

TELEHEALTH IN ALASKA: DELIVERY OF HEALTH CARE SERVICES FROM A SPECIALIST'S PERSPECTIVE

The ENT department at the Alaska Native Medical Center (ANMC) initiated a telemedicine program in 1999 to help achieve the mission of providing comprehensive ear, nose and throat care to the Native Alaskan population in the state of Alaska. In 2003, the department provided over 1200 store-and-forward telemedicine consultations. This service is opening the access for care and improving the quality of care. Telemedicine usage continues to grow as more providers adopt the technology.

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Background

The Alaska Native Medical Center (ANMC) is a 150 bed level II trauma center in Anchorage, Alaska serving a population of approximately 150,000 Native Alaskans throughout the state. The ANMC Ear Nose and Throat/Otolaryngology Department (ANMC ENT) is a seven physician department receiving referrals from regional hospitals as well as primary care facilities. ANMC ENT provides approximately 13,000 outpatient visits and 2000 surgical procedures per year. More than 50% of the patients are located outside of the Anchorage area in small towns and remote villages. Otolaryngology clinics are held in Anchorage (daily) while outreach clinics are delivered at the regional hospitals (either monthly or quarterly). Most patients living in rural Alaska must fly to the regional facility for otolaryngology care. This results in high travel costs and long waits for evaluation. The fact that so many patients are located hundreds of miles from their specialty care providers is the greatest obstacle to delivering consistent, quality care.

Preparing for telemedicine in a busy ENT clinic, testing the waters

An essential characteristic of a successful telemedicine program is that it is clinically driven; that a clinical need is identified and then a telemedicine solution is applied to that need. For the ANMC ENT, the clinical needs are readily apparent – thousands of patients are scattered across the diverse geography, long distances, and harsh climates of

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Alaska. Complications related to acute and chronic ear disease are frequently seen in the Alaska Native population. Other otolaryngological illnesses range from minor to potentially life threatening.

The department realized that patients were waiting too long for ENT evaluations, at times as long as a year, and it was difficult to adequately triage patients in the queue. Some patients had potentially serious problems that went unrecognized, and their problems worsened while they awaited evaluation. Others with more straightforward problems just needed direct referral for surgical care. Patients who had surgery required postoperative evaluation for follow up (such as follow up of tympanostomy tube placement). Finally, the process of traveling patient to meet doctor (and doctor to meet patient) is expensive, inefficient and, at times, dangerous.

A telemedicine solution was implemented by the department in collaboration with the Alaska Federal Healthcare Access Network (AFHCAN). AFHCAN offered newly developed software and a communication network linking villages and regional hospitals across Alaska. The ANMC ENT department worked with AFHCAN to research available video otoscopes, digital cameras and fiberoptic endoscopes. ANMC ENT and other primary care clinicians concluded that it was most important to have high quality tympanic membrane images - and the hardware and software had to be easy to use. This close working relationship allowed ANMC ENT to provide important feedback to AFHCAN during the initial software development stages, and allowed ANMC ENT to evaluate equipment .

A comprehensive review of available technology was conducted with the conclusion that diagnostic quality digital images could be obtained using the AMD Welch Allyn video otoscope (1). An example of an image is shown in Figure 1. The equipment was used for several months at ANMC ENT to take pre and post operative ear images. These images were used for patient education and to follow chronic processes over time. Video otoscopes were placed in all exam rooms; all providers were trained and encouraged to use the equipment. This led to the development of a set of best practices on how to best obtain images, including images in small children, standards for image orientation and field of view, and guidelines for focus and lighting.

High utilization of the equipment at ANMC ENT also uncovered critical issues that led to product improvements and product development. Difficulties in pre-focusing the scope prior to insertion in the ear led to

the development of a focus tool by AFHCAN that is now widely distributed throughout Alaska and considered a valuable tool by many users (2). ANMC ENT and AFHCAN worked with the video otoscope manufacturer (AMD and Welch Allyn) to redesign the barrel of the otoscope (to widen the field of view with pediatric specula) and to adjust the optical characteristics of the imaging system to improve image quality at high light intensity. While the intention was for the otoscope to be primarily used by those sending images to ANMC ENT, the importance of the specialists becoming familiar with the technology by means of high volume use cannot be overstated.

Performing video-otoscopy in our busy hospital clinic setting proved to be very useful. Obtaining ear images at the point of care provides a unique opportunity for patient education. This is especially true for diseases related to the tympanic membrane or middle ear. For example, showing a patient an image of their normal tympanic membrane makes it much easier to explain why antibiotics are not needed. Patient satisfaction was very high with this new imaging technology. Twenty-three patients were asked *"How well did the telemedicine technology help you understand your or your child's ENT problem?"* The average response rate was 3.95 on a scale of 1 to 4, indicating that the technology overwhelmingly improved their understanding. All 23 patients responded "Yes" to the question *"In the future, would you be willing to have a telemedicine exam for follow-up of you or your child's ENT problem?"*. Many patients provided positive statements similar to this patient's comment:

"I was able to see the problem - then the repaired normal condition – and discussed my problem - very informative!"

Imaging the tympanic membrane, throat, and skin lesions also provided a multimedia record for the medical staff. This allowed physicians to document pathology and resolution. Intraoperative pictures and postoperative results were also documented on some patients. For individual surgeons, this allowed for critical analysis of techniques and outcomes.

Validating the efficacy of telemedicine

The ultimate goal with having the ENT staff involved was to develop a means by which images could be used to deliver care to our patients at distant sites. It was very important that the technology be available in the ENT department examination rooms to perform video-otoscopy, and it was equally important to have the software accessible from the desktop or laptop computer of each ENT physician.

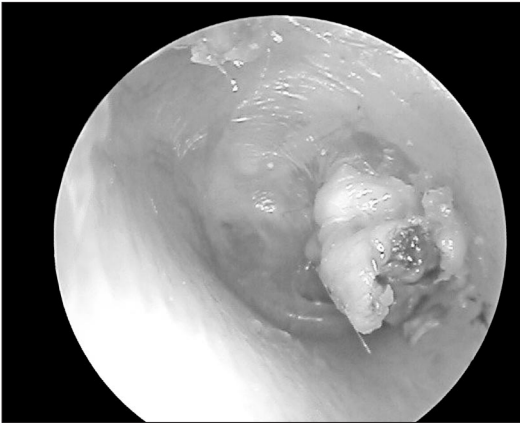


Figure 1. An example of an image that can be obtained with a video otoscope. Images, such as this cholesteatoma, can be diagnosed through telemedicine images.

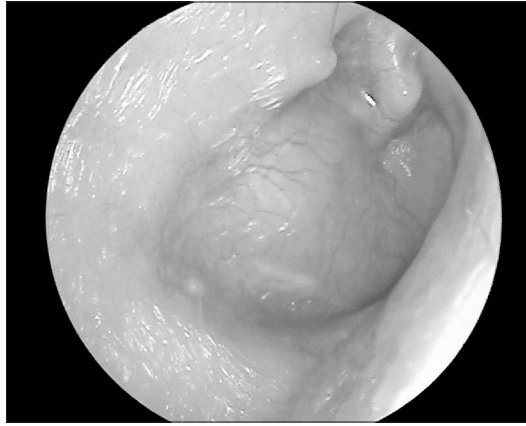


Figure 2. An example of Acute Otitis Media that can be diagnosed from an image of the tympanic membrane.



Figure 3. An example of Chronic Suppurative Otitis Media that can be diagnosed from an image of the tympanic membrane.

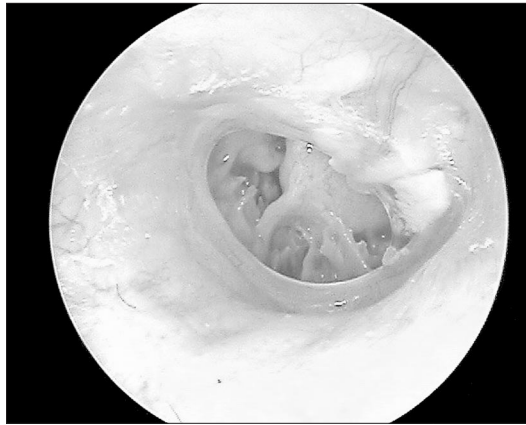


Figure 4. A perforation of the tympanic membrane, prior to surgical procedure.

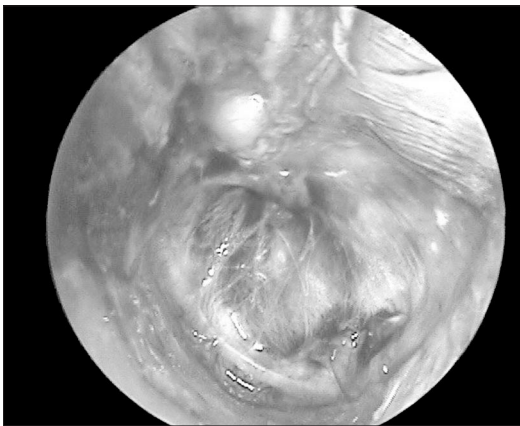


Figure 5. A post-operative image of the repaired tympanic membrane.



Figure 6. An example of the image quality available for imaging the pharynx.

- Utilization in the clinic gave ENT physicians hands-on experience which they would use later when discussing cases with clinicians who were creating and sending them cases.
- It gave the medical staff confidence that excellent images could be obtained, and that this could translate into a worthwhile telemedicine consultation.
- It raised the level of awareness which translated into enthusiasm to reply to cases.
- It enhanced the positive relationship the ENT physicians had with the referring audiologists, family physicians and pediatricians in the field.

Our survey of the literature indicated there was no published data demonstrating that tympanic membrane images could be reliably used to substitute for in-person ENT care. Recognizing the need for validation, ANMC ENT participated in a study to see if store-and-forward imaging of the tympanic membrane could approximate an in-person examination for one of our greatest clinical needs – the follow up of patients after ear tube placement. In 2003, ANMC ENT placed over 400 sets of ear tubes, primarily in children, for recurrent ear infection or hearing loss from chronic serous otitis. Following accepted standards of care, this number of tube placements generates the need for over 1000 follow up appointments per year. Since many of these patients live in remote sites, this represented an opportunity for high impact if telemedicine could be successfully applied.

The validation study, conducted in partnership with AFHCAN and Maniilaq Association (Kotzebue), compared in-person examinations by two board certified otolaryngologists with image reviews of the tympanic membranes of those same patients by the otolaryngologists at various times after the in-person exam. The agreement (or concordance) between the in-person examination and a telemedicine consult was not statistically different from the agreement between two otolaryngologists conducting an in-person exam on the same patient. The result of this study clearly indicates that store-and-forward image review is an acceptable means of performing ear tube follow up (3).

Moving beyond video otoscopy

The success with video otoscopy led to the installation of imaging equipment on surgical microscopes for intraoperative imaging, the attachment of CCD camera heads on flexible fiber optic scopes, and an

exploration of the use of digital cameras for other purposes. CCD cameras have been attached to surgical microscopes with moderate success. The image quality is reasonable - but not as high as that obtained with a video otoscope. Images obtained with an autofocus megapixel digital camera were also found to quite good for imaging facial lesions, but not adequate for either intraoral or intranasal images.

Flexible scopes are available and used at multiple regional hospitals throughout Alaska. Images captured from these scopes would provide valuable data to ANMC ENT specialist. However, we are currently unable to obtain high quality images from CCD cameras due to the moire effect on the images. This results from the optical interaction of the flexible fiber optic bundle on the CCD sensor. Images obtained using flexible fiberoptic scopes coupled to the available cameras are currently not of a quality that would allow ANMC ENT to make treatment decisions. This is an ongoing area for research.

Implementing a telemedicine program for ENT care

With the results of the validation study in hand and with increasing experience using the video otoscope, the ANMC ENT Department committed to making store-and-forward telemedicine a standard means of delivering care to remotely located patients. The medical staff discussed options for receiving cases and decided that all cases would be sent to the ANMC ENT Group - rather than individual physicians. All of the otolaryngologists are part of that group, and any of these physicians can look at the cases. However, it is the responsibility of the on-call physician to review and consult on the cases received during that on-call day. The physician has 24 hours to respond to the case, so if he or she is busy in the operating room during call, they still have time afterwards to answer the cases.

The department target was 100% cases responded to within 24 hours. AFHCAN worked with the hospital IT department to assure that the software was conveniently accessible on all computers that the ENT physicians routinely utilize. Some cases were reviewed from home or out of town using VPN internet connection. AFHCAN also trained physicians, midlevel providers and Community Health Aid/Practitioners (CHA/Ps) throughout the state to originate cases utilizing the software, video otoscope and digital camera.

The ENT department actively promoted telemedicine and encouraged the regional physicians, midlevel providers and CHA/Ps to try out the

telemedicine system as a means of sending their referrals. In return, the ENT department guaranteed rapid turnaround time, expedited care and educational content in responses. No restrictions were placed on the types of cases accepted. Providers were encouraged to send in any images and accompanying questions for which the opinion of an ENT surgeon was desired.

Volumes slowly increased, with the majority of cases coming from regional audiologists. Audiologists are specialists in the diagnosis and rehabilitation of hearing and balance disorders and they have a special relationship with otolaryngologists as both participate in the evaluation and treatment of the same patients. Telemedicine allows audiologists to send images, clinical data and hearing tests on both new and follow up patients. This partnership with regional audiologists was so successful that in some regions, wait times for ENT care improved significantly over short periods of time. Reports from several regional facilities indicated that waiting times, which ranged from 4 to 15 months, were significantly reduced through telemedicine. For example:

"Waiting time for a field clinic appointment has gone from 4-5 months a year ago to 1-2 months now. I've probably got 100 stories of patients or parents who were pleased with the quicker, easier access to ENT services they received either through telemed or direct referral."

Mike Comerford, Audiologist,
Yukon Kuskokwim Health Corporation, Bethel, Alaska

"The specialty clinic manager came to see me this morning to indicate that there were four open slots in ENT clinic for September. This is the first time they were having a tough time to fill those spots!! Speaks well of the telemedicine."

Phil Hofstetter, Audiologist
Norton Sound Health Corporation, Nome Alaska.
Aug 16th 2002

Extending care delivery to the village

One of the key benefits of the AFHCAN Project was the deployment of a common telehealth solution to every village clinic in Alaska. This empowered ANMC ENT to initiate a "traveling audiologist program", whereby a contract audiologist travels to village clinics and provides

care directly to village residents. The audiologist was initially trained in the use of video otoscope, digital camera and telemedicine software - and then used the AFHCAN equipment in the village clinic to originate and send consults to ANMC ENT.

These "virtual ENT clinics" were held using the audiologist and telemedicine in the most remote villages. Patients on waiting lists for ENT care were seen by this audiologist in their village. The cases were prepared and sent to ANMC ENT and the treatment or disposition was communicated back to the audiologist for implementation.

This program is very effective for regions without an audiologist. Having a single provider travel to the village obviates the need for 20 or more residents to travel to a regional facility, resulting in significant cost savings.

Currently, 21 virtual clinics have been conducted on 518 patients. The cost of this program - including travel, lodging, per diem, and contract audiological services - was \$40,000. However, to provide these same services through "in-person" specialty clinics would have exceeded \$88,000 in patient travel costs, plus specialist time, etc. Overall, traveling an appropriately trained midlevel provider to an underserved area as a telemedicine "case originator" is an effective means of delivering ENT care to an underserved population - both in terms of cost and access to care.

Telemedicine is also being used to eliminate the need for a face-to-face preoperative visit. Patient information is sent via telemedicine and the otolaryngologist reviews the data and images to make a decision on scheduling the patient for surgery in Anchorage. This greatly improves the efficiency of ANMC ENT by reducing the number of appointments needed to provide definitive care to the patient. For patients living in remote regions, direct routing to ANMC for definitive care is now possible, eliminating unnecessary travel and reducing wait times for treatment. Care is now delivered with fewer total appointments, resulting in improved appointment availability and access for care.

The routine use of images to plan therapy has evolved into creating an image archive for patients under our care. For most patients, this archive includes the images from their initial referral and images taken at the pre-operative visit. For a patient with an otologic problem, these images greatly facilitate patient education about their problem, counseling, and obtaining an informed consent for the proposed procedure. It is becoming more common for ANMC ENT to include intra opera-

tive and post operative images as part of this "image record." The effect on patient understanding of their problem is profound, and compliance with post operative care instruction appears to improve as a result.

Clinical applications

Store-and-forward telemedicine has broad application in the medical and surgical treatment of ear disease. Heavy usage is underway for otitis media, tympanic membrane perforations, hearing loss, facial trauma and lesions & pathology of the oropharynx.

Otitis media

Most cases of otitis media – whether acute or chronic serous otitis – can be diagnosed with a good quality image of the tympanic membrane (see Figure 2,3). In some cases, an image alone is not sufficient to determine the presence of fluid in the middle ear space. In these cases, tympanometry is a valuable addition to store-and-forward telemedicine cases involving middle ear disorders.

The decision to recommend the placement of ear tubes requires other information, and rests on the combination of history (of hearing loss, speech delay, or recurrent infections) and physical examination (tympanic membrane image, hearing test, and sometimes tympanometry). (4) ANMC ENT has worked with AFHCAN to develop guidelines and software-based forms to refer patients for ear conditions and follow up. The interactive nature of telemedicine makes it quite simple to request additional information when necessary.

Tympanic membrane perforations

Chronic tympanic membrane perforations require surgical repair in most cases. The decision to perform surgery (and what type of surgery) is based on the appearance of the tympanic membrane, the hearing status and the history. In general, we recommend repair of all tympanic membrane perforations in all healthy patients over the age of 5. After developing some experience in assessing ear images, ANMC ENT began making referrals for reconstructive surgery based solely on the telemedicine case – with the first in-person encounter occurring one day prior to scheduled surgery. ANMC ENT has triaged well over 100 patients for major ear surgery in this manner, and all patients triaged in this manner were found to be appropriate candidates for surgery. It appears that the ability to plan surgery is as effective using store-and-

forward telemedicine as it is with an in-person consultation. More formal evaluation of this experience is underway.

ANMC ENT has also been able to use transmitted images to perform post operative follow up, allowing patients in distant locations to return to their homes earlier yet still be monitored. Examples of a perforation and a post operative image are shown in Figures 4 and 5.

Hearing loss

A well constructed store-and-forward telemedicine case can often lead to definitive diagnosis and treatment recommendations for many patients with undiagnosed causes of hearing loss. The information provided must include a comprehensive history, clear images of the tympanic membranes and the appropriate audiology tests. The cause is readily apparent for most cases of conductive hearing loss. Referral for definitive treatment can be made for common etiologies such as serous otitis media, perforation of the tympanic membrane or otosclerosis. In those cases where the cause of the loss is uncertain, the workup can be expedited by arranging for the appropriate additional studies. Likewise, patients with sensorineural losses can be referred for amplification, follow up or further investigation, as in the case of an asymmetric loss.

Some patients with hearing loss clearly require an in-person evaluation by an ENT physician particularly if the clinical situation is complex or unusual. Telemedicine allows ANMC ENT to effectively determine which patients require an in person evaluation and those that can be served with a telemedicine encounter.

Store-and-forward telemedicine has been perfect for routine clearance for hearing aids. For an elderly patient in a remote area with a straight forward sensorineural loss, a telemedicine encounter provides the care they need without unnecessary delay or travel. It has been quite gratifying to learn of scenarios where a patient unable or unwilling to leave their village has had their "world opened" through the fitting of a hearing aid.

Facial trauma

Facial trauma is often the unfortunate consequence of accidents, motorvehicle crashes or interpersonal violence. Given the complex anatomy of the face and the cosmetic and functional implications of the treatment of lesions and injuries in different locations, an image is the

most valuable piece of information that can be provided to the consulting surgeon in advance of receiving the patient.

Store-and-forward telemedicine has enabled ANMC ENT to assist in (and arrange for) the appropriate treatment of facial soft tissue injuries and lesions. An image showing the location and severity of a facial soft tissue injury allows the consultant to make recommendations for treatment at the remote site, or, in cases of severe injury, for transfer. The consultant receiving the patient is then afforded the opportunity to plan treatment and arrange for additional workup or resources that may be needed.

In the case of a facial lesion for which the decision has already been made to refer, knowing the size and location of the lesion helps the receiving physician plan therapy. For example, it is possible to determine prior to seeing the patient whether the lesion can be removed with a simple office procedure or, alternatively, a more complex removal and reconstruction scheduled for the operating suite.

Disorders of the oral cavity, pharynx and larynx

The oropharynx, nasopharynx and larynx are susceptible to serious pathologies which can often be diagnosed using telemedicine. Imaging is especially challenging because of darkness and moisture. Inroads have been made using digital cameras (plus flash, ring light, or even flashlight), video dental scope, and flexible nasopharyngoscope. The technology has vastly improved recently, and it does appear that high quality digital images will eventually prove useful for diagnosis, triage and initiation of treatment (Figure 6). The technology for imaging these anatomic areas is not as mature as those used to image the tympanic membrane. As the capability to obtain quality images improves, clinical applications for disease states of the oropharynx, nasopharynx and larynx will emerge.

Provider productivity

The nature of store-and-forward telemedicine is such that the encounter is information rich. The visit requires origination by a clinician who has conscientiously included information he/she deems appropriate to the consultation. The originating case includes demographics, text, clinical data, and/or images. The originating provider is likely to include all relevant material. This is in contrast to a face-to-face encounter where emphasis is on the in-person event but lab values, notes, and other information are often lacking.

Where information is lacking, store-and-forward telemedicine allows a clinician to be more efficient. The telemedicine cases can be screened so that a case lacking important information or having poor quality images is returned to the provider with a request for more information. These cases, in fact, never need to reach the consulting physician until they have all of the necessary information. At ANMC ENT, cases with insufficient information are returned to the sending provider requesting an addendum. Telemedicine support staff are notified so that referring providers can obtain refresher training and reinforce the best practices for case origination. Case quality has steadily improved, and now ANMC ENT providers rarely see a case that is not ready for their analysis..

Telemedicine has enabled ANMC ENT to more closely meet standard of care in a high volume, crucial area: post tympanostomy tube follow up. The majority of these patients live in remote sites, and air travel is required for the physician, child and the adult escort to meet at the regional facility specialty clinic for a face to face encounter. The finding that store-and-forward tympanic membrane imaging reasonably approximates an in-person examination has allowed us to implement a protocol using this modality to perform follow up on these patients.

Store-and-forward telemedicine allows a clinician to care for more patients. In 2003, the ANMC ENT Department was able to add roughly 1000 telemedicine encounters to the practice without increasing staffing levels in the 7 physician department. This is possible with store-and-forward telemedicine as the clinician is able to fit cases into available time slots. The cases fill up otherwise unproductive times during a busy day: waiting for a case to begin in the operating room or a patient appointment cancelled with short notice, for example. A well constructed store-and-forward case typically requires 10 minutes to process, and these otherwise "dead" times become quite productive. This is in contrast to many face to face patient encounters where a critical piece of historical or laboratory information does not accompany the patient, decreasing the value of the encounter for both the patient and the provider

Educational content

ANMC ENT has now reviewed more than 6,000 ear images through the routine practice of telemedicine. While each telemedicine case af-

fords a chance for ANMC ENT to provide education to the originating provider, these images provide a basis for a rich multimedia curriculum on ear disease which could be used to educate a much broader audience. ANMC ENT has reviewed more than 6,000 images, developed a subset of clinically useful images as a foundation for this curriculum, and is working towards the goal of having a readily available teaching tool on ear disease derived solely from telemedicine cases.

Cost savings

ANMC ENT has worked extensively with the AFHCAN Office and the State of Alaska (Medicaid Program) to resolve a number of issues related to the reimbursement of store-and-forward telemedicine. A detailed analysis of the first 91 store-and-forward cases reimbursed by Medicaid revealed significant savings to the Medicaid program. Avoided travel costs were carefully calculated by determining the airfare to travel the patient to the nearest facility where specialty care was provided and by considering whether an escort would be needed, such as in the case of a minor. Of these 91 cases, 79 saved transport for the patient and an escort from the village to region at an average cost of \$307.57 per person round-trip. Overall, Medicaid paid \$6,970 in claims, yet saved an estimated \$55,437 in travel costs. For every \$1 spent on reimbursement for telemedicine, almost \$8 of travel cost was avoided.

Similarly, the traveling audiologist program demonstrated cost savings for the patient who otherwise would have had to travel to the regional clinic for a specialty outreach clinic. The avoided travel costs were more than twice the cost of providing the service (audiologists salary, travel, lodging.)

In 2003, ANMC ENT provided 1200 patient encounters using store and forward telemedicine without adding additional physician resources. The estimated cost in lost physician time to provide 1200 face to face encounters in a remote outreach clinic is \$30,000, representing another significant cost savings.

Providers indicate that patient travel is prevented for 40% of these encounters. Using a conservative estimate of \$300 round-trip cost per patient, travel savings for the patient are approximately \$144,000 annually for the 1200 ENT cases in 2003. These savings can double or triple when young patient travel with a guardian and lodging and per diem costs are included.

Providing prompt, high quality care through telemedicine realizes other cost savings in terms of societal costs, improved access and early identification of serious medical conditions. These have not yet been quantified.

Summary

Integrating store-and-forward telemedicine into the ANMC ENT practice for remotely located patients has improved access for care as well as the quality of care for our patients. The involvement of the ANMC ENT department in the design of the telemedicine system was critical. Yet building the telemedicine service required creative measures to encourage use and careful management of our capacity to receive a growing number of cases.

Cost savings due to avoided travel have been readily apparent, based on the high cost of travel in Alaska. The improvement in departmental productivity was an unexpected yet welcome outcome. Much of the current research in telemedicine appropriately focuses on the applicability of this modality to clinical problems. Our four years experience indicates that one of the challenges in the future will be to integrate telemedicine with the existing infrastructure of medicine so that it can more easily become part of mainstream practice.

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