

# Pacific Island Health Care Project: early experiences with a web-based consultation and referral network

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## Abstract

The Pacific Island Health Care Project (PIHCP) has in the past provided definitive care at the Tripler Army Medical Center (TAMC) for nearly 3000 patients. To contain costs, increase access, and provide consultative and referral services to physicians in the Pacific Basin, a web-based network was established in 1997. Four sites in the Western Pacific were provided with a desktop computer, digital still and video cameras, flatbed scanners, and printers. Consultations with supporting imagery are submitted to TAMC where the consults are data-based and dynamically posted on a secure web server. TAMC consultants triage and comment on the cases and the educational significance. Unnecessary or inappropriate referrals are returned with instructions for local care. Cases are formatted to allow rapid response, image review, consultant/provider interaction, and peer review. More than 180 consults have been submitted from the island nations electronically (30 September 1998) and initial experience indicates that the Internet can be easily used as an inexpensive store and forward consultation format. There has been an overwhelming enthusiasm for this project by all participants and for the first time since the inception of the PIHCP, funding was available during the entire fiscal year, with tens of thousands of dollars saved.

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## Introduction

For nearly ten years Tripler Army Medical Center (TAMC) has cared for medically underserved Pacific Islanders from the United States Associated Pacific Islands (USAPI), who uniquely benefit Graduate Medical Education (GME), as a part of the Pacific Island Health Care Program (PIHCP). The United States Congress annually appropriates funds in support of travel and limited reimbursement to the hospital for the medical costs incurred by patients cared for under the project. As medical costs escalated, the program was faced with significant challenges and budgetary constraints. During that same period TAMC pioneered several telemedicine initiatives in the Pacific Basin in an attempt to provide timely, accessible and cost effective consultative, referral and educational services to healthcare providers and their patients throughout the USAPI. An internet based consultation and referral network was established linking TAMC initially with five Micronesian hospitals. This network has been found to be uniquely fitting to all of our needs.

## Background

The former Trust Territories of the United States, now called The United States Associated Pacific Islands (USAPI) include six jurisdictions spread over a massive expanse of ocean (see Figure 1.). Three of the island nations are U.S.

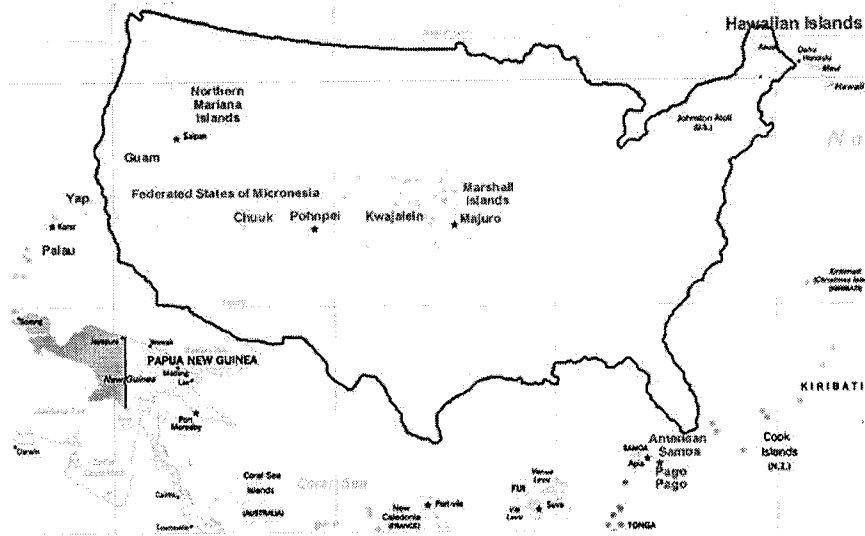
Flag territories: Guam; The Commonwealth of the Northern Mariana Islands (CNMI); and American Samoa. The other three are independent, freely associated states: The Republic of the Marshall Islands (RMI); The Federated States of Micronesia (FSM) including

the states of Chuuk, Kosrae, Pohnpei and Yap; and in the far Western Pacific, The Republic of Palau (ROP). Medical care for the indigenous peoples (approximately 500,000) is provided by medical officers, expatriate physicians, medical personnel of the U.S. Public Health Service, midwives, health assistants and traditional healers.

Off-island referrals have become all too commonplace from the USAPI with a small number of people utilizing a large portion of the various jurisdiction's limited health care budgets for such referrals. The recent Institute of Medicine

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Fig. 1. Map of the Pacific Islands overlaid on the U.S. map



report on healthcare in the Pacific Basin documents that more than a third of some jurisdiction's health budget benefits less than 1% of the populace.<sup>1</sup> The PIHCP has sponsored more than 2,500 patients in the past nine (9) years, but at an enormous cost, some years approaching US\$8,000,000. Medical educational benefits to trainees in the various residency training programs at TAMC have been substantial and the humanitarian aspects of the program are incalculable.

Table 1 lists the number and origin of the patients accepted under the PIHCP in the mid-1990s. Historically, the FSM refers the largest number of patients to the PIHCP. From the various states of the FSM, Chuuk State clearly leads the others; not only is it the largest and most populous state, but it has some of the most inadequate health care facilities. This is followed by the RMI where the great majority of patients come from Majaro, the capital of the Marshall Islands. This is followed by American Samoa, where patients are referred from the LBJ Tropical Medical Center in Pago Pago. The ROP in the Western Pacific, which

has some of the more sophisticated medical facilities of any of the islands of the USAPI, sends fewer patients. Finally, a small number of patients over the years come from Guam and the CNMI as both jurisdictions have national health insurance which provides for medical services in Guam, Saipan, the Philippines, or the U.S. mainland.

The largest number of patients in any given year are treated in the department of surgery, followed by the departments of medicine, pediatrics, and obstetrics and gynecology. In general, patients are only admitted to services and departments that are involved in GME. In the case of the various surgical sub-specialties, Pacific Islanders have an unusually high prevalence of a number of conditions which are infrequently seen in Residency Training Programs on the U.S. mainland. For example, malignant otitis media, chronic mastoiditis, and cholesteatoma are common among Pacific Islanders, affording trainees in otorhinolaryngology experience with radical mastoidectomy and in some cases experience in the treatment of brain abscesses. Head and neck cancers are very common in

Table 1. Pacific Island Health Care Program

Jurisdiction	Number of patients		
	FY 1994	FY 1995	FY 1996
FSM	187	141	60
RMI	164	140	48
American Samoa	60	68	23
ROP	41	51	27
Guam/CNMI	10	12	2
<b>TOTAL</b>	<b>462</b>	<b>412</b>	<b>160</b>

**Table 2. Pacific Island Health Care Program, 1995**

Department	Number
Surgery	201
Medicine	80
Pediatrics	74
Obstetrics/Gynecology	56
Dentistry	1
<b>TOTAL</b>	<b>412</b>

Pacific Islanders, again providing a unique opportunity for these sub-specialty trainees. Renal stones are frequent and hyperuricemia adds to the problem. Likewise, hypospadias is common in parts of the Pacific Rim and this allows trainees in urology the opportunity to surgically remove large kidney stones and to do reconstructive surgery, not to mention the presence of renal tuberculosis and renal tumors which provide unique training opportunities. In the areas of medicine, pediatrics and cardio-thoracic surgery, rheumatic heart disease is rampant in the Pacific and valve replacements are commonly done at TAMC. In the area of orthopedic surgery; osteomyelitis, septic arthritis, tuberculous bone and joint disease, malignancies, scoliosis, and trauma make up a significant part of the problems encountered by our orthopedic residents. The neurosurgeons are sought after for the treatment of patients with brain tumors, brain abscesses, subdural empyemas and hydrocephalus. General surgery's training program benefits from patients with congenital, malignant, and traumatic conditions, amenable to surgical intervention.

In pediatrics and internal medicine a number of Pacific Islanders with infectious diseases are treated; from tuberculosis to leprosy to tropical pyomyositis to leptospirosis, which is commonly encountered in Kosrae State in the FSM<sup>2</sup>. Diabetes mellitus is epidemic in the peoples of the Pacific with its attendant multi-system complications. In the area of obstetrics and gynecology, not only are there high risk pregnancies with young women who have rheumatic heart disease or tuberculosis, but there are many with advanced gynecological malignancies that are not commonly seen in the U.S.

Until the recent involvement of the internet-based consultation, referral network, patients were referred to the PIHCP by letter, facsimile or telephone. The problems of telephonic consultation are obvious and in the Pacific even more a problem, because of the fact that the international date line separates Hawaii from the Western Pacific and

there are five time zones as one moves westward. Furthermore, telephone communications have been less than ideal and often times in the middle of a conversation, the referring physician would be cut off from the Medical Director trying to make an assessment of the patient's condition, or in attempting to forward the telephone call to

**Fig. 2. Consultation form**

**Request for a Consult by Donald A. Person**

Please complete this form with as much detail as possible. The amount of information you provide us will determine the amount of assistance you receive.

Date: 10/02/2000 Location: Hawaii

**I have received verbal consent from the patient to submit this consult**  
Type Yes or No. No If not, please stop here.

**Patient Information:**

Is this a web based consult? Yes

Passport Last Name: \_\_\_\_\_ Passport First Name: \_\_\_\_\_

Date of Birth: 10/2/2000 Age: 0 year(s)  
(MM/DD/YYYY) Type in DOB or Click button to Select Date

Gender: Male Weight: 0 lbs. (2.2 pounds = 1 Kilogram)

Ethnicity: Yapese Other Ethnicity: \_\_\_\_\_

**Reasons for Consult**

Are you requesting to transfer patient to Tripler? Click to Select

Permission granted by referring off-island committee? Click to Select

Primary Diagnosis: \_\_\_\_\_

Secondary Diagnosis: \_\_\_\_\_

Tertiary Diagnosis: \_\_\_\_\_

What is your Question? \_\_\_\_\_

the appropriate specialist at TAMC. Fax seemed to work somewhat more efficiently but before official government travel orders were issued, the patient's name, date of birth and passport number were essential or the patient was not allowed to board the airplane. In the early years of the PIHCP, patients from the USAPI stayed an inordinate number of days in the hospital with average bed days exceeding twenty per patient. In the last several years, many of the jurisdictions have purchased, rented or leased properties on Oahu where their patients and accompanying family members stay when the patient is being treated at TAMC or where, when they go to an outpatient status, they can stay between visits. On average, the cost of a round trip here for a patient who can sit unattended averages on the order of fifteen hundred to three thousand dollars.

Years ago, the senior leadership at Tripler recognized the importance of telecommunications of all types and in fact, TAMC was designated test site for Composite Health Care System (CHCS) during the 1989/1990 timeframe. This computerized system evolved rapidly within the institution and between the hospital and outlying clinics. It allowed for electronic order entry of laboratory, pharmacy, radiology, outpatient and ultimately inpatient services. An e-mail function was extensively used for the purpose of communication within and without the institution and finally, with a software upgrade in December 1995, internet mail to CHCS became possible. File attachments, however, were not allowed into the secure CHCS system.

Telemedicine consultations between the U.S. Army Kwajalein Missile Range in Kwajalein, RMI, (where an existing AT&T video teleconference system and center had been built) and TAMC was initiated in 1993. This allowed TAMC specialists to provide about two hundred medical/surgical consultations involving active duty personnel, family members, contractors, and Department Of Defense civilians and a few Marshallese stationed on Kwajalein. This process certainly obviated a few unnecessary and expensive referrals to Honolulu<sup>3</sup>. The process, however, was difficult to

**Pacific Island Referral Form**

Island Referred from: Pohnpei

Patient's Last Name: Doe      Birthdate: 11/15/93      Sex: Female      Weight (In Pounds): 22.75 lbs.

Passport Number: \_\_\_\_\_      First Name: Jane      Age: 0.0      Citizenship: \_\_\_\_\_

Check One:  Emergency     Routine

Patient's Employer: \_\_\_\_\_ (Please note: Home for unemployed or self employed)

Is this a government authorized patient?  Yes  No

If yes, who is the signature authority on Government Authorization? (Must be Chief Financial Officer)

Date of authorization if government authorized (month, day, year)

Government Authorization: \_\_\_\_\_      Fax letter to (808) 433-9025

Insurance?  Yes  No

You can leave the rest of this insurance section blank if patient does not have insurance.

Name of Insurance Carrier: \_\_\_\_\_      Effective Date: \_\_\_\_\_      Policy Number: \_\_\_\_\_

Plan Number: \_\_\_\_\_      Telephone Number: \_\_\_\_\_

Island Physician's Last Name: \_\_\_\_\_      First Name: \_\_\_\_\_

Telephone Number: \_\_\_\_\_

Referring Provider Title: Staff Physician

support were all required. It is interesting to note that whereas the project in the first year had a large number of consultations, in subsequent years, the number decreased incrementally to less than 20 per year, at which point it was discontinued.

At the Charter Meeting of the Pacific Basin Medical Association held in Pohnpei in the FSM in April 1995, the utility of the Picasso still image telephone was demonstrated when a teleconsultation was made between Pohnpei and Koror, Palau, when I was able to consult on a teenager with systemic lupus erythematosus.

Using the same system we were able to provide a telelecture from TAMC to Pohnpei. This was well received and it allowed interactive participation by the attendees of the meeting in Pohnpei and Palau. Four Picasso phones were donated to jurisdictions in the Western Pacific and over thirty telemedicine demonstrations were successfully carried out both on the island of Pohnpei, between islands in Pohnpei State, and internationally between Alaska, Hawaii, Pohnpei, New Caledonia, Kosrae, and Palau<sup>4</sup>. A number of patients were referred and accepted under the PIHCP using this process however, the cost of long distance telephone calls became prohibitive and most jurisdiction's health budgets could not continue to pay such telephone costs.

**Methods**

With access to the Internet, and e-mail becoming available in 1996 a few practitioners began to e-mail referrals to my desktop CHCS terminal. My e-mail messages were over-run with 30-40 screens filled with random letters and numbers.<sup>5</sup> Upon discussing this with senior AKAMAI personnel, a simple web-based solution was developed.

During the fourth annual meeting of the Pacific Basin Medical Association (PBMA) in Weno, Chuuk State, FSM, from 16-18 February 1998 we were able to demonstrate the possible utility of Internet consultation. This was of considerable interest to the audience representing the health professionals of the region.

schedule around busy practitioner duties, particularly consulting surgeons at TAMC. Expensive computer and video hardware and costly maintenance with skilled technical

Electronic mail with attached images be an acceptable method for consultation

Fig 4. (CXR) - 11 month old with eventration of diaphragm (Pohnpei)



Fig 5. (CXR) - 1 year old with teratoma (Marshall Is)

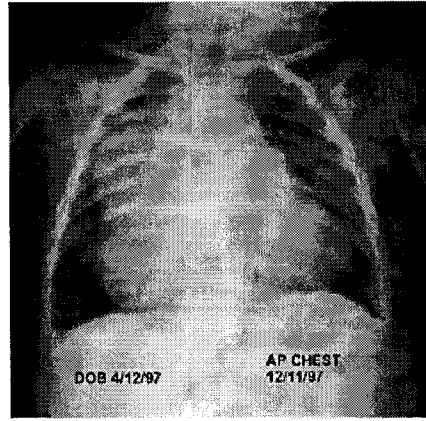


Fig 6. 1 month old infant with massive hepatospleno-megal secondary to congenital leukemia (Palau)

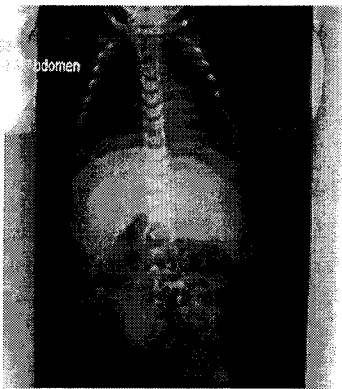


Fig 7. 20 year old woman with embryonal rhabdomyosarcoma (Yap)

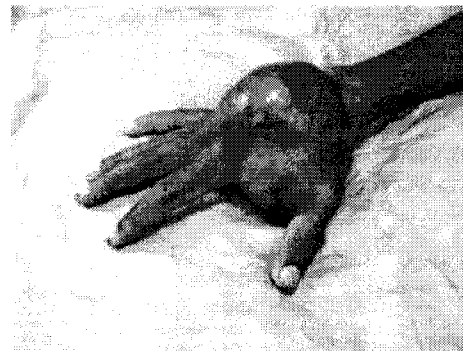


Fig 8. 10 year old girl with fistula in palate (Chuuk).

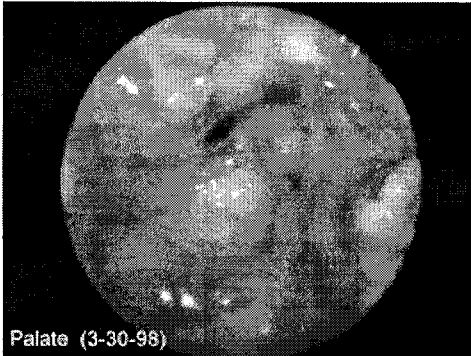


Fig 9. Newborn with ambiguous genitalia (Yap).

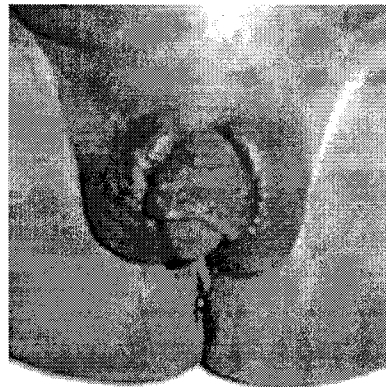
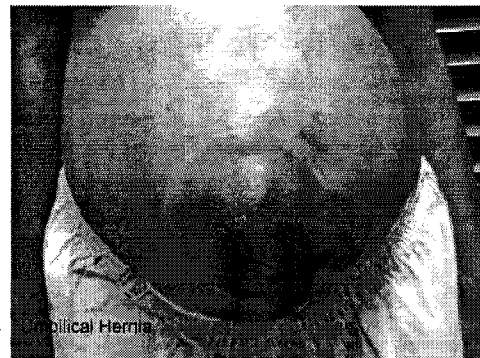


Fig 11. Non-union Fracture of Radius/Ulna (Chuuk).



Fig 10. Umbilical hernia (Chuuk)



tients. Several steps were needed to implement four beta-test sites within Micronesia. First, a consultation web page was created in Hyper Text Markup Language (HTML) with a clinical consultation form designed by the PIHCP Medical Director to ensure that the consultation contained sufficient information to allow the Medical Director as well as TAMC specialists to comment on the consultation. Second, a web page was created to post all current or recent consultations received from the Western Pacific. And third, (and ongoing), a group of TAMC specialists was trained in use of a web browser (Netscape Navigator) to access the consultations and referrals and comment on cases where appropriate. The use of a web-based system is a flexible approach

to patient management discussions through the support of accurate display and archival of pertinent patient data and imagery. The beta-test sites selected included; Weno, Chuuk State; Kolonia, Pohnpei State, FSM; Koror, ROP; and Majuro, RMI. Each location had relatively inexpensive Internet Service Providers (ISP), and 24 hour access to the Internet.

Each site was provided with:






- Desktop computer (Pentium II 300MHz, 64MB RAM, 4.3GB Hard Drive, 56KB Modem, 8MB Video Card, Video Capture Board, 17" .26 dpi Monitor)
- Digital camera (Olympus D-600L)
- Flatbed scanner with transparency adapter (Microtek Scanmaker E6 Professional)
- Digital video camera (Sony DCR VX-1000)
- Printer (Epson Stylus 800)

Additionally, two sites were provided with a digital otoscope and ophthalmoscope (American Medical Devices).





Training was conducted basically in two stages. First, a group of all interested clinicians at the fourth annual PBMA meeting in Chuuk was allowed an opportunity to familiarize themselves with, work with and test the equipment and be trained as desired. Then at each site subsequently, small groups were trained in a much more intensive one-on-one situation. For many of the medical officers, this was the first

**Fig 12. Case statistics.**

**A. Number of cases, by Location**

Chuuk		[42]
Majuro		[28]
Palau		[48]
Pohnpei		[48]
Yap		[11]

**B. Number of cases, by Department**

Medicine		[50]
OB/GYN		[8]
Pediatrics		[34]
Surgery		[85]

**C. Number of cases, by Gender**

Male		[100]
Female		[77]

**D. Consultation/Referral**

Consult Only		[134]
Referral		[43]

opportunity they had had to use a computer of any type. It should be noted that several senior American physicians in Yap, Pohnpei and Palau accessed the web page using their personal computers which contributed to the success and overall acceptance of this program.

A sample consultation form is shown in Figure 2 and a referral form is shown in Figure 3.

**Results**

The first consultation/referral sent using this web-based format was received on December 7, 1997. The patient was an adult Palauan male with a large renal staghorn calculus. Over the period of the next several months a few cases were referred by the senior

American physicians with personal computers in Palau, Yap and Pohnpei. It was not until after the meeting of the PBMA in February 1998, and individual training was completed at each test site in March, that consultations/referrals began to increase. In the first six months of the project nearly 200 patients have been consulted on or referred to TAMC.

Patient history, physical examination and laboratory data were included with each consultation request. When appropriate digital images were attached, these have included photographs of the patient or the area of interest or concern. Innovative use of lined superficial markings, tape measures, shadows, otoscopy, direct pharyngoscopy and laryngoscopy including video clips have all been effectively transmitted over the Internet to enhance the visual nature of selected cases. Laboratory flow sheets and serial electrocardiograms have been attached in several cases. Various radiological modalities including standard radiographs (in the early cases the digital camera was used to capture the image of an x-ray mounted on a light box), sonograms, mammograms, intravenous pyelograms and computerized axial tomograms (obtained in Guam) have been sent with some referrals. In several cases serial radiographs were transmitted, which allowed consultants to review the progression of the lesion(s). In some cases the Medical Director/Consultant suggested additional studies and in several cases chest radiographs were sent on the patient or

accompanying family member to rule out pulmonary tuberculosis in a PPD positive individual (as required by the airlines, so as to decrease the likelihood of spread of the *M. tuberculosis* to fellow passengers and crew during flight).

A number of representative images are shown in Figures 4-14.

Patient demographics and case statistics are posted automatically as cases are submitted. Island of origin, age, gender, consulting department, and consultation/referral patterns are graphically displayed as shown in Figure 12.

**Conclusion**

This project was initiated in an attempt to view images on a computer screen. The difficulty of dealing with a system that requires manual operation lead to the creation of an automated system. Thus we applied a methodology to help manage an practice with the developing c. There is no greater need for referral than in Micronesia where they struggle daily to care for numerous advanced medical and of minimal resources. Tripler

Government.

**References**

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attached. Referring physicians are able to dialogue with speciality and subspeciality consultants. The consultations have provided unique material for clinical conferences, grand rounds and clinical follow-up. The acceptance by the referring and consulting physician alike has been overwhelming. Cost savings have been substantial, not only direct costs but long distance telephone charges have been markedly reduced. Every patient treated on their home island represents a savings of US\$10,000-20,000, not to mention the disruption to the family that off island referrals produce.

**Disclaimer**

Views expressed in this paper are those of the author and do not reflect the official policy or position of the Department of Defense.

healthcare system. The difficulty that precluded Internet connection was an Internet based consultation system. A simple "store and forward" method would have allowed for enormous clinical consultation between countries of the Western Pacific for clinical consultation and where healthcare providers struggle with numerous patients with unique, of surgical conditions in a setting that has provided a complete system with by the referring physician to the consultation and referral as well as a medical community from which they are isolated.

In the first six months of operation the referral network has surpassed all expectations. Numerous consultations have been submitted.

... also learn more about the illness from the doctor who tells the story than from the story itself.  
 (1861 - 1954) Memories of Eighty Years

The doctor may tell the story  
 way the patient  
 J B Herrick (