

Telemedicine in the Federated States of Micronesia

DAVID RUTSTEIN*

Abstract

Telemedicine (other than costly long distance telephone and facsimile messages) in the Federated States of Micronesia (FSM) started approximately 4 years ago with the establishment of Internet access in the State of Yap. A local access, for medical use only, via already established trunk lines maintained by Continental Airlines was established. It provided a connection to CompuServe at a baud rate of 300 bps. FSM TeleCom provided this free service. While this connection was slow, it allowed medical staff at Yap State Hospital to send and receive text based email regarding patient management. By its use interest was generated in both medical and non-medical individuals to develop a commercial full scale Internet service. In March 1996, TeleCom became a full scale commercial internet Service Provider in Yap. Rates were reasonable and the CompuServe access was phased out. The full scale internet allowed medical personnel to engage in telemedicine activities, including email; email attachments; the search and retrieval of medical literature; transmission to medical specialists of X-rays, ECG's and other images; and real-time teleconferencing over the internet with both audio and video. In addition, to the improvement of medical care, this allowed for greater efficiency in arranging referral of patients for medical treatment outside of the FSM.

*US Public Health Service, Yap State Hospital, US Public Health Services, P.O. Box 750, Yap, FM 96943, Federated States of Micronesia, Ph: 691 350 2115; Fax: 691 350 3444; Email: drutstein@mail.fm

Introduction

Over the past several years, the practice of medicine in the Federated States of Micronesia (FSM) has taken on a new and exciting characteristic. In part, due to the widely distributed nature of the island states within the country, and in part, due to the decreasing financial resources available within those states, hospitals and medical practitioners have come to utilize and rely on a range of telemedicine components. How those components are used and the effects their use has had on the practice of medicine within the country will be discussed in this paper.

The Federated States of Micronesia

The FSM is comprised of four widely dispersed island states in the northwest Pacific Ocean. The four states, from East to West are Kosrae, Pohnpei, Chuuk, and Yap. They occupy an area of ocean, just North of the Equator, roughly 4.2 million km² in size. With the exception of Kosrae, which is only one island, all the states have a "main" island that contains the governmental and financial centers for the state, and inhabited "neighboring islands" which are generally less developed and lower in population. Each main island has an international airport. The neighboring islands are reached by ship, with few of them having rudimentary airstrips. In the 1994 census, the population of the entire country was determined to be 105,506 people¹.

The seat of the National government is located at Palikir, on the main island of Pohnpei. At the end of World War II, the United Nations established the Trust Territory of the Pacific, which comprised most of the islands in the Western Pacific North of the Equator. The United States was made the Trustee of this region. Over the succeeding years, the region divided according to customary and language affiliations leaving several nations, one of which was the Federated States of Micronesia. In 1986, the United States and the Federated States of Micronesia formally signed a Compact of Free Association, which delineated a 15 year period during which the United States would provide financial and technical assistance (valued at approximately US\$ 1.5 bil-

... due to the widely distributed nature of the island states within the country, and in part, due to the decreasing financial resources available within those states, hospitals and medical practitioners have come to utilize and rely on a range of telemedicine components.

lion) to the newly independent country. This assistance, designed to develop the infrastructure and stimulate the growth of an independent functioning economy, was provided through funds mandated by the U.S congress, to be decreased by one third in a step-wise fashion every 5 years. At present, the Federated States is in the last five-year period of the Compact. The Compact of Free Association is due to expire September 30, 2001.

The health care System

Most of the medical resources within each state are located on each main island. Each main island has a single publicly funded hospital, ranging from 35 to 75 bed capacities. In addition, there are dispensaries manned by health assistants or medexes located in remote areas of the main islands as well as in all the inhabited neighboring islands. These dispensaries, linked by single side band radios to the main hospital within the state, provide very basic medical services to their respective communities, having severely limited diagnostic and therapeutic capabilities. In addition, Pohnpei has a Community Health Center located in its largest town, Kolonia. There is also a physician in private practice working in the main island of Pohnpei.

Pharmaceuticals are supplied through the main hospital located in each state. These pharmacies fill prescriptions for patients as well as supply pharmaceuticals to the outlying dispensaries. In addition, both Pohnpei and Chuuk have privately owned and operated pharmacies.

The medical system is such that the main island hospitals serve as points for referral from the outlying dispensaries (either on each main island or in the neighboring islands). These hospitals also refer some complicated patients out of the country, generally to Hawaii, Manila or Guam. Policies and criteria determining out of country referrals vary from state to state. The number and total expense of out of country referrals also varies from year to year, however, these referrals are generally very costly to the individual state governments. An inordinate amount of health care funds are spent on these referrals. In some years, individual states have spent as much as 30% of their entire Department of Health Services yearly operating budget on these referrals, benefiting far less than 1% of their respective populations.

Initial telemedicine initiatives

In reality, telemedicine in the FSM began with the use of radio, then telephone used to consult off-island medical consultants. This began with the initiation of these services during the Trust Territory administration. In the late 1980's each state acquired facsimile machines, which were located at each main hospital. This further facilitated the timely transmission and reception of medical information to and from medical consultants residing outside the country.

The use of radio for medical consultations was of marginal value as medical consultants outside of the country had little access to, or familiarity with using radio to communicate. And telephone and facsimile use was severely limited due to the large expense involved in long distance international telephone calls. As financial resources continued to decrease, it became increasingly important to find an alternate way to communicate with medical consultants practicing at tertiary care centers outside the FSM. This was driven by two main

The use of radio for medical consultations was of marginal value as medical consultants outside of the country had little access to, or familiarity with using radio to communicate. And telephone and facsimile use was severely limited due to the large expense involved in long distance international telephone calls.

factors: 1) the need to improve both diagnostic and therapeutic capabilities of health care workers treating patients in the respective states, and 2) the need to more appropriately determine which patients would benefit from out of country referral.

Electronic mail

In early 1995, the Yap state Department of Health Service approached the local FSM TeleCom Corporation with the request to have electronic mail (email) service established in Yap, so as to facilitate better communication between health care workers at Yap State Hospital and consultants at tertiary care centers in other countries. FSM TeleCom, the main office of which is located in Pohnpei, was established with both public and private funds. It remains the sole provider of telephone services within the country with 12,139 telephone lines provided on a subscription basis throughout the four states of the FSM. However, in 1995, the Yap office was unfamiliar with the concept of, and technical requirements to establish email services. Nonetheless, they were willing to investigate and learn what was necessary to provide email services to be used at Yap State Hospital.

In June 1995, the first email system was established at the Yap office of the FSM TeleCom Corporation using a dedicated modem connected to a Time Division Multiplexor (TDM) device. This was set up in the switching room and enabled email to be transmitted and received at 300 bps. The TDM, normally used to route telexes, was configured to

Table 1. Subscribers to the Internet via FSM TeleCom, at October 1998 (Ref. 2)

	Chuuk	Kosrae	Pohnpei	Yap	Total
No. of subscribers	137	118	560	150	965

route email through a local access telephone number. The long distance carrier was CompuServe. By paying monthly membership fees to CompuServe (US\$ 9.95), physicians at Yap State hospital could send and receive email by accessing their CompuServe account using a real-time connection through the TDM via a local telephone number. FSM TeleCom provided this service for free, as they saw it as a way of both testing the technology and generating a market for future internet subscriptions.

With the establishment of locally accessible email in Yap, inexpensive and rapid communication between medical personnel and consultants outside of the FSM became possible. These consultants could be consulted about challenging cases and their recommendations could be implemented in Yap. The benefits of this were immediately apparent in Yap. Some cases that might have ordinarily been referred out of the country were successfully managed in Yap.

By December of 1995, this same service was extended to the other three states in the country. Medical personnel in the other states also realized near immediate and similar benefits from the use of email, including greater access to medical consultants and the more efficient transmission and reception of medical information. This included the reception of more timely reports of results of specimens sent to reference laboratories outside of the FSM. The countrywide use of email among medical personnel also allowed for consultation to take place within the FSM. Medical personnel began to more efficiently consult about challenging cases and share medical information among themselves. This exchange of information within the country also served to create a greater sense of cohesion among the medical community in the FSM.

As the baud rate was still very slow, communication was restricted to text based email only. However, soon FSM TeleCom began to increase the baud rate sequentially through 1200, 2400 and finally 9600 bps. In addition, the unrestricted the use of the email system so as to allow for use by non-medical personnel as well. FSM TeleCom still charged no fee for this service. With baud rates of 9600 bps, users of the system began to experiment with email attachments (see below).

Medical personnel began to more efficiently consult about challenging cases and share medical information among themselves. This exchange of information within the country also served to create a greater sense of cohesion among the medical community in the FSM.

Full internet access

Perhaps as a consequence of establishing an initially free email system, a great deal of interest in email and the internet was generated among the population of the FSM. Recognizing a significant market, FSM TeleCom Corporation introduced a full internet and World Wide Web service, with baud rates of up to 28,000 bps, available on a subscription basis in December 1996. Their stated goal was to establish the service at reasonable rates so the service would be utilized and the number of subscribers would grow.

The rates were as follows:

- Initial installation/hook-up fee: US\$25.
- Monthly subscription fee (which included 5 hours of access time per month): US\$ 19.95.
- Additional hours of access (beyond the 5 hours) US\$ 1.95 per hour.

With the advent of affordable, full internet access at fast baud rates, the free CompuServe based email system was discontinued. Within a few months there were hundreds of internet service subscribers, and the number of subscriptions continues to grow. Table 1 shows the present number of subscribers in the FSM, broken down by state.

The equipment commonly used in the FSM to take full advantage of the

internet include Pentium based or Power Macintosh computers, modems, color VGA monitors, internet browser, and email client software.

Email attachments

As individuals in the medical communities of the FSM became more comfortable with email, and relatively fast internet access, the use of email attachments became more widespread. The two most common email attachments were formatted documents and digitized photographs.

The exchange of documents formatted using commonly used word processor or spreadsheet programs became commonplace. In addition, files formatted to be read using commercially available "reader" software such as Adobe Acrobat also became commonly exchanged as email attach-

Table 2. Cases presented from the FSM to TAMC/PIHCP via the Akamai web site, since January 1998 (Ref. 3)

	Chuuk	Kosrae	Pohnpei	Yap	Total
No. of cases	49	0	55	13	117

ments. Examples of such documents include drafts of articles for publication, electronic versions of medical publications, patient case reports, laboratory/pathology reports and medical summaries of patients being referred out of the country.

Even more commonly used than formatted written documents, digitized photographs became routinely exchanged as email attachments. These photographs, taken with conventional cameras and then scanned into a commonly readable image format such as JPEG, TIFF or Bitmap; or taken with a digital camera directly, quickly became a popular and efficient way to convey clinical information among health professionals. In addition to photographs of patients, other images such as electrocardiograms and x-rays were easily and efficiently transmitted as email attachments. These could be reviewed by consultants either within or outside the FSM and their interpretations transmitted back to the sender via email.

The equipment needed to send images as email attachments include a color flatbed scanner and a high-resolution digital camera. Photo editing software used with these devices will ensure that the image quality is as good as possible. All of these items are affordable and readily available from retailers of office or personal computer equipment.

Vide Conferencing

Vide conferencing has become both possible and useful in the FSM. There are times when physicians need to confer in real-time, using audio, video, or both. This can be done using an inexpensive digital video camera over conventional long distance telephone lines, or over the internet. Using conventional long distance lines produces higher quality transmissions but can be very expensive. Vide conferencing over the internet is much less expensive, but also produces lower quality video transmission. Despite the lower quality of video transmission over the internet, with the use of Microsoft NetMeeting (free internet conferencing software that comes with Windows 98), internet vide conferencing can be done with sufficient quality to be highly productive. Physicians can communicate "face-to-face" as well as review, in "white board" fashion, digitized x-rays, electrocardiograms or other still images. This has allowed for in-depth discussion of complicated x-rays.

Vide conferencing has also allowed out-of-country consultants to actually see and interview patients in real-time, thus helping to turn a "complicated case" into a real person with an illness.

In addition to the standard equipment and software needed to access the internet, as well as the digital video camera with vide conferencing software, vide conferencing requires a microphone, sound card and speakers. All of these items are relatively inexpensive and commercially available.

Developing a list of willing consultants

With the advent of email, email attachments, audio and video conferencing, the technological difficulties in obtaining a consultation from the FSM have largely been overcome. In addition, the physical location of the consultant has become irrelevant. The internet dissolves all borders and distances.

It has become important to establish a cadre of willing and reliable consultants. This is not so easily done.

Finding consultants who feel comfortable using the technology described above and who have the professional expertise to render meaningful opinions can be difficult. Issues such as reimbursement for services, liability and quality of care become potential concerns for both the consultants and those requesting the consultations. Nonetheless, a list of willing and reliable consultants can be generated, usually by contacting those consultants who have either already been through the FSM, or whom we have previously consulted by telephone in the past. Slowly, interest has been generated among other physicians some of whom reside in quite distant countries, but who have a willingness to assist us with the management of challenging cases. Usually, altruism and novelty motivate these consultants.

However, medical consultants move, or change their email address or become unavailable for a number of reasons, some of which are unpredictable. Once a cadre of consultants is established, it needs to be constantly updated and developed, with new consultants being "recruited" to participate. This is to ensure that we have access to a consultant of a given specialty at any given time.

Using conventional long distance lines produces higher quality transmissions but can be very expensive. Vide conferencing over the internet is much less expensive, but also produces lower quality video transmission.

Table 3. Useful internet sites

The following internet sites are in common use in the Federated States of Micronesia:

- **PubMed** gives free access to the United States National Library of Medicine. <http://ncbi.nlm.nih.gov/PubMed>
- **Medscape** has an extensive free web site containing links to articles, publications and databases. <http://www.medscape.com>
- **Tripler Army Medical Center's Pacific Island Health Care Project.** <https://sweb.tamc.amedd.army.mil/pihpc>

Tripler Army Medical Center/Akamai PIHCP web site

Sometime in 1997, Tripler Army Medical Center in Honolulu, Hawaii, and the Akamai Project established a web site through which challenging cases could be presented for consultations and possible referral to Tripler's Pacific Island Health Care Project (PIHCP)³. Using the web site to present patient cases suddenly placed the entire medical staff of Tripler Army Medical Center at the disposal of referring physicians. In many ways this eased the problem of constantly having to maintain and update a list of willing consultants. And, as the web site evolved into easier and more powerful renditions, it became possible to submit email attachments in a variety of formats. The whole process was facilitated by the fact that in addition to establishing the web site, two states in the FSM (Pohnpei and Chuuk) received from the Akamai Project computer hardware and software to take advantage of it. Table 2 shows a breakdown of the number of cases presented from the FSM since the web site became fully functional in January 1998.

The use of the Akamai web site has greatly facilitated both the consultation process as well as the out of country referral of appropriate cases.

Medical literature searches

In addition to enabling easier access to consultants, the use of the internet has opened up to the FSM ready access to medical databases. Many of these databases can be accessed through the World Wide Web. Most require a simple one-time registration. Some require subscriptions and charge fees. Many of the databases are free. These databases, some of which are private and some of which are public, can be quickly and inexpensively searched for abstracts, citations and articles which can directly influence the care of patients within the FSM.

Medical education on the internet

There are several medical "portal" sites on the World Wide Web which serve as starting points for physicians interested in increasing their fund of medical knowledge. These sites provide links to electronic versions of medical journals, interesting or challenging case studies, recent advances in various medical fields, reviews of medical texts, and discussion groups for medical professionals. Such sites can be

used as a simple tool to provide continuing medical education to health care professionals within the FSM.

In addition, continuing medical education can be more proactively sought using the World Wide Web.

There are specific sites on the web that will search for specific courses, or search for information about planned courses. Finally, many medical institutions are beginning to offer actual courses for continuing medical education credit over the World Wide Web. This has the potential to alleviate a chronic problem in the FSM, namely the provision of adequate continuing medical education experiences for a collective physician base which is widely dispersed in small islands over a large area of ocean.

Radio

No discussion of telemedicine in the FSM would be complete without mentioning the vital role that radio has played in the country's medical development. As mentioned earlier, single side band radio has been used to manage cases in the neighboring islands within 3 of the 4 states of the country. Often, it remains the only link a neighboring island will have with the main island. Decisions regarding management and referral of cases are routinely made after extensive use of single side band radio contact with a health assistant or medex actually living and working on an outer island.

More recently, with the establishment of radio access to an orbiting satellite called PeaceSat, radio has been used to reach consultants outside of the country. In addition, it has become an excellent venue for conducting regional medical conferencing for both administrative and educational purposes. Its limitations involve scheduling difficulties and

... continuing medical education can be more proactively sought using the World Wide Web. There are specific sites on the web that will search for specific courses, or search for information about planned courses.

hardware maintenance problems. However, data transmission over the PeaceSat has recently begun and it is anticipated that PeaceSat use will expand and become an inexpensive and widely used tool for health care workers in the FSM.

Electronic newsletters

Since the widespread use of email, medical practitioners in the FSM have been able to take advantage of a wide range of electronic newsletters. Some of these publications have come into existence since email was introduced into the FSM. Others were available before then, however, it took the availability of email in the Federated States of Micronesia for the medical community to have reasonable access to them.

One of the first electronic newsletters to be developed in the region is PACNET. PACNET, established by the Secretariat of the Pacific Community, is an email based newsletter that is distributed on a free subscription basis to health care personnel within and outside the Pacific region. It primarily focuses on disease surveillance and notification of disease outbreaks from a public health point of view. It is commonly subscribed to by health care workers and institutions within the FSM.

Another electronic newsletter which is commonly circulated within the Federated States of Micronesia is the *Western Pacific Health Net (WPHNet)*. It was started by the Pacific Basin Medical Association as a means for its members, as well as other health care professionals, to share medical information. Its primary focus is the sharing of clinical information, though public health matters are also discussed and there is some overlap with *PACNET*. It is also disseminated via email on a free subscription basis.

There are a number of other electronic newsletters in circulation within the FSM. Unlike *PACNET* and *WPHNet*, they are not regional in origin or scope, however, they add to the pool of medial information that has become available since the advent of email in the region. Two examples are discussed below.

The Centers for Disease Control and Prevention (CDC) publishes its popular *Morbidity and Mortality Weekly*

Report (MMWR) in Adobe Acrobat format. Notification of the weekly topics is sent to subscribers via email and the issue can be downloaded from the CDC ftp site. It requires Adobe Acrobat, a free "reader" software that allows the *MMWR* to be viewed in its original format, with tables and graphs intact. The *MMWR* is only one example of this type of electronic newsletter used in the FSM.

Medscape's *Medpulse* is an example of the last type of electronic newsletter in use in the FSM. It is published weekly by a commercial service, and freely distributed via email on a subscription basis. It contains articles, topic links and other current medical information. This kind of newsletters disseminate rich medical content, with a strong emphasis on primary care medicine.

Conclusion

The introduction of email, then email attachments, followed by full internet and World Wide Web access in the FSM revolutionized the amount of medical information that could be quickly and affordably accessed by health professionals within the country. This information has come via enhanced contact with medical consultants and with greater access to published data. These developments have resulted in improved diagnosis and therapy of patients within the country, facilitation of appropriate out of country referrals, more timely notification of disease outbreaks, improved continuing medical education and more timely reception of reference laboratory data. It is anticipated that this trend, coupled with other existing technologies such as radio, will continue to increase, resulting in even greater benefits to the health care community, and by extension, the patients they serve.

References

1. *Census of the Federated States of Micronesia*, 1994
2. FSM Telecom Corporation data supplied upon request from the main office, Pohnpei, November 1998.
3. Tripler Army Medical Center/Akamai Project, World Wide Web site data, as of November 1998. □

Any sufficiently advanced technology is indistinguishable from magic.

Arther C. Clarke. Profiles of the Future 1962