Scottish Paediatric Telemedicine Project

Final Report
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1 Summary

1.1 Overview

Telemedicine is defined as the use of telecommunications technology for medical diagnosis and patient care when the provider and client are separated by distance. The National Health Service in Scotland presents unique challenges. These include:

- High demands on existing urban-based services
- Historic inequality in terms of access to consultant expertise, particularly in remote areas of the Highlands and Islands, some of which are inaccessible except by air in emergency situations
- Dispersed rural populations
- Tertiary care services clustered in different regions of the country
- Recognised difficulties with recruitment, retention and professional development of staff

The paediatric telemedicine project was set up to provide rapid diagnosis of children with cardiac or surgical problems at a distant centre. Mobile video conferencing units were installed in 10 sites throughout Scotland along with a video conferencing room at the Royal Hospital for Sick Children, Glasgow (Yorkhill).

Funding for the project was provided by the Scottish Executive Health Department (SEHD) via the Scottish Telemedicine Action Forum (STAF, 1999-2003). The objective of the telemedicine initiative was to support clinically driven service improvements and demonstrate where telemedicine could be sustainably implemented. Management of the project was carried out by a dedicated, full time project manager with the support of a Project Board made up of lead clinicians, STAF representation, evaluation experts, senior managers and IT representatives.

Using a mixture of ISDN (Integrated Services Digital Network - digital telephone lines provided by BT) and IP (Internet Protocol - computer based network connection) communications, systems based on the Tandberg Intern II have been installed at the 10 sites. By using this small footprint, highly mobile device it is possible to hold the video link at the patient’s bedside. This enables the remote consultant to see views of the patient, live echocardiograms and radiological images.

The Intern II in Operation
1.2 Results

Implementation of the system was carried out in two phases. Continuous feedback was sought and amendments to improve the service were made. Implementing new technologies into the clinical environment requires monitoring and adjustment to ensure the best 'fit' with the workflow of clinical users. Evaluation was carried at the end of the first phase of the project before progressing to phase 2.

Evaluations of the system from both functional and clinical perspectives were core aims of the project. It was therefore important to develop data gathering mechanisms to support the evaluation of the criteria listed below as agreed by the Project Board. The evaluation assessed these criteria from both a system and user perspective:

- Functional evaluation
- Assessment of diagnosis
- Assessment of patient management
- Review of patient transfers
- Measurement of user perception

During the project the system has been used for 77 cardiac and 27 surgical referrals.

Key Points – Cardiac

- Of the 77 cardiac consultations documented, satisfactory data was available for 58.
- In 53 of the 58 patients (91%) the diagnostic assessment was considered to be appropriate.
- A significant diagnostic error is unlikely to be made with a telemedicine consultation. Some images may not be of diagnostic quality, but this will be recognised and appropriate management agreed.
- In two cases the diagnosis was not complete. In these cases a ventricular septal defect was subsequently found. This may be explained on a clinical basis by raised right ventricular pressure with little flow at the time of examination. In all cases there were no factors in patient management that were considered inappropriate.
- In three cases image quality was insufficient to make a confident diagnosis and appropriate transfer undertaken.
- An estimated 8 emergency transfers and 15 non-urgent transfers were avoided.
- Of the cases referred by telemedicine, no patient transfers were undertaken which were later deemed unnecessary. During the period of the study, 2 patients were referred from participating centres without the use of telemedicine which were later deemed unnecessary.
- Telemedicine consultation has become part of the routine cardiac referral service to the Scottish National Cardiac Centre.

Cardiac Case Study

Dr Jon Staines, Consultant Paediatrician, Ayrshire Central Hospital

*A baby was born normally at term after an uncomplicated pregnancy. He was of good birth weight and appeared well. At six hours of age the paediatric team were asked to see him because he was found to be breathing rather rapidly. When examined he was not only breathing fast but also appeared pale and his circulation was sluggish. A problem with his heart was suspected.

Under the guidance of the cardiologists an echocardiogram was performed which showed that the left side of heart (which supplies blood to the body) was underdeveloped. This condition is fatal if not treated and surgery is only performed in selected centers in the UK. A quick and accurate diagnosis ensured that appropriate emergency drugs were successful in keeping the baby well until he could be moved to a hospital in London for his operation. The need for an initial transfer to
Glasgow to be seen by the cardiologists was avoided and his parents were counseled with confidence.”

Key points – Surgical

- 9 of the 27 surgical referrals were for acute problems where the neonatologist needed help and support in the management of the acutely sick neonate.
- One of the essential questions about this kind of system is how and whether it can effect a reduction in transfers. Based on clinical judgement, it is estimated that 13 patient transfers were avoided by supporting clinicians in the district hospital providing local care.
- Experience of using telemedicine at Ninewells has shown that it provides a useful mechanism for supporting split site working.
- The teleconferences were often carried out within minutes of the telephone referral. Clear details of the patient condition and status were quickly obtained.
- Video conferencing was used to view the patient’s condition, view X-rays and in some instances discuss the case with the parents.
- In the case of one patient, consent was obtained by across the telemedicine link to transfer the neonate and insert a central line. This involved the surgeon on call discussing both the benefits and risks of both the transfer and the procedure with the parents.

Surgical Case Study

Prof Robert Carachi, Consultant Paediatric Surgeon, Yorkhill

“Triplets born at 28 weeks were being cared for in the district hospital. At approximately 1 month of age triplet 1 was suffering from abdominal distension and required help breathing. During the telemedicine consultation further diagnostic tests were recommended and a conservative approach suggested and a further telemedicine consultation scheduled. The baby subsequently developed clinical signs of intestinal obstruction and was transferred to Yorkhill for surgery.

During the initial telemedicine consultation triplets 2 and 3 were also discussed. Triplet 2 had been suffering form abdominal distension, but was improving at the time of the telemedicine consultation. On reviewing the abdominal X-rays dilated loops of intestine were observed and further radiological investigation recommended to rule out the more serious condition of malrotation. At the follow up telemedicine consultation the barium x-rays were reviewed and shown to be normal. Without telemedicine this baby would probably have been transferred to Yorkhill for investigation.

At three weeks of age triplet 3 developed an infection and abdominal distension which was treated with antibiotics. Although improving at the time of the telemedicine consultation the abdominal x-ray was thought to be abnormal. Review of the x-ray suggested a mass in the right iliac fossa possibly causing a localised perforation. Further diagnostic tests were recommended. As the obstruction progressed, the baby was transferred to Yorkhill for surgical resection.

These cases demonstrate how joint management of complex cases can provide support to the local clinician, improve patient care and avoid unnecessary transfers.

All three triplets are now well and thriving.”
Key Points - General

- The patient group in question is a small one numerically. It is important to note that while the total number of neonatal patient transfers from the participating hospitals is low, the percentage of emergency transfers has fallen from 71% in the year prior to installation to 53% during the period of the study.
- Anecdotal evidence and results from the parental follow up interviews showed that parents involved were very positive about the use of video conferencing.
- Telemedicine has provided a useful medium for enabling face to face discussion between parents and the remote consultant.

1.3 Integrating the system; emergent uses

One of the most successful areas of the project has been the emerging uses made of the technology. These new uses now account for more than two thirds of the total number of 327 documented telemedicine sessions. Although outwith the immediate scope of the project, these uses demonstrate the wide and varied use made of the network and show how video conferencing can be used to facilitate improved patient care, better working practices, the development of clinical networks and the provision of continuing education. The integration of telemedicine systems has been shown, in other research, to be closely linked to the number of uses and users who accept and exploit the system.

The main uses of the network now include:

- The broadcast of weekly educational meetings to increase access and participation
- Psychiatry case conferences, discharge meetings, direct clinical work and research meetings linking with practitioners through Scotland. This use is now embedded into routine practice for both the Child Psychiatry team based at Yorkhill and the Adolescent Psychiatry team based at Gartnavel Hospital
- Joint tumour board meetings held with Glasgow, Edinburgh, Dundee, Aberdeen and Inverness
- Joint tumour boards with the All India Institute of Medicine in New Delhi
- Weekly microbiology / infection control meetings with the Western Isles
- Monthly neonatal journal club. Participating sites include Princess Royal (lead site), Queen Mothers Maternity, Southern General, Wishaw, Ayrshire, and Paisley
- Regular clinical networks activities include the Scottish Genital Anomalies Network (SGAN), Endocrine Network, Gastrointestinal Network, Palliate Care Network and Fetal Anomalies Group
- Joint Genital Anomalies Clinics between Glasgow, Edinburgh and Aberdeen
- Case conferences for complex ventilated care and renal cases

Psychiatry Case Study

Dr Michael Morton, Consultant Psychiatrist, Yorkhill

“A 10-year old living in a rural area had been attending the local Child and Adolescent Mental Health Service for one year with increasing difficulties in managing sufficient diet to maintain growth. Over a period of one month the child gave up eating altogether and increasingly restricted her fluid intake. Advice was sought from DCFP Ward. After outreach and outpatient contact a telemedicine conference was held to discuss arrangements for admitting the child for intensive psychiatric treatment. In view of the established contact with one of the local clinicians it was agreed that family therapy would be conducted with the involvement of that clinician and family members living locally, whilst the child and her mother were seen in Glasgow. Family therapy sessions occurred on a weekly basis in each area with regular telemedicine linked sessions of the
whole family and clinicians at Yorkhill and in the community. The child’s progress was reviewed in 6-weekly telemedicine conferences involving staff from the local area and staff in Yorkhill. Following discharge the telemedicine link around family work was continued to sustain the handover for 2 sessions. In addition the Yorkhill dietician had several telemedicine sessions with the child and the local dietician to support handover, as the child was particularly anxious about the change of dietician.

Without the telemedicine link the patient’s stay in hospital would have been significantly longer."

1.4 Plans for the future

The Paediatric Telemedicine Project shows how telemedicine can be used to support modernisation of care and improved access to expertise for patients and professionals. The implementation and successful development of this model of telemedicine, supporting emergency care and increasingly, being used by a wider group of clinicians has been achieved by clinical support, dedicated project management, ring-fenced project funding and strong leadership from a multidisciplinary steering group. Having successfully achieved linkage across 10 sites, integration of the use of telemedicine into routine clinical practice in both District General Hospital and specialist hospital services and the introduction of a wide and expanding range of clinical and educational services which are dependent on telemedicine support the goal must now be to consolidate the funding and infrastructure arrangements for the current service and to continue to explore appropriate mechanisms that will permit and encourage the roll-out of the service both geographically and in terms of the range of services provided.

1.5 Discussion

Worldwide the interest of health planners, professionals and patients in innovative health technologies has grown and changed the role of information and communication technologies (ICT) in health care. Reduced costs, infrastructure support and increased reliability of the technologies have resulted in them becoming a realistic option in planning and delivering care.

Since the telemedicine initiative (1999-2003), the Scottish Executive has published policy key documents in this area, the eHealth strategy (2004), Building a Health Service Fit for the Future (Kerr Report 2005) and Delivering for Health (2005). Delivering for Health has drawn upon the previous work and has emphasised the need for using ehealth or telemedicine tools in the delivery of care.

Each of these documents focuses on the importance of using Information and Communication Technologies infrastructure in the NHS in Scotland, in other words eHealth, which allows fast, accurate transfer of sound, text, and images to allow health professionals to communicate, consult and diagnose form a distance.

Telemedicine which is described here is one part of the wider eHealth strategy. It can mitigate the effects of distance in healthcare, reducing the requirement for patients to travel long distances to see a specialist; make better use of clinical time by reducing the need for consultants to travel to outreach clinics and securely transmitting clinical information as required to the experts.

The recent review of the Scottish health services, A National Framework for Service Change in the NHS in Scotland, by Prof D Kerr takes up the issue of how to provide the expertise at a local level further. The Kerr report acknowledges the importance of this technology infrastructure which supports care. The integration of telemedicine applications on a regional basis, following existing referral patterns into routine health care has an important role to plan in the future shape of the service. The project presented here has been developed and implemented following this model.
1.6 Structure of the report

The report is structured with an executive summary which gives an overview of the project aims and current status of implementation. Throughout the report we have included a number of lessons learned which are presented as recommendations. These recommendations are listed in the following section.

This report builds on the work documented in the Phase 1 Evaluation Report. For completeness, the Phase 1 report is contained in Appendix 2.

1.7 Lessons Learned

RECOMMENDATION: Good management from a dedicated project manager is essential to ensure the project delivers the objectives on time and in budget.

RECOMMENDATION: The Project Board should be made up of key stakeholders, representative of the participating sites, with the appropriate authority to support implementation.

RECOMMENDATION: An incremental approach to system implementation provides a mechanism for stakeholders to influence the process, enables a smoother technical installation and reduces risk.

RECOMMENDATION: Simplification and standardisation of network infrastructure and support will be required prior to a wide scale implementation of IP based video conferencing.

RECOMMENDATION: User training, through a variety of approaches, is essential to reach a wide user base and ensure good take up.

RECOMMENDATION: Ongoing support is required to ensure technical difficulties can be resolved.

RECOMMENDATION: To encourage uptake of telemedicine video conferencing and bridging facilities should be provided free to the user.

RECOMMENDATION: Telemedicine applications should be implemented in response to clear clinical and service priorities.

1.8 Health Service Journal Awards

The project won a 'Highly Commenced' in the prestigious Health Service Journal Award in Improving Care with E-Technology.

1.9 Acknowledgements

The project team would like to acknowledge the assistance and support given by members of the Project Board, clinicians at the participating sites and STAF representatives. Particular thanks are due to Ms Nessa Barry for advice and guidance, assistance in the design of the evaluation process, production of this report and support to the Project Manager.
2 Background to Project

The demands upon paediatric services in the NHS in Scotland are similar to demands on other clinical disciplines. The service issues driving the Modernisation Agenda in paediatric care include the availability of consultant paediatric expertise, the sustainability of accessible specialist services and access to support training for paediatricians. Issues from the client perspective include the following acute as well as routine services:

- Access to expertise from sites outwith specialist units
- Transport of critically ill and injured babies
- Provision of adequate diagnostic and patient management support such as follow-up clinics, whilst allowing the patient (and family) to remain at their local hospital.

The use of appropriate technological ‘ehealth’ or telemedicine solutions as tools to address clinical priorities has become a real possibility in Scotland in recent years. Experience in other areas has shown that when used to support clinical priorities and with strong management support for implementation ehealth applications can provide new ways of working and support the modernisation and improvement of the service for all users.

2.1 Challenges

With tertiary medical services for children in Scotland centralised in the major cities this contributes to the difficulty of providing equity of access to these services across Scotland, especially in acute or emergency conditions.

Following a successful bid to the Scottish Telemedicine Action Forum funding was secured for a project to address the issues using video conferencing technology.

Specific challenges to be addressed by this project included:

- Providing a rapid diagnosis of the ill child with suspected congenital heart disease in a distant centre.
- Providing a full assessment of the child with a possible heart defect who does not necessarily require immediate transfer for diagnosis but may have a significant lesion and would benefit from a cardiology opinion before the next outreach clinic.
- Visualising clinical state, imaging, X-rays and ultrasound information of neonates with surgical problems requiring an opinion or treatment from the tertiary centre.
- Providing professional support for echocardiography technicians in a distant centre.
- Assessing clinical information passed by telephone without access to physical and radiological images.

3 Project Description

3.1 Aims of the Project

The primary aim of the project was to support clinicians dealing with two distinct groups of patients; these are patients with cardiac problems and neonates with surgical problems.

Cardiology objectives

- To provide without delay, by consultants in Yorkhill, a diagnosis from echocardiographs performed on acutely ill infants at remote locations.
• To provide a ‘virtual’ clinic, staffed by a Yorkhill cardiologist, for less acute/asymptomatic patients at remote locations

**Surgical objectives**

To provide joint management of neonates with surgical problems to optimise patient care

### 3.2 Purpose of Report

This report provides an overview and assessment of the project. It describes systems installed, outlines the evaluation methodology and reports on the results from both Surgical and Cardiac referrals. It also details some of the alternative uses made of the system which have increased the overall perceived value and integration of the system for users.

The report will be made available to all stakeholders of the project and will be submitted to the SEHD for review.

### 4 Management of the Project

#### 4.1 Project Board

The role of the Project Board was to provide overall direction and management of the project. The Project Board approved all major plans and authorised any deviation from agreed plans. It also was the authority which signed off the completion of each stage of the project and approved reports and publications.

Membership of the Project Board is shown in table 1.

**Table 1 Project Board Membership**

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation</th>
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<tbody>
<tr>
<td>Morgan Jamieson</td>
<td>Chair</td>
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<tr>
<td>Hazel Archer</td>
<td>Project Manager</td>
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<tr>
<td>Robert Carachi</td>
<td>Senior User, Consultant Paediatric Surgeon Yorkhill</td>
</tr>
<tr>
<td>Alan Houston</td>
<td>Senior User, Consultant Paediatric Cardiologist Yorkhill</td>
</tr>
<tr>
<td>Brian Gracie</td>
<td>Senior Supplier, IT Manager Yorkhill</td>
</tr>
<tr>
<td>Nessa Barry</td>
<td>Scottish Executive Health Department, eHealth Advisor</td>
</tr>
<tr>
<td>John Brebner</td>
<td>Evaluation support</td>
</tr>
<tr>
<td>Ken Robertson</td>
<td>STAF Member</td>
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<tr>
<td>David Anderson</td>
<td>STAF Member</td>
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<tr>
<td>Jamie Weir</td>
<td>STAF Member</td>
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<tr>
<td>Jon Staines</td>
<td>Senior User, Ayrshire Central Hospital</td>
</tr>
<tr>
<td>Rosalie Wilkie</td>
<td>Senior User, Ninewells Hospital Dundee</td>
</tr>
<tr>
<td>Sam Ibhaneabhor</td>
<td>Senior User, Wishaw General Hospital</td>
</tr>
</tbody>
</table>
The Project Board also has the following key responsibilities:

- Confirmation of project tolerances.
- Approval of an accurate and satisfactory project initiation document (PID).
- Approval of the project budget
- Delegation of any project assurance roles.
- Review and approval of plans.
- Approval of approach.
- Approval of the end project report.

The relationship between the Project Board and the other stakeholders is shown in Figure 1

**Figure 1 Stakeholder Relationships**

4.2 Project Management

Management of the project was undertaken using formal project management methodology.

- The Project Board met on a quarterly basis. Between meetings delegated authority was given to the local management team.
- A Project Initiation Document (PID) was produced and approved by the Project Board. This defined the scope of the project and highlighted the assumptions and exclusions from scope. It also outlined the communication plan, detailed the evaluation requirements and defined the role of the Project Board.
• Project highlight reports were produced on a monthly basis. These included: progress against key milestones; update on project risks; update on project issues; update on change requests; and budgetary information, highlighting any deviation from the project budget.

• A change control procedure was implemented, with any significant changes requiring Project Board approval.

• A formal risk assessment was carried out and, where appropriate, remedial action taken.

• Interim reports were produced for SEHD after 6 months and 1 year. A conference report was produced after 18 months and this final report at the end of the project.

RECOMMENDATION: Good management from a dedicated project manager is essential to ensure the project delivers the objectives on time and in budget.

RECOMMENDATION: The Project Board should be made up of key stakeholders, representative of the participating sites, with the appropriate authority to support implementation.

4.3 Review Conferences

Two review conferences were held in June 2004 and June 2005. These gave stakeholders the opportunity to learn more about the service and share their experiences of telemedicine.

The 2004 conference was attended by approximately 20 delegates and was primarily an opportunity for sites participating in the Phase 2 rollout to learn more about the service.

The 2005 conference was an opportunity for those using telemedicine and those working in the field to hear interim results from the project. Interim results for both the Cardiac and Surgical cases were presented along with afternoon sessions covering other uses of the network such as Tele Education, Babycam, Infection Control and Tumour Boards. A copy of the conference proceedings is contained in Appendix 3.

4.4 Awards and Press Coverage

The project was awarded a 'High Commended' in the prestigious Health Service Journal awards in 2004.

Press coverage has included:

• Local and national newspapers for project launch
• BBC Reporting Scotland for project launch
• Local and national newspaper for launch of Babycam
• BBC Reporting Scotland and STV Scotland today for Babycam launch
• Health Service Review journal

Further details of press coverage is contained in Appendix 8.

5 Installation of the Telemedicine Network

5.1 Hardware

Following a review of video conferencing hardware with emphasis on the specification and requirements of the clinical team, it was agreed that the project would procure Tandberg systems. As well as being a leader in the video conferencing field, Tandberg produced a device that is specifically designed to meet the needs of providing bedside video conferencing facilities, the Intern II.
While the Intern II was procured for systems to be used in clinical areas, it was planned that the main telemedicine facility in Yorkhill would be based in a purpose built room to provide the most appropriate range of audio-visual equipment. It was agreed that this system would be based on the Tandberg 6000. This combination of a small freely moveable videoconferencing system and a dedicated, purpose built room offers greater functionality and has allowed users develop a range of different types of use, from the clinical acute scenario through to the case review and project meeting.

To ensure security, both systems offer a high level of encryption.

**The Intern II System**

The Intern II was specifically designed for applications where a smaller, more mobile system is required, while still retaining the flexibility of larger units. It utilises 15” flat-screen LCD displays creating a completely self-contained videoconferencing system. The system is based on an ‘IV’ stand design ensuring a high level of stability and maintains a small footprint, allowing ease of mobility within the ward.

The unit houses a Tandberg 880 video conferencing unit, providing the same functionality as more traditional fixed systems. This also supports the connection of multiple peripheral devices such as computer equipment, ultrasound devises and hand held cameras by way of a simple video or computer cable.

**The Tandberg 6000 System**

Within the telemedicine room at Yorkhill, a Tandberg 6000 was installed. This features high quality video, giving clear, crisp images by utilising the latest standards in video conferencing technology. It also supports higher bandwidth connections using ISDN\(^1\) and IP\(^2\) allowing multiple sites to simultaneously join in a conference.

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\(^1\) ISDN stands for Integrated Services Digital Network. It allows voice and data to be transmitted simultaneously across the world using end-to-end digital connectivity. There are two types of ISDN service: Basic Rate Interface (BRI) and Primary Rate Interface (PRI). A basic rate interface consists of two 64 kb/s channels. For video conferencing it is usual to install 3 basic rate interfaces providing a total of 6 channels.

A primary rate interface is intended for users with greater capacity requirements and is provided in bundles of between 8 and 30 channels per line.

\(^2\) IP stands for Internet Protocol. It is the communication method used by most computer systems. Both local and wide area computer networks, including HealthNet, support the IP protocol for the transmission of data.
Connected to the Tandberg 6000 is a set of peripheral devices allowing the transmission of different video streams. This allows the room to function as a multi-purpose video conferencing and presentation suite. These include:

- Twin LCD projectors, displaying images onto the projection wall
- DVD recorder and player, allowing video conference sessions to be recorded and played back.
- Video player, allowing the presentation of pre-recorded tapes
- Desktop computer, to view any PC source including PowerPoint presentations, digital X-Rays and images
- Visualiser (document camera) to view paper documents, film X-rays and other non-standard sources

The Yorkhill Telemedicine Room

To make the system user friendly, all standard features can be controlled from a single remote control device. This utilises a touch panel with a high quality graphics display. The panel is programmed to operate the video conferencing system, switch between devices and control the operation of individual components simply by tapping the appropriate icon on the screen.

5.2 System Procurement

As the project budget was managed by the University of Glasgow, procurement was carried out in line with the University's financial regulations. For the two main rounds of purchasing, this took the form of a formal invitation to tender with sealed bids opened in the presence of a witness. Smaller procurements were carried out by obtaining 3 quotes or by using contracts already negotiated with the procurement teams at either Yorkhill or the University.
5.3 Method of Approach

The method of approach adopted sought to minimise the risks to the project and ensure a successful implementation. Prior to installation a risk analysis was carried and where possible steps were taken to reduce the impact of any problems or to reduce the probability of occurrence.

One of the key lessons learned from other projects was the importance of incremental implementation in this type of service. This was built into the planning of the project by having a phased pilot stage where success was monitored and all participants and potential participants were involved (through workshops) in the decision about success and continued expansion of the project. A report was produced at this stage for all the stakeholders. The success of the pilot phase was also measured by the SEHD fund holders, and it was judged to be working well with good potential and with support from clinicians at all the participating sites. Stage two commenced taking into consideration local conditions.

The incremental approach taken to the installation schedule made it possible to build up experience and expertise which proved invaluable when dealing with the more complex installations later in the project.

Key steps of the project are summarised as follows:

Stage 1
- Installation and implementation of new procedures at Yorkhill, Ayrshire Central Hospital, Wishaw General Hospital and Ninewells Hospital Dundee
- Installation at Royal Hospital for Sick Children in Edinburgh (following a specific request by Mr Bill Manson, Consultant Paediatric Surgeon)
- Formal evaluation of the procedures, feasibility and an assessment of diagnosis, patient management, patient transfer, user perception and system function
- Assessment of Stage 1 by STAF, with a decision made to fund Stage 2

Stage 2 commenced Autumn 2004
- Extension of system to Aberdeen Children’s Hospital, Princess Royal Maternity Hospital Glasgow, Simpson Reproductive Medical Unit Edinburgh, Falkirk and Stirling Royal Infirmary and Raigmore Hospital Inverness
- Final evaluation and review
- Dissemination of findings, including report to SEHD, presentation to peers at appropriate venues and publication of findings in relevant clinical journals

RECOMMENDATION: An incremental approach to system implementation provides a mechanism for stakeholders to influence the process, enable a smoother technical installation and reduces risk.

5.4 Communications Network Challenges

The video conferencing systems are connected together using ISDN or IP. ISDN has been installed at the central sites in Yorkhill and also in sites where IP communication is not possible (Wishaw, Ayrshire, Stirling and Princess Royal). Due to the low bandwidth available on the Greater Glasgow network, call from IP only sites require to be routed via an ISDN gateway. This has been possible due to the generosity of the South Scotland Cancer Network (SSCN) in allowing devices from the paediatric project to share their infrastructure.

Devices in Aberdeen and Inverness are connected on the hospital IP network and routed over their own ISDN gateway.
5.5 Installation Schedule

Following the delivery of the Intern IIs in January 2004, work progressed on a programme of installation and testing. The first system was installed in Cardiology department of Yorkhill in late January. This was shortly followed by the installation at Ayrshire Central, Wishaw General and Ninewells. With agreement from the Project Board, the installation of a unit in the Royal Hospital for Sick Children in Edinburgh was moved forward to Stage 1 and was completed in June 2004.

By deliberately adopting an incremental rollout it was possible to ensure operation, obtain feedback, learn lessons and fine tune the process before proceeding to the next site.

In Stage 2, the complexity of the installation at some sites increased. Units in the Princess Royal and the Simpson were installed with relative ease in February and March 2005. Although not part of the project, due to interest raised and with agreement of the Project Board a unit was loaned to Forth Park hospital in Kirkcaldy in April 2005 and connected via an ISDN gateway operated by the South Scotland Cancer Network.

In Stirling Royal, the neonatal unit already owned a Polycom video conferencing system, however this had not been used in some time and communication links had been severed. After some testing it was agreed that this unit could be reconfigured an installed onto a mobile cart with an LCD television to provide a mobile unit similar to the intern. This configuration work was commissioned by the project and the revised unit installed in September 2005.
Problems arose during the installation phase at Aberdeen Maternity. Although ISDN lines were requested from the communication team in Aberdeen, it became apparent that there were insufficient underground cables to provide additional circuits to the maternity hospital. Following discussions with the team in Aberdeen it was agreed that monies earmarked for the ISDN circuits could be used to part fund the installation of an ISDN gateway. This has now been installed and the system tested, however the link only became fully operational in February 2006. This has hampered the inclusion of the Maternity Hospital in the project, however regular links with Aberdeen Children’s Hospital have been made using existing equipment.

The system for Raigmore Hospital in Inverness was delivered to site in summer 2005. Attempts were made to connect the system using IP to either Yorkhill or the ISDN gateway in Edinburgh. This required considerable work and reconfiguration of infrastructure by the Raigmore networking team. In November 2005 the link was established and training given to the medical staff, however it quickly became apparent that the quality of the connection was variable and unsuitable for holding conferences. Testing using an old ISDN gateway was carried out, however this also proved unsuitable due to unreliability of the gateway and congestion on the IP circuit to the gateway.

In February 2006 agreement was reached with Raigmore to purchase a new ISDN gateway. As with Aberdeen, it was agreed that monies earmarked by the project for the ISDN circuits could be used to part fund the gateway. The gateway was installed April 2006 and is now fully operational.

Although some conferences have been held using the Intern in Raigmore, the majority of meetings conducted with Raigmore have been held using existing equipment.

Having reviewed the installation process it is apparent that the complexity of installing IP based video conferencing is significant. This is caused by the large variation in network infrastructure (routers, firewalls, switches etc), differences in the support available from local IT departments, IT security policies affecting the ability to send video traffic through the firewall, the bandwidth available on connections to HealthNet (affecting the picture and sound quality) and the network addressing scheme adopted (Name Address Translation in particular) causing problems when trying to connect to internal and external systems. While it is possible to implement local IP based solutions using an ISDN gateway it is clear that before video conferencing using IP becomes an easy to implement standard on the NHS network, considerable work is required at all levels to simplify and standardise network infrastructure and support.

RECOMMENDATION: Simplification and standardisation of network infrastructure and support will be required prior to a wide scale implementation of IP based video conferencing.
Table 2 System Installation Schedule

<table>
<thead>
<tr>
<th>Site</th>
<th>Location</th>
<th>Date</th>
<th>Connection Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yorkhill Cardiology</td>
<td>Cardiology viewing room</td>
<td>Jan 04</td>
<td>ISDN</td>
</tr>
<tr>
<td>Ayrshire Central</td>
<td>Neonatal ICU</td>
<td>Feb 04</td>
<td>ISDN</td>
</tr>
<tr>
<td>Wishaw General</td>
<td>Neonatal ICU and Isolation Room</td>
<td>March 04</td>
<td>ISDN</td>
</tr>
<tr>
<td>Ninewells, Dundee</td>
<td>Neonatal Unit + any location</td>
<td>April 04</td>
<td>IP via SSCN</td>
</tr>
<tr>
<td>Yorkhill Telemed</td>
<td>Telemedicine Room</td>
<td>May 04</td>
<td>ISDN</td>
</tr>
<tr>
<td>Edinburgh RHSC</td>
<td>Intensive Care Unit + any location</td>
<td>June 04</td>
<td>IP via SSCN</td>
</tr>
<tr>
<td>Princess Royal Maternity, Glasgow</td>
<td>Neonatal ICU &amp; Seminar Room</td>
<td>Feb 05</td>
<td>ISDN</td>
</tr>
<tr>
<td>Simpson, Edinburgh</td>
<td>Neonatal Unit + any location</td>
<td>March 05</td>
<td>IP via SSCN</td>
</tr>
<tr>
<td>Forth Park, Kirkcaldy</td>
<td>Ultrasound office + any location</td>
<td>April 05</td>
<td>IP via SSCN</td>
</tr>
<tr>
<td>Stirling</td>
<td>Neonatal Unit</td>
<td>Sept 05</td>
<td>ISDN</td>
</tr>
<tr>
<td>Aberdeen</td>
<td>Neonatal Unit + any location</td>
<td>Feb 06</td>
<td>IP via gateway</td>
</tr>
<tr>
<td>Raigmore</td>
<td>Neonatal Unit + any location</td>
<td>April 06</td>
<td>IP via gateway</td>
</tr>
</tbody>
</table>

5.6 User Training

Although the systems are designed to be easy to use, feedback from the STAF Telemedicine Initiative panel and other non-technical users strongly advocated a structured approach to training and support. To this end, a number of training initiatives have been completed. These have included.

- The production of quick reference guides for the Intern II system
- One to one training sessions for clinicians
- The provision of both video conferenced and telephone support
- The production of a easy read user guide for the Tandberg 6000 system
- Short training session on using the Tandberg 6000 system, held in conjunction with the staff open day and when required
- Technical training for support staff

Feedback from users has indicated that the system is indeed easy to use.

RECOMMENDATION: User training, through a variety of approaches, is essential to reach a wide user base and ensure good take up.
6 Evaluation

Evaluation of the system from both functional and clinical perspectives was a core aim of the project. It was therefore essential to develop data gathering mechanisms to support the evaluation of the following criteria, agreed by the Project Board. The evaluation took into account the following aspects from a system and user level:

- Functional evaluation
- Assessment of diagnosis
- Assessment of patient management
- Review of patient transfers
- Measurement of user perception

6.1 Development of the Evaluation Process

The development of the evaluation process was a collaborative and iterative process. After initial ideas were developed internally these were reviewed by a group of the clinicians involved in the project. Along with feedback on piloting the data collection forms the sessions raised the issues of:

- Producing an agreed protocol, determining how the aims and objectives of the original proposal would be translated into data and which tools would be appropriate to use
- Identifying which staff members were responsible for data collection and management
- Whether Ethics Committee Approval was required
- Confidentiality of data and parental consent
- How to capture data on the emergent or unintended uses of the system

The process was further refined following review by the Project Board and research colleagues. The Project Board was keen to develop a practical and achievable evaluation strategy, which would be owned and supported by the users of the system.

It should be noted that the help and guidance provided by Ms Nessa Barry and Dr John Brebner, based on their extensive experience, greatly assisted in the development of the methodology adopted.

6.2 Evaluation Protocol

To document the evaluation process the ‘Telemedicine Protocol’ document was produced. This lists the hospitals involved in the project along with contact details for the lead clinicians, the patient groups to be included along with a flowchart outlining the process and instructions for completing the forms. A copy of the protocol is contained in Appendix 4.

6.3 Ethics

Consideration by the Project Board was given as to the requirement to obtain Ethics Committee approval for the project. It was agreed that this would be best achieved by writing formally to the chair of the Yorkhill Research Ethics Committee (REC). Following consideration, by the REC, it was agreed that the project could be classified as an introduction of new technology or service development rather than a research project. As such it was not required to seek ethical approval. However, the board were cognisant of the need for further developments that may be considered partly development and partly research to seek ethical guidance and approval. Any future plans to undertake research once the system is embedded, will undoubtedly involve a renewed discussion on ethical approval.
6.4 Confidentiality of Data

To ensure the project operated within the guidelines set out by Yorkhill Information Security Policy and the Protecting Patient Confidentiality report, an outline of data collection process along with copies of the data collection forms was submitted to the hospital’s Caldicott Guardian for approval. After consideration it was agreed that the data collection forms were appropriate and sufficiently anonymised to allow transmission via e-mail.

6.5 Parental Consent

Parental Consent for the project can be split into two categories, consent to allow the video conferenced referral to the tertiary centre and consent to allow personal details to be transmitted to Yorkhill to facilitate the parental follow up study.

The practice of contacting colleagues at a tertiary centre is widely used with the NHS. Contact would normally be made by telephone. For this contact to take place, parental consent is not normally requested. By utilising new technology to provide essentially the same service, it was agreed that parental consent was still not required.

It is however clear that the transmission of identifiable information for non-clinical purposes requires consent. The consent form developed in conjunction with clinicians, the Project Board and the Caldicott Guardian is contained in Appendix 3.

6.6 Data Collection and Management

The data collection forms are split into three groups, those completed by the referring clinician pre and post conference, those completed by the receiving clinician post conference and those completed by a panel of clinicians reviewing each case individually.

Forms were developed, submitted for review by both clinicians and researchers representing the SEHD Telemedicine Initiative and piloted. During the first few weeks of the project, the forms have been further modified to take into account feedback received. Forms were available in different formats for printing and for completing in MS Word. From the latter it was possible to e-mail the return and import the data into MS Access. The latest version of each form is available for download from the project website. In addition, the appropriate forms were located in a folder situated with each Intern.

Copies of the final set of evaluation forms are contained in Appendix 6.

6.7 Functional Evaluation

It is now widely accepted that one of the many factors influencing user resistance occurs when the technological tools do not provide the users with consistent quality and robustness of service. The functional evaluation therefore aims to measure reliability and usability of the system. This information is collected from both the Referrer and Receiver on Forms 4 and 4b. Details of any technical difficulties are requested along with an assessment on whether the transmission was of a quality suitable for diagnostic purposes.

Further details of functional evaluation are presented in Section 10.

6.8 Assessment of Diagnosis

In a consultation scenario information on the diagnosis / assessment of the patient was recorded:

- Prior to the video conference
• Immediately following the video conference
• And at time of discharge or 2 weeks later.

Also collected is information on what the receiving clinician contributed to the diagnostic process. This is measured by noting the certainty of the diagnosis pre and post conference.

The severity of the condition at each of these stages is recorded. The rationale for this aspect of evaluation is to ascertain the change (if any) made by telemedicine consultation, which in turn can be compared to the final diagnosis of the patient. As we know clinical judgement is core to all stages in the consultation process and it is necessary to develop imaginative and subtle ways of capturing alterations in the process.

A final assessment of the diagnosis is then recorded on the Case Review Form (Form 6). These forms are completed by the lead clinicians at a monthly review meeting. At the meeting, consensus is reached between the lead clinicians in attendance as to the appropriateness and completeness of the diagnosis obtained.

6.9 Assessment of Patient Management

Changes to patient management are recorded on Form 3, the Post Telemedicine Patient Assessment. This is reviewed at a review meeting where it is assessed if the patient management was optimal, or if improvements could have been made. This is an extra level of clinical effectiveness review but also quality control and an opportunity for learning.

6.10 Review of Patient Transfers

The cost of transferring patients, particularly neonates requiring specialist transfer, is high. This is due to the process being hugely resource hungry. As Telemedicine may affect both the number of transfers and the type of transfer (from requiring the emergency transfer team to a lower cost elective transfer) it is important that information is collected that measures any change.

Prior to the video conference the referrer is asked to state where they think the outcome of the conference will result in an emergency transfer, urgent transfer, non-urgent transfer or manage locally. The decision made is then recorded post conference.

This is reviewed at the case review meeting and the appropriateness of the decision questioned.

In addition to the information collected from the telemedicine consultations, data was analysed from the West of Scotland transfer team.

6.11 Measurement of User Perception

To ascertain the views of parents whose children were referred using video conferencing it was agreed that the best method to collect this information was to develop a questionnaire and collect the information by way of a telephone survey. To avoid bias and to ensure a suitable response when dealing with possible distressed parents, the surveys were to be conducted by a nurse from the Cardiac Liaison Team.

Limitations

Collection of this information proved very difficult for a number of reasons. The first problem encountered was in the completion of parental consent forms. Although consent was not require to use the system or to send anonymised data, written consent was required to send identifiable information and contact details. Of the 87 referrals recorded, 26 consent forms were completed.
The second challenge was completing the telephone survey. The Cardiac Liaison Nurse found contacting the parents difficult and very time consuming. As a result only 6 returns are available. The limited feedback does however provide a useful insight.

One of the lessons learned in the project is that a short involvement by a researcher would avoid many of the problems of relying on health professionals to collect and collate data.

### 7 Use of the Network

Since the opening of the Yorkhill Telemedicine room in May 2004, the frequency and variety of use of the telemedicine network has steadily grown. Table 3 details the meetings and telemedicine consultations documented. The actual number of instances, particularly meetings held outwith Yorkhill is likely to be higher due to under reporting.

It is worthy of note that the Cardiac and Surgical referrals, for which the project was established, now account for less that 1/3 of the total number of video conferences held.

#### Table 3 Documented use of the Telemedicine Network (up to December 2005)

<table>
<thead>
<tr>
<th>Type of Use (Frequency)</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac Referrals</td>
<td>77</td>
</tr>
<tr>
<td>Surgical Referrals</td>
<td>27</td>
</tr>
<tr>
<td>Psychiatry (case conferences, research meetings, direct patient care)</td>
<td>84</td>
</tr>
<tr>
<td>Education (weekly)</td>
<td>42</td>
</tr>
<tr>
<td>Microbiology / Infection Control (weekly)</td>
<td>13</td>
</tr>
<tr>
<td>Ventilated care case conference</td>
<td>3</td>
</tr>
<tr>
<td>Child protection network</td>
<td>5</td>
</tr>
<tr>
<td>Tumour Board (bi-monthly)</td>
<td>6</td>
</tr>
<tr>
<td>International Tumour Board with India (bi-monthly)</td>
<td>2</td>
</tr>
<tr>
<td>Fetal anomalies group</td>
<td>4</td>
</tr>
<tr>
<td>Fetal clinical consultation</td>
<td>4</td>
</tr>
<tr>
<td>Policy Meetings: Child Health Framework</td>
<td>10</td>
</tr>
<tr>
<td>Genetics clinical consultation</td>
<td>1</td>
</tr>
<tr>
<td>Journal Club (monthly)</td>
<td>5</td>
</tr>
<tr>
<td>Genital Anomalies Network</td>
<td>2</td>
</tr>
<tr>
<td>Genital Anomalies Clinic (6 per annum)</td>
<td>2</td>
</tr>
<tr>
<td>Endocrine Network (monthly)</td>
<td>6</td>
</tr>
<tr>
<td>Gastrointestinal Network (bi-monthly)</td>
<td>1</td>
</tr>
<tr>
<td>Type of Use (Frequency)</td>
<td>Number</td>
</tr>
<tr>
<td>------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Palliative Care Network (monthly)</td>
<td>1</td>
</tr>
<tr>
<td>Scottish Neonatal Consultants Group (quarterly)</td>
<td>2</td>
</tr>
<tr>
<td>Pulmonary hypertension clinic (with Great Ormond St)</td>
<td>2</td>
</tr>
<tr>
<td>Court appearance</td>
<td>1</td>
</tr>
<tr>
<td>International job interviews</td>
<td>2</td>
</tr>
<tr>
<td>Other (Admin, IT and other miscellaneous meetings)</td>
<td>20</td>
</tr>
<tr>
<td>International Links</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>327</strong></td>
</tr>
</tbody>
</table>

Along with the equipment provided by the project, sites such as Aberdeen and Inverness have video conferencing equipment elsewhere in the hospital. Other sites, such as Orkney, Shetland, Western Isles, Dumfries and the Borders were not included in project, but have been able to participate in meetings using existing facilities.

It is encouraging to note that both Dumfries and Raigmore have devoted local funds to improve communication links to the paediatric network. A successful and sustainable network will be utilised by a wide range of health professionals and disciplines. Gradual involvement of new users has been managed and technically supported by the project manager. This has become a growing role for the project manager and the Project Board were clear that managed rather than ad hoc developments should be encouraged.

Figure 3 show the uses made of the network across Scotland. Please note that the diagram only shows the main uses made of the network and is not exhaustive.
Figure 3 Main Uses of the Telemedicine Network

Western Isles * Cardiac, Education, Case Conference, Infection Control

Orkney* Case Conference, Psychiatry, Dietetics

Raigmore Inverness ** Cardiac, Case Conferences, Education, SNGC, Psychiatry

Ninewells Dundee Cardiac, Surgical, Tumour Board, Palliative Care, SNGC, Fetal

Forth Park, Kirkcaldy FAG, Fetal

Edinburgh RHSC Surgical, Tumour Board, SNGC

Simpson SNGC, FAG

Borders General * Education

Shetland* Case Conference, Psychiatry, Family Visit

Aberdeen** Case Conferences, SNGC, Tumour Board, SNGC

Yorkhill Cardiac, Surgical, Fetal Education, Case Conf, Journal Club, FAG, Palliative Care, Tumour Board, Infection Control, SNGC, Psychiatry, SGAN etc....

Stirling Cardiac, Education, SNGC

Princess Royal Education, Journal Club, Cardiac, SNGC

Wishaw Cardiac, Surgical, Endocrine, FAG, Journal Club, Endocrine, SNGC

Ayshire Central Cardiac, Surgical, Psychiatry, SNGC Education, Journal Club, Psychiatry

RAH Paisley* Education, Journal Club, SNGC

Dumfries* Cardiac, Education, Case Conference

SNCG Scottish Neonatal Consultants Group
SGAN Scottish Genital Anomalies Network
FAG Fetal Anomalies Group

* Equipment not provided by project
** Equipment provided not fully operational at time of calls, using own equipment
8 Cardiac Results

8.1 Study group

Cardiac consultations with telemedicine echocardiography were undertaken for 77 newborns in the period of the project. The protocol for the study determined that each consultation should be given a study number with no patient identifier such as name, date of birth or hospital number. As the study period progressed, the use of telemedicine became embedded into clinical practice and was used at a greater range of sites and by a wider group of clinicians. As a result it became increasingly difficult to obtain full data sets for all patients. As a result satisfactory data were obtained in 58 of the 77 recorded cases. This section will detail the outcome for these 58 infants.

It is possible that the other 19 might present a somewhat different group of patients with less severe lesions since significant defects are easier to trace using the Scottish National Paediatric Cardiology Patient Management System.

For the purpose of this report the information on the consultations has been allocated to groups and sub-groups in which there may be some overlap. Of necessity this has some simplification but should allow the reader to obtain and idea of the use and value of the telemedicine link.

8.2 Clinical reason for telemedicine consultation

The broad groups of presentation and numbers of each are detailed in Table 4. It is useful to consider the clinical importance of making speedy and accurate diagnosis in the management of a patient in each group.

An infant with cyanosis, heart failure or coarctation of the aorta can have a lesion that is potentially very serious and likely to need urgent surgical treatment: in some this can be improved with a drug (prostaglandin) infusion until surgery is undertaken. In others similar symptoms may occur due to non-cardiac causes when the heart is normal.

A murmur suggests a heart abnormality but does not allow distinction between one that is or is not likely to pose a significant problem in the early days of life. Knowledge of the cause of the murmur (i.e. diagnosis) allows a clear decision plan for management – in many a later out-patient review but in some urgent cardiac treatment.

Infants with Down's syndrome have a 40% chance of having a cardiac defect. This may not be apparent on early clinical examination. These do not usually require urgent treatment but knowledge of the presence or absence of a cardiac defect allows the neonatologist to advise the parents appropriately on all the implications of the condition and the management of an infant with Down’s syndrome. In the past these infants were referred directly for echocardiographic examination.

The other groups are generally those in which there is a question to be answered related to present management or long term follow-up but the infant is not acutely ill and urgent referral and treatment is not necessary.
Table 4  Reason for Telemedicine Consultation

<table>
<thead>
<tr>
<th>Reason for Consultation</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyanosis</td>
<td>17</td>
</tr>
<tr>
<td>Murmur</td>
<td>17</td>
</tr>
<tr>
<td>Heart failure / tachypnoea</td>
<td>10</td>
</tr>
<tr>
<td>Down’s syndrome</td>
<td>3</td>
</tr>
<tr>
<td>? Coarctation of the aorta</td>
<td>2</td>
</tr>
<tr>
<td>? Endocarditis</td>
<td>2</td>
</tr>
<tr>
<td>? Heart abnormality</td>
<td>2</td>
</tr>
<tr>
<td>Pericardial Effusion</td>
<td>2</td>
</tr>
<tr>
<td>Patent Ductus Arteriosus (PDA)</td>
<td>2</td>
</tr>
<tr>
<td>Abnormal antenatal scan</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>58</td>
</tr>
</tbody>
</table>

8.3  Cardiac diagnosis

Basic information on the final diagnoses for the consultations is given in Table 5. Full clinical information for detailed cardiac assessment is available but is not included in this report.

It is necessary to be aware that although some had a normal heart the consultation was undertaken because the infant was very ill and had a condition that suggested a possible heart abnormality; it is likely that the infant would otherwise have been transferred to the centre for definitive diagnosis.

On the other hand others may not have been of life saving importance but the correct assessment obviated travel to Glasgow or provided the local paediatrician with confidence in managing the infant locally for the immediate postnatal period.

Table 5 Cardiac Diagnosis

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Heart</td>
<td>14</td>
</tr>
<tr>
<td>Ventricular Septal Defect (VSD)</td>
<td>12</td>
</tr>
<tr>
<td>Atrioventricular Septal Defect (AVSD)</td>
<td>4</td>
</tr>
<tr>
<td>Left Heart Hypoplasia</td>
<td>4</td>
</tr>
<tr>
<td>Persistent arterial duct (PDA)</td>
<td>3</td>
</tr>
<tr>
<td>VSD + Pulmonary Atresia</td>
<td>3</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>2</td>
</tr>
<tr>
<td>Pericardial Effusion</td>
<td>2</td>
</tr>
<tr>
<td>Pulmonary Stenosis</td>
<td>2</td>
</tr>
<tr>
<td>Septal thickening  (Infant of diabetic mother &amp; steroid therapy)</td>
<td>2</td>
</tr>
<tr>
<td>Tetralogy of Fallot</td>
<td>2</td>
</tr>
<tr>
<td>Transposition of the Great Arteries + VSD</td>
<td>2</td>
</tr>
<tr>
<td>VSD + Pulmonary Stenosis</td>
<td>2</td>
</tr>
</tbody>
</table>
Aortic Stenosis 1
Pulmonary Atresia Intact Ventricular Septum 1
Total Anomalous Pulmonary Venous Drainage (TAPVD) 1
Truncus arteriosus 1
Total 58

8.4 Diagnostic accuracy

Consultations were not designed to make a full and detailed diagnosis, but rather to establish the nature of the problem and allow planning of the course to be followed. For instance in transposition of the great arteries no attempt has been made to determine the site of the coronary arteries as is necessary before surgery.

No clinically significant errors in diagnosis were made.

In 53 of 58 patients the diagnostic assessment was considered to be appropriate.

In 3 the diagnosis was not certain and the infants were transferred for further investigation.

In 2 cases a further abnormality (ventricular septal defect) was found at subsequent assessment. In one the diagnosis of pulmonary stenosis was made but later study showed an associated smallish VSD. This may be explained on a clinical basis by raised right ventricular pressure with little flow at the time of examination – similar situations are found with others examined in the early neonatal period. On the other hand it may be that the quality of the echo images sent was not sufficiently high or that once a basic diagnosis had been reached a full and detailed echocardiogram was not performed and assessed. In another a second VSD was subsequently shown – this is likely due to the fact that when a VSD was shown a search for a second was not undertaken as it would not alter management.

In one case where the diagnosis was uncertain a repeat echo at Yorkhill revealed that an atretic pulmonary artery arose largely from the morphological right ventricle rather than the left. This finding was not clinically significant. However it serves to highlight the limitation of the technology and clinical use, and reinforces the view that we should not be attempting to provide a full and detailed diagnosis, but establish the nature of the problem and plan follow up.

8.5 Diagnostic value and management change to referrer

The value of the telemedicine consultation and diagnostic opinion to the referrer varies from confirmation of a diagnosis already made with clinical examination and echocardiography to demonstration of a normal heart in a very ill infant where the referrer thought a cardiac problem was likely. The effect of the consultation on the immediate management is a relatively simple means of assessing its value in paediatric cardiology.

The decision on the categories is to an extent an arbitrary one. In each the referring doctor was asked for an opinion on any change in the plan from the telemedicine consultation. In any individual case this may be rather subjective. Groups have been chosen in relation to the possible confirmation or change in the diagnosis and effect on the referrer’s assessment and management decision from the telemedicine consultation.
Groups used are as follows:

**Telemedicine consultation effect on referrer’s assessment**
- CHD (congenital heart defect) resolved – referrer uncertain of problem, diagnosis made and patient management agreed
- No change – referrer had correct assessment
- CHD confirmed – referrer thought there might be a problem, diagnosis confirmed/refuted by cardiologist
- Uncertain – cardiologist could not make a definite diagnostic decision

**Telemedicine consultation effect on referrer’s action**
- No change, added confidence – although the referring clinician made no changes to patient management they were more confident that the diagnosis was correct and patient care was optimal
- No change to referrer’s action – no changes made to patient management, referring clinician already confident of diagnosis and patient management
- Non urgent transfer avoided
- Emergency transfer avoided

The comparison of the effect of the telemedicine consultation on assessment and action is summarised in Table 6.

This shows that in 32 (“CHD confirmed” and “No change”) the referrer had made a relatively accurate assessment. This attests to the capabilities of the referrer and the training undertaken as part of the project.

In 23 (CHD resolved) the telemedicine consultation provided information to allow the diagnosis to be clearly defined for appropriate management.

In assessing the effect on referrer’s action it seems that the transfers were altered with 8 emergency transfers and 15 non-urgent transfers/visits being obviated. Although there was no change in the referrer’s intention in more than half the telemedicine consultations (35/58) in half of these (18/35) the referrer was reassured and much more confident in the action taken.

There were no factors in patient management that have been considered to be inappropriate.

However in one where the infant remained in the referring centre until the next outreach clinic it was felt by the visiting cardiologist that therapy should have been modified before his visit. This has highlighted the requirement to consider regular follow up discussions in patients who remain locally and in whom the clinical condition might change, such as duct dependant lesions.

During the evaluation period, one infant was transferred from a participating site after the referrer declined a telemedicine consultation as he stated that he had made an appropriate echocardiographic diagnosis of transposition of the great arteries: the infant was found to have a normal heart. Another patient was transferred by air ambulance from a site awaiting installation of their telemedicine device. The referrer felt that a heart abnormality was likely but the baby was also found to have a normal heart. It seems likely that the use of a telemedicine consultation would have avoided these unnecessary transfers.
Table 6 Effect on referrers action

<table>
<thead>
<tr>
<th>Effect on assessment</th>
<th>No change, added confidence</th>
<th>No Change</th>
<th>Non-urgent transfer avoided</th>
<th>Emergency transfer avoided</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHD resolved</td>
<td>10</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>23</td>
</tr>
<tr>
<td>No change</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>CHD confirmed</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Uncertain</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>17</td>
<td>15</td>
<td>8</td>
<td>58</td>
</tr>
</tbody>
</table>

8.6 Diagnostic value and transfer status

A final assessment is that of the diagnostic value groups and patient management, detailed in Table 7. This does not allow full assessment of the effect of the telemedicine consultation but gives an overview of the outcome for these infants.

For this the groups of outcomes are as follows:
- Consultant attended remote site
- Emergency transfer
- Non-urgent transfer
- Stay&OP: Infant remained locally and was subsequently seen at an out-patient clinic
- No review: No cardiac defect and no cardiac review

Table 7 Patient Management

<table>
<thead>
<tr>
<th>Grouping</th>
<th>Consultant attended</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHD confirmed</td>
<td>1</td>
</tr>
<tr>
<td>CHD resolved</td>
<td>0</td>
</tr>
<tr>
<td>No change</td>
<td>2</td>
</tr>
<tr>
<td>Uncertain</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grouping</th>
<th>Emerg, Transfer</th>
<th>Non-urgent Transfer</th>
<th>Stay &amp; OP</th>
<th>No review</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHD confirmed</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>CHD resolved</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>No change</td>
<td>2</td>
<td>3</td>
<td>17</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>Uncertain</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>9</td>
<td>29</td>
<td>9</td>
<td>58</td>
</tr>
</tbody>
</table>

8.7 Conclusions

The results of this initial study support the following general findings:
- Telemedicine echocardiography provides an appropriate and accurate diagnosis for the management of newborns with suspected heart disease. This confirms the work of other groups i.e. Northern Ireland.
- A significant diagnostic error is unlikely to be made with a telemedicine consultation – some may not be diagnostic but this will be recognised and appropriate transfer undertaken
- A telemedicine consultation has a significant positive effect on the decision making process for the infant with suspected heart disease
- No transfers after a telemedicine consultation were later deemed unnecessary
• An emergency transfers can be avoided if a telemedicine consultations is undertaken (8 transfers avoided by using telemedicine, 2 unnecessary transfers were undertaken during the period of the study when referred by telephone only)
• Non-urgent transfers/consultations can be avoided (15 in this study - Table 6). This means that parents do not have to travel to the centre.
• Where highly specialised surgery is required at an alternative site, transfer can be arranged directly to the specialised centre negating the need for a transfer to Yorkhill. (For example surgery for Left Heart Hypoplasia is only carried out in Birmingham and London.)
• The referrer has much more confidence their decisions if a telemedicine consultation has been undertaken to reassure her/him that the diagnosis is correct
• The telemedicine link provides a useful way to communicate with parent and provide reassurance during a stressful time
• A telemedicine consultation has become part of the routine cardiac referral service to the Scottish National Cardiac Centre

8.8 Examples of Consultations

Dr Trevor Richens, Consultant Cardiologist, Yorkhill

“An infant born at term was found to have hydrops (marked retention of fluid causing swelling of skin and fluid in body cavities. This was not expected and the baby was quite unwell and they question arose as to whether this fluid retention was the result of a heart abnormality.

The neonatal consultant phoned the cardiologist to discuss the case. The cardiologist suggested a telemedicine echocardiogram to make or refute the diagnosis of a cardiac abnormality. The local consultant stated that he had no experience of echocardiography or telemedicine links. The cardiologist suggested that the try this and guided the local paediatrician through the whole process, including setting up the telemedicine and echo machines and manipulating the ultrasound probe.

It was concluded that there was no heart abnormality. The infant remained at the local hospital and an urgent transfer was avoided.”

He did not have a heart problem and has not seen a cardiologist.

Dr Jon Staines, Consultant Paediatrician, Ayrshire Central Hospital

"A baby was born normally at term after an uncomplicated pregnancy. He was of good birth weight and appeared well. At six hours of age the paediatric team were asked to see him because he was found to be breathing rather rapidly. When examined he was not only breathing fast but also appeared pale and his circulation was sluggish. A problem with his heart was suspected.

Under the guidance of the cardiologists a cardiogram was performed which showed that the left side of heart (which supplies blood to the body) was underdeveloped. This condition is fatal if not treated and surgery is only performed in selected centres in the UK. A quick and accurate diagnosis ensured that appropriate emergency drugs were successful in keeping the baby well until he could be moved to a hospital in London for his operation. The need for an initial transfer to Glasgow to be seen by the cardiologists was avoided and his parents were counseled with confidence”
9 Surgical Results

A total of 27 surgical patients were discussed and managed using telemedicine conferencing during this project period. Patients were from Ayrshire, Wishaw, Ninewells and the Princess Royal in Glasgow. A total of six consultant surgeons were involved in these referrals (Professor Robert Carachi, Mr. Carl Davis, Mr. Stuart O’Toole, Mr. Bill Manson, Mr. Fraser Munro and Mr. Peter Raine). Calls were received at both Yorkhill and the Royal Hospital for Sick Children, Edinburgh.

9.1 Supporting Split Site Working

Of the 27 surgical referrals, 17 were between Ninewells and the Royal Hospital for Sick Children in Edinburgh. Paediatric surgical services at Ninewells are provided by a Consultant post shared between the two sites. Since early June facilities have been in place to hold video conference between Dundee and Edinburgh. This has allowed the paediatric surgeon to provide a consultant service to Ninewells on the days when he is based in Edinburgh. According to the consultant involved (Mr Bill Manson) this has:

- Prevented unnecessary transfers
- Timed transfers appropriately
- Encouraged earlier referral

As well as the clinical uses, Mr Manson highlighted the fact that in his experience, using telemedicine could be a useful way to support the model he was working to, providing specialist paediatric surgical services in two locations.

9.2 Referrals

Nine of these referrals were for acute problems in the newborn period where the neonatologist needed help and support in the management of the acutely sick neonate, often with a life-threatening condition or an acute event that precipitated a major crisis (e.g. an ischemic limb in a very premature baby).

Many of these surgical patients had repeat consultations to follow up the progress of the baby and to plan future management on an elective basis.

Of the 27 surgical patients, 18 were discussed on a semi elective basis whereby the consultant telephoned in and arranged a time that same day for a consultation. Often the reasons for this was the local consultant was unsure of the diagnosis or management in ten cases and in eight cases the diagnosis was suspected but needed confirmation by visualising the patient and the X-rays.

9.3 Presenting Pathology

In 17 patients the pathology was primarily in the gastro intestinal tract (necrotising enterocolitis, intestinal obstruction, malrotation, volvulus, neonatal inguinal hernia (obstructed), abdominal wall defects and problems with perforation of the bowel with free gas in the peritoneal cavity).

In four patients there was a dysmorphism problem (two patients had oral lesions and cleft palate).

In one patient the problem was with an acute ischaemic limb in a premature baby. Two patients had respiratory problems and chest X-rays were viewed and discussed. In one patient with ambiguous genitalia a discussion with the paediatric endocrinologist allowed early management and decisions for sex assignment.
9.4 Discussion of Surgical Results

The videoconferencing affected the clinical decision in all the acute cases (nine patients) and in most of the elective cases discussed (17). In one patient the clinical decision was not effected because the local consultant was looking for reassurance and confirmation of a diagnosis already made.

The service did provide a rapid diagnosis of the sick surgical neonate in a distant centre in nine patients and allowed a full assessment of the sub-acute/elective problems in 18 patients allowing for a planned management of these patients.

This allowed clear visualisation of the clinical problem whether it was a sick baby or in one instance an ischaemic limb in a premature baby where the blood supply of the limb was vascular compromised. Most patients had either radiology of the chest or abdomen that was visualised at the time of the consultation. Although the images were not perfect quality, they allowed a clinical decision to be made at the time.

Repeated consultations about the same patient on subsequent days allowed assessment of the outcome of the consultations. Based on clinical judgement, all nine acute cases would have been transferred at the time if telemedicine had not been available. The teleconferences were carried out often within minutes of a telephone referral in acute cases (nine) and clear details of the patients’ conditions and status was quickly obtained often giving instructions at the time about the management of such patients in order to optimise their care.

Direct contact with the parents enabled staff to explain the problem to them and on one occasion get consent for an operation before transfer as the parents could not accompany the baby because of other family.

Video images and X-ray images were good enough for a diagnosis in 25 patients but were poor quality in two patients. These were due to distant technical camera problems and as a consequence these two had no decisions made.

Thirteen patients were managed locally and prevented acute transfers. In nine patients the use of telemedicine allowed a delayed transfer for more sophisticated imaging and further consultation. In two patients urgent transfer was organised after stabilisation of the patient. Parents were spoken to and reassured after consultation in six patients.

9.5 Examples of Use

Prof Robert Carachi, Consultant Paediatric Surgeon, Yorkhill

Case 1

“Triplets born at 28 weeks were being cared for in the district hospital. At approximately 1 month of age triplet 1 was suffering from abdominal distension and required help breathing. During the telemedicine consultation further diagnostic tests were recommended and a conservative approach suggested and a further telemedicine consultation scheduled. The baby subsequently developed clinical signs of intestinal obstruction and was transferred to Yorkhill for surgery.

During the initial telemedicine consultation triplets 2 and 3 were also discussed. Triplet 2 had been suffering form abdominal distension, but was improving at the time of the telemedicine consultation. On reviewing the abdominal X-rays dilated loops of intestine were observed and further radiological investigation recommended to rule out the more serious condition of malrotation. At the follow up telemedicine consultation the barium x-rays were reviewed and shown to be normal. Without telemedicine this baby would probably have been transferred to Yorkhill for investigation.
At three weeks of age triplet 3 developed an infection and abdominal distension which was treated with antibiotics. Although improving at the time of the telemedicine consultation the abdominal x-ray was thought to be abnormal. Review of the x-ray suggested a mass in the right iliac fossa possibly causing a localised perforation. Further diagnostic tests were recommended. As the obstruction progressed, the baby was transferred to Yorkhill for surgical resection.

These cases demonstrate how joint management of complex cases can provide support to the local clinician, improve patient care and avoid unnecessary transfers.

All three triplets are now well and thriving.

Case 2

This neonatal surgical referral involved an urgent transmission during a routine clinic on Tuesday morning. Within ten minutes the Consultant at the local hospital gave details of the problem and a Consultant to Consultant discussion took place. This very premature baby, less that a kilogram in weight, had an acute vascular problem with its right leg and buttock. Very good imaging was obtained and advice was given on the spot. This saved an unnecessary urgent transfer that morning.

A further review of the ischaemic leg was carried out early that afternoon to ensure there was no progression of the insult. A third transmission was carried out on the Friday that week involving two Consultant Surgeons at Yorkhill, a Consultant Neonatology and SpR to decide on the future management with the Consultant at the base hospital. It was decided that it would be safer to transfer the baby to the neonatal surgical unit for further care and insertion of a long line (operative procedure).

The parents were spoken to over the video link and permission was obtained for the surgical procedure. This baby has progressed well. This was an example of a multi-team effort using video teleconferencing, the end result being very successful.

10 Results of the Functional Evaluation

10.1 Technical Problems

Results of the data collection indicate that user (clinician) perception of the system has been good. Most users find the system easy to use and are happy to undertake videoconferences with minimal training. In a number of consultations either the referring or the receiving clinician had never used the system before. On these occasions it proved possible for the more experienced user to talk the other through the procedures on the phone, resulting in a successful video conference.

The full time project manager who is involved in implementation and training provides users with an opportunity to give regular feedback on the system and make any necessary improvements. It was recognised that to encourage ongoing participation it was important to identify and resolve technical problems promptly and to ensure that any persistent technical difficulties were addressed. A section on each of the forms, used to collect information about the videoconferences, was therefore dedicated to recording technical problems. (Forms are contained in Appendix 6.)
Table 8 Summary of Reported Technical Problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Frequency</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour Doppler / image colour</td>
<td>9</td>
<td>7 instances refer to problems with transmitting colour Doppler images from Ninewells.</td>
</tr>
<tr>
<td>Missing or poor images</td>
<td>8</td>
<td>Bandwidth over IP, poor connection to scanner, scanner operator inexperience, faulty codec, some causes unknown</td>
</tr>
<tr>
<td>Difficulty in viewing X rays</td>
<td>6</td>
<td>Difficulties with suitable lighting, distance from viewing box etc.</td>
</tr>
<tr>
<td>Unable to connect scanner</td>
<td>4</td>
<td>Combination of user error, broken cables and using different scanners</td>
</tr>
<tr>
<td>Connection difficulties</td>
<td>2</td>
<td>Additional training provided</td>
</tr>
<tr>
<td>User error</td>
<td>2</td>
<td>Instruction given on how to resolve problem</td>
</tr>
<tr>
<td>Self view not displayed on monitor</td>
<td>1</td>
<td>Upgraded system software to resolve problem</td>
</tr>
</tbody>
</table>

Total 34

Although the number of system problems seems high, in all but 7 instance image quality received was deemed to be of sufficient quality.

RECOMMENDATION: Ongoing support it required to ensure technical difficulties can be resolved

10.2 Interference on Colour Doppler

A difficult problem to resolve was the interference caused when attempting to send colour Doppler images from Ninewells. When the Intern was attached to the scanner a band of interference was displayed on both the scanner and the Intern. This made it impossible for even the local user to view the Doppler image. Attempts to replicate the problem on the same make and model of scanner in Yorkhill failed. The problem was eventually escalated to Tandberg in Sweden, who contacted the scanner manufacturer (also in Sweden). The problem was identified as being a faulty ultrasound probe, however to resolve the fault, local engineers installed a separate power supply in the Intern and disconnected the powered headphone socket.

10.3 Image Quality

Although the number of technical problems seems high, of the 103 consultations recorded, in only 7 instances was the image quality deemed of insufficient quality.

On two occasions video images of the patient were reported to be of insufficient quality. In this instance diagnoses were made using echocardiography, hence the limited view of the patient was not clinically significant. It was noted that obtaining a good view of the patient in an incubator is sometimes difficult with the fixed camera on the Intern II. Some success has been achieved at Wishaw by careful positioning of both the baby and the camera, however use of a hand held video camera in Ayrshire has provided good results in both surgical and genetic consultations.

Two instances involved the transmission of X-ray images where it was impossible to position the camera close enough to the light box due to the length of the cables attached to the Intern. In general it was noted that sending reasonable images of X-rays requires careful set-up to ensure the correct position of the camera and suitable lighting. Although image quality appears to be acceptable for limited surgical and cardiac use, the transmission of X-rays for accurate diagnostic
purposed by a radiologist is not appropriate due to the limited resolution of the video image. In this instance, the image should be viewed at high resolution using a PACS system.

On three occasions the echo images received has been of insufficient quality. In one case, the quality was sufficient to exclude a major heart lesion, but the baby was transferred to Yorkhill for a follow up scan. On the other two occasions insufficient information is available to determine the nature of the problem.

11 Results of the Review of Patient Transfers

11.1 West of Scotland Transfer Results

Information on patient transfers was available from the West of Scotland transport team based at the Princess Royal Maternity Hospital. Data was available from April 2003 – June 2004 and January to December 2005. Hospitals covered by the West of Scotland team include Ayrshire Central and Wishaw General Hospitals. All other hospitals involved in the project are covered by other teams.

By analysing the information it was possible to identify patient transfers from Ayrshire and Wishaw involving babies with cardiac or surgical problems. Transfer information was further categorised into emergency and non-emergency calls.

Table 9 Neonatal Transfers

<table>
<thead>
<tr>
<th></th>
<th>No of Transfers</th>
<th>No of Emergency Transfers</th>
<th>% of Emergency Transfers</th>
<th>Transfers per Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wishaw Pre-Telemed</td>
<td>34</td>
<td>24</td>
<td>70%</td>
<td>3.1</td>
</tr>
<tr>
<td>April 03 – Feb 04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wishaw Post-Telemed</td>
<td>46</td>
<td>19</td>
<td>41%</td>
<td>3.1</td>
</tr>
<tr>
<td>April 04 – June 04, Jan – Dec 05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ayrshire Pre-Telemed</td>
<td>7</td>
<td>5</td>
<td>86%</td>
<td>0.7</td>
</tr>
<tr>
<td>April 03 – Jan 04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ayrshire Post-Telemed</td>
<td>30</td>
<td>21</td>
<td>70%</td>
<td>1.9</td>
</tr>
<tr>
<td>March 04 – June 04, Jan – Dec 05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These results are important for stimulating further discussion about the impact of using telemedicine on emergency transfers. However, it is important to be cautious regarding the analysis of the information due to the small numbers of transfers overall and difficulties in categorising the data.

Although there was no evidence of a drop in the total number of transfers this data does indicate a drop in the percentage of emergency transfers, particularly from Wishaw, with average of 71% of transfers categorised as an emergency prior to telemedicine falling to 53% after telemedicine.

This finding corresponds to the personal feedback from clinicians that by providing a definite diagnosis prior to transfer, transfers can be planned appropriately and expert advice can be given on the appropriate use of medical interventions such as providing ventilation and administering prostaglandins.
To examine this finding further it would be necessary to set up a multi-site trial comparing telemedicine verses ‘traditional’ telephone referrals. It is anticipate that this type of research would be difficult to get funding and approval for and was simply not in the remit of this project.

Nonetheless, there is a benefit often unrecorded, when using telemedicine, in changing the nature of transfers by improving the communication in emergency cases when any transfer is required and to provide support in decision making and providing reassurance to parents.

11.2 Transfer Costs

The cost of neonatal transfers is difficult to quantify as budgets are held by the transfer team, the ambulance service and the local health board. Information from the West of Scotland Team yielded the following information. While the information is limited, it provided a further dimension of the overall service.

Table 10 Transfer Costs

<table>
<thead>
<tr>
<th>Transfer team costs</th>
<th>£1070 per transfer*</th>
<th>Bases on budget of £604k, 565 transfers in 2003/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff, equipment, training etc</td>
<td>Information not currently available</td>
<td></td>
</tr>
<tr>
<td>Ambulance service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed wing / civilian helicopter</td>
<td>£1000 per hour</td>
<td></td>
</tr>
<tr>
<td>MOD Helicopter</td>
<td>£25 – 40k per transfer</td>
<td></td>
</tr>
</tbody>
</table>

* This is the cost for each patient movement. Transfer to the tertiary centre will usually involve a return trip to the district hospital.

12 Results of the Parental Follow-Up

Although only 6 parents were questioned, all were very positive about the use of video conferencing. A selection of responses regarding their experience and in particular the reassurance it affords them in a very frightening situation follows:

“Brilliant, made to feel more at ease as 2 doctors discussed case. Reassured as had second opinion from a specialist doctor in Yorkhill!”

“Fantastic facility. Helpful to make decisions and confirm diagnosis. Allowed doctors at local hospital to commence life saving medicines straight away.”

“Brilliant. Very impressed. Had triplets both Mother and babies too ill to travel. Liked having information from the experts at Yorkhill on the same day. However would have liked to be at the link to ask questions from the doctors at Yorkhill.” - This has been raised with the clinical team

“Think it's a great idea for doctors to get to the root of the problem quicker.”

“Yes it was useful. Doctor in Yorkhill confirmed diagnosis.”

“My child’s case was a routine consultation where the doctor locally did the scan and was shown over the link to a specialist. It was good not having to travel down to the technicians in Yorkhill. I liked the idea that the specialist could discuss the results immediately.”

“If my child required emergency treatment at Yorkhill would opt for the transfer first. But video link is food for routine and non urgent situations.”
Two parents voiced concern about the system relating to the separation from their child during the video conference and not being present in the room when the referral took place.

“Took baby into another room ….. anxiously separated from baby when this discussion was taking place”

“Was not present when video link was being conducted between the doctors. Would have liked to be present.”

Although it was left up to individual clinicians to decide if the parents should be present or not, it was clear that the service could be improved by allowing the parents an opportunity to discuss the case with the remote consultant. Clinicians were encouraged to facilitate this in the future.

13 Psychiatry

13.1 Child and Adolescent Psychiatry in Scotland

Within Scotland, in-patient services for child psychiatry are provided at the Department of Child and Family Psychiatry (DCFP) in-patient unit at Yorkhill. For adolescent psychiatry, services for Scotland are provided from three units in Edinburgh, Dundee and Gartnavel Hospital in Glasgow. The Glasgow unit covers the West of Scotland from the Highlands to the Borders.

Use of telemedicine in child and adolescent Psychiatry has steadily grown over the 2 years of the project. A total of 84 sessions have been held, initiated by the DCFP in-patient unit, the Adolescent Unit at Gartnavel, the University of Glasgow Department of Child and Adolescent Psychiatry and several satellite DCFP out patient clinics.

The uses make of the system vary between departments. The adolescent unit primarily use video conferencing to hold multi disciplinary case conferences for patients living in remote areas. In addition to case conferences, much of the use made by DCFP involved direct clinical work. This has involved clinicians, family members and the patient. On one occasion it was possible for the clinician in Yorkhill to consult with a remote patient and engage with them using far-end camera control. This allowed the clinician to track the patient as they moved around the room.

The University Department have primarily used the system to conduct a multi-site research project into reactive attachment disorder.

Users of the service have noted that the use of telemedicine has lead to real improvements in the services provided. Of particular note are the improvements to handover of patients at admission and discharge. Prior to the use of telemedicine the opportunities for professionals to work together and to attend meetings would have been more limited. Some of these meetings would have involved very considerable travelling costs and time allocation but others would simply not have occurred.

It is anticipated that telemedicine will form an integral part of the development of a Managed Clinical Network for children with severe and complex psychiatric disorders.

13.2 Example of use of Telemedicine in Psychiatry

Dr Michael Morton, Consultant Psychiatrist, Yorkhill

“A 10-year old living in a rural area had been attending the local Child and Adolescent Mental Health Service for one year with increasing difficulties in managing sufficient diet to maintain growth. Over a period of one month the child gave up eating altogether and increasingly restricted her fluid intake. Advice was sought from DCFP Ward. After outreach and outpatient contact a
telemedicine conference was held to discuss arrangements for admitting the child for intensive psychiatric treatment. In view of the established contact with one of the local clinicians it was agreed that family therapy would be conducted with the involvement of that clinician and family members living locally, whilst the child and her mother were seen in Glasgow. Family therapy sessions occurred on a weekly basis in each area with regular telemedicine linked sessions of the whole family and clinicians at Yorkhill and in the community. The child’s progress was reviewed in 6-weekly telemedicine conferences involving staff from the local area and staff in Yorkhill. Following discharge the telemedicine link around family work was continued to sustain the handover for 2 sessions. In addition the Yorkhill dietician had several telemedicine sessions with the child and the local dietician to support handover, as the child was particularly anxious about the change of dietician.

Without the telemedicine link the patient’s stay in hospital would have been significantly longer.”

14 Education

The requirements for continuing education for both junior and senior clinical staff are well established. There is however considerable duplication of effort involved in setting up educational meetings for paediatric staff at remote sites. In addition it can often be difficult to provide a suitable range of speakers to provide a good cross section of training.

Following a successful pilot in November 2004, weekly education meetings have been broadcast from Yorkhill. The weekly 2 hour session normally consists of 2 presentations and covers a wide variety of subjects. Participating sites have included Ayrshire, Princess Royal Maternity, Paisley, Dumfries and Galloway, Borders and the Western Isles. Average attendance varied from 2 to 4 remote sites depending on the programme. It is also hoped to develop the programme by enabling speakers at the remote sites to broadcast to Yorkhill.

Feedback from users of the service indicate that using telemedicine in this way avoids duplication of effort, enables maximal attendance by allowing participation without leaving the neonatal unit, provides a mechanism for enabling trainees to keep in touch with the tertiary centre and raises awareness of the district general hospitals in the tertiary centre.

Since February 2006 weekly pre-membership teaching sessions have also been broadcast to the Princess Royal Maternity. Although there is interest in expanding this service, this move has been resisted to ensure the interactive nature of this session is preserved. It is anticipated this will be reviewed at the end of the current session, by which time lectures will have had a chance to adapt their teaching to the new medium.

Plans are also in place to improve the facilities with the Yorkhill lecture theatre. While video images have been of a consistent quality, difficulties with the room sound system have at times proved distracting. It is hoped that following a planned refurbishment of the lecture room in Summer 2006, these issues will be resolved.
15 Microbiology / Infection Control

Clinical standards state that an infection control team must include a consultant medical microbiologist if the infection control doctor is from another speciality. In the case of the Western Isles, this is provided by Dr Williams at Yorkhill.

Telemedicine has so far been used in two main areas - scheduled discussions and outbreaks.

During the recent outbreak a case of suspected meningitis was to be transferred off the island. However, there was a history of other children in the class with flu like symptoms. Further investigation revealed 800 children with flu like systems out of a school population of 2500.

Particular problems dealing with the outbreak included: the low level of vaccination; spread of the disease by a small number of key workers such as bus drivers and nurses; and the possibility of spread to the mainland.

Following the set-up of an outbreak committee a number of difficult decisions had to be made regarding how and when to use Tamiflu, how to identify and treat the vulnerable population and how to increase vaccination rates.

By using the telemedicine link over a series of meetings it was possible to provide high levels of support from the infection control doctor and Health Protection Scotland and improve working relationships between those based on the Mainland and member of the Island infection control team. It was also possible to optimise the usage of expensive medication.

The final outcome was that the flu epidemic was contained and never became an issue on the Mainland.

Weekly microbiology meeting are currently scheduled to take place till Summer 2006.

16 Tumour Board / Palliative Care

Tumour boards are multidisciplinary meetings, attended by oncologists, surgeons, pathologists, radiologists and other relevant specialists. Clinical cases are discussed, along with examination, radiology and pathology results, and management decisions are made.

6 successful meetings have been held involving Glasgow, Edinburgh, Dundee and Aberdeen and more recently Inverness. Advantages realised have included: improved networking and collaboration; avoiding travel; shared care centres allowing more involvement in the decision making for difficult cases; improved education and training for SpRs; and increased motivation.

It is anticipated that the regular bi-monthly meetings will be enhanced by improving the facilities at other sites for the broadcast of case presentations, inviting guest speakers, organising pre-meetings for the oncologists and holding supra-regional meetings.

Following on from the success of the tumour board meetings, the Palliative Care meeting is now held in the telemedicine room on a monthly basis, allowing clinicians in Dundee and Glasgow to discuss issues around the care of terminally ill patients.

A regular international link with All India Institute of Medical Science in New Delhi has also been established. To date, two tumour board meetings have been held and plans are in place to hold monthly meetings to discuss complex cases.
17 Neonatal Journal Club

Since September 2005, the Neonatal Journal Club had met on a monthly basis. Managed and co-ordinated by Dr Chris Lilley of the Princess Royal Maternity Hospital, participation in the group has steadily increased. Regular participant now include the Queen Mothers Maternity Hospital, Southern General, Royal Alexandra Hospital in Paisley, Wishaw General and Ayrshire Central.

The format of the meeting involved each site in turn presenting recently published research articles into neonatal care. Consultants, registrars and SHO’s then discuss the publication. This provided a valuable learning opportunity and promotes joint working between the centres.

18 SGAN

The Scottish Genital Anomaly Network (SGAN) is an informal network of a multidisciplinary group of health care professionals that was formed in 2002 with the primary longer term aim of providing an optimal level of care to affected patients through the development of a managed clinical network (MCN), thus preserving services within all localities, whilst maintaining access to national expertise.

Members of the network are based in Glasgow, Aberdeen and Edinburgh. Video conferencing has been used successfully to facilitate executive group meetings for a number of years. Meetings were originally held Beatson Oncology Centre in Glasgow, but following the installation of the Yorkhill Telemedicine room, the meetings were transferred to the local facility.

A recent improvement has been in the use of telemedicine to facilitate a wide participation of clinicians at SGAN clinics. Clinics take the form of a discussion with the clinical and allied staff in an anti-room. Following discussion, the patient is seen by a maximum of 2 clinicians. After the appointment a further discussion is held. To avoid travelling, the discussion elements of the clinics held in Aberdeen and Edinburgh are now carried out using telemedicine. It is anticipated that the next Glasgow clinic will also be linked in this way.

19 Offshoot Projects

19.1 Babycam

Telemedicine in the Princess Royal using the Intern II was installed in April 2005. At this time it was recognised that it would be possible to use the Intern II to broadcast pictures of the baby to a mother who was unable to visit due to her own medical condition. To assess this novel use of the equipment a trial was set up involving a patient staying in the plastic surgery ward for 6 weeks, 1/4 mile away.
Following the success of the trial a small Tandberg T150 was purchased at a cost of £2500 from endowment funds. The unit connects to the hospital IT network and can be positioned at the mother’s bedside. Privacy issues are addressed by the ability of both mother and nursing staff to mute microphones and turn off either camera. Privacy is further enhanced by ensuring staff screen all incoming calls from the mother.

Feedback from mothers has been very good. Although care has to be taken to ensure that the explanation of how to use the system is complete before connecting the call to the baby, as the mothers then generally hold the unit and cry.

Although nursing staff were initially a little self conscious and wary of the technology, they quickly learned how to use the system and are supportive in its use.

Babycam systems are now being commissioned in Wishaw General and Ayrshire Central hospitals.

19.2 Neonatal Transport Team

The transport of neonates is recognised as being a specialist and at time difficult task. In the West of Scotland, the transport team is based at the Princess Royal Maternity. Having seen the paediatric network in action, the transport team recognised the potential benefits of have a video conferencing system available when dealing with complex transfers and critically ill neonates. As a result, when their new offices were being renovated a system was installed. To date, this has been used for attending education meetings and holding administrative meetings. It is anticipated that it will shortly be used in conjunction with the paediatric network to assist in the transfer of sick neonates.

19.3 Yorkhill Paediatric ICU

Plans are currently in place to install a video conferencing facility within the Paediatric ICU at Yorkhill. It is hoped that this system will be developed to help in the transfer of critically ill children and also give help and support to clinicians caring for a sick child at a remote site.

20 Discussion

The Scottish Executive Health Department established the Telemedicine Action Forum (STAF) in 1999 against a background of considerable enthusiasm for technological solutions to underpin clinical developments. The clinical team at Yorkhill was very keen to pilot and if successful, roll out a telemedicine system, which would address their particular clinical priorities.

There was some evidence that such projects in the past had demonstrated the capabilities of telemedicine not necessarily leading to sustainable clinical projects. We identified that providing adequate project management resource and appropriate IT support are key issues for ensuring a successful implementation. Much has also been gained by seeking advice and building on the knowledge gained from previous Telemedicine developments with NHS Scotland.
20.1 Clinical Results

From the data collected the salient issues of clinical acceptability and technical feasibility have been addressed. Having clear and wide ranging training and involvement of clinical users has allowed us to develop a system that we believe is a robust tool to facilitate improved response to the problems associated with centralising specialist care.

Cardiac

The results have confirmed the findings of other groups that the use of telemedicine links and the video output from an ultrasound machine allows a diagnosis to be correctly made in the tertiary centre.

This service has not been designed to provide the full and detailed diagnostic features necessary for planned surgical intervention. However it has allowed an appropriate diagnosis to be reached and appropriate treatment to be discussed and initiated. Significant diagnostic errors are unlikely to be made with a telemedicine consultation. Some images may not be of diagnostic quality, but this will be recognised and appropriate steps taken.

In two cases further abnormalities were discovered when scans were repeated in the tertiary centre. In these cases the scans were undertaken in the first day of life and it is likely that the pulmonary artery pressure was still high and flow through the defects may have been minimal. This would suggest that if there is a defect the infant should be subsequently seen by the cardiologist at a later outpatient clinic. None of the omissions were of clinical significance.

An important consideration is the effect on patient transfer. Some infants with symptoms suggesting a possible heart lesion are transferred to the tertiary centre and then found to have a normal heart. They are often very unwell and require the attendance of a full transfer team. This has been obviated in some in this study. In addition many infants have a duct dependant lesion and are started on prostaglandin (PGE). The major side effect of this is that apnoea (stopping breathing) may occur. As a result the accepted management of an infant on PGE is that he/she be intubated and ventilated for transfer. Under these circumstances a full transfer team is required. In addition in some case intubation and ventilation can have a deleterious effect and should be avoided if possible.

An unexpected finding in this group of patients is that at the transmitting end an operator with virtually no experience of echocardiography can manipulate the probe in such a way that an accurate diagnosis can be reached. This does not mean that training should not be carried out for the operators, but indicates that with some training most operators should be able to provide satisfactory view for making a diagnosis.

Surgical

The experience so far with 27 patients has show significant benefit. Of particular note is the benefit realised by Mr Bill Manson in his split site role between Edinburgh and Dundee.

The main strengths of the system have been: the ability to hold face to face clinical discussions with the remote consultant; the ability to view images of the patient, making it possible to plan surgery in advance; the ability to discuss any concerns with the parents; and the opportunity provide to carry out follow up sessions and review progress.

One of the weaknesses of video conferencing is in the transmission of high resolution radiological images. Although reasonable pictures can be obtained at the tertiary centre, imaging alone is not sufficient to be able to confidently make a clinical decision. This is due to the drop in resolution when the film is captured by the video camera. a although uptake amongst surgeons , where a
consultation was carried out by telemedicine has highlighted the following strengths and weaknesses of the system. This will hopefully be resolved by the ongoing PACS implementation.

Review by Remote Clinicians

Dr Jon Staines, Consultant Paediatrician, Ayrshire Central Hospital

“The availability of this technology has already had a significant impact on the quality of care we are able to give babies on our unit. Some transfers have been avoided completely and those infants who have still needed to go to Glasgow have been able to have their treatment and investigations planned in advance. We remain cautious as we learn about the limitations of the equipment but new uses continue to be discovered. Feedback from parents of neonates who have benefited from the technique are uniformly enthusiastic. Rather than undermining their confidence in the care we deliver they report that our ability to converse in greater detail with specialists about their child is a source of comfort.”

Dr Sam Ibhanesebhoh, Consultant Neonatologist, Wishaw General Hospital

“Following the official launch of the Telemedicine between Yorkhill and Wishaw General Hospital Neonatal unit in May 2004 the ‘on-site’ visit by a Consultant Cardiologists for the diagnosis of congenital cardiac problems has become a rare event. There has equally been a reduction in the transfer of babies to and from Yorkhill cardiology department for diagnosis.

Training of senior medical staff has ensured that at any one time there is a senior Neonatal staff member with the necessary skills for echocardiography. With the available resources, we are now able to plan the management of simple and complex cardiac and surgical conditions with the active and collective participation of Parents, local Neonatal consultant staff and Yorkhill cardiology and Surgical colleagues.

Parents have found their live participation in the decision making of the clinical care of their babies very helpful.”

20.2 Emergent Uses

The greatest success of the project has been the large variety of other uses made of the network. The original remit of cardiac and surgical consultations now account for less than 1/3 of the total number of transmissions. New users of the network are still regularly being added to the diary and the Yorkhill telemedicine room has become popular with NHS users across the city. This is in part due to the provision of a facilitation service to help plan and run meetings and revenue costs being met by the project.

RECOMMENDATION: To encourage uptake of telemedicine, video conferencing and bridging facilities should be provided free to the user

In a number of services, in particular child and adolescent psychiatry, ventilated care, renal services, microbiology and endocrine, the use of telemedicine has become embedded into routine practice. This has not only lead to a reduction in time spent travelling, but has lead to real improvements in service delivery. It has been commented that some of the work undertaken and many of the multi-disciplinary case conferences held would simply not have been attempted without telemedicine.
20.3 Sustainability

Over the course of the SEHD funding period for telemedicine projects it has become abundantly clear that the majority of the challenges related not so much to technical capabilities so much as “organisational issues” and to how a project and changes effected are managed.

Experiences from cumulative projects in the field have been brought to this development. The project overall has benefited from these experiences. Such developments need careful evaluation both on clinical outcome acceptability and indeed the capacity to contribute to educational development.

The Policy background that this project was developed against emphasised targeting national clinical priorities and modernisation to improve care. The project team is hopeful that the service will continue to thrive and develop further and continued close management and evaluation will yield further clinical and educational outcomes as well as lessons for the implementation of telemedicine systems in any field.

At the outset of this report we spoke about the approach to this project, the involvement of stakeholders and the preparation and planning of each stage of development. Our experience reflects that of many other SEHD funded telemedicine developments, the most successful and sustainable telemedicine systems (especially videoconferencing) are multifunctional, multi-professional and often mobile in practice.

As we pointed out earlier in this report, the last 2-3 years have seen a definite shift in the importance of ehealth generally in Scotland’s NHS. Policy documents have placed ehealth at the core of improving and modernising health services.

Telemedicine is one of a range of discrete options, where clinical priorities are driving use. In each case these developments require support at a local and national level to be fully integrated and to prove their value to the service as a whole.

It is recognised that telemedicine is not always the appropriate option or the solution to a service problem and that some previous telemedicine projects have not been sustainable. It is also our experience that the best, most successful, systems are supported by experienced project management, providing technical and management expertise in a service development framework.

Sustainability of all telemedicine systems is a real challenge. In the case of the Yorkhill project, sustainability was an item on the steering group agenda from the very beginning of the project. All the steering group members were conscious that many previous telemedicine projects despite showing innovation and success in clinical terms had no life after their funding period.

In the case of this project, the project management approach and the involvement of clinicians from all the participating sites had generated a stable and growing use of the system by the midway point. At that stage the steering group together with the clinical leads from participating sites (stakeholders) held a progress evaluation workshop which we have discussed earlier. The stakeholders came up with a plan at the review workshop. It was clear that clinical and educational uses would continue and develop. However, the other key element to sustainability was the financial input from participating sites.

Agreement was reached by the stakeholders, to tackle this problem before the end of the funding period, to write to the Chief Executives of each of the participating sites for ongoing funding. At the time of the letter being sent, this amounted to £7,000 per site.

One of the biggest problems with telemedicine in general and project funding in particular is that it is always short term in nature and not usually seen as ‘core business’. Instead of being considered
a part of the modernisation and improvement agenda, telemedicine has been seen as something peripheral. This results in a situation where very often lessons, especially about what was most difficult, are not learned.

At the time this report is being written continued funding from participating sites has still not been fully agreed.
21 Appendices

21.1 Appendix 1 Video Conferencing Communications

Video conferencing systems have traditionally used multiple basic rate ISDN interfaces (BRI) or multiple lines on a primary rate interface (PRI). The Tandberg systems purchased generally use 6 simultaneous channels. At standard BT rates this costs in the regions of 50p per minute.

With the increasing availability of high bandwidth data communication circuits it has become possible to transmit video conferencing images across them. This negated the requirement to rent ISDN circuits and pay call charges, hence significantly reducing the overall cost of establishing and running a video conferencing network.

Challenges

There are however a number of difficulties to be overcome before IP can be regarded as a true alternative to ISDN

- Available bandwidth – some sites do not currently have sufficient bandwidth to allow video conferencing traffic.
- Quality of Service is not currently available on HealthNet. This can lead to unsatisfactory image quality on busy networks
- Firewall traversal – some routers do not support the H323 protocol used by video conferencing
- Firewall security – ports on the firewall need to be open to support video conferencing.
- Complexity of implementation – each site required negotiation with local IT department, consultation with network managers along with equipment configuration
- Adequate IT and project management support are required

In addition to these issues, it has been noted that the Tandberg device does not correctly support Name Address Translation (NAT). Where NAT is in use it is necessary to program the NATed address into the CODEC. This then prevents within site calls, not using NAT, from taking place. Till a resolution to this problem is developed (expected Q1 2005), further development of complex video conferencing networks may be hampered.

Within the Telemedicine Project IP connectivity has been established at Yorkhill, Ninewells and Edinburgh RHSC and Raigmore. However the image quality associated with these links has not been suitable due to the available bandwidth. Connections have therefore been established by using IP to connect to and ISDN Gateway. This allows for ISDN lines to be shared between multiple devices, hence reducing ongoing expenditure.

It is anticipated that the implementation of the N3 network will improve communications by providing increased bandwidth and quality of service, however this on its own is unlikely to address the remaining issues.

The following table outlines the advantages and disadvantages of both communication methods.
Table 11: Comparison of ISDN and IP for Video Conferencing

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ISDN</strong></td>
<td>Proven technology</td>
<td>Unit restricted to ISDN points install. Not possible to route across hospital</td>
</tr>
<tr>
<td></td>
<td>Simply implementation</td>
<td>Installation costs</td>
</tr>
<tr>
<td></td>
<td>Access to external sites both national and international</td>
<td>Ongoing rental and call costs</td>
</tr>
<tr>
<td><strong>IP</strong></td>
<td>Mobility, system can use wireless technology or be plugged into any live data point</td>
<td>Cost of additional bandwidth</td>
</tr>
<tr>
<td></td>
<td>No call charges</td>
<td>Cost of implementing Quality of Service</td>
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<tr>
<td></td>
<td>Remote management of system</td>
<td>No direct connection to sites outwith HealthNet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difficulty in implementation (firewall, security, IT support)</td>
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Scottish Paediatric Telemedicine

Phase 1 Evaluation

Version 2.2
17 September 2004
1 Summary

1.1 Overview

The paediatric telemedicine project, funded by the Scottish Telemedicine Action Forum, was set up to provide rapid diagnosis of children with cardiac or surgical problems at a distant centre. Mobile video conferencing units were installed in Ayrshire Central, Wishaw General, Ninewells, Edinburgh Sick Children’s and Yorkhill along with a video conferencing room at Yorkhill.

This report details the findings from this first phase of the project and presents the case to release funding for the sites planned for phase two, these are:

- Raigmore Hospital, Old Perth Road, Inverness
- Royal Aberdeen Children's Hospital, Cornhill Road, Aberdeen
- Simpson Reproductive Medical Unit, The Royal Infirmary of Edinburgh at Little France, Old Dalkeith Road, Edinburgh
- Stirling Royal Infirmary, Livilands, Stirling
- Princess Royal Maternity Hospital, Alexander Parade, Glasgow

Using a mixture of ISDN and IP communications, systems based on the Tandberg Intern II have been installed at the remote sites. By using this small footprint, highly mobile device it is possible to hold the video link at the patients' bedside. This enables the remote consultant to see views of the patient, live echocardiograms and radiological images.

1.2 Results

Evaluation of the system from both functional and clinical perspectives are core aims of the project. It has therefore been essential to develop data gathering mechanisms to support the evaluation of the following criteria agreed by the Project Board. The evaluation takes into account the following aspects from a system and user level:

- Functional evaluation
- Assessment of diagnosis
- Assessment of patient management
- Review of patient transfers
- Measurement of user perception

To date (6/9/04) the system has been used for 19 cardiac and 9 surgical referrals.

Key Points - Cardiac

- In 18 of the 19 cardiac cases (95%) the diagnostic assessment was considered to be appropriate. In one case the diagnosis was not complete. In this case the infant was not unwell and the omission was not clinically significant. It is not possible to determine whether this omission was due to the use of telemedicine or was caused by physiological factors or operator omission. In all cases there were no factors in patient management that were considered inappropriate.
Of the cases referred by telemedicine, no patient transfers were undertaken which were later deemed unnecessary. It is estimated that of these cases, 7 would have been urgently transferred to Yorkhill were telemedicine not available.

A further 8 cases required later follow up. The telemedicine consultation allowed these cases to be reviewed electively.

Key points – Surgical

- 6 of the 9 surgical referrals were for acute problems where the neonatologist needed help and support in the management of the acutely sick neonate.
- One of the essential questions about this kind of system is how and whether it can effect a reduction in transfers. Based on clinical judgement, in the cases described above, all 6 acute cases would have been transferred if telemedicine had not been available.
- The teleconferences were often carried out within minutes of the telephone referral. Clear details of the patient condition and status were quickly obtained.
- Video conferencing was used to view the patient’s condition, view X-rays and in some instances discuss the case with the parents.
- In the case of one patient, consent was obtained by across the telemedicine link to transfer the neonate and insert a central line. This involved the surgeon on call discussing both the benefits and risks of both the transfer and the procedure with the parents.

Key Points - General

- The patient group in question is (thankfully) a small one numerically. It is important to note that while the total number of neonatal patient transfer from the participating hospitals is low, the percentage of emergency transfers has fallen from 71% to 45%.
- Results from the parental follow up interviews showed that all parents involved were very positive about the use of video conferencing.
- Some parents indicated that they would have liked the chance to discuss their child’s condition with the remote consultant. This consideration is being recommended for future transmissions where appropriate.

1.3 Integrating the system; emergent uses

Although outwith the scope of this project, the videoconferencing systems installed have also facilitated a number of other uses. These have included educational meetings, management meetings and a range of clinical consultations and meetings.

- The broadcast of educational meetings to increase access and participation
- Psychiatry case reviews linking with practitioners in Inverness and Orkney, this use is now being embedded into the routine of psychiatry case review
- Supporting West of Scotland Child Protection Network meetings, with plans in place to establish child protection peer review meetings
- Fetal medicine consultation
- Clinical genetics consultation
- Perinatal Clinical Network meeting with Ayrshire. Plans in place to hold regular multidisciplinary meetings
- Testing of links between Yorkhill and Edinburgh Sick Children’s with the intention of holding joint Tumour Board meetings
- Ventilated child case conferences
- International links with Jordan

1.4 Discussion

This report provides background details and findings from the pilot of the Scottish Executive Health Department (Telemedicine Initiative) funded Scottish Paediatric Telemedicine System.
Until the telemedicine option is as a readily available tool and is integrated into the routine of healthcare delivery it is still necessary when undertaking new uses to consider practical issues around feasibility and acceptability. The project team have gathered information during the pilot period (February to September 2004). During the pilot period 4 sites have been linked to provide acute clinical support.

The salient data on clinical acceptability and technical feasibility has been collected. From the data collected it is evident that providing clear and wide ranging training, involving of clinical users and dedicated project management support have allowed us to develop a system that is going to be a robust tool to facilitate improved response to the problems associated with centralising specialist care.

Secondly, the cardiac results to-date have reinforced the findings of other groups that the use of telemedicine links and the video output from an ultrasound machine allows a diagnosis to be correctly made in the tertiary centre.

Thirdly, that while numbers reviewed by the surgical team have been small, the experience so far has illustrate the added value of having this facility in the main teaching hospitals. Already we have seen the benefit of being able to discuss an acute situation with the local Consultant team and the parents providing assistance with the diagnosis, management and the long term care of the patient.

Finally, Parents have found their live participation in the decision making of the clinical care of their babies very helpful at a stressful time.

### 1.5 Health Service Journal Awards

The project has recently been short listed for the Health Service Journal Award in Improving Care with E-Technology.

### 1.6 Acknowledgements

The project team would like to acknowledge the assistance and support given my members of the Project Board, clinicians at the participating sites and STAF representatives. Particular thanks is due to Ms Nessa Barrie and Dr John Brebner for advice and guidance, assistance in the design of the evaluation process and production of this report.
2 Introduction

2.1 Project Background

The demands upon paediatric services in the NHS in Scotland are undoubtedly similar to demands on other clinical disciplines. The service issues driving the Modernisation Agenda in paediatric care include the availability of consultant paediatric expertise, the clustering of services in the central belt and access to support training for paediatricians. Issues from the client perspective include the following acute as well as routine services:

- Access to expertise from sites outwith the central belt
- Transport of critically ill and injured babies
- Provision of adequate diagnostic and patient management support such as follow-up clinics, whilst allowing the patient (and family) to remain at their local hospital.

The use of appropriate technological ‘ehealth’ or telemedicine solutions as tools to address clinical priorities has become a real possibility in Scotland in recent years. Experience in other areas has shown that when used to support clinical priorities and with strong management support for implementation ehealth applications can provide new ways of working and support the modernisation and improvement of the service for all users.

With tertiary medical services for children in Scotland centralised in the major cities this contributes to the difficulty of providing equity of access to these services across Scotland, especially in acute or emergency conditions. This report presents preliminary findings on the Scottish Paediatric Videoconferencing Pilot funded by the Scottish Executive Health Department (SEHD), Telemedicine Initiative.

Following a successful bid to the Scottish Telemedicine Action Forum (STAF) funding was secured to for a project to address the issues using video conferencing technology.

Specific challenges addressed by this project include:

- Providing a rapid diagnosis of the ill child with suspected congenital heart disease in a distant centre.
- Providing a full assessment of the child with a possible heart defect who does not necessarily require immediate transfer for diagnosis but may have a significant lesion and would benefit from a cardiology opinion before the next outreach clinic.
- Visualising clinical state, imaging, X-rays and ultrasound information of neonates with surgical problems requiring an opinion or treatment from the tertiary centre.
- Providing skilled support for echocardiography technicians in a distant centre.
- Assessing clinical information passed by telephone without access to physical and radiological images.

2.2 Project Objectives

The project deals with two distinct groups of patients; these are patients with cardiac problems and neonates with surgical problems.

Cardiology objectives

- To provide without delay, by consultants in Yorkhill, a diagnosis of remote echocardiographs in acutely ill infants at remote locations
- To provide a ‘virtual’ clinic, staffed by a Yorkhill cardiologist, for less acute/asymptomatic patients at remote locations.
Surgical objectives

To provide joint management of neonates with surgical problems to optimise patient care

2.3 Method of Approach

The project is being implemented / organised as follows:

Stage 1
- Implementation of new procedures at Yorkhill Hospital, Ayrshire Central Hospital, Wishaw General Hospital and Ninewells Hospital Dundee
- Formal evaluation of the procedures, feasibility and an assessment of diagnosis, patient management, patient transfer, user perception and system function
- Assessment of stage 1 by STAF, with a decision made to fund stage 2

Stage 2 commencing Autumn 2004
- Extension of system to Aberdeen Children’s Hospital, Royal Hospital for Sick Children Edinburgh and Princess Royal Maternity Hospital Glasgow
- Evaluation and review of procedures
- Extension of system to Simpson Reproductive Medical Unit Edinburgh, Falkirk and Stirling Royal Infirmaries and Raigmore Hospital Inverness
- Final evaluation and review
- Dissemination of findings, including report to SEHD, presentation to peers at appropriate venues and publication of findings in relevant clinical journals

Project Management

The project applicants recognised at the outset the importance of dedicated project management support for implementation. To ensure appropriate management of the project, formal project management methodologies have been applied. These have included:

- The formation of a Project Board
- The development of a project initiation document detailing the project outcomes, scope, roles of board members and reporting mechanisms
- Representation on the Project Board of the SEHD Telemedicine Initiative panel (N Barry)
- Embracing the experiences of the other SEHD Telemedicine Initiative projects in areas such as project management, technology procurement and implementation and models of evaluation
- The development of a change control process
- Sound financial management

2.4 Purpose of Report

This report provides an overview and assessment of stage 1 of the project. It describes systems installed, outlines the evaluation methodology and reports on the results from both Surgical and Cardiac referrals. It also details some of the alternative uses made of the system which we estimate have increased the overall perceived value and integration of the system for users.

The report will be made available to all stakeholders of the project and will be submitted to the SEHD and STAFF for review. It is anticipated that following this review funding for stage 2 will be released.
3 Project Overview

3.1 Management Overview

The project is formally managed by the full Project Board. This group meets quarterly and consists of Managers, Clinicians, Researchers, IT, Staff Representatives and the Project Manager. Between Project Board meetings the local steering group has delegated authority.

Day to day management of the project is conducted by the project manager.

Figure 1 Management Overview
3.2 Hardware Utilised

Following a review of video conferencing hardware with emphasis upon the specification and requirements of the clinical team, it was agreed that the project would procure Tandberg systems. As well as being a leader in the video conferencing field, Tandberg produce a device that is specifically designed to meet the needs of providing bedside video conferencing facilities, the Intern II.

While the Intern II was procured for systems to be used in clinical areas, it was planned that the main telemedicine facility would be based in a purpose build room to provide the most appropriate range of audio-visual equipment. It was agreed that this system would be based on the Tandberg 6000. This combination of a small freely moveable videoconferencing system and a dedicated, purpose built room offers greater functionality and has allowed users develop a range of different types of use, from the clinical acute scenario through to the case review and project meeting.

To ensure security, both systems offer a high level of encryption.

The Intern II System

The Intern II was specifically designed for applications where a smaller, more mobile system is required, while still retaining the flexibility of larger units. It utilises 15” flat-screen LCD displays creating a completely self-contained videoconferencing system. The system is based on an ‘IV’ stand design ensuring a high level of stability and maintains a small footprint, allowing ease of mobility within the ward.

The unit houses a Tandberg 880 video conferencing unit, providing the same functionality as more traditional fixed systems. This also supports the connection of multiple peripheral devices such as computer equipment, ultrasound devices and hand held cameras by way of a simple video or computer cable.

The Tandberg 6000 System

Within the telemedicine room at Yorkhill, a Tandberg 6000 was installed. This features high quality video, giving clear, crisp images by utilising the latest standards in video conferencing technology. It also supports higher bandwidth connections using ISDN$^3$ and IP$^4$ allowing multiple sites to simultaneously join in a conference.

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$^3$ ISDN stands for Integrated Services Digital Network. It allows voice and data to be transmitted simultaneously across the world using end-to-end digital connectivity. There are two types of ISDN service: Basic Rate Interface (BRI) and Primary Rate Interface (PRI). A basic rate interface consists of two 64 kb/s channels. For video conferencing it is usual to install 3 basic rate interfaces providing a total of 6 channels.

A primary rate interface is intended for users with greater capacity requirements and is provided in bundles of between 8 and 30 channels per line.

$^4$ IP stands for Internet Protocol. It is the communication method used by most computer systems. Both local and wide area computer networks, including HealthNet, support the IP protocol for the transmission of data.
Connected to the Tandberg 6000 is a set of peripheral devices allowing the transmission of different video streams. This allows the room to function as a multi-purpose video conferencing and presentation suite. These include:

- Twin LCD projectors, displaying images onto the projection wall
- DVD recorder and player, allowing video conference sessions to be recorded and played back.
- Video player, allowing the presentation of pre-recorded tapes
- Desktop computer, to view any PC source including PowerPoint presentations, digital X-Rays and images
- Visualiser (document camera) to view paper documents, film X-rays and other non-standard sources

To make the system user friendly, all standard features can be controlled from a single remote control device. This utilises a touch panel with a high quality graphics display. The panel is programmed to operate the video conferencing system, switch between devices and control the operation of individual components simply by tapping the appropriate icon on the screen.

### 3.3 System Rollout

Following the delivery of the Intern IIs in January 2004, work progressed on a programme of installation and testing. The first system was installed in Cardiology department of Yorkhill in late January. This was shortly followed by the installation at Ayrshire Central, Wishaw General and Ninewells. With agreement from the Project Board, the installation of a unit in the Royal Hospital for Sick Children in Edinburgh was moved forward to phase 1 and was completed in June 2004.

By deliberately adopting an incremental rollout it was possible to ensure operation, obtain feedback, learn lessons and fine tune the process before proceeding to the next site.
Table 1 System Installation Dates

<table>
<thead>
<tr>
<th>Site</th>
<th>Location</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yorkhill Cardiology</td>
<td>Cardiology viewing room</td>
<td>30/1/04</td>
</tr>
<tr>
<td>Ayrshire Central</td>
<td>Neonatal Unit</td>
<td>20/02/04</td>
</tr>
<tr>
<td>Wishaw General</td>
<td>Neonatal Unit</td>
<td>17/3/04</td>
</tr>
<tr>
<td>Ninewells</td>
<td>Neonatal Unit</td>
<td>2/4/04</td>
</tr>
<tr>
<td>Yorkhill Telemed</td>
<td>Telemedicine Room</td>
<td>6/5/04</td>
</tr>
<tr>
<td>Edinburgh RHSC</td>
<td>Intensive Care Unit</td>
<td>4/6/04</td>
</tr>
</tbody>
</table>

3.4 The Telemedicine Network

The video conferencing systems are connected together using ISDN or IP. ISDN has been installed at the central sites in Yorkhill and also in sites where IP communication is not possible. It should be noted that it is not currently possible to connect between the IP only sites to the ISDN only sites. This limitation may be resolved shortly by further integration with the South Scotland Telemedicine Network, allowing calls to be routed from the IP network to an ISDN gateway.

Figure 2 The phase 1 Telemedicine Network
3.5 User Training

Although the systems are designed to be easy to use, feedback from the STAF Telemedicine Initiative panel and other non-technical users strongly advocated a structured approach to training and support. To this end, a number of training initiatives have been completed. These have included:

- The production of quick reference guides for the Intern II system
- One to one training sessions for clinicians
- Both video conferenced and telephone support and guidance
- The production of an easy read user guide for the Tandberg 6000 system
- Short training session on using the Tandberg 6000 system, held in conjunction with the staff open day
- Technical training for support staff

Feedback from users has indicated that the system is indeed easy to use. Of the 12 technical problems mentioned on the evaluation forms only 3 were related to user error.

3.6 Evaluation

Evaluation of the system from both functional and clinical perspectives is a core aim of the project. It has therefore been essential to develop data gathering mechanisms to support the evaluation of the following criteria agreed by the Project Board. The evaluation takes into account the following aspects from a system and user level:

- Functional evaluation
- Assessment of diagnosis
- Assessment of patient management
- Review of patient transfers
- Measurement of user perception

3.7 Development of the Evaluation Process

The development of the evaluation process has been a collaborative and iterative process. After initial ideas were developed internally these were reviewed by a group of the clinicians involved in the project. Along with feedback on piloting the data collection forms presented the sessions raised the issues of:

- Producing an agreed protocol, determining how the aims and objectives of the original proposal would be translated into data and which tools would be appropriate to use
- Identifying which staff members were responsible for data collection and management
- Whether Ethics Committee Approval was required
- Confidentiality of data and parental consent.
- How to capture data on the emergent or unintended uses of the system

The process was further refined following review by the Project Board and research colleagues. The Project Board was keen to develop a practical and achievable evaluation strategy, which would be owned and supported by the users of the system.

It should be noted that the help and guidance provided by Ms Nessa Barrie and Dr John Brebner, based on their extensive experience, greatly assisted in the development of the methodology adopted.
Evaluation Protocol

To document the evaluation process the ‘Telemedicine Protocol’ document was produced. This lists the hospitals involved in the project along with contact details for the lead clinicians, the patient groups to be included along with a flowchart outlining the process and instructions for completing the forms. A copy of the protocol is contained in Appendix 2.

Ethics

Consideration by the Project Board was given as to the requirement to obtain Ethics Committee approval for the project. It was agreed that this would be best achieved by writing formally to the chair of the Yorkhill Ethics Committee. Following consideration, by the committee, it was agreed that the project could be classified as an introduction of new technology or service development rather that a research project. As such it was not required to seek ethical approval. However, the board are cognisant of the increasing expectation of areas that may be considered partly development and partly research to seek ethical guidance and approval. Any future plans to undertake research once the system is embedded, will undoubtedly involve a renewed discussion on ethical approval.

The project manager also consulted the MREC website for guidance on consent forms.

This is an area where previous experiences on other ehealth developments are particularly useful to consider. Other key issues in relation to data collection included:

Confidentiality of Data

To ensure the project operated within the guidelines set out by Yorkhill Information Security Policy and the Protecting Patient Confidentiality report, an outline of data collection process along with copies of the data collection forms was submitted to the hospitals Caldicott Guardian for approval. After consideration it was agreed that the data collection forms were appropriate and sufficiently anonymised to allow transmission via e-mail.

Parental Consent

Parental Consent for the project can be split into two categories, consent to allow the video conferenced referral to the tertiary centre and consent to allow personal details to be transmitted to Yorkhill to facilitate the parental follow up study.

The practice of contacting colleagues at a tertiary centre is widely used with the NHS. Contact would normally be made by telephone. For this contact to take place, parental consent is not normally requested. By utilising new technology to provide essentially the same service, it was agreed that parental consent was still not required.

It is however clear that the transmission of identifiable information for non-clinical purposes requires consent. The consent form developed in conjunction with clinicians, the Project Board and the Caldicott Guardian is contained in Appendix 3.

Data Collection and Management

The data collection forms are split into three groups, those completed by the referring clinician pre and post conference, those completed by the receiving clinician post conference and those completed by a panel of clinicians reviewing each case individually.

Forms have been developed, submitted for review by both clinicians and researchers representing the SEHD Telemedicine Initiative and piloted. During the first few weeks of the project, the forms
have been further modified to take into account feedback received. Forms are available in different formats for printing and for completing in MS Word. From the latter it is possible to e-mail the return and import the data into MS Access. The latest version of each form is available for download from the project website. In addition, the appropriate forms are located in a folder situated with each machine.

Copies of the final set of evaluation forms are contained in Appendix 4.

3.8 Functional Evaluation

It is now widely accepted that one of the many factors influencing user resistance occurs when the technological tools do not provide the users with consistent quality and robustness of service. The functional evaluation therefore aims to measure reliability and usability of the system. This information is collected from both the Referrer and Receiver on Forms 4 and 4b. Details of any technical difficulties are requested along with an assessment on whether the transmission was of a quality suitable for diagnostic purposes.

3.9 Assessment of Diagnosis

In a consultation scenario information on the diagnosis / assessment of the patient is recorded:

- Prior to the video conference
- Immediately following the video conference
- And at time of discharge or 2 weeks later.

Also collected is information on what the receiving clinician contributed to the diagnostic process. This is measured by noting the certainty of the diagnosis pre and post conference.

The severity of the condition at each of these stages is recorded. The rationale for this aspect of evaluation is to ascertain the change (if any) made by telemedicine consultation, which in turn can be compared to the final diagnosis of the patient. As we know clinical judgement is core to all stages in the consultation process and it is necessary to develop imaginative and subtle ways of capturing alterations in the process.

A final assessment of the diagnosis is then recorded on the Case Review Form (Form 6). These forms are completed by the lead clinicians at a monthly review meeting. At the meeting, consensus is reached between the lead clinicians in attendance as to the appropriateness and completeness of the diagnosis obtained.

3.10 Assessment of Patient Management

Changes to patient management are recorded on Form 3, the Post Telemedicine Patient Assessment. This is reviewed at the monthly review meeting where it is assessed if the patient management was optimal, or if improvements could have been made. This is an extra level of clinical effectiveness review but also quality control and an opportunity for learning.

3.11 Review of Patient Transfers

The cost of transferring patients, particularly neonates requiring specialist transfer, is high. This is due to the process being hugely resource hungry. As Telemedicine may affect both the number of transfers and the type of transfer (from requiring the emergency transfer team to a lower cost elective transfer) it is important that information is collected that measures any change.
Prior to the video conference the referrer is asked to state where they think the outcome of the conference will result in and emergency transfer, urgent transfer, non-urgent transfer or manage locally. The actually decision made is then recorded post conference.

This is reviewed at the case review meeting and the appropriateness of the decision questioned. Using clinical judgement on whether transfers were indeed avoided consensus is reached among the clinicians in attendance.

In addition to the information collected from the telemedicine consultations, data was analysed from the West of Scotland transfer team. This information detailed all neonatal patient transfers from March 2003 to the present date.

### 3.12 Measurement of User Perception

An important aspect of the evaluation was to ascertain the views of the parents whose children were referred using video conferencing. Following discussion with the Project Board, clinicians an researchers it was agreed that the best method to collect this information was to develop a questionnaire and collect the information by way of a telephone survey. We acknowledged that this may be a sensitive topic for some parents but, to reduce bias all parents are offered the chance to participate.

To avoid bias and to ensure a suitable response when dealing with possible distressed parents it was agreed that the survey would be conducted by a nurse from the Cardiac Liaison Team.

A copy of the questionnaire used is contained in Appendix 4.

### 4 Cardiac Results

#### 4.1 Descriptive Statistics of Service to Date

To 28/08/04 there have been 19 cardiac consultations.

**Table 2 Cardiac Consultations**

<table>
<thead>
<tr>
<th>Pilot Centre</th>
<th>Number of cases</th>
<th>Grade and number of clinicians involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayrshire</td>
<td>7</td>
<td>2 consultants</td>
</tr>
<tr>
<td>Wishaw</td>
<td>5</td>
<td>1 consultant</td>
</tr>
<tr>
<td>Dundee</td>
<td>7</td>
<td>2 consultants, 1 SpR</td>
</tr>
<tr>
<td>Cases received at Yorkhill</td>
<td>19</td>
<td>3 consultants, 1 SpR</td>
</tr>
</tbody>
</table>
### Table 3 Primary Reason for Referral

<table>
<thead>
<tr>
<th>Reason</th>
<th>Diagnosis</th>
<th>No of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyanotic</td>
<td>Normal</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>TGA(^5) with VSD(^6)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>tetralogy of Fallot</td>
<td>2</td>
</tr>
<tr>
<td>Collapse / failure</td>
<td>left heart hypoplasia</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Hydrops</td>
<td>1</td>
</tr>
<tr>
<td>Murmur</td>
<td>pulmonary stenosis with VSD</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>VSD</td>
<td>3</td>
</tr>
<tr>
<td>Cardiomegaly</td>
<td>infant of diabetic mother</td>
<td>1</td>
</tr>
<tr>
<td>Possible endocarditis</td>
<td>Septicaemic baby</td>
<td>1</td>
</tr>
<tr>
<td>Down syndrome</td>
<td>AVSD(^7)</td>
<td>1</td>
</tr>
<tr>
<td>Question of shunt size</td>
<td>Persistent arterial duct</td>
<td>1</td>
</tr>
<tr>
<td>Post-operative review</td>
<td>AVSD</td>
<td>1</td>
</tr>
</tbody>
</table>

It should be noted that although clinicians have been encouraged to use and test the system, all cases reported have been referred for clinical reasons. Test / training transmission have not been recorded.

### Table 4 Diagnostic Groups by Transfer Status

<table>
<thead>
<tr>
<th>No immediate transfer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal heart</td>
<td>3 cyanosis</td>
</tr>
<tr>
<td></td>
<td>1 hydrops</td>
</tr>
<tr>
<td></td>
<td>1 Possible endocarditis</td>
</tr>
<tr>
<td>Minor lesion, later assessment</td>
<td>1 Infant of diabetic mother</td>
</tr>
<tr>
<td></td>
<td>1 mild pulmonary stenosis</td>
</tr>
<tr>
<td></td>
<td>3 VSD</td>
</tr>
<tr>
<td>Significant lesion: diagnosis,</td>
<td>1 AVSD</td>
</tr>
<tr>
<td>plan, later assessment</td>
<td>2 Fallot</td>
</tr>
<tr>
<td></td>
<td>1 PDA(^8)</td>
</tr>
<tr>
<td>Severe lesion, consultant</td>
<td>2 left heart hypoplasia</td>
</tr>
<tr>
<td>attended to discuss with parents</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Immediate transfer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant lesion, atrial</td>
<td>2 TGA with VSD</td>
</tr>
<tr>
<td>septostomy possibly needed</td>
<td>Both transferred without PGE(^9), 1</td>
</tr>
<tr>
<td></td>
<td>same &amp; 1 next day</td>
</tr>
<tr>
<td>No telemedicine consultation</td>
<td>1 Normal heart</td>
</tr>
<tr>
<td>held, local echo diagnosis of</td>
<td></td>
</tr>
<tr>
<td>TGA</td>
<td></td>
</tr>
</tbody>
</table>

| Consultation to obviate travel| 1 Effusion review following return to local hospital |

\(^5\) TGA Transposition of the Great Arteries  
\(^6\) VGA Ventricular Septal Defect  
\(^7\) AVSD Atrioventricular Septal Defect  
\(^8\) PDA Persistent Arterial Duct  
\(^9\) PGE Prostaglandin E treatment
Table 5 Preliminary Effect on Emergency Transfer Team at 3 Months

<table>
<thead>
<tr>
<th>Category</th>
<th>Diagnosis</th>
<th>No of Cases</th>
<th>No of Urgent Transfers</th>
<th>No of Urgent Transfers Avoided(^{10})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using Telemedicine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal heart</td>
<td>cyanosis</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>hydrops</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>? endocarditis</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Minor lesion</td>
<td>Infant of diabetic mother</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mild pulmonary stenosis</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>VSD</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Significant lesion</td>
<td>AVSD</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Fallot</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>TGA with VSD</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>PDA</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe lesion</td>
<td>Left heart hypoplasia</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total: 7</td>
</tr>
<tr>
<td>Without use of telemedicine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal heart</td>
<td>Normal (thought to be TGA)</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

By carrying out patient reviews at the local hospital using the telemedicine link, travel to Glasgow has been avoided in these cases. This is clearly of benefit to the parents, who were only required to travel to their local hospital.

### 4.2 Assessment of diagnosis – evidence from data collected and case review

Consultations have not been designed with the intention of making a full and detailed diagnosis. Rather they are to establish the nature of the problem and allow planning of the course to be followed. E.g. in TGA no attempt has been made determine the site of the coronary arteries as would be necessary before surgery.

In 18 of 19 new cases the diagnostic assessment was considered to be appropriate. In one case the diagnosis was not complete. This was an infant who was not unwell. Images transferred

\(^{10}\) Based on consensus reached during case review meeting
confirmed the diagnosis of pulmonary stenosis but subsequent studies showed an associated VSD. Possible reasons may include:

- Pulmonary pressure was high so there was little flow through the ventricular septum
- The quality of the echo images sent was not sufficiently high
- A full and detailed echo was not performed and assessed.

Having reviewed all cases, no errors of clinical significance have been made to date.

4.3 Assessment of patient management

In the 19 cases of telemedicine consultation there are no factors in patient management, which have been considered to be inappropriate.

In one case where the infant remained in the referring centre until the next outreach clinic it was felt by the visiting cardiologist that therapy should have been modified before his visit. This has highlighted the requirement to consider regular follow up discussions in patients where clinical condition might change, such as duct dependant lesions.

During the evaluation period, one infant was transferred from a participating site without the use of telemedicine. He was diagnosed locally after an echocardiography study as having a significant defect (TGA). On arrival the infant was found to have a normal heart.

It is now clear that the use of the telemedicine system would have avoided this unnecessary transfer.

4.4 Review of patient transfers using telemedicine to support clinical decision making

Of the cases referred by telemedicine, no transfers were undertaken which were later deemed unnecessary. It is estimated that of these cases, 7 would have been urgently transferred to Yorkhill were telemedicine not available.

One case transferred from a participating site, did not make use of the video link. Although diagnosed with a significant lesion, when examined at Yorkhill the heart was found to be normal. This transfer could have been avoided by the use of telemedicine.

The two remaining urgent transfers both involved significant lesions. By making use of the telemedicine link, the Cardiologist at Yorkhill was able to advise on the most appropriate transfer management. In both cases the infants could be transferred without the use of drug therapy such as prostaglandins. The significance in this case was to enable travel without being intubated on a ventilator. This greatly simplified the transfer process.

A further 8 cases required later follow up at Yorkhill or at local cardiology clinics. The telemedicine consultation allowed these cases to be reviewed electively without the need of the emergency transfer team.

One patient was discharged from Yorkhill with a pericardial effusion needing ongoing review. A cardiologist saw the patient when attending the local outreach clinic in Dundee. There was still a significant effusion and he attended Glasgow 2 days later for further assessment. Review the following week was required but there was no outreach clinic planned. Rather than travelling to Glasgow a telemedicine consultation was scheduled and undertaken in Dundee.
4.5 Examples of Consultations

The following are descriptive examples of experiences of the primary clinical users of the network.

Dr Alan Houston, Consultant Cardiologist, Yorkhill Hospital

Case 1

"An infant born at term was found to have hydrops (marked retention of fluid causing swelling of skin and fluid in body cavities. This was not expected and the baby was quite unwell and they question arose as to whether this fluid retention was the result of a heart abnormality.

The neonatal consultant phoned the cardiologist to discuss the case. The cardiologist suggested a telemedicine echocardiogram to make or confirm the diagnosis. The local consultant stated that he had no experience of echocardiography or telemedicine links. The cardiologist suggested that the try this and guided the local paediatrician through the whole process, including setting up the echo machine and manipulating the ultrasound probe.

It was concluded that there was no heart abnormality. The infant remained at the local hospital. An urgent transfer was avoided."

Case 2

"An infant was born at 33 weeks gestation (7 weeks early) weighing 2.1 Kg. On examination the infant was recognised to have trisomy 21 (Down syndrome). He was found to have a heart murmur and be somewhat blue. The local consultant undertook investigations and on echo demonstrated a VSD and possible tetralogy of Fallot. Since those with tetralogy of Fallot can rapidly become more blue and severely hypoxic (low oxygen in blood) the question arose of transfer to Glasgow for observation. The telemedicine link was used and the clinicians confirmed the diagnosis. The size of the lung arteries and valve was such that rapid deterioration was unlikely to occur.

The infant then remained at the local avoiding the stress of a transfer hospital and was seen by a visiting cardiologist 10 days later. He was subsequently transferred to Yorkhill for surgery."

Dr Jon Staines, Consultant Paediatrician, Ayrshire Central Hospital

"A baby was born normally at term after an uncomplicated pregnancy. He was of good birth weight and appeared well. At six hours of age the paediatric team were asked to see him because he was found to be breathing rather rapidly. When examined he was not only breathing fast but also appeared pale and his circulation was sluggish. A problem with his heart was suspected.

Under the guidance of the cardiologists a cardiogram was performed which showed that the left side of heart (which supplies blood to the body) was underdeveloped. This condition is fatal if not treated and surgery is only performed in selected centres in the UK. A quick and accurate diagnosis ensured that appropriate emergency drugs were successful in keeping the baby well until he could be moved to a hospital in London for his operation. The need for an initial transfer to Glasgow to be seen by the cardiologists was avoided and his parents were counselled with confidence"
5 Surgical Results

There have been nine surgical consultations up until 27th August.

Table 7 Surgical Referrals

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>No of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayrshire Central</td>
<td>Yorkhill</td>
<td>5</td>
</tr>
<tr>
<td>Wishaw General</td>
<td>Yorkhill</td>
<td>1</td>
</tr>
<tr>
<td>Ninewells</td>
<td>Edinburgh RHSC</td>
<td>3</td>
</tr>
</tbody>
</table>

Three were carried out between Dundee and Edinburgh and a further six were carried out between Wishaw, Ayrshire and Yorkhill Hospital. Some of these patients had several transmissions for follow up purposes and continuity of care.

Ayrshire Referrals – examples of use

The first two surgical patients that were discussed between Ayrshire and Yorkhill involved consultation about unusual X-ray appearances. Both of these patients required eventual transfer to Yorkhill as elective patients for further radiological examinations. Both patients did not require surgery and parents and the local Consultant at the base hospital were reassured.

In one instance, the possible diagnosis of an eventration of the diaphragm was raised and further review of the images revealed an artefact. These were very clearly imaged by video teleconferencing.

The second patient thought to have an abnormal stomach that was diagnosed antenatally by ultrasound had further X-rays at birth and these were very clearly imaged by teleconferencing. Advice was given to treat the baby normally and a barium swallow and follow through was organised electively at Yorkhill Hospital. This turned out to be normal and the parents were reassured that there was no structural abnormality.

The next three patients from Ayrshire were triplets who were extremely premature and had acute abdominal problems with difficult venous access. The three patients were viewed on two separate occasions and were managed locally when they were then transferred to Yorkhill for insertion of surgical lines for venous access. One patient developed intestinal obstruction three days after the teleconference and had a localised bowel problem that needed surgical intervention. A defunctioning stoma was found and the patient is now well and thriving.

Wishaw Referral

The neonatal surgical referral from Wishaw involved an urgent transmission on a Tuesday morning during a routine clinic. Within 10 minutes the Consultant in Wishaw gave details of the problem and a Consultant to Consultant discussion took place. This very premature baby weighing less than a kilogram in weight had an acute vascular problem with its right leg and buttock. Very good imaging was obtained and advice was given on the spot. This saved an unnecessary urgent transfer that morning.

Further review of the ischaemic leg was carried out early that afternoon to ensure there was no progression of the insult. A further transmission was carried out on the Friday that week which involved two Consultant Surgeons at Yorkhill, a Consultant Neonatologist and SpR to decide on the future management with the Consultant at the base hospital. It was decided that it would be safer to transfer the baby to the neonatal surgical unit for further care and insertion of a long line
(operative procedure). The parents were spoken to over the video link and permission was obtained for the surgical procedure. This baby has done well and is now in PD. This was an example of a multi-team effort using video teleconferencing. The end result being very successful.

Ninewells Referrals

Paediatric surgical services at Ninewells are provided by a consultant post shared between Dundee and Edinburgh RHSD. Since early June facilities have been in place to hold video conferences between Dundee and Edinburgh. This has allowed the paediatric surgeon to provide a consultation service to Ninewells on the days when he is based in Edinburgh.

During the first two weeks of this service three patients were referred. Although the evaluation process for these referrals has not yet been completed it is clear from the initial returns that the care of these patients has been improved by the provision of timely specialist advice and advice given on which procedures to follow.

6 Results of the Functional Evaluation

6.1 Technical Problems

Results of the data collection indicate that user (clinician) perception of the system has been generally good. Most users find the system easy to use and are happy to undertake videoconferences with minimal training. In a number of consultations either the referring or the receiving clinician had never used the system before. On these occasions it proved possible for the more experienced user to talk the other through the procedures on the phone, resulting in a successful video conference.

We recognise that it is important to record and then to address any persistent technical difficulties. A section on each of the forms, used to collect information about the videoconferences, is therefore dedicated to recording technical problems. (Forms are contained in Appendix 4.)

Table 8 Summary of Reported Technical Problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Frequency</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty in positioning camera</td>
<td>2</td>
<td>Supply hand held camera, discussion of camera positions</td>
</tr>
<tr>
<td>Problems resolved by further training</td>
<td>3</td>
<td>Production of step-by-step guides, further training</td>
</tr>
<tr>
<td>Image quality</td>
<td>2</td>
<td>Faulty cable replace, explained to user impact of using IP on frame rates</td>
</tr>
<tr>
<td>Colour missing</td>
<td>2</td>
<td>Cable connected to wrong socket</td>
</tr>
<tr>
<td>Self view not displayed on monitor</td>
<td>1</td>
<td>Telephone support to resolve problem</td>
</tr>
<tr>
<td>Lines dropping</td>
<td>1</td>
<td>No resolution available, system automatically reconnects</td>
</tr>
<tr>
<td>System crash</td>
<td>1</td>
<td>Upgrade system software</td>
</tr>
</tbody>
</table>

Of the technical problems reported by the users, all have been minor and easily rectified. On a number of occasions, technical problems have been reported which were attributed to user error. These issues were picked up via the evaluation forms and additional training given.

Of the two image quality problems reported, one was caused by a faulty cable (subsequently replace) and the second was due to the transmission being carried out over IP.
6.2 Image Quality

Of the 19 cardiac cases reviewed, 19 echo studies were carried out over the video conferencing link. All 19 were regarded as being of suitable quality for diagnostic purposes. Using the IP link to Ninewells it has been noted that on occasions the frame rate of the picture has slowed, or picture has broken up slightly. This has been easily overcome by directing the local clinician to hold the position for slightly longer or to repeat some movements.

To date 10 X-rays have been transmitted by pointing the camera at a light box displaying the film. Information on 8 such transmissions is available, stating that the images were of suitable quality.

On one occasion video images of the patient were reported to be of insufficient quality. In this instance diagnosis was made using echocardiography, hence the limited view of the patient was not clinically significant. It has been noted that obtaining a good view of the patient in an incubator is sometimes difficult with the fixed camera on the Intern II. Some success has been achieved at Wishaw by careful positioning of both the baby and the camera, however trials have started in Ayrshire using a hand held camera. Preliminary test have yielded good results. The project team will continue to collect data in these areas to further improve the ease of use and integration of the system into routine care. The continued data collection and analysis will also be used to provide robust evaluation for the final report and dissemination.

7 Results of the Review of Patient Transfers

7.1 West of Scotland Transfer Results

Until the recent set-up (Spring 2004) of a national database, information on patient transfers was collected in varying formats by each of the three neonatal transfer teams. Detailed information from March 2003 was available from the largest team covering the West of Scotland. By analysing this information it was possible to identify patient transfers from Ayrshire and Wishaw involving babies with cardiac or surgical problems.

Table 9 Number of Neonatal Transfers

<table>
<thead>
<tr>
<th></th>
<th>Cardiac</th>
<th>Surgical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wishaw</td>
<td>22</td>
<td>27</td>
<td>49</td>
</tr>
<tr>
<td>Ayrshire</td>
<td>5</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>39</td>
<td>66</td>
</tr>
</tbody>
</table>

Transfer information was further categories into emergency and non-emergency calls.

Table 10 Emergency Transfers

<table>
<thead>
<tr>
<th></th>
<th>No of Transfers</th>
<th>No of Emergency Transfers</th>
<th>% of Emergency Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wishaw Pre-Telemed April 03 – Feb 04</td>
<td>34</td>
<td>24</td>
<td>70%</td>
</tr>
<tr>
<td>Wishaw Post-Telemed April 04 – June 04</td>
<td>12</td>
<td>5</td>
<td>41%</td>
</tr>
<tr>
<td>Ayrshire Pre-Telemed April 03 – Jan 04</td>
<td>7</td>
<td>5</td>
<td>86%</td>
</tr>
<tr>
<td>Ayrshire Post-Telemed March 04 – June 04</td>
<td>10</td>
<td>5</td>
<td>50%</td>
</tr>
</tbody>
</table>
Although there was no evidence of a drop in the total number of transfers there appears to be a significant drop in the percentage of emergency transfers from an average of 71% to 45%. It is considered a priority by the team to continue to collect data on this and to develop the findings.

### 7.2 Transfer Costs

The cost of neonatal transfers is difficult to quantify as budgets are held by the transfer team, the ambulance service and the local health board. Information from the West of Scotland Team yielded the following information.

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer team costs</td>
<td>£1070 per transfer</td>
<td>Bases on budget of £604k, 565 transfers in 2003/4</td>
</tr>
<tr>
<td>Staff, equipment, training etc</td>
<td>Information not currently available</td>
<td></td>
</tr>
<tr>
<td>Ambulance service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed wing / civilian helicopter</td>
<td>£1000 per hour</td>
<td></td>
</tr>
<tr>
<td>MOD Helicopter</td>
<td>£25 – 40k per transfer</td>
<td></td>
</tr>
</tbody>
</table>

### 8 Results of the Parental Follow-Up

Of the 6 parents questioned, all were very positive about the use of video conferencing. A selection of responses regarding their experience and in particular the reassurance it affords them in a very frightening situation follows:

*Brilliant, made to feel more at ease as 2 doctors discussed case. Reassured as had second opinion from a specialist doctor in Yorkhill!*

*Fantastic facility. Helpful to make decisions and confirm diagnosis. Allowed doctors at local hospital to commence life saving medicines straight away."

*Brilliant. Very impressed. Had triplets both Mother and babies too ill to travel. Liked having information from the experts at Yorkhill on the same day. However would have liked to be at the link to ask questions from the doctors at Yorkhill."* - This has been raised with the clinical team

*Think it’s a great idea for doctors to get to the root of the problem quicker.*

*Yes it was useful. Doctor in Yorkhill confirmed diagnosis.*

*My child’s case was a routine consultation where the doctor locally did the scan and was shown over the link to a specialist. It was good not having to travel down to the technicians in Yorkhill. I liked the idea that the specialist could discuss the results immediately.*

*If my child required emergency treatment at Yorkhill would opt for the transfer first. But video link is food for routine and non urgent situations.*

Two parents voiced concern about the system relating to the separation from their child during the video conference and not being present in the room when the referral took place.

Discussion with the clinicians involved highlighted the need to be able to openly discuss the case. It was felt that this discussion would be severely hampered were the parent present. However, it is clear that the service could be improved by allowing the parents an opportunity to discuss the case.
with the remote consultant at the end of the transmission. Clinicians will be encouraged to facilitate this in the future.

9 Emergent / Other Uses of the system

Although outwith the scope of the telemedicine project, the systems installed have already been used for a variety of other purposes. This section summarises these uses and details further planned developments. We acknowledge that while embedding systems it is important to cautiously encourage other to avoid systems becoming idle. Research literature also supports the importance of systems, which can be exploited to offer multi-modality uses to widen participation across professional disciplines and further embed the system.

9.1 Education

Video conferencing is increasingly used to support education delivery in urban as well as remote and rural areas. This enables a wider participation, will hopefully lead to an increase in attendance and will improve the range of available educational activities. It will also reduce the need to travel for both providers and trainers. Several publications have already demonstrated its efficacy in teaching in difficult situations.

With the extensive education programme already in place at Yorkhill Hospital it may be possible to set up a joint medical education programme with other centres. It may also be useful for teaching undergraduate medical students in the five Universities in Scotland to allow them to share areas of specialisation that may only be available in certain centres.

Our aim is to encourage different groups of people to use this new facility and develop their own area of expertise and training.

By utilising the Intern II it is possible to broadcast a multi-site videoconference from anywhere on the Yorkhill site. This has been utilised to broadcast two CME meetings to Ayrshire and one to Wishaw from the main hospital lecture theatre. On each occasion approximately 6 clinicians at the remote site took part in both the presentation and the following discussion.

To improve this service work has recently been completed to link the video conferencing system directly into the lecture room audio-visual system. This allows a direct feed from the lecture theatre to be sent via the video conferencing system, enabling the remote used to see PC presentations and video streams at much higher quality.

Currently the number of sites that can simultaneously join a meeting are restricted by the available bandwidth at Yorkhill. Technology, which will allow addition sites access to such meetings, is already installed within NHS Scotland. It is therefore anticipated that following planned collaboration, it will be possible to broadcast education meeting to a wider audience.

It is also important to note that utilising a system (when not clinically required) to support the education and training of users does give them experience which when necessary can be applied in a clinical scenario.

9.2 Psychiatry Case Review

Following the Telemedicine Open Day, interest in using the telemedicine system was express by clinicians working in child psychiatry. As the in-patient team accepts referrals from the whole of Scotland they have a requirement to hold case conferences with local clinicians, social workers, educational psychologists, teachers and dieticians throughout Scotland. Previously this would have been achieved by travelling to the remote hospital or holding meetings using a conference telephone.
To date, four case conferences have been held with participants in Inverness and Orkney. Average attendance at these meetings has been 7 attendees at Yorkhill and 5 attendees at the remote site. This represents a significant increase over telephone conferences. A further 2 case conferences are scheduled along with a national referrers meeting.

It is anticipated that video case conferences will become a regular feature. The project team are cautiously encouraging new uses of the system. The rate of inquiries and interest from other clinicians and managers, highlights the need for dedicated support for this system. If it was only available as part of a much larger IT resource it is unlikely the successful embedding of the system would have occurred.

Michael Morton, Consultant Child and Adolescent Psychiatrist, Dept of Child and Family Psychiatry (DCF), Yorkhill Hospital

“DCFP Ward has used the Telemedicine system to link with Child and Adolescent Mental Health Professionals and families to discuss children with complex difficulties in more remote rural areas of Scotland. Conference links with Inverness and Kirkwall have enabled large case conferences to take place involving a range of health, social work and educational professionals in both sites to communicate in a way that also involves family members, and a smaller conference involved a 12 year girl in discussing her school curriculum with staff in her home area and staff in the ward.

Previously DCFP ward has used telephone conference links to manage this kind of discussion and the ability of the video system to enable conference Chairs to respond to the non-verbal communication of family members and professionals in a cross-distance link has greatly enhanced the quality of these communications. The possibility of involving children in conferencing was not manageable with telephone conference but has a real future in telemedicine. This experience has opened up options for shared clinical work between community based staff and staff at the DCFP ward, and feedback has been generally very positive.”

Again these uses highlight the opportunity to stimulate new ways of working for the clinicians involved.

9.3 Child Protection

Issues

Child Protection medical services in the West of Scotland are provided by often quite isolated Clinicians based throughout the Region from Oban to Dumfries. There is also difficulty in providing equity of access to peer review for Paediatricians across the West of Scotland, resulting in few numbers of Paediatricians being involved in peer review for Child Protection work.

Peer review is an essential component of the education and support mechanisms, which should be available to all Clinicians working in Child Protection.

Specific difficulties for paediatricians include:

- Limited opportunities to widen individual experience due to low case numbers (in particular for sexual abuse and non accidental injury)
- Small number of Consultant Specialist Paediatricians in Child Protection who can offer local support.

To address these issues a pilot study has been proposed that will use existing telemedicine facilities to provide an opportunity to improve the support and education offered to Paediatricians.

The pilot will focus on peer reviewing cases of neglect and non-accidental injury. Images transmitted are likely to include anonymous photographs, x-rays, cat-scans and digital images.
Expected Benefits

It is anticipated that this project will lead to the following improvements:

- An increased number of Paediatricians will have access to peer review for Child Protection services.
- Enhanced clinical education and support.
- Experience of rare and difficult cases and good practice can be shared with a wider group.
- Less travelling time for Clinicians.
- Raised profile of Child Protection work throughout the Region.

9.4 Fetal Medicine

Dr Karen Mcleod, Consultant Paediatric Cardiologist, Yorkhill Hospital

“Our first fetal telemedicine consultation took place in July 2004 with a link to Ninewells hospital. The mother, a 41 year old woman with 8 previous children, could not travel all the way to Glasgow for social reasons. A scan of the fetal heart when she was 24 weeks pregnant suggested a heart abnormality. Using the telemedicine link, we were able to obtain very clear pictures of the fetal heart, make a diagnosis and counsel the parents.

The telemedine link saved the parents a long journey and allowed counselling in a place with which they were familiar. It is hoped that further fetal telemedicine links will help to ease the demand for the services of the overstretched fetal medicine department at Yorkhill. It should also allow greater access to specialist fetal scanning services for women throughout Scotland.”

9.5 Clinical Genetics

Dr John Tolmie, Consultant Clinical Geneticist, Yorkhill Hospital

“Doctors from the Clinical Genetics Department were asked for advice from Dr Jon Staines, at Ayrshire Central Hospital, who was caring for a newborn with various orthopaedic deformities. The video conference permitted details of the history to be given and video images shown of abnormal clinical signs that were evident on examination of the infant. A management plan was discussed and a follow up appointment planned. This meant that the parents could be advised on the different diagnostic possibilities and the way these might be investigated in the future.

This video meeting speeded up the referral process, avoided travel to Ayrshire and permitted an instantaneous clinical opinion to be given. Without the system the baby would have waited several days to be seen by a clinical geneticist.”

9.6 Perinatal Clinical Network

Dr Alan Cameron, Consultant Obstetrician, The Queen Mother’s Maternity Hospital, Yorkhill

“The multidisciplinary perinatal group meets weekly to discuss pre-natal diagnosis and fetal therapy of cases referred to the fetal medicine unit. As well as the local clinicians attending these meetings, obstetricians and pathologists from Ayrshire, Lanarkshire and Dumfries try to attend when they can. The use of the telemedicine suite has enabled us to pilot the use of video conferencing as a means of hosting a multi-site meeting. To date a successful meeting has been held with Ayrshire and further meetings are planned with Wishaw and Dumfries”
9.7 Joint Tumour Board

Plans are currently being developed to hold joint Tumour Board meetings between the oncology department of Yorkhill and Edinburgh Sick Childrens Hospitals. It is anticipated these meetings will start in Autumn 2004.

These joint meetings will be used to discuss individual cases, review radiology and pathology results and discuss treatment plans.

9.8 Ventilated child case conferences

To date two case conferences have been held using video conferencing. The first concerned a child requiring 24hour ventilation. With the aim of returning the child to his home in Keith, a case conference was held between clinicians in Yorkhill, clinicians and managers in Aberdeen and with the child’s father and GP in Keith.

This provided an opportunity for all parties to discuss the logistical, financial and medical requirements for his return home and also provided an opportunity for the father to discuss the case (and see his wife and child) from Keith without the need to make the long journey to Glasgow.

It is estimated that this obviated the need for 3 clinicians to travel from Glasgow to Aberdeen, gave an opportunity for the Child’s GP to discuss the case with the Intensivist and Cardiologist in Glasgow and allowed the parents to take part in the discussion.

The second conference concerned a child returning to Ayrshire. This was attended by clinical, finance and social work staff in Ayrshire and clinical staff at Yorkhill.

9.9 International Links

By using ISDN circuits it is possible to connect to video conferencing systems throughout the world. As the hospital has already developed close links with the King Abdullah hospital in Jordan, we were privileged to be able to take part a recent ceremony to celebrate the opening of their new conference centre. This took the form of a multi-site call where several unusual cases were presented. The link clearly demonstrated the both the collaborative and teaching opportunities available to international partners.

10 Discussion

The Scottish Executive Health Department established the Telemedicine Action Forum (STAF) in 1999 against a background of considerable enthusiasm for technological solutions to underpin clinical developments. The clinical team at Yorkhill was very keen to pilot and if successful, roll out a telemedicine system, which would address their particular clinical priorities. There was some evidence that such projects in the past had demonstrated the capabilities of telemedicine not necessarily leading to sustainable clinical projects.

Tertiary medical services for children in Scotland are centralised in the major cities. This centralisation contributes to the difficulty of providing equity of access to these services across Scotland, especially in acute or emergency conditions.

This project aimed to provide the following services using video conferencing technology:

- Without delay, a diagnosis of remote echocardiographs in acutely ill infants at remote locations by consultants in Yorkhill,
- A ‘virtual’ clinic, staffed by a Yorkhill cardiologist, for less acute/asymptomatic patients at remote locations
Joint management of neonates with surgical problems to optimise patient care

Mobile video conferencing facilities have now been installed at Ayrshire Central, Wishaw General, Ninewells and Edinburgh RHSC. A mobile and fixed system has also been installed at Yorkhill.

This paper has reported on the implementation phase of the project as well as presenting preliminary clinical results, collected over the staggered roll-out period.

We have identified that providing adequate project management resource and appropriate IT support are key issues for ensuring a successful implementation. Much has also been gained by seeking advice and building on the knowledge gained from previous Telemedicine developments with NHS Scotland.

10.1 Clinical Results

From the data collected, although covering the preliminary period, the salient issues of clinical acceptability and technical feasibility have been addressed. Having clear and wide ranging training and involvement of clinical users has allowed us to develop a system that, on preliminary results, we believe is going to be a robust tool to facilitate improved response to the problems associated with centralising specialist care.

Cardiac

The results have confirmed the findings of other groups that the use of telemedicine links and the video output from an ultrasound machine allows a diagnosis to be correctly made in the tertiary centre.

This study has not been designed to provide the full and detailed diagnostic features necessary for a surgeon. However, it has allowed an appropriate diagnosis to be reached and appropriate treatment to be discussed and initiated. In one case the presence of a ventricular septal defect was not identified. This was undertaken in the first day of life and it is likely that the pulmonary artery pressure was still high and flow through the defect may have been minimal. This would suggest that if there is a defect the infant should be subsequently seen by the cardiologist at a later outpatient clinic.

An important consideration is the effect on patient transfer. Some infants with symptoms suggesting a possible heart lesion are transferred to the tertiary centre and then found to have a normal heart. They are often very unwell and require the attendance of a full transfer team. This has been obviated in some in this study. In addition many infants have a duct dependant lesion and are started on prostaglandin (PGE). The major side effect of this is that apnoea (stopping breathing) may occur. As a result the accepted management of an infant on PGE is that he/she be intubated and ventilated for transfer. Under these circumstances a full transfer team is required. In addition in some case intubation and ventilation can have a deleterious effect and should be avoided if possible.

The two cases of left heart hypoplasia are worth specific consideration. This condition is a very severe one and the only lesion for which surgery is not at present undertaken in Scotland. The decision has to be made as to whether the infant is left to die in relative comfort or surgery is to be offered. In the latter case the infant would be transferred to England, usually Birmingham, for this. In the two cases the consultant cardiologist on call saw the images and made the diagnosis. In both he opted to travel to the maternity unit to discuss the situation with the parents, rather than bringing the baby to Yorkhill and then discussing it. In one the baby was left locally and died. In the other (Ayrshire) the infant remained locally and was transferred by air ambulance from Prestwick airport.
An unexpected finding in this group of patients is that at the transmitting end an operator with virtually no experience of echocardiography can manipulate the probe in such a way that an accurate diagnosis can be reached. This does not mean that training should not be carried out for the operators, but indicates that with some training most operators should be able to provide satisfactory view for making a diagnosis.

**Surgical**

The experience so far with the 9 patients, where a consultation was carried out by telemedicine has highlighted the following strengths and weaknesses of the system.

**Strengths:**

One of the main benefits in all 9 patients has been the immediate discussion and availability of a teleconference as soon as the problem in the district hospital has been perceived. Most of the transmissions were co-ordinated and set up within 30 minutes of the first telephone call to the consultant on call. All 9 patients had acute problems where the local consultant needed advice on the acute management and whether a surgical referral was appropriate. None of the patients needed acute transfers but were eventually transferred at an appropriate time for further imaging that was unavailable locally or needed insertion of lines for vascular access. Repeated transmissions were carried out on subsequent days to check up on progress or deterioration of the patient. In one patient with necrotising enterocolitis the patient 48 hours later developed intestinal obstruction and needed surgery to relieve it. The baby did well. All the patients on follow up survived and did well.

Parents in some instances were spoken to and were introduced to the surgical team before transfer. In one instance, consent was obtained for a surgical procedure.

**Weaknesses:**

Radiological transmission and the accurate visualisation of X-rays is suboptimal and further assessment is needed of this modality. At present imaging alone is not sufficient to be able to confidently make a clinical decision.

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**Review by Remote Clinicians**

**Dr Jon Staines**, Consultant Paediatrician, Ayrshire Central Hospital

The availability of this technology has already had a significant impact on the quality of care we are able to give babies on our unit. Some transfers have been avoided completely and those infants who have still needed to go to Glasgow have been able to have their treatment and investigations planned in advance. We remain cautious as we learn about the limitations of the equipment but new uses continue to be discovered. Feedback from parents of neonates who have benefited from the technique are uniformly enthusiastic. Rather than undermining their confidence in the care we deliver they report that our ability to converse in greater detail with specialists about their child is a source of comfort."

**Dr Sam Ibhanesebhoro**, Consultant Neonatologist, Wishaw General Hospital

“Following the official launch of the Telemedicine between Yorkhill and Wishaw General Hospital Neonatal unit in May 2004 the ‘on-site’ visit by a Consultant Cardiologists for the diagnosis of congenital cardiac problems has become a rare event. There has equally been a reduction in the transfer of babies to and from Yorkhill cardiology department for diagnosis.
Training of senior medical staff is planned to ensure that at any one time there is a senior Neonatal staff with the necessary skills for echocardiography. With the available resources, we are now able to plan the management of simple and complex cardiac and surgical conditions with the active and collective participation of Parents, local Neonatal consultant staff and Yorkhill cardiology and Surgical colleagues.

Parents have found their live participation in the decision making of the clinical care of their babies very helpful.

10.2 Training

In addition to the core aims, the system has also been shown to be useful in delivering education to a wider audience. Having learned valuable lessons from our first transmissions of educational meeting we are in the process of improving the audio-visual systems to provide high quality images at the remote centre. Following these improvements it is anticipated that a programme of events will be developed for broadcasting to participating centres.

By combining resources with other NHS centres it is anticipated that in the future this service could be open up to a wider audience.

10.3 Other Uses

Although outwith the scope of this project the development of other uses of the system has been encouraging. Of particular note has been the benefits obtained from using video conferencing to host Psychiatry case reviews. This has opened up options for shared clinical work between community based staff and staff at Yorkhill.

10.4 Further Evaluation

In addition to the information presented we are committed to developing and improving the system with feedback from users, parents and managers. We will therefore continue to undertake the following:

- Obtain feedback from clinicians working with the system
- Obtain the view of the parents by carrying out a telephone survey
- Assess the number of patient transfers before and after the introduction of telemedicine

Over the course of the SEHD funding period for telemedicine projects it has become abundantly clear that the majority of the challenges related not so much to technical capabilities so much as "organisational issues" and to how a project and changes effected are managed.

Experiences from cumulative projects in the field have been brought to this development. The project overall has benefited from these experiences. Such developments need careful evaluation both on clinical outcome acceptability and indeed the capacity to contribute to educational development.

The Policy background that this project was developed against emphasised targeting national clinical priorities and modernisation to improve care. The project team is hopeful that the rollout and continued close management and evaluation will yield further clinical and educational outcomes as well as lessons for the implementation of telemedicine systems in any field.
Scottish Paediatric Telemedicine Conference

Held on 15th June 2005
Stirling Royal Conference Centre

Project Funded by the Scottish Executive Health Department, Telemedicine Initiative

Report by Hazel Archer
Telemedicine Project Manager
Yorkhill Hospital
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Summary of Proceedings

This summary presents a short overview of the proceedings at the recent (June 2005) Scottish Paediatric Telemedicine Conference held in Stirling. The Conference was hosted and organised by the Scottish Paediatric Telemedicine Project, funded by the Scottish Executive Health Department.

The Scottish Paediatric Telemedicine Project aims to provide a national telemedicine network to support clinical services in paediatric care. The Project commenced as a pilot involving 5 linked hospitals in Spring 2004 and has been rolling out since the start of 2005 to a further 6 sites. Funding was provided by the Scottish Executive Health Department's Telemedicine Initiative, with the goal of demonstrating whether the technology could provide robust support to address a clear clinical priority area in paediatric services across Scotland.

The funding period ends in March 2006 and the Project Board believes it is now necessary to assess the impact of this project and to secure the future of the network which has been put in place.

The Conference had a twofold purpose. Firstly, to bring together the most up to date results on the implementation of the paediatric telemedicine network and, secondly, to present to the wider user group (clinical and managerial) the possible uses of the system and to collate their proposals for the future of the network.

The day itself provided examples of a telemedicine network which is supporting a very positive and diverse range of uses across paediatric services. In effect, this 'mini' telemedicine conference of innovative paediatric applications put the uses of the technology to the forefront and highlighted how Scotland wide telemedicine, although not yet a fully integrated part of clinical services, is providing the essential communications infrastructure to support clinical staff in delivering paediatric care.

The original scope of the project (surgical and cardiac consultations) was always expected to be a vital but partial picture of how uses could develop. This has proven to be the case with cardiac and surgical consultations accounting for less than half the total number of telemedicine sessions.

The conference acknowledged (and discussed at some length) the difficulties still encountered in implementing telemedicine, particularly IP based solutions, and the fact that many in the wider NHS community do not see telemedicine as a priority.

However, the key message from this conference is that the main aim is to improve provision in paediatric care. While the technology involved is innovative, it is not the focus of the network.

In total there have been over 200 telemedicine sessions.

This summary of proceedings will be circulated to all the participants and attendees at the June conference and to the relevant Scottish Executive Health Departments.

Introduction - Dr Linda de Caestecker

Dr de Caestecker (head of the Women and Children's Unit in the Scottish Executive Health Department) began by highlighting the importance of the recently published Kerr Report, "Building a Health Service Fit for the Future" (May 2005). Specifically, in the context of paediatric telemedicine, one of the key recommendations of the report was

"to further roll out technologies such as telemedicine and digital image transfer to support delivery of specialized paediatric services in partnership with local services."

Dr de Caestecker emphasised that many respondents in the evidence gathering process for the Kerr Report commented that the development of telemedicine would greatly assist their ability to deliver services locally. The Report also concludes that better integration is needed between specialist children's hospitals and local District General Hospitals, some of which could be achieved or made possible using telemedicine.

Dr de Caestecker went on to note how aspects of the work of the Women and Children's Unit which may involve telemedicine include the reform of child protection services and the development of national managed clinical networks and in the development of the Framework for child and Adolescent Mental Health Services.

Dr de Caestecker concluded her introduction by noting that the recommendations from the Kerr Report would now be taken forward by various agencies and departments and that this is a key time to be considering telemedicine and in particular there was the potential for a Scottish centre for telemedicine implementation.
Overview of the Paediatric Telemedicine Project - Hazel Archer

The project was set up to evaluate the use of telemedicine for children with cardiac problems and neonates with surgical problems. Utilising a mobile video conferencing system (Tandberg Intern II), services are now provided in Ayrshire, Wishaw, Ninewells, Edinburgh RHSC, Simpson, Princess Royal, Kirkcaldy and Paisley, with systems about to be commissioned in Aberdeen, Inverness and Stirling. Within Yorkhill service is provided by both fixed room (Tandberg 6000) and mobile systems.

Communication between devices is based on both ISDN and IP communications. However IP communication is proving to be complicated and time consuming to establish.

To ensure the system is used effectively a comprehensive training programme was implemented comprising the production of easy read guides, one to one and group training sessions and telephone and video conference support.

The telemedicine consultations in the pilot phase are part of an evaluation which included: functional evaluation; assessment of diagnosis; assessment of patient management; review of patient transfers; measurement of user perception; and a record of other uses.

The main success of the project has been the number and variety of uses made of the network. These have included: surgical, cardiac, fetal, renal, genetics and genital anomaly consultations; educational broadcasts; MCN network meetings; case conference; infection control meetings; job interviews; and a variety of admin meetings. However the most prolific user of the system has been child and adolescent psychiatry departments with a total of 52 meetings for case conferences, research meetings and out patient appointments.

Lessons learned have been the importance of using telemedicine to build relationships between clinicians, ensuring systems are easy to use and have a clear benefit for the clinicians and ensuring adequate support is available.

Of concern is the difficulty in commissioning IP communications. This is mainly caused by lack of standardisation in network infrastructure, lack of bandwidth and time taken to make changes. With the implementation of N3 planned, care must be taken to ensure it does not disrupt existing services.

Surgical Results - Prof Robert Carachi, Mr William Menson

Prof Carachi reported that there had been 19 surgical consultations using the Intern II between February 2004 and May 2005. In 10 cases the referrer was unsure of the diagnosis and management and in 9 cases the diagnosis was suspected but in need of confirmation. Cases covered included gastrointestinal problems, dysmorphism, oral / cleft, ambiguous genitalia, respiratory and ischaemic limb.

It was estimated that of the 19 surgical consultations using the Intern II, 10 transfers were prevented, 7 were deferred and 2 patients were transferred urgently after stabilization.

The system is not particularly used to speak with parents, however, in 4 of the 19 cases the link was used to speak directly to parents to provide reassurance.

Professor Carachi explained that closer look at the more qualitative outcomes of using the system has
shown that the users, the consultants caring for the patient, do find benefits such as:

- Providing a more accurate diagnosis
- Allowing immediate treatment to be discussed and implemented
- Optimising care / management
- Planning safe transfer
- Preventing transfer by supporting local management
- Reassuring anxious parents
- Providing consultant to consultant support

Cardiac Results - Dr Alan Houston

Dr Houston reminded the audience that remote communication in clinical medicine is well established. Methods include letters, phone calls, fax and transfer of video images by post of courier. With the development of high quality video conferencing equipment it is now possible to send live images from a camera, ultrasound machine or of X-rays and scans.

Given the size and remoteness of many part of Scotland the transport of neonates is difficult in both acute and non-urgent situations. By viewing echocardiogram images sent by video conference it is possible to diagnose heart defects and advise on both treatment, patient management and potential transfer.

Mr Manson then took the floor and explained his unique role as a consultant at both Ninewells hospital in Dundee and the RHSC in Edinburgh and the vital role telemedicine played in providing adequate cover in Dundee on days when he was based in Edinburgh. A number of examples of consultations were described.

The conclusions made were that telemedicine:

- Prevented unnecessary transfer
- Timed transfer appropriately
- Encouraged earlier referral

As well as the clinical uses Mr Manson highlighted the fact that in his experience, using telemedicine could be a very useful way to support the model he was working to, providing specialist paediatric surgical services in two locations.

To date there have been 51 cardiac consultations. Of these, 8 children were referred with heart failure. The consultants involved estimated that in these 9 cases, without telemedicine, 7 would have been immediately transferred to Yorkhill. Following the telemedicine consultation only 4 were actually transferred. A similar pattern was seen in those with Cyanosis. Of the 12 patients it was estimated that 11 would have been transferred. The actual number transferred was 8.

In addition to reducing the number of emergency and eventual transfers. The value of the telemedicine is that a more complete or accurate diagnosis can be achieved before any transfer. This can avoid the need to ventilate the baby for transfer and hence reduce the complexity of the transfer, staff at Yorkhill can be better prepared for the baby's arrival and if necessary theatre time can be arranged in advance.

When assessing the accuracy of the diagnosis achieved by telemedicine, 2 patients were found to have additional defects when scanned at Yorkhill.
Although neither omission proved clinically significant it is impossible to tell whether the diagnosis was missed on the initial transmission or if the defects developed later due to the changes in pulmonary blood pressure after birth.

Significant benefits have been realised when using the telemedicine system: in 88% of the cardiac cases clinicians claim it has affected their clinical decision: local clinicians are reassured that the correct diagnosis had been made and appropriate action taken; parents are given a definite diagnosis and treatment plan; and patient transfers can be planned more accurately.

The system has suffered from occasional problems. In particular there have been problems with interference on the colour Doppler at Ninewells and poor image quality has been reported at times. However even in these circumstances the clinicians involved had still indicated that the transmission was useful.

It is hoped that given the success of the project it will be possible to expand the service to other units and use it as a model for future implementations.

Emerging Uses of Telemedicine

Miss Archer started the afternoon session by introducing Dr Morton and Dr Ronghie, participating by video conference from Yorkhill. During a series of short presentations the diversity of work being undertaken via telemedicine and video conferencing was presented.

Telemedicine and Psychiatry - Dr Michael Morton

Use of telemedicine in child and adolescent Psychiatry has steadily grown over the last year. A total of 52 sessions have been held, initiated by the DCPP (Department of Child and Family Psychiatry) in-patient unit, the Adolescent Unit from Gartnavel Hospital and the University of Glasgow department of Child and Adolescent Psychiatry. Of the meetings held 8 were for psychiatry research, 4 for service development, 15 for case conferences and 25 for direct clinical work.

Feedback from the users of the service indicate that the system saves travel time and cost. However it has sometimes been difficult to pick up the child’s voice. Improvement in participation has also been noted, in particular it has been possible to engage with patients using the far end camera control. The system has also provided a mechanism for skill sharing and improvements to handover at admission and discharge.

It is anticipated that telemedicine will form the basis for the development of a Managed Clinical Network for Children with Severe and Complex Psychiatric Disorders.

Tumour Boards - Dr Milind Ronghie

Tumour boards are multidisciplinary meetings, attended by oncologists, surgeons, pathologists, radiologists and other relevant specialists. Clinical cases are discussed, along with examination, radiology and pathology results, and management decisions are made.

3 successful meetings have been held involving Glasgow, Edinburgh, Dundee and Aberdeen. An international link to Jordon has also been held.

Advantages realised have included: improved networking and collaboration, no travelling involved; shared care centres allowing more involvement in the decision making for difficult cases; improved education and training for SpRs; and increased motivation.

It is anticipated that the regular bi-monthly meetings will be enhanced by improving the facilities at other sites for the broadcast of case presentations, inviting guest speakers, organising pre-meetings for the oncologists and holding supra-regional meetings.

A Case Conference in Progress
Use of ‘Babycam’ - Dr Chris Lilley

Telemedicine in the Princess Royal using the Intervent II was installed in April 2005. At this time it was recognised that it would be possible to use the Intervent II to broadcast pictures of the baby to a mother who was unable to visit due to her own medical condition. To assess this novel use of the equipment a trial was set up involving a patient staying in the plastic surgery ward for 6 weeks, 1/4 mile away.

Following the success of the trial a small Tandberg T150 was purchased at a cost of £2500 from endowment funds. The unit connects to the hospital IT network and can be positioned at the mother’s bedside. Privacy issues are addressed by the ability of both mother and nursing staff to mute microphones and turn off either camera. Privacy is further enhanced by ensuring staff screen all incoming calls from the mother.

Although nursing staff were initially a little self-conscious and wary of the technology, they quickly learned how to use the system and are supportive in its use.

Feedback from mothers has been very good. Although care has to be taken to ensure that the explanation of how to use the system is complete before connecting the call to the baby, as the mothers then generally hold the unit and cry.

Teleded Education - Dr Sheena Kinmond

Education is needed for junior doctors for college requirements and modernising medical careers; senior doctors for continuing professional development; medical students; and other staff. Telemedicine can help informally as every telemedicine consultation is a learning experience and formally through lectures, case presentations and other discussions.

Currently the Yorkhill Tuesday CME meetings are broadcast on a weekly basis to up to 4 sites, thus avoiding duplication of effort and allowing maximal attendance. It also has the added benefit of keeping trainees in touch with the tertiary centre and raises awareness of DGHs in the tertiary centre.

Teled-Education in Progress in Ayrshire

It was noted that the education could be even better if the sound quality of questions from the floor was improved and those involved in Ayrshire were less shy and took part in discussion.

The options for extending the service are numerous and could include; the recording of sessions; trying new formats such as workshops; linking smaller groups; and undergraduate plenary sessions. Also highlighted was the training requirements for the new Foundation Years.
Infection Control in the Western Isles - Dr Craig Williams

The conference heard from Dr Williams about another example of an emerging use of telemedicine during a recent influenza outbreak in the Western Isles and the subsequent management of the outbreak by the Infection Control team.

Clinical standards state that an infection control team must include a consultant medical microbiologist if the infection control doctor is from another specialty. In the case of the Western Isles, this is provided by Dr Williams at Yorkhill.

Telemedicine has so far been used in two main areas - scheduled discussions and outbreaks.

During the recent outbreak a case of suspected meningitis was to be transferred off the island. However, there was a history of other children in the class with flu like symptoms. Further investigation revealed 800 children with flu like systems out of a school population of 2500.

Particular problems dealing with the outbreak included: the low level of vaccination; spread of the disease by a small number of key workers such as bus drivers and nurses; and the possibility of spread to the mainland.

Following the set-up of an outbreak committee a number of difficult decisions had to be made regarding how and when to use Tamiflu, how to identify and treat the vulnerable population and how to increase vaccination rates.

By using the telemedicine link over a series of meetings it was possible to provide high levels of support from the infection control doctor and Health Protection Scotland and improve working relationships between those based on the Mainland and member of the Island infection control team. It was also possible to optimise the usage of expensive medication.

The final outcome was that the flu epidemic was contained and never became an issue on the Mainland.

Future Funding of the Paediatric Telemedicine Project - Hazel Archer

Miss Archer, the project manager, started the afternoon discussion session by outlining the key issues in the funding of the telemedicine network. The funding of telemedicine falls into two categories, maintenance of existing provision and new developments.

Maintaining existing provision includes ongoing management, small service developments, technical support and equipment maintenance. The proposed annual budget for maintaining provision is £70k.

As communication charges vary from site to site it is recommended that the responsibility for ISDN circuits is transferred to the sites responsible.

Current budget forecasts indicate that project funding is available until March 2006, however a small contribution of £2k is required from each site in February 2006 for annual hardware maintenance. From April 2006 a contribution of £7k is required from each site.

Any new developments with capital or revenue implications will require a suitable funding package.
Open Forum

Ms Barry opened the discussion by thanking the Project Board for organizing the day's events and spoke about how satisfying it was to be able to attend a teledemology conference in Scotland with so many innovative uses represented and so much enthusiasm from all those present to promote and develop the network, not for the sake of the technology, but to fulfill the clinical priorities around improving paediatric services across Scotland.

Ms Barry went on to stress that the purpose of the final session was to collate the thoughts of those present on how to take this project forward. Ms Barry, emphasised by Mr Anderson, who was also a member of the original Scottish Executive Telemedicine Initiative, explained that the experience from all the Scottish Executive Health Department funded telemedicine projects indicated that unless the value to clinicians was clear in their day to day work, the excitement of the technology would never be integrated into routine use.

That value had to be demonstrated not only to the clinical community but also to the wider health service management and policy communities for telemedicine to become a realistic option in the planning and delivery of services.

Ms Barry echoed the sentiments of Dr de Caestecker and others present that it is important that the overall guiding principle for any developments in the paediatric network is that they are supporting paediatric services, in particular, where clinical priorities are most acute.

Ms Barry also noted that despite the relatively small amount of annual funding projected by Miss Archer in the model, from the experience of other successful projects, the ability to secure ongoing funding, to obtain agreements about infrastructure and management/development of telemedicine systems is very difficult.

That was one of the reasons why all those who participate in and benefit from the service must be in agreement if the ongoing use is to be sustained successfully.

Ms Barry went on to explain that while the primary focus of the Scottish Executive Health Department in terms of health in general, is the development of an electronic patient record based on the CHI number, there is a great deal of interest, as introduced by Dr de Caestecker, on how telemedicine solutions may be used to help deliver our clinical priorities and provide care across Scotland.

From that context, Ms Barry highlighted the general discussion through the day's presentations and the recurring theme of viewing the paediatric telemedicine network not as a discreet project but as a service embedded into local systems as a real option in care delivery with adequate management and support.

Other key points from the discussion included –

- Write up a summary of the day and use this to pursue the case of ongoing funding through the participating sites management and raise awareness at the chief executive level.
- The need for ongoing support to facilitate meetings, provide support and guidance and help develop new services.
- Help resolve funding issues by adopting a top down approach, encouraging adoption of the service at a high level.
- Ensure all sites participate in funding to avoid any budgetary shortfall.
- Raising awareness of the service through further press involvement.
- A recent telemedicine installation by the neonatal transport service might be a suitable opportunity to provide further publicity on the planned open day.
- The vital use telemedicine is now starting to play in the delivery of clinical services.
Appendix 1  Conference Agenda

10:00 Welcome and Coffee
10:15 Introduction to the Day – Dr Linda de Caestecker,
10:30 Project Overview – Miss Hazel Archer, Project Manager
11:00 Cardiac and Surgical results - Dr Alan Houston, Prof Robert Carachi, Mr William Manson

12:30 Lunch

13:30 Emerging uses of telemedicine
  Dr Michael Morton – Child Psychiatry
  Dr Milind Ronghe – Tumour Board
  Dr Chris Lilley - Use of BabyCam™
  Dr Sheena Kinmond – Education
  Dr Craig Williams –Microbiology

15:00 Funding requirements for future years – Miss Hazel Archer, Project Manager
15:15 Open Forum – future developments – Ms Nessa Barry, SEHD
16:00 Close

Appendix 2  Attendees

Dave Anderson*, Communications Manager, NHS Grampian
Hazel Archer*, Telemedicine Project Manager, Yorkhill
Nessa Barry*, Scottish Executive Health Department
Robert Carachi*, Professor of Surgical Paediatrics, Yorkhill
Alan Houston*, Consultant Paediatric Cardiologist, Yorkhill
Bridget Cates, RARARI Paediatric Fellow, Western Isles Hospital
Sheena Kinmond, Consultant Paediatrician, Ayrshire Central Hospital
Aaron Bell, SPR Paediatric Cardiology, Yorkhill
William Manson, Consultant Paediatric Surgeon, RHSC Edinburgh
Tom Gardner, Telemedicine Project Manager, Edinburgh
Rosalie Wilkie, Consultant Paediatrician, Ninewells
Gareth Gray, Account Manager, NuVideo
Chris Lilley, Locum Consultant Neonatologist, Princes Royal Maternity
Linda de Caestecker, Women and Children's Unit, Scottish Executive Health Department
Mohammed Wayalat, Consultant Paediatric Cardiologist, RHSC Edinburgh
Craig Williams, Consultant Microbiologist, Yorkhill
Carol Lucas, Clinical Scientist, Yorkhill
Carol McAr, Neontal Transport Sister, Yorkhill
Val Baker, Director of Clinical Information, NHS Lothian
Doreen Kelly, General Manager Women & Children's Services, NHS Ayrshire & Arran
Janet Burns, Consultant Paediatric Cardiologist, RHSC Edinburgh
Richard Thomson, Consultant Paediatric Surgeon, Aberdeen Children's Hospital
Charles Skeoch, Consultant Neonatologist, Princess Royal Maternity

Participation via video conference

Michael Morton, Consultant Psychiatrist, Yorkhill
Milind Ronghe, Consultant Paediatric Oncologist, Yorkhill

* Project Board Members
21.4 Appendix 4 Evaluation Protocol

Scottish Paediatric Telemedicine

Telemedicine Protocol

Version 1.4
28 April 2004

Document Version: 1.4
Contacts

Tertiary Centres

Miss Hazel Archer
Telemedicine Project Manager
Royal Hospital for Sick Children
Yorkhill NHS Trust
Glasgow, G3 8SJ
Tel: 0141 201 0460

Mr Robert Carachi
Consultant Paediatric Surgeon
Royal Hospital for Sick Children
Yorkhill NHS Trust
Glasgow, G3 8SJ
Tel: 0141 201 0000

Dr Alan Houston
Consultant Paediatric Cardiologist
Royal Hospital for Sick Children
Yorkhill NHS Trust
Glasgow, G3 8SJ
Tel: 0141 201 0000

Mr Bill Manson
Consultant Paediatric Surgeon
The Royal Hospital for Sick Children
9 Sciennes Road,
Edinburgh, EH9 1LF
Tel: 0131 536 0000

District General Hospitals

Dr Jonathan Staines
Consultant Paediatrician
Ayrshire Central Hospital
Ayrshire Central Hospital
Kilwinning Road
Irvine, KA12 8SS
Tel: 01294 274191

Dr Rosalie Wilkie
Consultant Paediatrician
Ninewells Hospital
Dundee, DD1 9SY
Tel: 01382 660111

Dr Sam Ibhanesebhor
Consultant Paediatrician
Wishaw General Hospital
50 Netherton St
Wishaw, ML2 0DP
Tel: 01698 361100
Patient Groups for Inclusion
- Neonates with surgical problems. Problems may be acute, sub-acute or elective.
- Children with cardiac problems. Problems may be acute, sub-acute or elective.

All patients must be hospital in-patients at the time of inclusion.

Referring Clinician (‘the Referrer’)
The Referrer should be a qualified consultant. In some cases referrals may be made by a specialist registrar, however permission must be given in each case by the consultant in charge.

Receiving Clinician (‘the Receiver’)
The Receiver should be a qualified consultant based at a tertiary hospital.

Responsibility of Care
At all time the patient is the responsibility of the hospital where the child is an in-patient. Should a patient be transferred to another hospital, normal procedures for the change in responsibility will apply.

Parental Consent
In order to take part in the evaluation Parental Consent must be obtained. The consent form details to the parents what is involved and provides contact details for further information. When completed the consent form should be faxed back to Hazel Archer on 0141 201 0858.

Process Flowchart
The following flowchart details the steps involved in the process and what evaluation forms should be completed by the Referrer and the Receiver.
Paediatric Telemedicine Flowchart

Use existing procedures

Patient suitable for inclusion & consent obtained?

No

Yes

Phone on call consultant at Tertiary Centre

Agree to video conference?

No

Yes

Telephone consultation

Video Conferencing consultation

Transfer to Tertiary Centre?

Yes

No

Manage at Tertiary Centre

Transfer back to DGH

Yes

No

Manage at District General Hospital

Patient discharge

Referrer to complete post telemedicine assessment (Form 3)

Referrer and receiver to to complete video conferencing evaluation (Referrer Form 4, Receiver Form 4b)

Referrer to complete follow up assessment and return form to Yorkhill (Form 5)

Assessment of parent perception

Assessment of parent perception carried out post discharge via telephone survey

Yes

No

Basic information, patient details and initial assessment to be completed by Referrer (Form 2)

Telephone consultations to be included in study as control group

Yes

No

Video conferencing may be used if appropriate, details should be recorded in ‘other information’ on Form 5

Yes

No

Patient discharge

Assessment of parent perception carried out post discharge via telephone survey

Patient discharge

Referrer to complete follow up assessment and return form to Yorkhill (Form 5)
Completion of Evaluation Forms
Forms are available in two versions. The standard version is a word format document that should be printed and completed by hand. Completed forms should be returned by fax for the attention of Hazel Archer to 0141 201 0858.

An on-line form is also available. These are word documents which can be opened in MS Word and the appropriate fields typed in. After saving the document e-mail a copy of the form to hazel.archer@yorkhill.scot.nhs.uk

Forms can be downloaded from the project website at:
http://www.show.scot.nhs.uk/yorkhill/telemedicine/filedownload.htm

When completing the forms please allocate a unique ‘Patient Reference Number’ as follows:

- Site / date of initial consultation / number of patient that day
- Site  A – Ayrshire Central  
  W – Wishaw  
  N – Ninewells
- Date of initial telemedicine consultation eg 290204
- Number of patient that day, eg 3 would be the third patient referred by telemedicine that day

For example A/290204/3 would be the third patient discussed on 29th Feb from Ayrshire.
21.5 Appendix 5 Consent Form

Form 1 – Parental Consent To be completed by Parent or Guardian

The consultant in charge of your child’s care will be contacting the Sick Children’s Hospital in Glasgow or Edinburgh to discuss the condition with a specialist. This will include consultation by the use of telephone and video conferencing.

The video conferencing images of your child such as X-rays and scans will be transmitted across a secure link. Video images of your child may also be sent if appropriate. To help review the video conferencing sessions, some sessions may be recorded. We intend to evaluate the benefits of using the system and as part of this process details of your child’s condition will be recorded and information passed back to Yorkhill. At no point will information that can identify your child be passed on to any third party.

We also think it important to evaluate the parental perception of this way of consulting. To do this we would like to contact you at a later date, either at a clinic or by telephone, to find out what you thought of the video conferencing. We hope that you will agree to this and sign the sheet below to indicate your agreement to participate. If you do not wish to participate your child’s care will not be affected in any way.

If you want more information please contact Hazel Archer at Yorkhill Hospital on 0141 201 0460 or e-mail hazel.archer@yorkhill.scot.nhs.uk

Patient name ___________________________ DOB ___________________________

- I agree that video images and details of my child’s progress may be transmitted and stored at Yorkhill
- I agree that my address details may be used to contact me at a later date

Your Name

Please Print ___________________________

Signature ___________________________ Date ___________________________

Address

________________________________________

________________________________________

Telephone ___________________________

Relationship to patient

Mother [ ]

Father [ ]

Other, please specify ___________________________

To be completed by clinician

Patient Ref No ___________________________ Site / date of initial consultation / number of patient that day eg A52800450 would be the third patient discussed on 29th Feb from Ayrshire

Site A – Ayrshire Central, W – Wishaw, N – Ninewells

Witnessed By ___________________________ Date ___________________________
21.6 Appendix 6 Evaluation Forms

Paediatric Telemedicine Evaluation Form

Form 2 – Basic Information    To be completed prior to telemedicine consultation

Basic Information

Your name    Date

Name of responsible consultant at local hospital    Hospital

Type of referral
Surgical    ☐
Cardiac    ☐

Severity of referral
Acute    ☐
Sub-acute    ☐
Elective    ☐

Name of receiving consultant

Patient Details

Patient Ref No

Site / date of initial consultation / number of patient that day
eg A/290204/3 would be the third patient discussed on 29th Feb from Ayrshire
Site    A – Ayrshire Central, W – Wishaw, N - Ninewells

Initial Assessment (pre telemedicine consultation as reported by referring doctor)

Likelihood of Transfer
Expected managed locally    ☐
Expected emergency transfer    ☐
Expected urgent transfer    ☐
Expected non-urgent transfer    ☐
Paediatric Telemedicine Evaluation Form

Form 3 – Post Telemedicine Patient Assessment

<table>
<thead>
<tr>
<th>Patient Ref No</th>
<th>Time of initial call</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type of telemedicine consultation</th>
<th>Phone only</th>
<th>Phone and video conf</th>
<th>Video conf only</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Severity of condition</th>
<th>Less severe than initial estimate</th>
<th>As severe as initial estimate</th>
<th>More severe than initial estimate</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Changes from initial assessment</th>
<th>Same as initial assessment</th>
<th>Different from initial assessment</th>
</tr>
</thead>
</table>

Please detail any changes from initial assessment

<table>
<thead>
<tr>
<th>Patient Management at this point</th>
<th>Managed locally</th>
<th>Emergency transfer</th>
<th>Urgent transfer</th>
<th>Non-urgent transfer</th>
</tr>
</thead>
</table>

Please detail any changes agreed to patient treatment / management
Paediatric Telemedicine Evaluation Form
Form 4 – Video Conferencing Evaluation (Referrer)

<table>
<thead>
<tr>
<th>Patient Ref No</th>
<th>____________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your name</td>
<td>____________________________</td>
</tr>
<tr>
<td>Date of call</td>
<td>____________________________</td>
</tr>
<tr>
<td>Time between initial phone call and start of video conference</td>
<td>____________________________</td>
</tr>
</tbody>
</table>

Did the patient's condition change during this period  
If Yes please detail below

<table>
<thead>
<tr>
<th>What types of images did you use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video images of patient</td>
</tr>
<tr>
<td>X-Ray</td>
</tr>
<tr>
<td>Echo/Ultrasound</td>
</tr>
<tr>
<td>ECG</td>
</tr>
<tr>
<td>Other __________________________</td>
</tr>
</tbody>
</table>

Did the use of video conferencing affect your clinical decision  
If Yes please detail below

Did you experience any technical difficulties with the system  
If Yes please detail below
Paediatric Telemedicine Evaluation Form
Form 4b – Video Conferencing Evaluation (Receiver)

<table>
<thead>
<tr>
<th>Patient Ref No</th>
<th>Date of call</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Your name</th>
<th>Time of call</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What was the nature of the referring clinician's diagnosis?

- Something wrong with patient, diagnosis unknown
- Not sure of diagnosis
- Probable diagnosis
- Definite diagnosis

<table>
<thead>
<tr>
<th>Type of images sent</th>
<th>Images of sufficient quality for diagnosis</th>
<th>Images NOT of sufficient quality for diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video images of patient</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>X-Ray</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Echo/Ultrasound</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>ECG</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other___________</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

After consultation what was the nature of the diagnosis?

- Something wrong with patient, diagnosis unknown
- Not sure of diagnosis
- Probable diagnosis
- Definite diagnosis

In what way did you help the referring clinician (tick all that apply)

- Diagnosed condition ☐ Advised on patient transfer requirements ☐
- Confirmed existing diagnosis ☐ Provided help for local patient management ☐
- Recommended treatment ☐ Planned patient follow up ☐
- Other, please specify

Did the use of video conferencing affect your clinical decision? Yes / No
If Yes please detail below

Did you experience any technical difficulties with the system? Yes / No
If Yes please detail below
Paediatric Telemedicine Evaluation Form
Form 5 – Final Patient Assessment (Changes form post telemedicine assessment)
To be completed at patient discharge or after 2 weeks as in-patient

Patient Ref No

Your name  Date of assessment

Severity of condition
Less severe than telemed estimate
As severe as telemed estimate
More severe than telemed estimate

Changes from telemed assessment
Same as telemed assessment
Different from telemed assessment

Please detail any changes from telemed assessment

Was the decision regarding patient transfer the most effective
Yes / No
If no please detail below

Other Information
Paediatric Telemedicine Evaluation Form
Form 6 – Case Review

Patient Ref No __________________________________________
Your name ______________________________ Date of assessment ______________________

Was the appropriate diagnosis achieved using telemedicine                         Yes / No
If No please detail below

Was anything extra found subsequently                         Yes / No
If Yes please detail below

Was the decision to manage locally / transfer the most appropriate                   Yes / No
If No please detail below

Would this patient have been transferred if telemedicine not available   Yes / No
If Yes please detail below

Could management of this patient have been improved      Yes / No
If Yes please detail below

<table>
<thead>
<tr>
<th>Please indicate your level of agreement by ticking the box</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine made the consultation and decision making process more rapid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The ability to visualise clinical data during the consultation has positively improved the process of clinical decision making</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The availability of telemedicine did not influence any clinical decision making</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The availability of telemedicine influenced the decision to transfer or manage locally</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telemedicine provided significant reassurance to the referring doctor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Paediatric Telemedicine Evaluation Form
Form 7 – Parental Follow Up

Patient Ref No

Name of Interviewer    Date of assessment

As you know when your baby was ill the doctors used a video link to talk other specialists for advice and to see how the baby was at that time. The reason we are contacting you now is because this is a new system and we want to find out how the video link is working from the perspective of the doctors and the nurses and parents. The questions should not take very long but please feel free to expand on your answers.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes / No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were you present when the video link took place?</td>
<td></td>
</tr>
<tr>
<td>Did the doctor explain why the video link was being used?</td>
<td></td>
</tr>
<tr>
<td>Were you or your partner involved in the discussion with the remote doctor?</td>
<td></td>
</tr>
<tr>
<td>From your point of view, what did you think about using the video link?</td>
<td></td>
</tr>
<tr>
<td>Free text response:</td>
<td></td>
</tr>
<tr>
<td>Did you find the video link helpful?</td>
<td></td>
</tr>
<tr>
<td>Did you have any concerns about your child’s case being discussed by the doctors using a video link?</td>
<td></td>
</tr>
<tr>
<td>If Yes, what were the concerns</td>
<td></td>
</tr>
</tbody>
</table>
I’d like you to think about the use of video link more generally when you reply to the following:

If you had the option of travelling to see the consultant doctor or, having a video link meeting at your local hospital - would it depend on:

- Whether the condition is an emergency
- Whether the doctor at the local hospital thought it was necessary
- Who your going to see (ie. Specialist)
- How far away it is from your local hospital
- Other (please explain)

Please indicate your level of agreement by ticking the box:

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>As far as possible a baby should be treated at the same hospital as its mother</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Video conferencing made no difference in the way the doctors cared for my child</td>
<td></td>
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</tr>
<tr>
<td>Video conferencing made a positive difference in the way the doctors cared for my child</td>
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</tr>
<tr>
<td>Video conferencing allowed me/us to talk to the specialist about my child’s condition</td>
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</tr>
<tr>
<td>Video conferencing should not be used to allow doctors to consult at a distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Babies should be transferred to a specialist hospital rather than care be given locally with support from video conferencing</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Is there anything else you feel is important that we have not mentioned?

Is there anything else you would like to add?

Thank you for participating in this interview, your views will be included in the overall system evaluation and will be used to help us identify any strengths and weaknesses in the system.
# Paediatric Telemedicine Evaluation Form

## Form 8 – Video Conference Evaluation

<table>
<thead>
<tr>
<th>Your Name</th>
<th>Your Department</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

<table>
<thead>
<tr>
<th>Date of call</th>
<th>Time of Call</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Your Location</th>
<th>Duration of call</th>
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<tbody>
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<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Remote Locations</th>
<th></th>
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<tbody>
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<table>
<thead>
<tr>
<th>No of local attendees</th>
<th>No of remote attendees</th>
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### Purpose of video conference

- Case conference
- Patient referral
- Education / training
- Administrative meeting
- Other _______________________________

### Type of attendees (tick all that apply)

- Medical
- Research
- Admin
- Patient
- Patient next of kin
- Other _______________________________

### Type of images sent or received

<table>
<thead>
<tr>
<th>Images of sufficient quality</th>
<th>Images NOT of sufficient quality</th>
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<tr>
<td>Person view</td>
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<td>Video / DVD</td>
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<td>Computer</td>
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<td>Visualiser</td>
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<td>Other _______________________</td>
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**Did the use of video conferencing avoid participants travelling to site?**

Yes / No

If no – how would you have accomplished the task otherwise.

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**Did you experience any technical difficulties with the system?**

Yes / No

If Yes please detail below

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**Other comments**
Editorial

I would like to pay a personal tribute to June Humphinson, our publisher, proof-reader etc, etc, who for many years now has performed such an excellent job in producing the Scottish Medical Journal as we know it. Since my association with the journal began when I was appointed Editor in May 2004, it has been a privilege to watch a perfectionist and a professional at work. With this will be the last issue June will produce before we move to a new era in 2008. I wish her all the best and thank her for all her help over the past 18 months.

This issue has a number of comments, all very topical, and some of a political nature. But first I would like to update readers on the developments in Paediatric Telemedicine in Scotland, a topic very close to my heart.

Paediatric Telemedicine in Scotland

The Scottish Paediatric Telemedicine Project aims to provide a national telemedicine network to support clinical services in paediatric care. The Project commenced in 2004 as a pilot involving five linked hospitals in Spring 2004 and has been rolling out since the start of 2005 to a further five sites. Funding was provided by the Scottish Executive Health Department's Telemedicine Initiative, with the goal of demonstrating whether the technology could provide robust support to address a clear clinical priority area in paediatric services across Scotland.

A review conference in June 2005 had a two-fold purpose. Firstly, to bring together the most up to date results on the implementation of the paediatric telemedicine network and, secondly, to present to the wider user group (clinical and managerial) the possible uses of the system and to collate their proposals for the future of the network.

The day itself provided examples of a telemedicine network which is supporting a very positive and diverse range of uses across paediatric services. In effect, this mini telemedicine conference of innovative paediatric applications put the users at the forefront and highlighted how Scotland-wide telemedicine - although not yet a fully integrated part of clinical services - is providing the essential communications infrastructure to support clinical staff in delivering paediatric care.

The original scope of the project (surgical and cardiology consultations) was always expected to be a vital but partial picture of how users could develop. This has proven to be the case with cardiology and surgical consultations accounting for less than half the total number of telemedicine sessions. Some of the emerging uses of the system are:

Child Psychiatry

Dr Michael Morton from the Department of Child and Family Psychiatry reported that the use of telemedicine in child and adolescent psychiatry has steadily grown over the last year. From a total of 52 meetings held, 15 were for case conferences and 35 for direct clinical work.

Feedback from the users of the service indicate that the system saves travel time and cost. Improvement in participation has also been noted, in particular it has been possible to engage with patients by controlling the remote camera. The system has also provided a mechanism for skill sharing and improvements to handover at admission and discharge.

Tumour Board

Dr Mithu Rongie, Consultant Paediatric Oncologist at Yorkhill, reported on the success of holding multi-site tumour board meetings. These are multidisciplinary meetings attended by oncologists, surgeons, pathologists, radiologists and other relevant specialists. Clinical cases are discussed, along with examination, radiology and pathology results, and management decisions are made.

Three successful meetings have been held involving Glasgow, Edinburgh, Dundee and Aberdeen. An international link to Jordan has also been held.

Advantages realised have included improved networking and collaboration; no travelling involved; shared care centres allowing more involvement in the decision making for difficult cases; improved education and training for specialists; and increased motivation.

Babycam

Dr Chris Lilley, Consultant Neonatologist at the Princess Royal Maternity, has been using the telemedicine system since it was installed in April 2005. At this time it was recognised that it would be possible to use the device to broadcast pictures of the baby to a mother who was unable to visit due to her own medical condition. To assess this novel use of the equipment a trial was set up involving a patient staying in the plastic surgery ward for 6 weeks, 1½ miles away.

Following the success of the trial a small device was purchased and connected to the hospital IT network. This allows the device to be positioned at the mother’s bedside. Although nursing staff were initially a little self-conscious and wary of the technology, they quickly learned how to use the system and are supportive in its use. Feedback from mothers has been very positive.

Tele-Education

Dr Sherma Kinmond, Consultant Paediatrician from Airdrie General Hospital reminded the conference that education is needed for junior doctors for college requirements and modernising medical careers; senior doctors for continuing professional development; medical students; and other staff. Telemedicine can help informally as every telemedicine consultation is a learning experience and formally through lectures, case presentations and other discussions.

Currently the Yorkhill Tuesday CME meetings are broadcast on a weekly basis to up to 4 sites, thus avoiding duplication of effort and crucially allowing maximal attendance. It also has the added benefit of keeping minutes in touch with the tertiary centre and raises awareness of DGIs in the tertiary centre.

Infection Control

Dr Craig Williams, Consultant Microbiologist from Yorkhill, told the meeting about another example of an emerging use of telemedicine during a recent influenza outbreak in the Western Isles and the subsequent management of the outbreak by the Infection Control Team. Following the set up of an outbreak committee a number of difficult decisions had to be made regarding how and
when to use Tamiflu, how to identify and treat the vulnerable population and how to increase vaccination rates.

By using the telemedicine link over a series of meetings it was possible to provide high levels of support from the infection control doctor and Health Protection Scotland and improve working relationships between those based on the Mainland and members of the Island infection control team. It was also possible to optimise the usage of expensive medication. The final outcome was that the flu epidemic was contained and never became an issue on the mainland.

The conference acknowledged the difficulties still encountered in implementing telemedicine, and the fact that many in the wider NHS community do not see telemedicine as a priority. However, the key message from this conference is that the main aim is to improve provision in paediatric care. While the technology involved is innovative, it is not the focus of the network.

Hazel Archer, Allan Houston, Robert Carachi
21.8 Appendix 8 Press Coverage

Evening Times May 2004

Specialists join forces in pioneering project at hospitals

Video link brings ‘virtual’ docs to kids’ bedsides

SCOTS children’s hospitals were today linked by a hi-tech video network which will allow specialists to be at children’s bedside virtually.

The “telemedicine” network uses mobile cameras and monitors to link paediatric centres across the country.

For the first time in Scotland, it brings the expertise of centralised paediatric specialists to the bedside of babies and children in hospitals via high-quality video and sound.

The Intern2 system has not been used before in the UK, and early results suggest it could prevent a significant number of child patients having unnecessary transfers to other hospitals.

The system currently links Yorkhill Hospital in Glasgow, Wishaw General Hospital in Lanarkshire, Ayrshire Central in Irvine and Ninewells Hospital in Dundee.

But plans are under way to expand the network to other Scottish paediatric and neonatal units.

Some of the uses of the new system include:

◆ Bringing parents and children’s specialists together to discuss a child’s treatment face-to-face – while being miles apart.

◆ Viewing heart sounds from newborn babies.

◆ Examining X-rays.

Dr Alan Houston, a paediatric cardiac consultant at Yorkhill, is impressed by the new £500,000 system, which is being funded by the Scottish Executive.

He said: “The technology involved in this project is tremendous, allowing us to interact with patients and colleagues in outlying district general hospitals in a way that has not been possible before.

“The network offers clinicians a high standard of detail that is comparable to actually being on-site with the patient.

“It is a truly 21st century way of allowing paediatricians to work together and make the best possible decisions for some of Scotland’s most ill children.”

Health Minister Malcolm Chisholm said: “I’m delighted at this development as it helps ensure patients can have access to first-class, highly-specialised care which realistically can only be provided in a very few centres of clinical excellence.

“I want to see this approach widened to benefit more patients being treated in more specialities across the NHS in Scotland.”
SICK KIDS GET TELLY DOCTORS

DOCTORS in Scotland can now diagnose sick children in hospitals hundreds of miles away.

A telemedicine network, designed to bring together paediatric centres using hi-tech mobile cameras and monitors, was launched yesterday.

It means specialists can give expert “bedside” advice for babies and children – even if they are on the other side of the country.

They can even view heart ultrasounds and examine X-rays.

And worried parents can discuss treatment with doctors who are miles way.

Designed to reduce risky transfers between hospitals, the system is the first time the technology has been used in the UK.

So far, Yorkhill Hospital in Glasgow, Wishaw General in Lanarkshire, Ayrshire Central and Ninewells, in Dundee, have been linked up through the network.

Yorkhill paediatric cardiac consultant Dr Alan Houston said: “The technology involved in this project is tremendous.

“The network offers a high standard of detail that is comparable to actually being on-site.”

The paediatric system is the first stage of a £500,000 telemedicine network by the Executive.

HOSPITAL NETWORK WILL MEAN BETTER BABY CARE

Wishaw Press May 2004

BBC Reporting Scotland May 2004
The project: An innovative mobile video-conferencing system has made it possible to bring telemedicine to the patient's bedside. It allows clinicians at a remote hospital access to specialists at a tertiary centre without the need to move a child, who may be acutely ill, to a video-conferencing room.

In addition to being able to view the patient and their condition, connections to diagnostic equipment allow the remote consultant to make an accurate diagnosis, advise on the best course of treatment and, if necessary, plan the most appropriate type and timing of patient transfer.

Management: At the outset, the project team recognised the importance of adequate management support for the scheme and, to ensure appropriate management of the project, formal project-management methodologies were applied.

Also important has been the involvement of the clinicians using the systems. At all stages, clinicians have been involved at project board level, defining the equipment requirements, developing clinical protocols and designing the evaluation process.

The Intern II video-conferencing system used has now been installed in five Scottish hospitals. Plans are also in place to extend the system to a further five sites in the near future.

Innovations and successes: Benefits of using the system were realised immediately. By obtaining an accurate diagnosis from the remote specialist, treatment can be started and patient management planned quickly. Subsequently, the percentage of emergency neonatal transfer has fallen from 73.45 per cent.

The benefits to the anxious parents of a sick child are also evident. Not only is it possible to speed up the diagnosis process to quickly give accurate information to the parents, but the system provides an opportunity for face-to-face discussion with the remote specialist.

The judges said: The structured project approach and teamwork were obvious strengths. Very high-quality project management and excellent clinical engagement will realise maximum benefits.

Contact: Hazel Archer, telemedicine project manager, Yorkhill Division, NHS Glasgow, 0141-201 0660, hazel.archer@yorkhill.scot.nhs.uk

Highly commended: project manager Hazel Archer and Yorkhill Hospital consultant paediatric cardiologist Alan Houston.
A system for sharing

Hazel Archer, Project Manager for the Scottish Paediatric Telemedicine Project, champions the use of telemedicine in paediatric care...

The Scottish Paediatric Telemedicine Project has been funded by the Scottish Executive to provide a national telemedicine network to support clinical services in paediatric care. The network now extends to 10 sites across Scotland.

The use of a small and mobile videoconferencing device has made it possible to bring the videoconferencing system to the patient’s bedside for the transmission of real-time diagnostic images such as ultrasound, images of the patient and x-rays.

Neonatal cardiology and surgery
Ultrasound imaging of the heart (echo-cardiography) has been particularly useful and has been used in over 80 remote neonatal cardiology consultations. For babies born with a suspected heart defect, the echo-cardiogram images can be viewed by a consultant cardiologist without the need to transfer the baby to a specialist centre. This provides local clinicians with a definitive diagnosis, allowing advice to be given on immediate treatment and, if more specialised treatment is required, facilitates transfer of the patient to the specialist cardiac centre. This reduces the number of babies being transported, provides reassurance to the local team caring for the baby, allows anxious parents to be advised of the child’s condition at the earliest opportunity and, in many cases, gives them the opportunity to talk to the cardiologist.

The bedside videoconferencing system has also been used for over 20 surgical consultations. Cases covered a range of clinical problems, including those with gastrointestinal problems, dysmorphism, cleft lip and palate, respiratory problems and an ischaemic limb.

The original scope of the project (surgical and cardiac consultations) was always expected to be a vital but partial picture of how telemedicine could develop. This has proven to be the case, with cardiac and surgical consultations accounting for less than half the total number of telemedicine sessions.

Some of the emerging uses of the system are described below.

Child psychiatry
Dr. Michael Morton from the Department of Child and Family Psychiatry at Yorkhill Hospital in Glasgow has been a regular user of the telemedicine network. The use of telemedicine in child and adolescent psychiatry has steadily grown over the last year, with the system being used for case conferences, direct clinical work and research meetings.

Users of the service agree that using videoconferencing saves travel time and costs for both families and staff. Improvement in participation has also been noted, in particular, during direct clinical work, it has been possible to engage with patients by controlling the remote camera. The system has also provided a mechanism for skill sharing, and improvements to handover at admission and discharge.

Babycare
Dr. Chris Lilley, Consultant Neonatologist at the Princess Royal Maternity in Glasgow, has been using the telemedicine system since it was installed in April 2005. At this time, it was recognised that it would be possible to use the device to
broadcast pictures of the baby to a mother who was unable to visit due to her own medical condition.

By using a small Tandberg T150 system connected over the hospital’s IT network, it was possible to provide a low cost system, small enough to be positioned on the mother’s bedside table. This allows the mother to view the baby and talk to the staff on the neonatal ward. Feedback from mothers using the system has been very positive.

Infection control during a flu outbreak
Clinical standards state that an infection control team must include a consultant medical microbiologist. If the infection control doctor is from another speciality, the case of the Western Isles, this service is provided from the mainland by Dr Craig Williams from Yorkhill Hospital in Glasgow. This remote service is greatly enhanced by the availability of videoconferencing.

The use of telemedicine in child and adolescent Psychiatry has steadily grown over the last year, with the system being used for case conferences, direct clinical work and research meetings.

This was clearly demonstrated during a recent flu outbreak on the islands. Following the set-up of an outbreak committee, a number of difficult decisions had to be made regarding how and when to use antiviral medication, how to identify and treat the vulnerable population, and how to increase vaccination rates.

By using the telemedicine link over a series of meetings, it was possible to provide high levels of support from the infection control doctor and Health Protection Scotland, and improve working relationships between those based on the mainland and members of the island infection control team. It was also possible to optimise the usage of expensive medication.

The final outcome was that the flu outbreak was contained and did not spread to the mainland.

The Paediatric Telemedicine Network was established with the aim of providing a remote cardiac and surgical service. The benefits of this service have been clearly demonstrated. However, the greatest success of the project has been the varied and diverse nature of the other uses made of the system. This article has highlighted just a few examples. While reliable and robust technology is essential to provide the infrastructure of the network, it is of vital importance in the development of telemedicine in the network of clinicians across Scotland working together to improve paediatric care.
Experts amazed as baby webcam is a hit with mums

Hi-tech system eases agony of family separation at Glasgow hospital

By JOHN McCANN
Health Prover

MEDICAL experts at a Glasgow hospital have been stunned by the success of a hi-tech camera system that allows mums to start bonding with new babies even when they are in separate rooms.

The £25000 Babycam monitor at the Princess Royal Maternity Hospital - part of the Royal Infirmary - is used when mothers and babies have

The mother will often just grab the monitor and hold it close

HAZEL ARCHER

to be kept apart, often because one needs surgery.

The separation can be traumatic for mothers, who just want to hold their new child.

However, the Babycam system has helped ease the agony.

Hazel Archer, head of the telemedicine unit, which is based at the Yorkhill children’s hospital, said: “As soon as the picture comes up, the mother will often just grab the monitor and hold it close.

“You can see what it means to families.”

The camera and intranet system is part of a £25,000 telemedicine network that usually links consultants in hospitals across the country.

But the Babycam monitor to let parents see their children was provided by the Glasgow Royal Infirmary Appeals Trust.

Doctors believe Babycam may save the lives of premature babies because it helps some mums recover quicker from surgery.

Dr Chris Lilley said: “It is extremely important for premature babies to have breast milk in the first few days.

But we now know bonding helps and my instinct is the Babycam helps mums to express milk.”

Dr Lilley said that once babies are feeding naturally, they need fewer tubes and lines into their bodies, reducing the chance of infection.

Normal feeding also reduces the chance of dangerous bowel complications.

Caroline Church, 22, was one of the first to use the Babycam.

Her first child was born by emergency Cowperaean three months early and weighed only 1lb 16.5oz.

All Caroline wanted to do was hold her daughter. Instead, she was in tears as little Paige was rushed to intensive care.

Caroline needed an operation because she had pre-eclampsia and had to go to another part of the Princess Royal Maternity Hospital to recover.

However, staff brought the portable computer monitor to Caroline’s bedside so she could watch Paige through a special camera in neonatal intensive care.

Caroline, 22, said: “Paige had been put in an incubator and I couldn’t see her from where I was. I was really upset. I wanted to see my baby, but she was on another floor.

“When they showed me on the monitor, it was brilliant. I just started crying. It was great to see her.”

Paige, who was born 13 weeks premature 16 weeks ago, is now 5lb 3.5oz.

John McCann
eveningtimes.co.uk