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Summary

Background

This study responds to a specific naval research directive to examine the impact of telemedicine technologies, such as Internet and live video teleconferencing (VTC) for shipboard medical departments. Preliminary studies conducted aboard large ships may not generalize to small ships with limited medical departments; furthermore, no telemedicine capabilities currently exist on small ships. Thus, the aim of the present study was to evaluate telemedicine use in remote military treatment facilities (MTFs) ashore with limited access to specialty care. These data can help predict the utility and clinical impact of telemedicine in small ships with analogous limitations on access to specialized care.

Method

A retrospective evaluation of telemedicine use was conducted in the MTFs of TRICARE Region Nine. Region Nine has a relatively new telemedicine network with a hub facility at the Naval Medical Center, San Diego (NMCSD) providing specialty consultations for remote MTFs in southern California. The first 2 .5 years of network operation (June 1997 to January 2000) were evaluated. This included VTC consultations by physician specialists at NMCSD for providers and their patients at remote MTFs. All consultations were scheduled and recorded using Region Nine's Internet web site, the Referral Management System (RMS). The RMS captured data on various factors related to telemedicine use (e.g., patient history, MTF, date of consult), clinical impact (provider and consultant diagnoses), and applications (medical specialty, purpose of consultation).

Results

RMS managed and recorded a total of 1,364 telemedicine consultations. These sessions consisted of VTC (76%) and store-and-forward (24%) modalities; more than 90% of patients were active-duty personnel. There was substantial variation in telemedicine use among the seven remote MTFs (e.g., Port Hueneme = 352 consults; Vandenburg = 45 consults). The primary variable related to telemedicine use was age of system (time since operational). The rate of use increased with the age of the entire Region Nine network, the age of systems at each of five MTFs and the age of several medical specialties (ear/nose/throat [ENT], neurology, psychiatry). The ENT specialty accounted for more than 90% of clinical applications. Preliminary data indicated that the consultations had substantial clinical impact, with 49% of sessions resulting in a change in diagnosis.

Conclusions

The rate of telemedicine use for specialty care in TRICARE Region Nine increased regularly and substantially during the first 2.5 years of network operation. This finding generalized across MTFs and several medical specialties. Preliminary data suggested that telemedicine consultations have substantial clinical impact on patient care. The relatively high rate of telemedicine use for specialty care in this network makes TRICARE Region Nine an excellent system for additional study. Quantitative models including those factors that predict the use and clinical impact of telemedicine in remote MTFs would provide valuable guidance for application of such technologies on small ships at sea.

A Retrospective Evaluation of Telemedicine in Remote Naval Populations Seeking Specialty Care

Introduction

Telemedicine is the use of telecommunication technologies, such as the Internet or live video teleconferencing (VTC), to deliver health care to distant treatment sites (Bashur, 1995; Jerome et al., 2000; Nickelson, 1998; Walters, 1996). This approach has great potential to assist naval personnel in remote situations, such as those stationed on ships at sea (Nice, 1987; Patel, 1994), or personnel and their dependents treated in medically underserved facilities ashore. One important problem faced by such facilities is limited access to appropriate care for specialized health problems. The delay and physical stress of transport or evacuation may complicate medical conditions before treatment even begins and cause substantial burden in cost and lost work hours (Cubano et al., 1999; Stoloff, Garcia, Thomason & Shia, 1998; Vidmar, 1999).

This study evaluates recent use of telemedicine for specialty care in a relatively new telemedicine network in the military treatment facilities (MTFs) of TRICARE Region Nine. TRICARE is the military health care provider consisting of 12 Department of Defense (DoD) regions including Region Nine, with many MTFs located in southern California. Region Nine possesses several attributes that make it a compelling model for naval telemedicine study:

- The telemedicine organization is relatively new; therefore, it should be possible to describe and evaluate changes in telemedicine use over time.
- TRICARE Region Nine faces the basic problems associated with delivering specialized care to distant facilities with limited resources.
- The MTFs in the region are connected in two important ways:
  - They are able to manage and record telemedicine referrals via a common Internet web site, the Referral Management System (RMS).
  - They have VTC capabilities, allowing live, interactive communication among MTFs.

The overall objective of this study was to describe telemedicine use by remote MTFs to determine what factors contribute to the use and clinical impact of telemedicine. For instance, are there differences between MTFs in the use of telemedicine? Is the rate of telemedicine use related to the length of time the telemedicine system has been operational? What are the clinical outcomes? How often do telemedicine consultations result in a change in diagnosis between the primary provider and the consulting physician? What factors might be associated with changes in diagnoses?

Background

Telemedicine has a substantial history of 30 to 40 years of application for various medical purposes inside and outside the military (Sosa-Iudicissa, Wooton, & Ferrer-Roca, 1998). The field is still relatively young in many ways (Grigsby, Schlenker, Kaehny, Shaughnessy, & Sandberg, 1995), with applications accelerating in recent years (Scannell, Perednia, & Kissman, 1995). This is due, in part, to advances and accessibility of communication technologies such as the Internet and VTC (Jerome, 2000). The military has provided some insightful evaluation studies of telemedicine in the armed forces, (Larson, Burr, Pearsall, & Silva, 1998; Nice, 1987; Walters, 1996), but the resulting data have limited generality (Health Resources and Services Administration [HRSA], 1997).

A primary goal of past research has been to determine how to apply telemedicine capabilities in the complicated military environment (Nice, 1987; Stoloff et al., 1998; Vidmar, 1999; Walters, 1996). The Navy requires sophisticated algorithms to guide the allocation of its telemedicine resources (Patel, 1994). Substantial benefits and costs are at stake in terms of the health of personnel and of operational efficiency and money (Stoloff et al., 1998). Unfortunately, for practical reasons, (Grigsby et al., 1995; HRSA, 1997; Larson et al., 1998) proper evaluation studies are difficult and sparse. Carefully designed and meaningful studies require considerable time and effort to complete. Therefore, a strong demand exists for systematic studies to evaluate the acceptability, application, use, and clinical impact of telemedicine (HRSA, 1997; Larson et al., 1998; Patel, 1994).

The present study was developed based on a specific naval research requirement by the Chief of the Bureau of Medicine and Surgery to evaluate telemedicine for shipboard medical departments (Patel, 1994). The Naval Health Research Center conducted initial studies onboard large ships, the aircraft carriers USS *GEORGE WASHINGTON*, *ENTERPRISE,* and *THEODORE ROOSEVELT*, which were equipped with telemedicine capabilities such as VTC and store-and-forward technologies (Larson et al., 1998). The results were consistent with evaluation studies outside the Navy (Gomez, Poropatich, Karinch, & Zajtchuk, 1996) in showing that telemedicine consultations were more likely to change patient treatment plans (39%) than initial diagnoses (9%) (Larson et al., 1998). Dermatology was the most active medical specialty for telemedicine consultations, followed by orthopedics, radiology, and ear/nose/throat (ENT).

Most importantly, the results from large ships may not generalize to small ships with limited medical departments for specialized health care (Nice, 1987). Because no small ship telemedicine capabilities currently exist, the aim of the present research was to evaluate telemedicine use in remote MTFs ashore. Ultimately, this information can be used to predict the utility and clinical impact of telemedicine for ships with analogous limitations in specialty care. The results also provide direct evidence of the utility of telemedicine applications in the MTFs.

Surprisingly, there are few systematic evaluation studies of telemedicine by rural health care facilities in the United States (HRSA, 1997). One reliable finding in the most relevant study is that the rate of telemedicine use increases with the age of the system or the duration of its operation (HRSA, 1997). The HRSA study had a strong methodology but was limited to nonmilitary rural hospitals or clinics. It also appears to be the only one to use multivariate

analysis to isolate an independent association between study variables such as age of the telemedicine system and its rate of use. The HRSA study controlled for the contributions of factors such as facility size, type of medical personnel, and patient demographics. Another study reported that rate of use increased with the telemedicine experience of military medical personnel (Walters, 1996). Finally, a study conducted in a university pediatric department found that a physician's personal experience, or even exposure to colleagues using telemedicine, is associated with an increase in positive attitudes and perceptions toward telemedicine (Karp et al., 2000).

The present study describes a retrospective analysis of the nature and outcomes of telemedicine for specialty care over a 2.5-year period in TRICARE Region Nine. More than 1,300 VTC or store-and-forward consultations were analyzed. The first purpose of the analyses was to document factors related to the use of telemedicine. For instance, is there variation in telemedicine use among MTFs? Is the age of the telemedicine system related to its rate of use? Does telemedicine use vary between medical specialties (e.g., ENT, neurology, psychiatry)? What are the general purposes of the telemedicine consultations (e.g., initial evaluation, preoperative, postoperative, follow-up)? How often does technical difficulty occur during the consultation? The second purpose of the analyses was to describe the clinical impact of the consultation. For instance, does the initial diagnosis of the provider seeking the consultation change as a function of telemedicine consultation with the specialist?

Method

Subjects

The unit of observation was the individual telecommunication consultation for specialty health care. All such patient consultations ($N = 1,364$) that occurred between June 23, 1997, and January 10, 2000, were extracted from the database at the Naval Medical Center, San Diego (NMCSD). The consultations were provided for patients at various MTFs in TRICARE Region Nine and the Lemoore Naval Air Station, Lemoore, CA. These facilities comprised the functional telemedicine network centered at NMCSD. Individual patients contributed one or more observations for the same or alternative medical conditions. All personal identifying information was excluded from the database prior to analysis.

TRICARE Region Nine Telemedicine Network

This study was a retrospective evaluation of a relatively new telemedicine organization within the MTF's of TRICARE Region Nine. TRICARE provides health care for active-duty personnel, their qualified family members, Civilian Health and Medical Program of the Uniformed Services eligible retirees, and the family and survivors of all uniformed services. TRICARE consists of 12 DoD health services regions in California, Hawaii, Oregon, Washington, Texas, Oklahoma, Arkansas, Louisiana, Florida, Alabama, Mississippi, South Carolina, and Georgia.

The lead agent for Region Nine is at NMCSD, where the resources for specialized care (i.e., the consultant physicians) are located. There are seven MTFs in the telemedicine network in southern California, and most have limited medical specialization. Table 1 lists the components of this network, along with their start dates and total days of operation as part of the network.

Table 1. MTFs in the TRICARE Region Nine Telemedicine Network

MTF	Network Designation (distance from hub facility)	Start Date	Days in Operation*
NMCSD	Hub (0)	6/1/97	953
Port Hueneme	Spoke (182 miles)	8/14/97	879
Fort Irwin	Spoke (213 miles)	10/17/97	815
Edwards AFB	Spoke (201 miles)	3/26/98	655
Vandenberg AFB	Spoke (290 miles)	11/12/98	424**
Twentynine Palms	Spoke (121 miles)	11/23/98	413
Los Angeles AFB	Spoke (174 miles)	3/10/99	306
Lemoore NAS	Spoke (327 miles)	9/16/99	116

*Days in operation were counted until the January 10, 2000 end date for the present study.
**The Vandenburg facility was inoperative for six months due to technical difficulties.

NMCSD functions as the "hub" facility in the telemedicine network. The remote MTFs, such as Port Hueneme, Fort Irwin, Edwards Air Force Base, Vandenberg Air Force Base, Twentynine Palms, Los Angeles Air Force Base, and Lemoore Naval Air Station, function as "spoke" facilities at various distances from NMCSD. The Lemoore facility is not part of Region Nine but was included in the present study because it is part of the telemedicine network centered at NMCSD. The spoke MTFs generally seek telemedicine consultations from medical specialists at the hub MTF in San Diego. This is true for ENT (start date: June 1997) and neurology (start date: February 1999). Psychiatry and rheumatology specialists are located at Twentynine Palms (start date: May 1999) and Fort Irwin (start date: May 1999) respectively. Such a "hub-and-spokes" model for a telemedicine network has been applied frequently in recent years in many settings (Jerome et al., 2000; Nickelson, 1998).

Referral Management System

In TRICARE Region Nine, telemedicine consultations are managed and recorded via RMS, an Internet-based web site. For example, when a primary provider (e.g., medical doctor, physician's assistant or nurse practitioner) determines that a patient requires a consult, he or she refers the patient to a staff coordinator. If the specialty care is not available at the patient's MTF, the telemedicine coordinator (e.g., independent duty corpsman, medical technician) will access RMS to schedule a telemedicine consultation with a specialist physician, usually located at the NMCSD. This determination is based on the availability of specialty care at individual MTFs and the implementation of telemedicine for the specialty.

The patient at the remote MTF is registered in RMS with relevant information on his or her background, reported symptoms, and primary provider diagnosis. RMS then allows the provider to make an appointment with a specialist consultant at NMCSD who can access the patient's information for review. The consulting physician checks RMS to determine his or her schedule of referred patients. The telemedicine coordinator then presents the patient to the consultant via telecommunications (usually VTC). Finally, the consultant enters his or her comments on diagnosis and treatment in the patient's RMS record following the telemedicine appointment. A Telemedicine Operations Manual has been established for TRICARE Region Nine and its MTFs (Appendix A). The Region Nine web site also reviews the RMS.

The following variables were recorded in RMS during this study:

a. Patient demographics (age, gender, and military status)
b. Reason for consultation (initial, preoperative, postoperative, follow-up, other)
c. MTF where the patient received the telemedicine consultation
d. Consultant medical specialization (ENT, rheumatology, psychiatry, neurology)
e. Primary provider and consultant diagnosis
f. Telemedicine modality (VTC or store-and-forward)
g. Whether technical difficulties occurred during the telemedicine consultation
h. Date the consultation was scheduled (the actual consultation usually took place within a few days to 2 weeks).

Data Analysis

Three general questions were assessed:

a. What variables influenced the observed frequency of telemedicine consultations for specialty care? Consultations were categorized by variables such as patient MTF, medical specialty of the consulting physician, patient demographics, age of the telemedicine system (time since operational), purpose of consultation, and telemedicine modality.
b. What percentage of telemedicine consultations resulted in a change in diagnosis between provider and consultant?
c. What factors were associated with changes in diagnosis?

Analytical Limitations

The present data set includes only telemedicine cases and not contemporary cases that were not referred for telemedicine consultation. Thus, the analysis will focus on those variables associated with telemedicine cases that occurred during the study period. Because this is a retrospective study, it does not include surveys of patient, provider or consultant reactions during the period of study. These issues will be addressed further in the discussion.

Results

Demographics

Table 2 shows the frequency of telemedicine consultations for specialty care by the patients' gender, age group, and military status. These were predominantly active-duty adult males between the ages of 18 and 44. There were approximately three times as many males as females in the present sample. There were more than twice as many older adults (ages 25–44) as young adults (18 – 24) and relatively few children, adolescents, and seniors (approximately 10%). Unfortunately, there were a significant number of records (approximately 15%) where gender or age was missing. However, it is clear that the vast majority (90%) of consultations were scheduled to treat active-duty personnel.

Table 2. Demographic Characteristics of Patients Involved in Telemedicine Consultations in TRICARE Region Nine

	N	%
Total Consults	1,364	100
Gender		
Male	893	65.5
Female	235	17.2
Unknown	236	17.3
Age Group		
1–10	45	3.3
11–17	14	1.0
18–24	306	22.4
25–44	736	54.0
45–65	82	6.0
Unknown	181	13.3
Military Status		
Active duty	1,228	90.0
Spouse	65	4.8
Children	70	5.2
Unknown	1	0.1

Region Nine Telemedicine Use

Table 3 illustrates that telemedicine use in TRICARE Region Nine changed substantially among the MTFs and as a function of the modality used (VTC or store-and-forward).

Table 3. Telemedicine Use in TRICARE Region Nine as a Function of MTF and Telecommunications Modality

	N	%
Total Consults	1,364	100
MTF		
Port Hueneme	352	25.8
Fort Irwin	280	20.5
Edwards AFB	247	18.1
Vandenburg AFB	45	3.3
Los Angeles AFB	132	9.7
Twentynine Palms	173	12.7
Lemoore	135	9.9
Modality		
VTC	1,040	76.2
Store & Forward	324	23.8

The MTFs themselves differed greatly, with three of the facilities (Port Hueneme, Fort Irwin, Edwards AFB) accounting for almost two thirds (64.4%) of all consultations observed in the region. Approximately three fourths (76.2%) of the consultations consisted of live VTC sessions, with the remainder consisting of store-and-forward material or messages. In absolute terms, the VTC sessions totaled over 1,000 consultations.

Age and Use of the Telemedicine System

Table 3 clearly shows the substantial variation in telemedicine use between MTFs in TRICARE Region Nine. The facilities with the oldest systems, such as Port Hueneme and Fort Irwin, were generally those with the most use (Table 1). However, it is critical to determine whether the age of the telemedicine system (time since operational) is related not only to *total use,* but to the *rate of use.* This is important, because a healthy system should be used more frequently over time. The variable of system age was the primary predictor of telemedicine use in a nationwide study of telemedicine use in U.S. rural hospitals (HRSA, 1997). The remainder of this section presents a qualitative analysis to determine whether the rate of telemedicine use for specialty care increased with the age of the entire network, the age of individual MTFs, and/or individual medical specialties.

Figure 1 shows the change in the number of telemedicine consultations in TRICARE Region Nine over time since the first system became operational at Port Hueneme. The rate of telemedicine use for specialty care for the entire Region Nine network increased regularly and substantially over the 2.5-year study period. The providers at remote MTFs scheduled and completed fewer than 50 specialty consultations per quarter (3-month period) during the first several quarters. This rate increased to between 250 and 300 consultations per quarter during the final three quarters of the present study period.

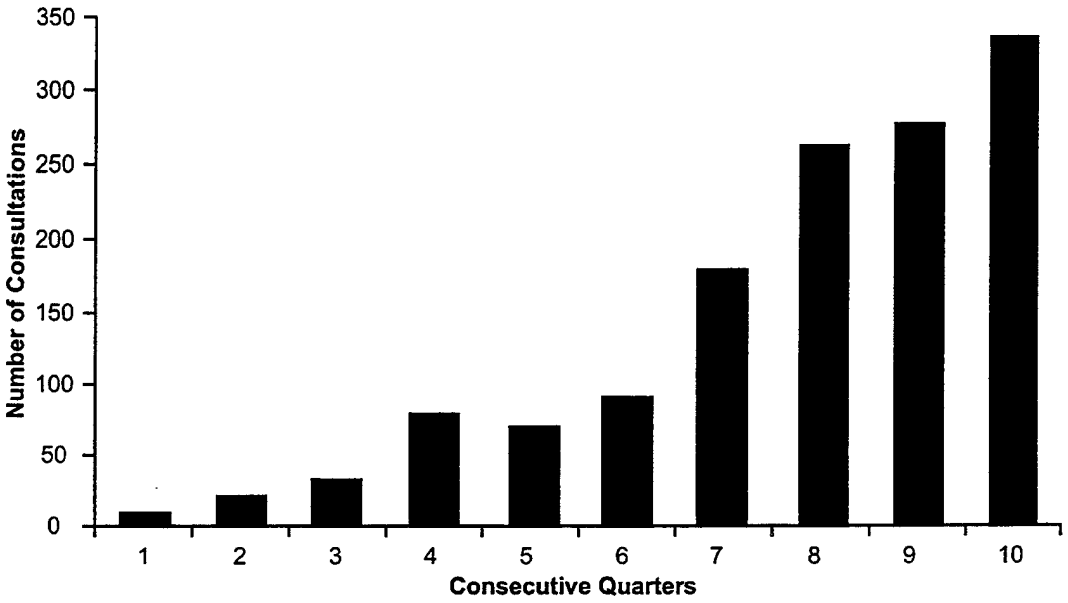

Figure 1. Region Nine Telemedicine Consults Over Time

Figure 1 presents data where age is confounded with a number of factors. For instance, some or all of the increased telemedicine use seen could be explained by the periodic addition of MTFs to the telemedicine network. (The staggering of telemedicine start dates for MTFs during the present study period is presented in Table 1.) This created a larger patient population over time; therefore, absolute use would be expected to increase independent of rate of use.

Figure 2 shows the change in telemedicine use individually for each of five MTFs with at least one year of operation (PH = Port Hueneme, FI = Fort Irwin, EAF = Edwards Air Force Base, LAAF = Los Angeles Air Force Base, 29P = Twentynine Palms). As illustrated, the increase in telemedicine use occurred generally in each of five MTFs during their first year of telemedicine operation.

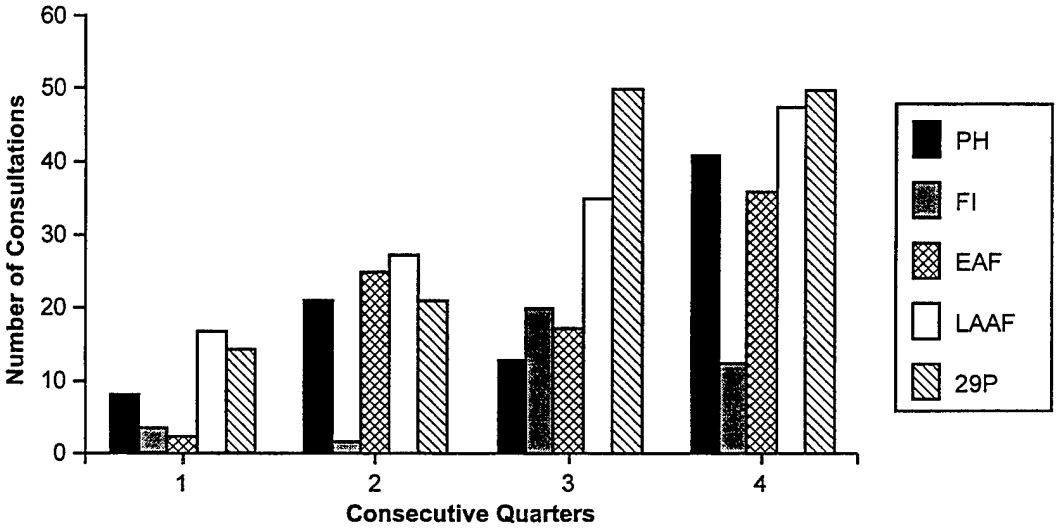

Figure 2. Telemedicine Consultations for Individual MTFs Over Time

The addition of new telemedicine specialties could also contribute to the increased telemedicine use shown in Figure 1. Again, this increased the patient population and, therefore, created more opportunities for telemedicine consultations. If a true increase in the rate of telemedicine use occurs over time, it should be seen within a specialty and within MTFs as their systems age.

Thus, Figure 3 shows the change in the rate of telemedicine use over time for the first specialty operational in Region Nine, ENT, for the two MTFs with the earliest start dates (PH and FI). A general increase in consultations over time at each facility is seen when only the ENT consultations are considered.

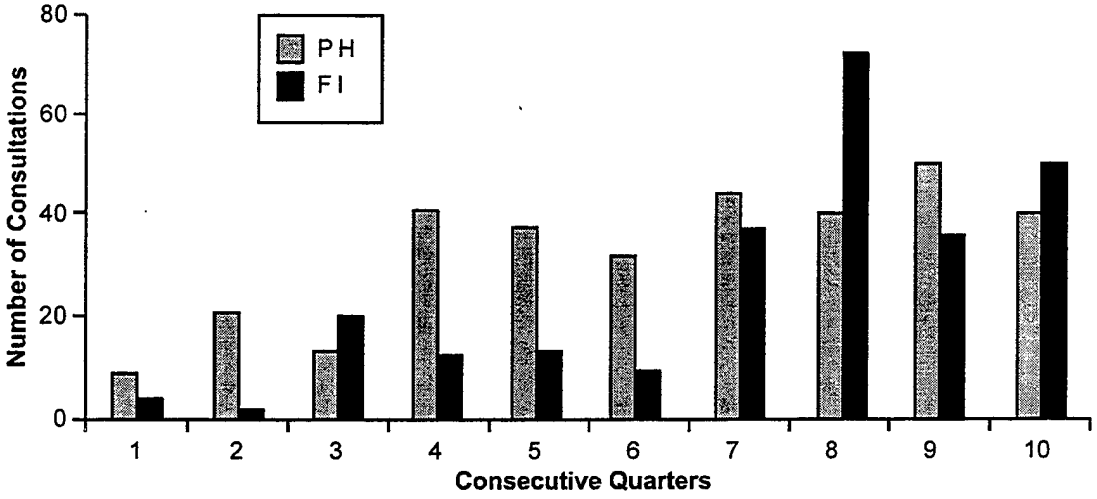

Figure 3. ENT Consults Over Time

Increased rates of use with age also generalized to specialties besides ENT. Figure 4 shows the change in the rate of telemedicine consultations for each of the four active specialties during their first full year of use. As seen, three of the four specialties showed numerical increases in the rate of use during the first year of operation. The rate of telemedicine use for both ENT and neurology nearly doubled between the first and third quarters. However, the gains for psychiatry were relatively modest and rheumatology showed too few cases to evaluate.

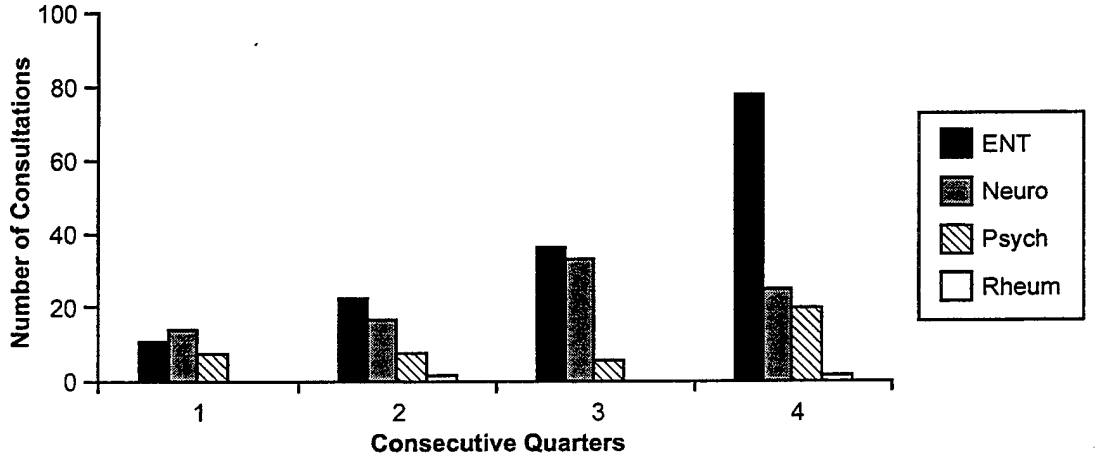

Figure 4. Telemedicine Consults for Individual Specialties Over Time

Clinical Impact and Applications

Table 4 shows two important findings. First, for those sessions in which both provider and consultant entered diagnoses, nearly equal percentages resulted in either a change in diagnosis (49%, $n = 187$) or a diagnosis where the primary provider and specialist consultant agreed (51%, $n = 198$).

Table 4. Clinical Impact and Applications of Telemedicine Consultations

	N	%
Total Consults	1,364	100
Change in Diagnosis?		
Yes	187	13.7
No	198	14.5
Unknown	979	71.8
Medical Specialty		
ENT	1,256	92.1
Neurology	87	6.4
Psychiatry	20	1.5
Rheumatology	1	0.1
Purpose of Consult		
Initial evaluation	662	48.5
Preoperative	89	6.5
Postoperative	66	4.8
Follow-up	198	14.5
Other	349	24.6

The second finding was that most RMS consultation records did not contain sufficient information to determine whether a diagnosis change occurred. Almost all the records indicated a diagnosis from the primary provider (over 90%), but only approximately 30% of consultant diagnoses were recorded and available for analysis.

The high rate of sessions with indeterminate diagnoses raises an important question: Does the rate of change in diagnosis that can be determined, nearly 50%, represent the remaining 70% of sessions? Some additional data are worth presenting on this point. First, virtually all sessions (over 99%) where change in diagnosis can be determined are VTC sessions. Store-and-forward sessions function to provide supporting materials to the specialist. Thus, the relevant rate of VTC consultations where diagnosis change can be determined is 37%, slightly higher than indicated in Table 4. This still leaves more than half the sessions as indeterminate for diagnosis, and it is unclear whether these cases might be randomly left out. If not, the 49% rate of diagnosis change might be suspect or biased. The special nature of this estimate must be kept in mind during the consideration of trends that influenced the clinical impact of the telemedicine consultations.

Most MTFs had similar rates for changed diagnoses. The exception was the Lemoore facility, where change was relatively high at 65%. Most MTFs also had similar rates for missing diagnoses, again with the exception of the Lemoore facility, which had a relatively low rate of 44%. Lemoore was the most recent addition to the telemedicine network and treated the highest percentage of dependents (approximately 50%) of all the MTFs in this study.

The purpose of the consultation (e.g., initial evaluation, preoperative, postoperative, follow-up) appears relevant to change in diagnosis. The consultations on initial evaluations were most likely to lead to changed diagnosis, at least for sessions where diagnosis could be determined. Of the initial evaluations, 58% resulted in a change in diagnosis and 40% of diagnoses changed in the other categories. Initial evaluation was the primary purpose recorded for most consultations (Table 4). It is important to note that consultation diagnosis usually did not change for second and third consults (e.g., pre-op or follow-up visits) for the same patient. Thus, the initial evaluation sessions probably provide the most reliable indication of rate of diagnosis change due to telemedicine consultation in the present study.

It is encouraging that there were fewer missing diagnoses from RMS as age of network increased. Approximately 90% of records had missing diagnoses early in the present study period. This rate decreased to between 50 and 60% during the final quarter of this study. Later in the study period, a trend for increased clinical impact was visible. During the first seven quarters, 35% of consultations resulted in changed diagnoses, whereas 50% of diagnoses changed for consultations conducted during the last three quarters.

With regard to clinical applications, Table 4 shows that almost all consultations came from one medical specialty, with ENT accounting for over 90% of consultations. However, there was also some activity in neurology and psychiatry, with more than 100 consultations for these two specialties combined.

Approximately half of all consultations were conducted for initial patient evaluation. It is noteworthy that there were significant numbers of preoperative and postoperative consultations (n = 155) although these cases represented only 11% of all consultations as categorized by purpose in the table. A substantial percentage of "other" cases consisted primarily of store-and-forward sessions (323 out of 349 cases).

Technical Difficulties

RMS records indicated that no technical difficulties occurred in over 95% of the consultation sessions. However, this variable may be misleading as presently measured. Many of the difficulties may have prevented the session from occurring at all. Therefore, records most likely exist for those sessions that were completed without problems. The Vandenburg facility, which shut down its telemedicine system for at least six months during the present study period, showed little evidence of these problems in RMS. This explains the relatively low total use of telemedicine at this MTF given its relatively early start date. Ultimately, the issue of technical problems may be best assessed through direct interviews with providers and consultants.

Discussion

The present study provides an initial descriptive evaluation of a relatively new telemedicine network for specialty care in the MTFs of TRICARE Region Nine. Retrospective analysis of the first 2.5 years of network operation indicates several important findings. First, the rate of telemedicine use increased regularly and substantially during the study period. This finding generalized across MTFs and several medical specialties. Second, the preliminary data suggest that telemedicine consultations have substantial clinical impact. For those telemedicine consultations where both provider and consultant diagnoses were available for comparison, approximately half (49%) resulted in a change in diagnosis. These data are preliminary and should be viewed cautiously because of the high rate of missing diagnoses. Finally, the relatively high rate of telemedicine use for specialty care seen in this network makes TRICARE Region Nine an excellent system for additional study.

Ultimately, quantitative models, including those factors that predict the use and clinical impact of telemedicine for specialty care in remote treatment facilities, would provide valuable guidance for application of such technologies in shipboard medical departments of various sizes (Patel, 1994). We will discuss these findings in turn and suggest recommendations for further study in the following sections.

Age of Telemedicine System

The strongest finding and the focus of much analysis in this report was the dramatic increase in telemedicine use during the first 30 months of network operation. As presented in the results, this appears to be a true increase in rate of use. It is not simply due to additional opportunity for consultations with new medical specialties and MTFs, which increased the overall size of the network. However, it remains possible that additional confounding factors (e.g., increase in overall patient population) might explain some of the increased rate. Additional measures not available at the time of this writing will be necessary, along with multivariate analysis, to produce a quantitative model to determine the relationship between the age of the telemedicine system and its rate of use. Such an analysis will allow the strongest test of independent association between system age and rate of use and the strength of the association between these two variables.

One previous study of nonmilitary rural facilities reported such an analysis (HRSA, 1997). This previous finding supports the basic conclusion of the present study that as system age increases, so does telemedicine use. No other studies have been found that directly address this issue. Therefore, future study to accomplish such a quantitative analysis in a military setting such as TRICARE Region Nine would provide a valuable contribution to the telemedicine literature, particularly for military applications.

Clinical Applications and Impact

The present study provided a preliminary estimate of provider diagnoses that changed as a function of VTC consultation with a specialist. The 49% rate of changed diagnosis is relatively high compared to previous reports (e.g., Larson et al., 1998; Nice, 1987; Walters, 1996). At least two hypotheses could account for this relatively high rate of diagnosis change. First, approximately 90% of all consultations in the present study came from the ENT specialty. Second, the telemedicine modality used for consultation was almost exclusively VTC because this method is essential in ENT. In contrast, previous studies such as Larsen et al. (1998) included a diversity of specialties and telemedicine modalities, such as dermatology and store-and-forward transmissions. Clearly, further study of various specialties and modalities would help evaluate the generality of the clinical impact data in the present study. Some undetermined problems prevented consultants from recording diagnoses in many cases in RMS; therefore, they were unavailable for analysis. The consultant must have communicated his or her diagnosis to the primary provider outside the RMS format (e.g., telephone call, verbal comment during VTC session). It will be worth considering whether some procedural modification may assist in preserving consultant diagnoses in RMS.

Recent data from RMS indicate that diagnoses from both provider and consultant are available in more than half of the telemedicine sessions. Thus, it will be important to conduct follow-up analyses to compare rates of diagnosis change in the present study with more recent estimates, which should be more representative of all telemedicine cases conducted in the region. A more complete data set will allow further study of factors related to clinical impact, such as medical specialty and age of system.

Study Limitations and Recommendations for Future Work

The present study had some important limitations, which should be addressed to help improve the design of a follow-up prospective study in TRICARE Region Nine. This study was primarily descriptive and focused mainly on the active ENT specialty. Further, some additional measures that have proven valuable in a few previous studies should be included to develop a strong quantitative model of telemedicine use and clinical impact. For instance, provider and consultant attitudes and experiences with telemedicine should be assessed before and after the study period. Informal discussions with the lead ENT specialist suggest that his/her positive attitudes on telemedicine motivated the strong growth of this specialty as seen in the present results (Figure 4). In addition, operational information on each MTF would provide a context for analysis of telemedicine cases.

Thus, it will be important to determine the various sizes of each MTF (e.g., patient volume) and relative frequencies of patients treated for various medical conditions (ENT, psychiatry, neurology) and for telemedicine and nontelemedicine cases. It will then be possible to use multivariate techniques to test for independent associations between variables, such as the age of the system and its rate of use. Similar analysis could isolate predictors of the clinical impact of telemedicine.

It is also important to discuss the importance of demonstrating the relationship between the age of a telemedicine system and the increased rate of its use. First, any factors that are predictive must be considered for an optimal quantitative model. Second, it may provide a measurable standard or vital sign for the operational efficiency of new telemedicine networks or specialties within such networks. This finding invites additional investigation to identify

modifiable factors that could facilitate the time it takes to increase telemedicine use and therefore increase overall medical efficiency and operational readiness. One modifiable variable may be changes in attitudes and perceptions of personnel using the telemedicine systems (e.g., the patients, providers and/or consultants). In nonmilitary settings, simple exposure to positive attitudes on telemedicine was associated with increased likelihood of its use (Karp et al., 2000).

As mentioned, anecdotal evidence of this exists in TRICARE Region Nine with the lead ENT specialist. It would also be interesting to determine reactions to RMS, which appeared to play a critical role in the growth of the telemedicine system in TRICARE Region Nine. In addition, technical difficulties generally dissuade providers from telemedicine use. The Vandenburg facility had one of the lowest totals for use, but its telemedicine system was one of the oldest. This facility also experienced special technical difficulty, with the system being down for at least 6 months. This may also have affected provider attitudes, which could translate into decreased use even when the system is operational.

The paucity of evaluation studies on telemedicine in military settings makes the present and future studies valuable despite the stated limitations (Grigsby et al., 1995; Larson et al., 1998). The present study also provides groundwork for future study that would provide data for a quantitative model to guide telemedicine applications ashore and at sea. Such information would be a valuable addition to the literature and would provide justification for naval telemedicine operations (Patel, 1994).

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Appendix A

Telemedicine Operations Manual

TRICARE Region Nine

Telemedicine Operations Manual

Version (1)
May 1999

TRICARE Region Nine

a. **PURPOSE**: The purpose of this plan is to develop a standard operating procedure for the use of Telemedicine in patient care throughout TRICARE Region Nine. This plan is meant to be a guide for the Regional Telemedicine Program, but does not supersede the Military Treatment Facility (MTF) policy governing the use of Telemedicine. Comments, suggestions and complaints referencing this plan should be directed to the Telemedicine Clinical Coordinator, Office of the Lead Agent, TRICARE Region Nine.

b. **SCOPE**: This publication is applicable to all personnel assigned to the TRICARE Region Nine Telemedicine Program. The Telemedicine & Technology Assessment Office (TTAO) at the Office of the Lead Agent, TRICARE Region Nine coordinates the program. Regional sites that have active telemedicine programs are: Vandenberg AFB, Port Hueneme, LA AFB, Edwards AFB, Weed Army Community Hospital, Fort Irwin, and 29 Palms Marine Corps Base.

c. **REFERENCES**:

- JCAHO Accreditation Manual for Hospitals 1998
- 1999 Compendium of Telemedicine Laws: Selected Statute Excerpts and Article Citations Relating to Telemedicine.
- Consent Manual: A Reference for Consent & related to Health Care Law 26th Edition. California Healthcare Association.
- Core Principles on Telehealth. American Nurses Association 1999

d. **ENCLOSURES**:

- Enclosure (1): Patient Care Process
- Enclosure (2): Referral Management Scheduler/Telemedicine Schedule
- Enclosure (3): Informed Consent/Patient Handouts
- Enclosure (4): List of MTF Equipment/Network diagram
- Enclosure (5): Scope cleaning recommendations from manufacturer/supplier

e. **VISION**: To plan, demonstrate and implement a healthcare system that provides seamless specialty care to remote sites through the use of Telemedicine.

f. **MISSION STATEMENT**: Our goal is to showcase the power of Telemedicine in a managed care environment by increasing readiness, improving access to care, and reducing the cost to deliver that care.

g. **GOALS**:

- Install a working telemedicine system.
- Train users and system administrators on the proper use of the telemedicine system.
- Establish working procedures and policies.
- Utilize and critique the system for future improvements.
- Reduce patient transports to Naval Medical Center San Diego (NMCSD) for specialty care.
- Provide services with no decrement in the quantity or quality of care to patients.
- Market the system as a TRICARE Region Nine success to both patients and providers.
- Ingrain the system as a permanent part of our continuum of care.

h. **SCOPE OF SERVICE**:

- Available Specialty Services from NMCSD:
  a. EENT
  b. Neurology
  c. Follow up appointments
  d. Other specialties as requested and approved
- Patient assessment criteria:
  i. Active duty (priority)

- Family Members 18 years and older (Family Members under 18 years old need prior approval).
- Condition not life threatening or requiring immediate care
- Patient Care Process: See Enclosure (1)

- Required Reports from each MTF:
  a. List of patients scheduled for Telemedicine consults. This list must include appointments that were canceled. This list must be kept by the MTF, but available for TRICARE Region Nine's use to verify metrics.
  b. Patient Satisfaction Sheets – mailed to TRICARE Region Nine Telemedicine Clinical Coordinator every month.

Program Administration

Scheduling a Telemedicine Consult

When a patient is to be seen via the Telemedicine Program, they will be scheduled through the *Referral Management System.* This system is an Internet based program allowing the MTF to schedule a patient with the Specialist. The program is Y2K-Compliant, and 128 bit encrypted. The referring site registers a patient, and the Specialist receives email describing the patient's complaints and the date/time of the appointment. The email does not contain patient identifiers i.e. name, SSN, etc.

Each MTF has been allotted a time slot on to conduct Telemedicine consults. The schedule is subject to change in order to accommodate both the Specialist and MTF. (See Enclosure (2).)

If the *Referral Management System* is inaccessible, the referring site will fax the consult to NMCSD. Regular email should not be used to transfer this information for security reasons.

Patient Information Briefs

Initial Provider-to-Patient Brief

a. **Define telemedicine for the patient**, i.e.: *"Telemedicine is the process of sending video, audio and/or text from one site to another for the purpose of consulting with a Specialist."*

b. **Give handouts** to the patient describing the telemedicine process. (See Enclosure (3).)

c. **Define the Process** for the patient, i.e.: " instead of a trip to another Military Treatment Facility (MTF), you (the patient) will be sent for a telemedicine consult. This simply involves going to the telemedicine room where the staff will record some demographic information, and then either take digital photos or schedule an appointment for you to see the Specialist via a video teleconference arrangement.

Telemedicine Staff-to-Patient Brief:

a. **Briefly describe the Telemedicine System** and how it works.

b. **Explain the *Privacy Act Statement***, i.e.: "In this session, I am going to create an electronic medical record for you. Just like your paper medical record, the information stored here is protected by the *Privacy Act Statement* and can only be viewed by qualified medical personnel with a need to know, to include your doctor, the specialist, telemedicine technicians like myself and maybe Quality Improvement personnel who review records for our quality assurance program. Please read the *Privacy Act Statement*, sign it and it will be put in your electronic medical record."

c. **Describe what procedures will be done**, i.e. digital photos/physical examination with the scope.

d. **Describe the Live Video Program**, and provide a summary of how it works.

e. **Discuss the following "Camera Presence Do's and Don'ts"** with the patient:

- Remind the patient to look at the camera when talking.
- Remind the patient to be open and candid with the physician as if the person were sitting across the desk from you.
- Remind the patient to try to keep from rocking, fidgeting, or moving too much to help keep the camera focused at all times.
- Remind the patient to be specific, and to keep to the point, since appointment time is limited.

f. **Discuss patient confidentiality**, i.e.: "everything that goes on here is protected by the *Privacy Act Statement* which you signed and we put in your electronic record. Nothing in the session will be recorded except for digital photos that may be requested by the Specialist either before the consult or during the consult. There will be written notes by the Specialist detailing the encounter and this will go in your medical record."

g. **Rehearse the session** with the patient with the time remaining prior to the live video meeting, and ensure all questions are answered and the patient feels comfortable with the telemedicine encounter.

h. **Informed Consent** - A patient must be briefed on the potential risks, consequences and benefits of telemedicine prior to signing an informed consent. Ensure the patient understands they may withdraw consent at anytime without penalty. The Informed Consent shall become part of the patient's medical record. Every patient utilizing Telemedicine regardless of military status must sign an Informed Consent. (See Enclosure (3).)

i. **Patient Privacy** - The Telemedicine encounter must provide as much privacy as possible. Limit access to the Telemedicine Suite to essential personnel only. If another health care provider requests to view a Telemedicine Encounter on either end of the encounter, the patient must be informed and give permission. The patient also has the right to request non-medical personnel to leave the room during the encounter.

j. **Patient Satisfaction Survey** - each patient will be asked to complete a patient satisfaction survey so that continual improvements can be made to the program.

Handling the Difficult Patient

- A thorough prebrief is paramount to a successful telemedicine session. On occasion, a patient's behavior may become difficult to manage. When this occurs, the Telemedicine staff will temporarily suspend the session, and attempt to remedy the problem. If the patient is agreeable to the resolution, the procedure will continue. If the situation cannot be easily resolved, the session will be terminated.

Job Descriptions, Duties and Responsibilities

- *Telemedicine Team Leader*: Provides guidance, supervision and instruction regarding the implementation and use of the Telemedicine System. Also includes consult scheduling through the Referral Management System (RMS). Reviews all policies and reports for Telemedicine, holds periodic quality review meetings with team members. Acts as the primary liaison with the Office of the Lead Agent (OLA). The *Telemedicine Team Leader* must have a minimum of one-year left at the MTF.

- *Telemedicine Technician*: Primary operator of the Telemedicine System. Conducts patient briefings and encounters. Maintains electronic medical records, stores and forwards, and alerts providers of incoming records. Provides preventive maintenance on the system, orders supplies, and is the primary physical security officer. Provides, collects, and consolidates reports. Provides software maintenance. Manages security codes and passwords. It is highly recommended that the MTF designate a secondary Telemedicine Technician in order to provide uninterrupted care. The Telemedicine Technician must have a minimum of one-year left at the MTF.

- *Telemedicine System Manager*: Provides hardware maintenance and repair. Installs system upgrades, conducts higher level preventive maintenance. Responds to trouble-calls and interfaces with OLA and contract technicians. This is usually a staff member from the MTF Systems/IRMD

- *Managed Care Representative:* Coordinates with the Telemedicine Staff for periodic review of records IAW MTF/Department policies. Assists with record review for Quality Improvement, Utilization Management and Risk Management as needed and liaison with OLA in collecting and tracking data for the Telemedicine Program.

- *Specialist:* Provides specialty care to the scheduled Telemedicine patient and remains a credentialed provider through their MTF. If an evaluation cannot be satisfactorily performed via telemedicine, the specialist may request an in person evaluation through the normal referral mechanism.

Training

As the Telemedicine program was implemented in TRICARE Region Nine, designated staff from each MTF received the "Telemedicine Implementation Course." The course included the history of Telemedicine; legal implications; data collection; camera presence with the patient, and instruction on how to use the equipment. A copy of the course is kept in TTAO.

Current Telemedicine program personnel at each MTF will train new personnel and will then sign off the Telemedicine Orientation Certificate. A video entitled "Rhinolaryngoscope Exam" is also available to supplement training. The Telemedicine & Technology Assessment Office is available to facilitate the training of new personnel as needed.

Equipment

a. Enclosure (4) is a list of equipment the MTF received to implement the Telemedicine Program and the network diagram.
b. The Telemedicine Staff at the MTF should contact the Department Head, Telemedicine & Technology Assessment Office (TTAO) or Telemedicine Clinical Coordinator at OLA to report problems with the Telemedicine equipment.
   The TTAO Staff will contact the manufacturer and arrange for technical support as available.
c. It is the responsibility of the individual MTF to ensure that their Biomedical Department inspect and approve the equipment. Any concerns should be directed to TTAO.
d. The care and cleaning of the Telemedicine peripherals (scopes, etc.) should be done in accordance with (IAW) the MTF Infection Control Policy. Enclosure (5) includes cleaning recommendations from the manufacturer.

System Security

Physical Security: When not in use, the Telemedicine room must be secured IAW the MTF policies.

System Security: Access codes and passwords will be safeguarded IAW the MTF policies.

Metrics

Metrics are tracked by TTAO. Data is collected through the Referral Management System (RMS), and verified with the individual MTF. The metrics include:

a. Number of patients seen via Telemedicine.
b. Man-hours saved by keeping the Active Duty member at their Command.
c. TAD/TDY Costs Deferred

The metrics are based the following information:

San Diego Per Diem	To Dec 98	Jan 99 –
Low = No Gov't Meals + I.E.	$38	$46
Median = No Gov't Meals + I.E. + 16 (random quarters amt.)	$54	$62
High=Max Lodging + No Gov't meals + I.E.	$131	$135
	To Dec 98	**Jan 99 –**
Max per diem	$131	$135
Max Lodging	$93	$89
No Gov't meals	$36	$44
Provided meals	$0	$26
Incidental expenses	$2	$2

Travel Statistics

MTF	Man-Hrs	Mileage	Travel Costs
Edwards AFB	8	402	$124.62
Ft. Irwin	15	426	$132.06
Pt. Hueneme	16	364	$112.84
Vandenberg AFB	16	580	$179.80
LA AFB	8	242	$75.02
29 Palms	8	348	$107.88

A quarterly metrics report will be sent to the MTF Commanders, Telemedicine staff and Managed Care Departments.

Miscellaneous Information

Telemedicine-related web sites:	
Department of Defense Telemedicine	www.tatrc.org
Telehealth Magazine	www.telemedmag.com
American Telemedicine Association	www.atmeda.org
Telemedicine Today Magazine	www.telemedtoday.com
Association of Telemedicine Service Providers	www.atsp.org
Legamed, Inc.	www.legamed.com
Telemedicine Information Exchange	http://208.129.211.51
The Federal Telemedicine Gateway	www.tmgateway.org
The Office of Advancement of Telehealth	www.telehealth.hrsa.gov

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14. ABSTRACT (maximum 200 words)

Telemedicine technologies, such as Internet and live videoteleconferencing (VTC), have great potential to provide specialized health care for naval personnel in remote situations at sea or onshore. A retrospective evaluation was conducted on telemedicine use in TRICARE Region Nine which has a hub military treatment facility (MTF) at Naval Medical Center, San Diego providing specialty consultations for seven remote MTFs in southern California. A total of 1,364 telemedicine consultations by VTC (76%) and store-and-forward (24%) modalities were analyzed. Substantial variation in telemedicine use was seen among the MTFs (Port Hueneme = 352 consults; Vandenburg = 45 consults). The rate of telemedicine use for specialty care in TRICARE Region Nine increased regularly and substantially with the age of the telemedicine systems (time since operational); this finding generalized across MTFs and several medical specialties. Preliminary data indicated that diagnoses changed in 49% of consultations. The relatively high rate of telemedicine use for specialty care seen in this network makes TRICARE Region Nine an excellent system for study. Quantitative models including factors that predict use and clinical impact of telemedicine for specialty care in remote MTFs would provide valuable guidance for application of such technologies on small ships at sea.

15. SUBJECT TERMS
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