

Fetal TeleUltrasound Project

**Kapi`olani Medical Center for Women & Children
Honolulu, Hawaii**

TOP Award #15-60-99035

FINAL EVALUATION REPORT

October 1, 1999 through September 30, 2003

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February 23, 2004**

Fetal TeleUltrasound Project Overview

To improve access to specialty medical care for Hawaiian women with High Risk pregnancies, the Kapi`olani Medical Center for Women and Children Fetal TeleUltrasound Project began October 1999 with the goal to link the Neighbor Islands of Hawaii to Hawaii's urban center of Honolulu on the Island of Oahu via real time clinical video conferencing (telemedicine) systems and necessary network infrastructure.

The need to provide these telemedicine systems and connectivity is driven by the fact that the State of Hawaii's entire Maternal Fetal Medicine (MFM) specialist physicians are located on the Island of Oahu in Honolulu, but the need for services provided by these MFM specialists is distributed across the geographic distance of the seven populated Hawaiian Islands. Because Hawaii is an island state, air travel was previously required by either the patient and/or the physician to receive and provide MFM services for High Risk pregnancies. Emergent / unscheduled MFM care for High Risk pregnancies was very stressful for the patients requiring it, as they would have to book last minute travel to Honolulu's Kapi`olani Medical Center to see an MFM physician there. This last minute travel caused greater anxiety for an already stressful situation for the patient and family as well as incurring additional cost for round trip "no advance reservation" airfare.

To solve this problem of providing MFM examinations to the rural residents of Hawaii, the Fetal TeleUltrasound Project designed a technological solution to provide this care remotely via Real Time Telemedicine. This solution involved testing the video conferencing capabilities of 5 different system types and technologies, both IP and ISDN based. The design called for connecting a video conferencing system to the video output of a remote Ultrasound (Echo) system and transmitting the Fetal Ultrasound images live in real time from the remote clinic "spoke site" to a central "hub site" at the Kapi`olani Fetal Diagnostic Center (FDC) in Honolulu. The MFM Physicians would then perform the Fetal Ultrasound examination by viewing the live ultrasound images on the telemedicine system at the FDC's hub site. The most important requirement of the real time telemedicine systems was the ability to provide an Ultrasound image quality across the video conferencing link equal to viewing the Ultrasound image directly on the Ultrasound system "in-office". The second primary requirement was for the ability of the MFM Physician to be able to interact with the remote site Sonographer during the Ultrasound "scan" so that adjustments could be made to probe placement to provide the view needed by the MFM to check for anomalies in the Fetus. This is why only real time two way technology could be used.

The IP based video conferencing systems available at that time were ruled out early due to poor and unstable image quality. 2 vendor's products were tested extensively for image quality and stability on various ISDN bandwidths. The final ISDN bandwidth chosen was 768kbps direct dial. ISDN bandwidths higher than 768kbps did not produce a proportional or noticeable increase in Ultrasound image quality between the spoke site and the hub site. The final equipment selection of the Tandberg HCS3/6000 codec system was based on its ability to meet all the specific requirements of this project.

The Fetal TeleUltrasound Project then set out with the intent to establish eight remote examination spoke sites across the Hawaiian Islands and one central hub site at the Kapi`olani FDC in Honolulu. The eight remote sites initially identified consisted of:

- | | |
|-----------------------|---|
| ■ Lihue, Kauai | Wilcox Memorial Hospital |
| ■ Kailua-Kona, Hawaii | Hawaii Radiologic Associates |
| ■ Hilo, Hawaii | Women’s Imaging Center |
| ■ Waimea, Hawaii | North Hawaii Community Hospital |
| ■ Wailuku, Maui | Maui Radiology Associates |
| ■ Aiea, Oahu | Kapi`olani Medical Center at Pali Momi |
| ■ Waianae, Oahu | Waianae Coast Comprehensive Health Center |
| ■ Kaunakakai, Molokai | Molokai General Hospital |

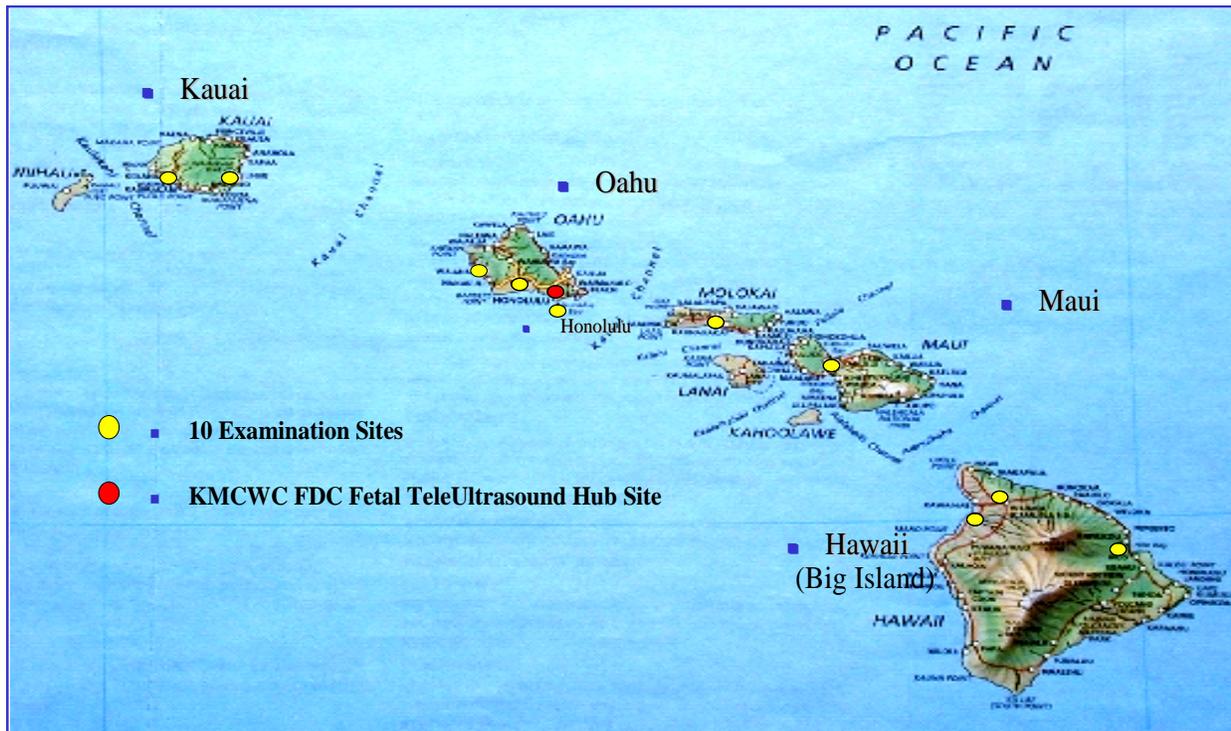
Late in the project a ninth remote site was added at the community’s and site’s request:

- | | |
|-----------------|----------------------------------|
| ■ Waimea, Kauai | Kauai Veterans Memorial Hospital |
|-----------------|----------------------------------|

An examination spoke site was also installed with the Kapi`olani FDC to allow for the capability to serve as a remote site for a consultation with another MFM specialist physician at a location outside of the FDC and to allow the performing of emergent exams on patients at the FDC in Honolulu in the event that their MFM is off island.

The Telemedicine Hub Site where the Ultrasound examinations are interpreted by the MFM’s is located at the Kapi`olani Medical Center in Honolulu on the Island of Oahu.

A geographical depiction of the Fetal TeleUltrasound sites is below:



These sites were selected to provide MFM services to high risk pregnancies to meet the following known community needs:

Location	City	Island	Annual Patient Visits
1 Wilcox Hospital	Lihue	Kauai	360
2 Maui Radiologic Associates	Wailuku	Maui	144
3 Women's Imaging Center	Hilo	Hawaii	240
4 Hawaii Radiologic Associates	Kona	Hawaii	192
5 North Hawaii Community Hospital	Waimea	Hawaii	360
6 Waianae Coast Comprehensive Clinic	Waianae	Oahu	720
7 Kapi`olani Medical Center at Pali Momi	Aiea	Oahu	354
8 Kapi`olani Medical Center for Women & Children	Honolulu	Oahu	15,630
Total			18,000

Locations 1 through 7 are Outreach Clinics performed by FDC's MFM's traveling to location

The table above reflects where patients were receiving Fetal Ultrasound examinations as of January, 2000. The relatively large number of patient visits at Kapi`olani Medical Center for Women & Children includes women from neighbor island and rural areas who were required to travel to Kapi`olani Medical Center to receive MFM services.

In addition to the installation of Telemedicine systems at ten Fetal TeleUltrasound spoke sites and one hub site, an ISDN network infrastructure had to be built from the ground up. 1.5 Mbps ISDN PRI service was eventually selected to provide connectivity between the Hawaii Pacific Health corporate network from Kapi`olani Medical Center to the external spoke sites. This required the installation of an ISDN Gateway and eventually a Multipoint Conferencing Unit (MCU Bridge) to allow multiple connections between systems simultaneously. A second 1.5Mbps PRI has also been added.

Each Telemedicine external spoke site required the installation of 768kbps ISDN 6-BRI dial-up service. The lead times were one to two months and installation problems plagued the initial sites. Site wiring quality and Telco "facilities" proved to be the most common problems. Also, the external site ISDN BRI line charges are the single largest recurring expense to the Fetal TeleUltrasound Project, averaging approximately \$500 per month per site. Long term, the project is looking at other lower cost network options for providing the same direct dial "bandwidth on demand" for the remote spoke sites.

All eleven current Fetal TeleUltrasound sites are fully operational and used on a regular basis for both OB and GYN examinations by MFM specialist physicians. These sites are able to connect with any ISDN based telemedicine or video conferencing system worldwide. The selected technology of 768kbps ISDN based real time telemedicine systems is performing exactly as planned and has met all clinical requirements. This technology and infrastructure is the foundation for continued expansion of the project.

Fetal TeleUltrasound Project Outcomes

1. Decrease infant mortality and improve birth outcomes within identified project population (amended).

The achievement of this outcome cannot be measured at this time. There is no data capture process currently or previously in place at the Kapi`olani Medical Center FDC or the spoke sites to record these statistics on patients examined via Fetal TeleUltrasound versus in-office exams. The only available statistics are for the entire State of Hawaii. Therefore, the required data is not available for the comparison of the Fetal TeleUltrasound Project to the statewide data.

2. Increase number of patients seen remotely at each site real-time and store/forward approach.

This outcome has been achieved. The baseline for real time and store/forward examinations at the Fetal TeleUltrasound sites is zero. The store/forward telemedicine approach was deselected as not meeting the project’s requirements. The Fetal TeleUltrasound service was officially implemented on March 1, 2001. A total of 281 OB and GYN ultrasound examinations were completed using the Fetal TeleUltrasound systems during the period of March 1, 2001 through September 30, 2003. Detailed monthly Telemedicine examination data are shown below:

Kapi'olani Medical Center for Women & Children Total Number of Telemedicine Exams For the period from 03/01/2001 to 09/30/2003			
Month	OB	GYN	Total
Mar-01	1	0	1
Apr-01	6	4	10
May-01	8	7	15
Jun-01	1	1	2
Jul-01	4	2	6
Aug-01	0	3	3
Sep-01	12	2	14
Oct-01	2	2	4
Nov-01	4	4	8
Dec-01	1	1	2
Jan-02	3	0	3
Feb-02	8	1	9
Mar-02	3	1	4
Apr-02	1	3	4
May-02	7	0	7
Jun-02	5	4	9
Jul-02	2	2	4
Aug-02	5	0	5
Sep-02	9	2	11
Oct-02	18	5	23
Nov-02	11	2	13
Dec-02	15	1	16
Jan-03	13	3	16
Feb-03	11	0	11
Mar-03	4	0	4
Apr-03	9	0	9
May-03	11	0	11
Jun-03	7	1	8
Jul-03	12	0	12
Aug-03	12	0	12
Sep-03	24	1	25
Totals	229	52	281

3. Reduce number of trips made by high risk pregnant women to tertiary medical center.

This outcome has been achieved. 281 OB & GYN examinations were performed at local clinics and medical centers on the Neighbor Islands and in the patients' home areas instead of requiring travel to the Kapi`olani Medical Center in Honolulu. Of 281 OB & GYN Telemedicine exams, it is estimated that 80% were for Neighbor Island residents. This equates to 225 Neighbor Island to Honolulu trips saved at \$200 per trip. This is a cost savings of \$45,000 not including saved personal time or lost work time. Evidenced by Kapi`olani Patient Accounting System, patient logs, and known inter-island travel costs.

Immeasurable benefits of utilizing these systems include reduced anxiety for patients and their families as well as the convenience of not having to travel for an examination or wait for the next Neighbor Island Outreach Clinic to see an MFM.

4. Increase patient and physician (referring and specialist) satisfaction (amended).

Baseline data is not available for pre-Fetal TeleUltrasound patient and physician satisfaction. However, referring physicians using Fetal TeleUltrasound and Fetal TeleUltrasound service patients were provided with a satisfaction survey to complete after each telemedicine examination. The results of these surveys are:

Patient Survey Results

Surveys completed = 98
 - 1st time patients = 80
 - repeat patients = 18
 % of surveys returned = 35%
 Min / Max score possible = 0 / 4
 Average total survey score = 3.33
 Average for 1st time patients = 3.35
 Average for repeat patients = 3.24

Physician Survey Results

Surveys completed = 71
 % of surveys returned = 25%
 Min / Max score possible = 1 / 6
 Average total survey score = 5.6

Based on answers to 7 questions with an answer range of 1-6 each

Based on answers to 3 Yes=1 / No=0 Questions & one -1 / +1 / 0 point question

Patient Survey observations: all averages scores indicate Very Good level of satisfaction. It is interesting to note that repeat patients seemed to have a higher level of expectation than the 1st time telemedicine patients.

Physician Survey observations: scores indicate Outstanding Physician satisfaction.

Patient and Referring Physician Survey forms are contained in Appendix A, attached. Please see Patient and Physician Surveys completed by zip code detail on next page.

Surveys completed and returned by Zip Code:

Patient Surveys received by community		
Zip Code	Island - Town	#surveys
96704	Hawaii - Captain Cook	1
96720	Hawaii - Hilo	18
96725	Hawaii - Holualoa	1
96740	Hawaii - Kailua Kona	4
96745	Hawaii - Kailua Kona	3
96743	Hawaii - Kamuela	7
96755	Hawaii - Kapaa	2
96749	Hawaii - Keaau	7
96750	Hawaii - Kealahou	1
96760	Hawaii - Kurtistown	2
96771	Hawaii - Mountain View	1
96778	Hawaii - Pahoa	2
96780	Hawaii - Papaaloa	1
96783	Hawaii - Pepeekeo	1
96738	Hawaii - Waikoloa	7
Hawaii Total		58

Physician Surveys received by Clinic Zip		
Zip Code	Island - Town	#surveys
96720	Hawaii - Hilo	27
96740	Hawaii - Kailua Kona	10
96743	Hawaii - Kamuela	18
96766	Kauai - Lihue	4
96796	Kauai - Waimea	8
96793	Maui - Wailuku	2
96701	Oahu - Aiea	2
Total Physician Surveys		71

96703	Kauai - Anahola	1
96705	Kauai - Eleele	4
96714	Kauai - Hanalei	1
96715	Kauai - Hanamaulu	1
96746	Kauai - Kapaa	6
96752	Kauai - Kekaha	3
96756	Kauai - Koloa	1
96766	Kauai - Lihue	6
96796	Kauai - Waimea	1
Kauai Total		24

96761	Maui - Lahaina	1
Maui Total		1

96729	Molokai - Hoolehua	3
96748	Molokai - Kaunakakai	9
96757	Molokai - Kualapuu	1
96770	Molokai - Maunaloa	1
Molokai Total		14

96701	Oahu - Aiea	1
Oahu Total		1

Total Surveys		98
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Fetal TeleUltrasound Project Outcomes – observations

Population Served: it is clear from the geographic distribution of patient surveys that the Fetal TeleUltrasound service is indeed reaching the target population of medically underserved rural Hawaii residents and native Hawaiian residents in those areas.

Patient Survey comments

It is a great compliment to the project that 100% of the 98 patient surveys received answered Yes to the question ‘Would you be agreeable to using tele-ultrasound again’?

Positive comments written in on the patient surveys had a theme of “thought it was really cool”, “high tech”, “I enjoyed the experience”, “the doctor in Honolulu was clear and easy to understand”, and many stated “it is great not to have to fly to Honolulu”.

The few (less than 10) negative comments written were regarding long wait times for the MFM doctor at Kapi`olani FDC, scheduling mix-ups between the remote site and Kapi`olani FDC, and 2 occasions of telemedicine system / network malfunctions.

Physician Survey comments

More than 50% of the 71 referring physician surveys responded with the maximum score of 6 in all 7 categories of the survey.

The few low ratings and negative comments received were in regard to scheduling delays between the remote site and Kapi`olani, long wait times for the Kapi`olani MFM to start the exam while the patient waited at the remote site, and telemedicine system / network malfunctions.

The surveys indicate the telemedicine technology in use has been well received and accepted by 100% of the survey respondents.

The subjects of the negative comments have been addressed by the Kapi`olani FDC and the Telemedicine Program

Fetal TeleUltrasound Reimbursement

While reimbursement was not a stated intended outcome of the project, it was a high priority item to address. At this point in time, private Third Party Payers in Hawaii, namely HMSA are reimbursing for Fetal TeleUltrasound exams at the same Physician professional fee and Sonographer technical fee rates as for office examinations. The remote site bills the technical and Kapi`olani FDC bills the professional fee. A Telemedicine “modifier” code must be added to the billing transaction. Hawaii Medical Service Association (HMSA), the largest Third Party Payer in Hawaii, has been very supportive of Fetal TeleUltrasound and indicates they will reimburse for Kapi`olani’s other planned telemedicine services, including Store & Forward physician consultations.

Spin off Activities: The Fetal TeleUltrasound service, processes, and infrastructure have provided the foundation to establish enterprise-wide video conferencing services as well as expansion of both real time & store / forward telemedicine services.

Accomplishments / Awards

- Telecon National Conference – December, 2000. Best Healthcare Project Nationwide.
- Hawaii Pono Tech December, 2001 – best Non Profit Organization Information Technology Project in Hawaii.
- Model for Arizona tele-ultrasound telemedicine project.
- Interviews
 - KITV Morning News Interview of Dr. Jana Hall on January 8, 2002.
 - Dale Moyon guest speaker on one hour Hawaii Public Radio “Think Tech Hawaii” weekly technology interview show on May 29, 2002.
- Positive Public Relations
 - Provided 3D image model of Nainoa Thompson’s hand for NASA / University of California at Stanford TOUCH Telemedicine Project.
 - PBS Kids Health Episode #104 featured Kapi`olani and the TOP Fetal TeleUltrasound Project.

Project Testimonial

The best example of the benefit that the Fetal TeleUltrasound service provides is shown by the period immediately after the 9/11 disaster. For several days after 9/11, all Inter-Island Air Travel was grounded in Hawaii. However, all scheduled Neighbor Island Fetal Ultrasound Exams were still performed using telemedicine. Without these systems and service in place, these patients would have had to wait (with great anxiety) for the air travel ban to be lifted. This capability is an asset in place for future disasters as well as normal day to day access to MFM Specialty Care.

Project Team Support

The project would not have been possible or successful without the involvement and strong support of the following Fetal TeleUltrasound Project team members:

Dr. Greigh Hirata, Medical Director / Kapi`olani Fetal Diagnostic Center - Principle Investigator / Project Director for the Fetal TeleUltrasound Project. Without the clinical enthusiasm generated and leadership provided by Dr. Hirata for this project, it would have not succeeded. **Clinical Point of Contact for the Fetal TeleUltrasound Project.**

Tammy Stumbaugh, Lead Genetic Counselor / Kapi`olani Fetal Diagnostic Center – has been instrumental in providing clinical process development and daily clinical operational support for the Fetal TeleUltrasound service at the Kapi`olani FDC.

Project Team Support (continued)

Dr. Jana Hall, Vice President / Hawaii Pacific Health Research Institute - has performed many roles during the life of the project from Project Manager to Administrative Director. Her support has been invaluable to the success of this project and the service.

Dr. Richard Friedman – initial Project Director who put together the project vision and was instrumental in the successful TOP Grant Application and Award.

Joel Gushikuma – Telemedicine Systems Engineer & Coordinator / Hawaii Pacific Health - implemented the systems and infrastructure required to bring the service on-line, as well as the process needed to provide technical support for the service – a one man show.

Todd Shiraishi, Network Engineer / Hawaii Pacific Health – assumed Joel's responsibilities as of May 2003.

Micah Ewing – Network Supervisor / Hawaii Pacific Health - provided the reliable infrastructure design and implementation required for this project and service to succeed.

Mike von Platen, Engineer / University of Hawaii Telemedicine Project – the technical design consultant working with the project to analyze various telemedicine products and implement the technologies required. Provided expertise to the project where none previously existed. Provides on-going consultation.

Reyna Nakata, Telehealth Coordinator / Hawaii Pacific Health – provides daily telemedicine technical operations and process support keeping the service running. The service and project could not have been maintained without her daily support.

Steve Robertson, Vice President / Hawaii Pacific Health Information Systems – has provided the technical resources needed by the project to implement and support the service. The project would not have succeeded without the commitment of these technical resources.

Russell Okumura, Lead Ultrasound Technician / Kapi`olani Fetal Diagnostic Center – instrumental in implementation of Fetal TeleUltrasound at Molokai General Hospital.

Allison Lopes, Director Grants & Contracts / Hawaii Pacific Health Research Institute – provided the financial management, reporting, and budgeting support for the project.

Financial Reporting Point of Contact for the Fetal TeleUltrasound Project.

Dale Moyon, Telemedicine Program Manager / Hawaii Pacific Health Research Institute – provides daily project management for all administrative and technical aspects of the project and service. **Technical and Administrative Point of Contact for the Fetal TeleUltrasound Project.**

Fetal TeleUltrasound Project

Appendix A

Patient Survey form – A1

Referring Physician Survey form – A2

Tele-Ultrasound Patient Survey

Today's date _____ Your zip code _____

Are you pregnant? yes / no (N/A) If yes, what is your due date? ____ / ____ / ____

Is this your first experience with tele-ultrasound? yes / no (N/A)

Comments: _____

Could you see and hear the doctor in Honolulu? yes / no (1/0)

Comments: _____

Were you comfortable using this service? yes / no (1/0)

Comments: _____

Did tele-ultrasound change any nervousness you might have? (-1) Increase (+1) Decrease (0) No Change

Suggestions for improving tele-ultrasound service: _____

Would you be agreeable to using tele-ultrasound again? yes / no (1/0)

3/01

(X) - POINTS PER QUESTION FOR SURVEY RESULTS

**Tele-Ultrasound Survey
(for Physicians and Sonographers)**

Date _____ Time _____:_____ a.m.
p.m.

Clinic zip code 96 _____ Patient zip code 96 _____

Patient: Ob (EDC ___/___/___) Gyn ___ Cardiac ___ Other ___

Dx: _____

of channels used? (1 - 12) _____ Dual video used? Y / N (scan + room)

Level of confidence in tele-ultrasound diagnosis?
(low) 1 2 3 4 5 6 (high)

Comments: _____

Ease of use?
(humbug) 1 2 3 4 5 6 (easy)

Comments: _____

Quality of consult?
(poor) 1 2 3 4 5 6 (excellent)

Comments: _____

Problems during evaluation?
(many) 1 2 3 4 5 6 (none)

Comments: _____

Patient reaction to tele-ultrasound service?
(neg) 1 2 3 4 5 6 (pos)

Comments: _____

Was tele-ultrasound service a convenience to you?
(Inconvenient) 1 2 3 4 5 6 (convenient)

Comments: _____

Was tele-ultrasound service a convenience to patient?
(Inconvenient) 1 2 3 4 5 6 (convenient)

Comments: _____

minutes for tele-ultrasound? Pt also scheduled for real-life scan with per? Y / N