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AIDMAN – a Versatile Telemedicine Platform

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Abstract - **Telemedicine has long promised to be introduced on a wide scale, yet despite dramatic falls in the cost of hardware and increasing power and capability of equipment, there has been little impact on routine medical service [1, 2, 3]. Many projects have been reported in the literature in a wide variety of medical disciplines, but generally these have been pilot and have almost always ceased once funding has ended [4]. The question remains, "What obstacles remain to be overcome?" The AIDMAN project, based in Chorleywood, UK, has established tele-clinics in many clinical specialities within a single primary care setting so that it becomes routine. To date, tele-clinics in dermatology, cardiology and peripheral vascular surgery (wound care) run routinely. On the clinical side, experience has shown that patients are very satisfied with the video consultation and outcome is at least as good as existing procedures. However the goal is to develop a full range of tele-clinics so that system cost is reduced through re-use of the equipment.**

I. Introduction

Telemedicine has been heralded as the universal solution to the problem of providing medicine to people in the remote community. Projects over many years have demonstrated that it can be successful for a wide variety of medical disciplines including dermatology, psychiatry, radiology, obstetrics and oncology. At the same time, cost of equipment has fallen dramatically and performance has increased substantially. However, despite their reported success, the majority of projects do not continue beyond the end of their funding and there has been very little uptake of telemedicine in routine medical environments.

If the promise is to be fulfilled and telemedicine is not to remain in small scale or pilot form, then the reasons for the failure in uptake should be determined and remedied. Several reasons can be put forward: the project is too specialised; lack of enthusiasm from users; inappropriate project connecting centres otherwise unconnected; little use is made of the system. Some of these reasons are hard to combat, but the lesson to be learnt should be that telemedicine must be deployed away from highly specialised applications and become a general tool with wide application. Only in this way can the user base increase to a number that makes telemedicine viable. The problem remains how to take the system from its current position to the point where it can be self-sustaining.

II. The AIDMAN Environment

The AIDMAN project has taken this as the premise for its design and seeks to develop a general-purpose telemedicine environment that can support many specialities. It is based in primary care and has so far developed links with three specialities: dermatology, cardiology and vascular surgery. The intention is to develop a series of routine clinics that may be offered to patients in preference to the usual hospital appointment. The environment is based on the virtual consultation workstation, developed as part of the project, and depicted in figure 1.

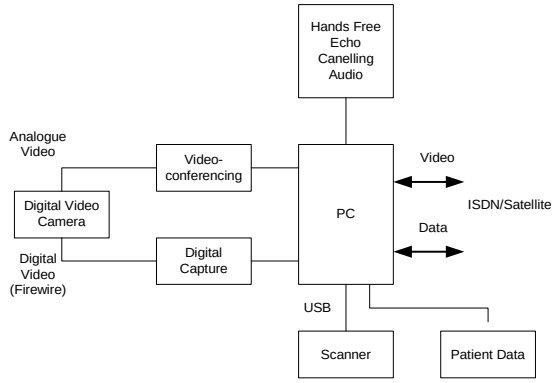

Fig. 1 Virtual Consultation Workstation

The workstation has been designed to provide the functionality to support each medical speciality. In addition to a remote controlled camera, a digital video camera may also be used to provide analogue video for the remote consultant. Digital capture allows the field of view to be captured as a high resolution, full colour image, which may transferred digitally, preserving resolution and colour. This is most useful for specialities needing to visualise the condition, as in dermatology and wound care [6]. The health centre also has Holter monitoring equipment for 24-hour ambulatory blood pressure and ECG measurement and exercise stress test equipment. For cardiology, patients may undergo full investigation within the practice and the results shared with the cardiologist. Diagnosis is immediate and treatment rapid as time-consuming is undertaken at the periphery of the health service. This is not only quicker and more convenient for the patient but is the basis of evidence-based referral, where only those needing the services of the hospital are referred. This then allows the specialist services to be more efficient. In cardiology, rapid investigation is essential to save life and our system has reduced the time from initial diagnosis to referral for angiography and subsequent treatment to days rather than weeks or months.

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Abstract

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III. An Integrated Communications Environment

Underpinning the system is an integrated communications environment that supports all the different aspects of IT within the health centre, combining telephony and networking. The communication system needs to be flexible to support a wide variety of applications, and by designing an integrated communications environment the total system cost is reduced as costs are shared between applications and there is high re-use of components. Such an approach to the design is essential if telemedicine is to be cost effective and if use is to become ubiquitous.

Our own communication system is shown in figure 2. A primary ISDN line (6B rented) enters the health centre to a digital PBX and can provide direct dial to the desk. The PBX is provided with a card to give a number of ISDN-2 outlets. Category 5 wiring throughout the building is used for high-speed networking and allows ISDN-2 to be routed to the telemedicine clinic for video-conferencing and to other outlets for other purposes (e.g. ISDN modem). ISDN-2 gives a connection for ISDN routers for access to other networks. Video-conferencing can thus take place as H320 over ISDN or H323 over TCP/IP according to bandwidth and quality.

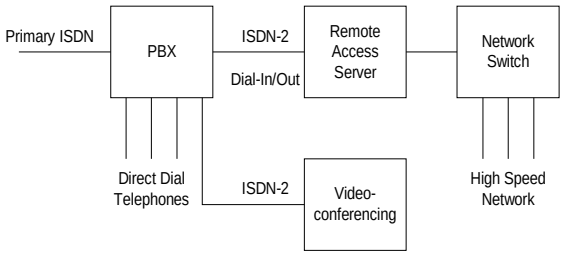

Fig. 2 Integrated Communications Environment

IV. Experience

A. Dermatology

Teledermatology was the first tele-clinic to be introduced. This was designed to run alongside the existing outreach clinic (specialist visits the health centre) and to take place once a month. Patients were offered the tele-clinic as an alternative should it be sooner. Experience has shown the clinic to be a success (patients very satisfied), though there is much room for improvement. Lighting and camera settings were problematic and procedures were rather inefficient. Experience has solved the former and a recent review has identified areas where efficiency can be improved:

- Photos to be taken in advance of consultation
- Detailed referral letter with images to be available to consultant
- Patient ready undressed where appropriate

B. Cardiology

The Holter system at Chorleywood has been installed since March 1999 and the stress system since October 1999. This is a primary care health centre to the north west of London, with a practice population of around 5000. To date 38 BP Holter, 11 ECG Holter, 27 stress ECG and 12 resting ECG have been recorded. The number is small by conventional cardiology department standards, but is in line with the rate of referral for a general practice of this size. The practice nurse performs and analyses the ECG recordings.

Of the 27 having the stress test (plus Holter as appropriate) seven have gone on to have cardiological intervention. One further patient was found to be positive but has decided to have only drug therapy. Video-conferencing is with St. Mary's, Paddington, UK.

Figure 3 shows a typical cardiology video-conference session. The cardiologist (right video window) discusses the significant change in lead V4 with the GP (seen left of patient) a treatment plan is agreed in consultation with patient and doctor. Although the ECG system is fully digital, the data is previously analysed and only the report is forwarded to the cardiologist as a PDF file. The patient history can also be made available during the consultation.

Figure 3. A Video-Conference Session

C. Peripheral Vascular Disease

The peripheral vascular clinic differs from the previous two in being nurse led. Using a digital camera, peripheral ulceration is photographed and the image stored in the patient notes. A temporal record is built up and the progress can be assessed. Those wounds not seen to be healing are further investigated through Doppler ultrasound to determine the status of the venous systems. Patients deemed likely to respond to vascular surgery are referred directly for surgery.

The nurse continues visits to the patient in the home after surgery to monitor post surgery progress, taking further photographs. Complications are quickly and easily referred and dealt with. Follow up appointments with the specialist are easily arranged to take advantage of the tele-clinic and so avoid a difficult journey to the distant hospital.

V. The Virtual Consultation

The virtual consultation is central to the tele-clinic. This differs from the hospital consultation, which would be between only the patient and consultant, by also having present either the local nurse or doctor. As figure 4 shows, new interactions are introduced to the consultation. These affect the dynamics and the process of the consultation, as figure 5 shows. The local doctor or nurse can act as an advocate for the patient. In the early phases of the consultation this is used to advantage to ensure the complete history is available to the consultant. It is also valuable to the patient, who is reassured and who can have difficulties with understanding explained and resolved. The management of the problem will occupy a significant proportion of the latter phase of the consultation. Within this period, patient, consultant and doctor will agree the management plan, responsibilities and timescale. Our experience has shown that this process is more efficient and can be time saving compared to the usual process.

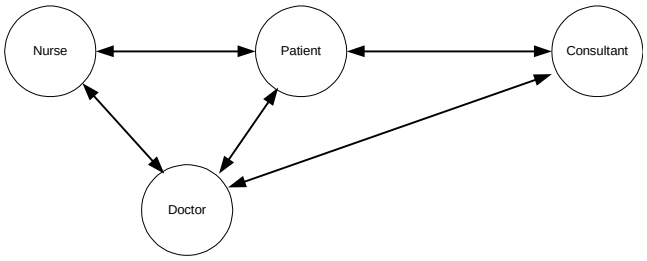

Fig. 4. The Virtual Consultation

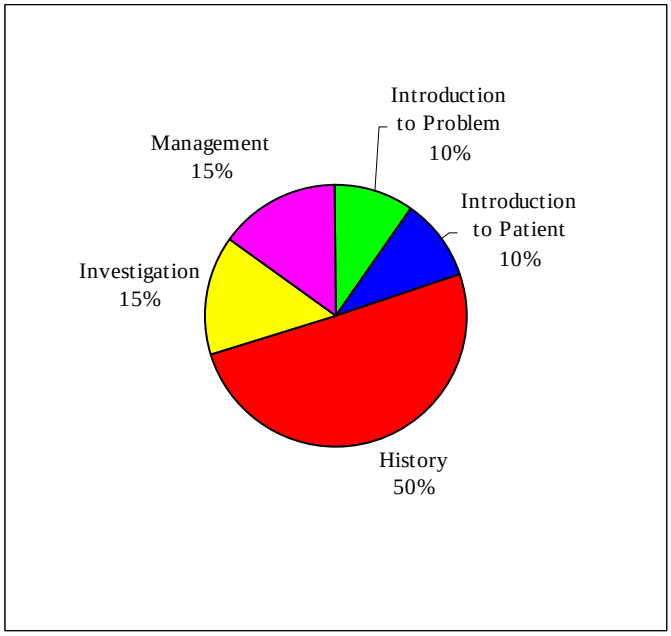

Fig. 5. Typical Consultation Time

V. Discussion

Despite many projects, telemedicine has yet to be deployed for routine service use. In general, most pilot projects have concentrated on a single speciality, and few have continued beyond their initial phase. If telemedicine is not to remain a toy for the few, the reasons for its slow uptake must be addressed. The major problems would appear to be issues with the technology and the financial aspects. Recent advances have made technology available, affordable and reliable and this should no longer be a barrier. The financial aspect then remains. Our work has attempted to demonstrate that a system can be designed to be general purpose and thus be used for many specialities. We have so far considered three very different specialities and this has shown that there can indeed be a common core to service the majority of needs, and that numerous other functionalities can easily be integrated to support specific needs. We have also developed an integrated communications environment in which to place the work, and this has been vital to the success of our project.

We have also concentrated on the ability to have all the information available at the time of the consultation. For this reason, investigative procedures more normally found in the hospital, have been developed within the health centre. This leads to the concept of *evidence-based* referral. This is not only more efficient for the consultant, but the consultation can be significantly more focussed on the problem and its management. Such discussion is also very educational for all parties.

The simple lesson is that such an environment can be developed at relatively low cost, and is not significantly greater than the piecemeal development that can take place if each service is considered and supported in isolation. In this way,

costs are shared across activities, and the whole can become economic, where previously the sum of each individually would not be. The important lesson has been that the activity must be seen as an integrated part of the activities of the health centre.

ACKNOWLEDGMENTS

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