of death.

*Case No. 10 (Myocardial infarction with sudden death during recovery):* A 72-year-old man was admitted with his second myocardial infarction. He had an uneventful course and was recovering well, when, on his 11th day, he experienced cardiac arrest. Resuscitation attempts were unsuccessful.

### **Discussion**

Previous studies have addressed the frequency and types of complications occurring in the trans-

port of patients, although the parameters of these studies vary significantly from the current study.<sup>4</sup>

In Scotland, Waddell<sup>4</sup> has studied the effects of interhospital transport on critically ill patients and found no increased mortality in his study group; however, the average transport time involved in his cases was 12 minutes. He has also studied the transport mortality and morbidity occurring in mountain-climbing injuries in the Scottish Highlands. The mortality rate in 175 cases was 2.8 percent.<sup>5</sup>

The transport of ill neonates has been extensively studied. In a series of studies, infant mortality in the first 24 hours varied from 10 to 16 percent. Factors correlated with mortality included lower birth weight, male sex, and reasons for transport other than respiratory distress syndrome.<sup>6-8</sup>

Aeromedical transport of patients has been noted to occur with a low frequency of intratransport complications. In certain patients, however, there are particular physiologic considerations involved in aeromedical transfer. Dysbarism (the tendency of gas to expand with falling ambient pressure) is of particular importance in closed-space injuries such as neurological trauma and gastrointestinal and urologic injuries, and hypoxemia is a major consideration in intracranial and retinal injuries and for those patients with cardiopulmonary compromise. Myocardial infarctions and patients with diminished cardiac reserve are at great risk during aeromedical transfer. Noise, space, access, low humidity, and a lack of electrical supply are considerations in the aeromedical transport of all patients.<sup>9-11</sup>

The patterns of transport and referral of the patients in this study are similar to those reported by previous authors, although the incidence of surgical cases is somewhat higher in this study. Physicians considering locating in such isolated settings should note the pattern of transports in this study and consider stressing orthopedics, general surgery, and obstetrics in their training.

Three cases involving transport-related complications are described (case 1, epidural bleeding; case 3, recurrent gastrointestinal bleeding; and case 8, precipitous premature delivery with complications of care). The incidence of such complications in this study was under 2 percent, and the eventual outcomes in all the reported cases were good. Although the patients described were seriously ill, eventual arrival at sites of subspecialty care

seemed to ensure good results for these patients.

Seven cases involving prolonged morbidity or mortality are described (4.5 percent of all transports). None of the intratransport complications had prolonged morbidity, and if the quality of care is questioned in these cases, it reflects the delay in transport to subspecialty support. The authors consider that the outcomes for those cases may have not been altered, even if the patients were living next door to medical subspecialty support. There was one death described in this study (case 7, infant mortality, for a mortality rate of 0.6 percent of all transports). This case reflects most acutely the dilemma of the isolated nonsurgical physician who, faced with a life-threatening emergency, cannot turn to immediate surgical support.

Unfortunately, the lack of closely comparable studies limits the usefulness of these figures in attempting to compare the quality of medical care in this setting with that in communities with close subspecialty support. It is difficult for the physician involved to accept even one case that does poorly because of isolation from support. The actual incidence of such cases is apparently quite low. Such information should reassure both the physician considering practice in such locations and the person who chooses to live in such a locale.

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