

Original Research

The Pacific Asynchronous TeleHealth (PATH) System: Review of 1,000 Pediatric Teleconsultations

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Abstract

Objective: The aim of this study was to evaluate the impact on pediatric care of the Pacific Asynchronous TeleHealth (PATH) system, a provider-to-provider teleconsultation platform utilized by military medical facilities throughout the Pacific Region. This review focuses on access to care, quality of care, and cost savings for the Department of Defense as a result of ongoing development of the PATH system from 2006 to 2009. **Methods:** This is a retrospective review of 1,000 consecutive teleconsultations occurring from January 2006 to March 2009. Three pediatric subspecialists reviewed the characteristics of each teleconsultation and the ultimate outcome. **Results:** The PATH system processed > 300 pediatric teleconsultations in 2009 from 20 hospitals and clinics throughout the Pacific Region. The number of teleconsultations has grown significantly since 2006. Median teleconsultation response time was 14.5 h with 97% of teleconsultations answered within 1 week. The majority (75%) of teleconsultations came from areas without host nation pediatric subspecialty resources. Most teleconsultations (72%) involved diagnostic questions, whereas 21% were primarily for treatment issues. Teleconsultations originated predominantly from outpatient clinics (90%), with question resolution in 60% of cases without a face-to-face subspecialty evaluation. Fifteen percent of teleconsultations resulted in patient transfer to our center for definitive diagnosis and treatment. The diagnostic and/or treatment plan was modified in 74% of teleconsultations. PATH precluded patient transfer in 12%–43% of teleconsultations (annual savings: \$208,283–\$746,348 per year) and generated an average of 1.7 relative value units per teleconsultation. **Conclusions:** PATH provided patient access to pediatric subspecialty expertise via provider-to-provider asynchronous teleconsultation. Internet-based pediatric subspecialty teleconsultation provides fast, convenient, cost-effective, quality pediatric care to populations of patients who might otherwise require transfer to a distant medical facility for more advanced care. PATH serves as a model for future asynchronous teleconsultation platforms in both the military and civilian healthcare arenas.

Key words: pediatrics, telemedicine, asynchronous, military medicine

Introduction

The Department of Defense (DoD) Healthcare System for the Pacific Region is widely distributed over five time zones and the International Date Line. Primary care clinics and community hospitals are scattered throughout Japan, Guam, and South Korea to provide healthcare to military service members, retirees, veterans, and their dependents as well as eligible civilian employees. Tripler Army Medical Center (TAMC), located on the island of Oahu (State of Hawaii), serves as the military's tertiary medical referral center for the Pacific Region. However, travel to Hawaii for evaluation requires costly air travel and lodging, which represents significant cost to the DoD healthcare system. Alternatively, host-nation subspecialty consultation resources are available in some locales, but limited by cultural/language barriers, out-of-pocket patient costs, and patient/parent concerns.

To improve access to care, reduce cost, and improve the quality of care, for the past decade pediatric subspecialists in our center have used the Pacific Asynchronous TeleHealth (PATH) system to provide secure, HIPAA-compliant, provider-to-provider, asynchronous (store-and-forward) teleconsultation. Store-and-forward telemedicine involves acquiring medical data (such as medical images and biosignals) and then transmitting these data to a doctor or medical specialist at a convenient time for assessment offline. It does not require the presence of both parties at the same time. A review of our initial teleconsultation efforts demonstrated that PATH improved access and quality while reducing cost.¹ Consequently, in 2006, PATH was transitioned from a demonstration project and began functioning as a routine component of pediatric practice in the Pacific Region. This retrospective review of 1,000 pediatric teleconsultations from 2006 to 2009 evaluates the PATH system's impact with regard to access, quality, and cost, demonstrating the benefits of incorporating asynchronous provider-to-provider teleconsultation into routine pediatric practice. Further details of PATH system function may be found elsewhere.¹

Methods

PATH TELECONSULTATION SYSTEM

PATH supports teleconsultations from >20 hospitals and clinics located in Japan, Korea, and Guam. General pediatricians, family medicine physicians, and physician extenders use the PATH system to submit teleconsultations to pediatric subspecialty consultants at TAMC. The PATH system is Health Insurance Portability and Accountability Act (HIPAA) compliant, operating on a secure platform using encrypted passwords for provider authentication. The PATH system is maintained at TAMC by the informatics department on existing servers. Remote providers utilize their own Internet browser

and any scanners, cameras, or other devices to provide relevant media necessary in remote locations to submit teleconsultations. Using PATH, a remote provider submits patient information with any associated media (images, video, sound, etc.) and concludes the submission with a consultation question. The teleconsultation request is automatically routed to a PATH case manager who directs the teleconsultation to one or more appropriate pediatric subspecialty consultants. The subspecialist reviews the teleconsultation and may ask for further information and/or render advice to the remote care provider. The responses of all participating providers are logged chronologically and form an ongoing discussion among all providers involved. Additional details on the teleconsultation submission process and PATH functionality have been reported previously.¹

RETROSPECTIVE REVIEW

The study protocol was approved by the TAMC Human Use Committee. The PATH system records basic demographics as well as location and specialty of all physicians involved in each teleconsultation. Forwarding time (time from consult submission to forwarding action by a case manager) and response time (time from consult submission to first response from the subspecialist) were also recorded and reported for all teleconsultations.

Three pediatric subspecialists familiar with the PATH system independently reviewed each teleconsultation and answered nine questions for 1,000 consecutive PATH cases beginning in January 2006 and ending in March 2009. The questions explored the characteristics of the teleconsultation as well as the outcomes and impact (Table 1).

Table 1. Questions Completed by Our Panel of Reviewers for Each Teleconsultation

1. Was the teleconsultation submitted primarily for pretransfer/case management information purposes only? Yes/no
2. Was the teleconsultation submitted primarily for the review of images?^a Yes/no
3. Was the teleconsultation for an inpatient? Yes/no
4. Was further information/data requested by the subspecialist?^b Yes/no
5. Teleconsultation question type—choose one: diagnosis/treatment/prognosis/other
6. Teleconsultation outcome—choose one: question resolved/air evacuation to TAMC/referred to local area subspecialist/other
7. Was a face-to-face subspecialty visit avoided? Yes/no
8. Was the diagnostic plan modified by teleconsultation? Yes/no
9. Was the therapeutic plan modified by teleconsultation? Yes/no

^aExamples of images include but are not limited to radiographs, electrocardiograms, and others.

^bExamples of consults requiring further information from the referring provider include requests for evaluation of syncope without inclusion of a 12-lead electrocardiogram and pulmonary consults without a chest X-ray.

TAMC, Tripler Army Medical Center.

The cost savings from prevented patient transfers to our center were estimated for full evaluation. Using the data from the above teleconsultation review, the minimum and maximum estimates for cost savings/avoidance from unanimous agreement (3/3) and simple majority ($\geq 2/3$) among reviewers, respectively, were derived. Travel cost for patient transfer was estimated to include the average cost of two commercial airline tickets from the western Pacific to Hawaii (child and one parent) at \$2,331 each. The *per diem* reimbursement for the parent was \$331 per day for 10 days (average cost paid by DoD for a parent and child staying in Hawaii for medical evaluation to cover meals, lodging, and incidentals). Thus, the total cost for one transfer in this model was estimated to be \$5,641.

The revenue generated for our institution was calculated by determining the number of relative value units (RVUs) generated by all PATH cases each year for which data are available (January 1, 2007 to December 31, 2009). RVUs were multiplied by our institution's reimbursement rate per RVU as provided by the military health system administrative system.

Results

The number of PATH teleconsultations increased over the period of review (Table 2). Of 1,000 teleconsultations reviewed, 74% came from remote areas without local pediatric subspecialty resources, whereas 26% originated in areas with locally available host nation pediatric subspecialty services (Tokyo, Japan or Seoul, Korea metropolitan area). Median patient age was 2.9 years (range: birth to 18 years). Teleconsultation requests originated from general pediatrics (80%), family medicine (10%), neonatology (7%), or other disciplines (3%). Inpatient teleconsultations constituted 10% of all cases. Each year, referring providers submitted ~ 10% of teleconsultations specifically to facilitate patient transfer and case management and an additional 10% primarily for review of images and media versus formal consultation. On average, 2.3 multimedia images (audio, video, and/or sound) per teleconsultation were uploaded. This can be compared with 0.9 per case from 2004 to 2005 and likely reflects increasing availability of digital imaging/recording devices. Median forwarding time from consult manager to the subspecialist was 3.8 h. Median subspecialist response time was 14.5 h (92% by 3 days, 97% by 1 week). Twenty-eight different pediatric

Table 2. Pacific Asynchronous Telehealth System Teleconsultations 2006–2009

YEAR	TOTAL NUMBER OF NEW TELECONSULTATIONS
2006	276
2007	288
2008	385
2009	380 ^a

^aOnly the first 51 cases from 2009 were analyzed in our review of 1,000 consecutive cases.

Table 3. Most Frequently Consulted Pediatric Medical and Surgical Subspecialties 2006–2009

PERCENTAGE OF MEDICAL AND SURGICAL TELECONSULTATIONS	
Medical specialties	
Cardiology	20%
Gastroenterology	17%
Neurology	16%
Endocrinology	14%
Surgical specialties	
Otolaryngology	31%
Urology	23%
Pediatric surgery	11%

subspecialties were consulted with the most frequently consulted medical and surgical subspecialties listed in *Table 3*.

Based on our panel’s review, referring providers achieved question resolution in 63% (range: 57%–65%) of all teleconsultations. An additional 24% of all teleconsultations resulted in patient transfer to our center for a face-to-face (in-person) visit. Patients transferred to our center came from remote areas without local subspecialists in 74% of teleconsultations and 26% came from urban areas with locally available subspecialists. Only 2% of cases were referred to local subspecialists.

Data collected from reviewer questionnaires offered further detail regarding the characteristics and ultimate outcomes of the teleconsultation. Subspecialists requested further information from the referring provider in 25% (range: 10%–39%) of all teleconsultation (e.g., *Table 1*). Teleconsultation questions were diagnosis related in 72% (range: 69%–79%), treatment related in 21% (range: 7%–31%), and related to prognosis or other issues in 8% (range: 1%–15%). The diagnosis and/or treatment plan was modified in 74% (range: 65%–84%) of teleconsultations.

All three reviewers agreed that PATH obviated face-to-face subspecialty evaluation in 12% of all teleconsultations. Two of three

reviewers agreed that PATH teleconsultation prevented face-to-face subspecialty evaluation in an additional 31% of cases. Thus, in 43% of teleconsultations, a majority of reviewers answered that PATH teleconsultation prevented face-to-face subspecialty evaluation. Using the 12%–43% of our 1,000 cases in which reviewers assessed that face-to-face consultation was prevented, the conservative cost savings estimate was found to be \$208,283 per year and the high-end estimate was \$746,348 per year.

Revenue generated from RVUs earned from PATH teleconsultations between January 1, 2007 and December 31, 2009 is presented in *Table 4*. RVUs per teleconsultation ranged from 1.5 per case in 2009 to 2.0 per case in 2008. This amounts to an average of 1.7 RVUs per teleconsultation. Average generated revenue was \$36,177 per year.

Discussion

Over the past decade, PATH has grown and developed into a firmly established, widely utilized asynchronous telemedicine system in the Pacific Region. PATH has improved access and quality of care delivered at considerable cost savings to the DoD Health System. The system is secure and easy to use for provider-to-provider communication with responses to clinical questions occurring in a timely fashion. This study confirms many findings from the previous report¹ on military telemedicine in the Pacific. Response times have remained essentially unchanged since 2005 and are still considerably faster than local referral, arguing even for use of asynchronous telemedicine in metropolitan areas. With no official mandate for use, user training, or active promotion, PATH continues to receive increasing numbers of teleconsultations each year, a sign of PATH’s utility and ease of use. PATH extends subspecialist expertise to distant providers faced with limited or no local subspecialty support.

PATH also improves the quality of care delivered locally. As rates of diagnosis and/or treatment modification indicate (65%–84%), in PATH’s absence, some diagnoses may not be made, and some treatments may be delayed or not offered. The rates of diagnosis and/or treatment modifications have increased from 15% to 24% in a previous paper to 65%–84% of teleconsultations in this review, although our methods for measuring effectiveness differed from the previous study. This high rate of diagnosis or treatment modification suggests that primary care providers use PATH teleconsultation not only for

Table 4. Annual Relative Value Units Generated for 2007–2009

YEAR	CASES ^a	TOTAL RVUS	RVUS PER CASE	% OF RVUS FROM CPT	DOLLAR AMOUNT PER RVU	TOTAL GENERATED REVENUE PER YEAR
2007	288	483	1.7	13%	\$59.29	\$28,637
2008	385	756	2.0	12%	\$48.71	\$36,825
2009	380	576	1.5	20%	\$74.77	\$43,068
Total or average	1,053	1,815	1.7	15%	–	\$36,177 per year

^aApproximately 2/3 of all PATH cases had a bill submitted.

CPT, current procedural terminology; PATH, Pacific Asynchronous Telehealth; RVUs, relative value units.

reassurance but also to aid them in offering patients an improved plan. The increase in rates of diagnosis and/or treatment modification might also reflect fundamental changes in primary care practice and referral patterns after incorporating a reliable subspecialist teleconsultation platform into routine practice. If the primary care doctors have confidence that they can have a question answered quickly and reliably from trusted subspecialty consultants, they may wait for input from the subspecialist before implementing an initial diagnostic or treatment plan.

Perhaps most compelling is that over 60% of all teleconsultation resulted in resolution of the referring provider's question. This suggests that a network of physicians with fast, reliable, and convenient access to subspecialists would be able to achieve much greater quality of care delivered at a significant cost savings. This form of consultation would also enable the primary care provider to remain "the familiar face" of the patient's medical home. Subspecialists would also benefit from reductions in unnecessary appointments to address questions that could have instead been addressed through teleconsultation with the patient's primary care provider. Even when multiple communications between providers were necessary, PATH facilitated such an exchange, as evidenced by subspecialists requesting further information in approximately one-fourth of teleconsultations.

Our reviewers unanimously agreed that face-to-face subspecialty visits were avoided in 12% of teleconsultations. This rate is identical to that found during the review of PATH's early impact by Callahan et al.¹ The true amount saved through air evacuation avoidance may be even higher. Using a simple majority for avoided air evacuations, the cost avoidance is nearly four times (\$746,348 per year) the conservative estimate (\$208,283 per year) of total savings over the period of this review. To improve the precision of cost avoidance and efficacy estimates, future studies exploring the effectiveness of teleconsultation systems should include the opinions of expert panels, blinded reviewers, and use of surveys to be completed by the referring providers upon completion of each teleconsultation.

The introduction in 2007 of the workload capture functionality enabled the PATH system to generate revenue for our institution (Table 4). Billing for teleconsultations answered in PATH is neither mandatory nor universal. RVUs generated amount to \$43,068 in 2009.

A literature search of asynchronous pediatric telemedicine yields references related to the provision of care to underserved children in austere, resource-limited, or hazardous environments.²⁻⁴ To our knowledge, PATH is the only provider-to-provider pediatric teleconsultation system that is utilized in routine pediatrics practice by a network of participating physicians. With effective written communication between providers, our asynchronous telemedicine approach adequately addresses most clinical questions without the inconvenience and cost of synchronous formats. A retrospective review of subspecialists managing oncology patients with the help of experts at centers of excellence using an asynchronous teleconsultation system demonstrated improved efficiency in communicating treatment recommendations.⁵ Others have previously demonstrated that store-and-forward videoconferencing may also play a role in future asynchronous systems.⁶

This study has several limitations and leaves some issues unresolved. The reviewers in this study acted as the consultants for some of the teleconsultations reviewed, creating a possible source of bias. In this article, determination whether teleconsultation obviates the need for transfer in any specific case is a subjective judgment. Incorporating surveys from the referring provider with comments on transfer avoidance would further enhance understanding the effect of teleconsultation on transfer rates. Future studies could include blinded, independent reviewers. Any person or organization generalizing teleconsultation lessons learned from PATH must recognize that numerous factors contribute to PATH's success within our unique healthcare environment. Active duty military members and their families undergo medical screening prior to assignment overseas in the western Pacific. The military attempts to exclude service members with severely medically affected family members from overseas assignment or service in remote locations. Although some severe pathology occurs within this population, overall health rates tend to be better than the general American population. Therefore, medical problems encountered at our referring hospitals and clinics tend to include higher rates of new diagnoses of disease rather than chronic conditions followed longitudinally. Even in areas with locally available subspecialists, referring providers are relying upon PATH for subspecialty consultant support at high rates. This may reflect cultural and language barriers (i.e., consultation reports, laboratory results, and interpretations of electrocardiograms and electroencephalograms are in Japanese or Korean) to local care between patients and doctors extant in many of the referring sites and presents yet another difficulty of this unique practice environment. Finally, because of the added expense of a parent accompanying the child, pediatric transfers are more expensive than adult patient transports and increase the cost savings estimates from avoided transfers. Of note, the DoD typically absorbs the cost of patient/parent transfers, whereas patients often have to pay the cost of travel to a distant provider in Japan or Korea. Finally, the DoD allows for the claiming of workload credit via asynchronous teleconsultation and civilian counterparts may not always pay for this interaction.

Future studies of asynchronous provider-to-provider teleconsultation systems should include outcomes and quality studies incorporating input from the referring providers. System designers and administrators might also benefit from learning in more detail the rationale by which a referring provider chooses to submit a case for PATH teleconsultation versus alternative options (i.e., referring to a local subspecialist, discussion with a colleague within his/her own discipline, telephone call, e-mail, direct air evacuation to Hawaii, or managing the problem independently). A randomized, prospective, controlled trial of teleconsultation with the possibility of subsequent referral if indicated after teleconsultation versus direct referral would be difficult to orchestrate because of cost and distance involved in the Pacific Region. For low-acuity, nonurgent subspecialty referral, such a trial might be accomplished within a network of providers interested in the development of an asynchronous teleconsultation system similar to PATH. Various subspecialties, particularly within adult medicine and surgery, also merit further inquiry and represent areas of potential future investigation.

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Disclaimer

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Disclosure Statement

No competing financial interests exist.

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