

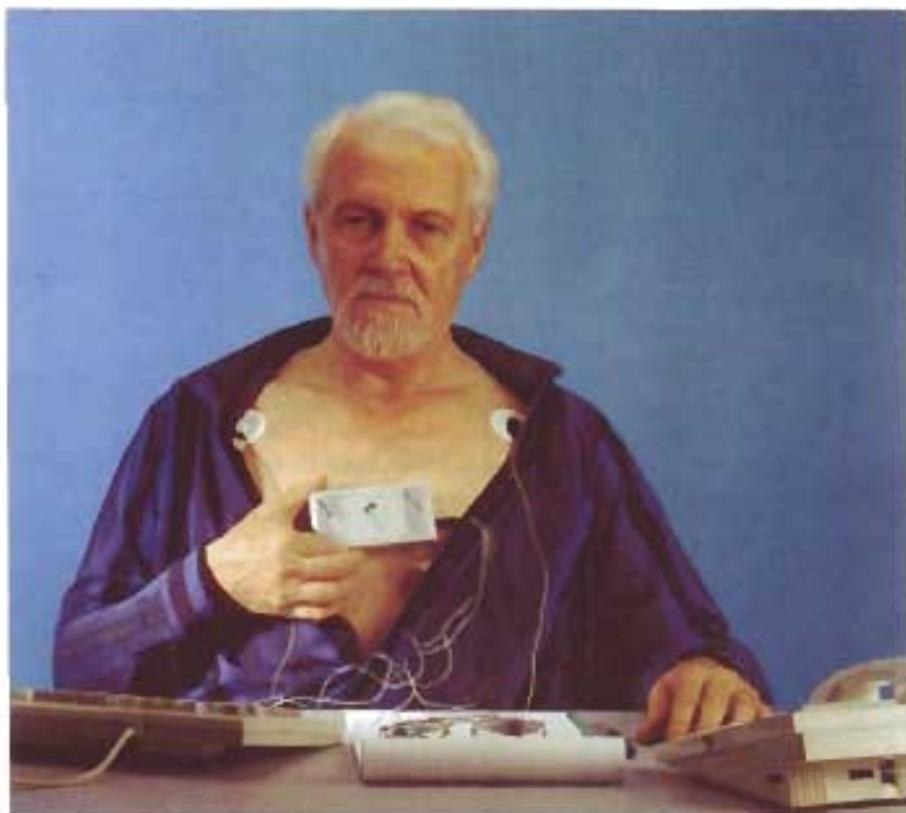
*Maximising specialist resources*

# Cardiac services on the line

*Developments in communications technology now allow doctors and patients to consult specialists at a distance. Dan Shanit reviews the advance of telecardiology.*

**T**EL AVIV: Telecardiology has its origins in the 1970s when the need to monitor the earliest generations of implanted pacemakers led to the development of single-lead trans-telephonic electrocardiographs. With computer and communication technology leaps, telecardiology now sees the cardiologist using off-the-shelf workstations for the manipulation of "teledata" such as electrocardiograms, echocardiograms, heart murmurs, vocal messages and images. Thus a cardiac specialist can use a two-way sound and picture connection to conduct and control an examination carried out elsewhere by a GP. Similarly, individuals can be closely monitored either from their homes or place of work, eliminating clinic visits. Numerous studies have shown that the diagnostic quality of such transtelephonic remote systems could be equal to that of an ordinary, in-hospital examination. The standard diagnostic tools for non-invasive cardiac assessment are electrocardiography and echocardiography which provide high-resolution images of cardiac structure, function and intracardiac blood flow in real-time. Trans-telephonic electrocardiography has been long established as a cost-effective tool for diagnosis, monitoring and rehabilitation of patients with paroxysmal arrhythmias and transient ischaemic changes. However, only recent advances in transmission capability, such as the equipment miniaturisation, image compression improvements and the introduction of ISDN lines, have permitted extension of remote cardiac diagnostics to include tele-echocardiography. Another teleclinical assessment can incorporate cardiac transtelephonic auscultation through audio/video and data communication links using an electronic stethoscope.

Shortening of the onset-to-intervention



*The Heartview personal monitoring system from Aerotel offers high-risk patients continuous access to a cardiac monitoring centre where their records are held for comparison.*

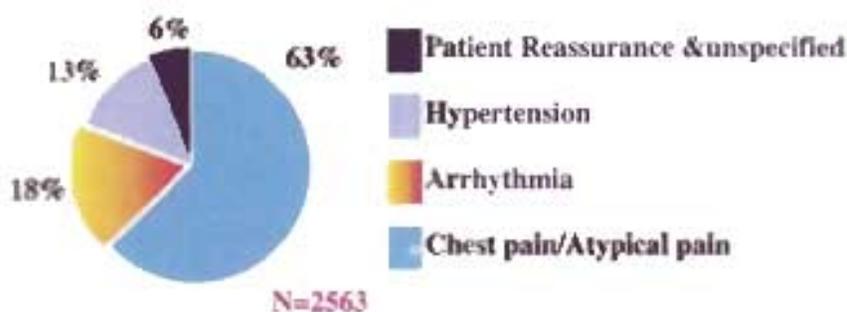
interval is a critical factor in immediate and long term outcomes for cardiac crisis patients: those suffering acute myocardial infarct (AMI). Emergency care services or mobile coronary care units play a key role in the "chain of survival" concept described by the Access to Care Subcommittee of the National Heart Attack Alert Program Coordinating Committee in the USA. The committee recommended use of transtelephonic 12-lead electro-cardiograms for fast diagnosis and intervention or the pre-warning of receiving hospitals based on confirmed

pre-hospital diagnosis. Similarly the published guidelines of the Task Force on the Management of AMI of the European Society of Cardiology suggests pre-hospital ECG, and preferably transmission to hospital, as the appropriate strategy for pre-hospital intervention.

#### **Monitoring systems**

In parallel with the development of mobile emergency services, personal monitoring systems have been designed which offer high-risk patients continuous access to a cardiac monitoring centre where their

## Reason for consultation



medical history and baseline ECGs are held for comparison. Such systems, usually staffed by teams of CCU trained nurses and cardiac technicians supported by consultant cardiologists, offer instant remote diagnosis in emergency situations and can organise mobile coronary care units for fast intervention. They can also eliminate false alarms which otherwise may have made unnecessary use of hard-pressed CCU resources.

Experiments in telemedicine have been carried out in such fields as radiology, pathology, neurology, dermatology, psychiatry, cardiology, nephrology, paediatrics, ophthalmology, orthopaedics, obstetrics, physical therapy and otorhinolaryngology. However, few of these have led to the establishment of a routine practice, mainly held back by the prohibitive costs involved.

The *raison d'être* for telemedicine is often described as either a lack of resources at the site where they are most needed, or the extension of specialist services from a centre of excellence to the periphery, thus creating an equal opportunity to access quality services. Until now, the routine utilisation of telecardiology systems has been limited although spectacular technological achievements have been seen such as joint stent insertion procedure between Houston (USA) and Jerusalem (Israel), or robotic surgery being performed over telecommunication networks between Hawaii and the Netherlands. However the following case study illustrates the less dramatic but vitally important routine application of tele-cardiac assessment and consultation carried out in the UK.

## Case Study

A pilot study was undertaken as part of an assessment programme of a comprehensive telecardiology consultation service. It aimed to assess telesupport for GPs in their routine, daily practice based upon their requirements for specialist consultation when making management decisions about cardiac treatment. The service also helped to prioritise local out-patient clinics' workloads, filter patients and identify the minority in need of emergency attention.

The study included 93 GPs from 26

health centres serving about 200,000 North London patients. GPs were offered telecardiac consultation from their practices or from patients' homes and were supplied with a hand-held standard 12-lead electrocardiogram transmitter (the Heartview from Aerotel) and given direct voice access to the cardiac monitoring centre (CMC) for on-line cardiac consultation and ECG interpretation. Since ECGs require multiple leads to be placed correctly on the patient's chest, a purpose-designed harness was supplied, making the consistent placement of standard leads easy. The CMC, based at the Cardiology Department in Edgware General Hospital, London, operated a 24-hour service which included collecting and analysing data, consulting and reporting.

The telecardiology support system followed a simple procedure. When required, the GP or nurse would call in, identify the patient by name and date of birth, provide clinical details, patient's history and reason for consultation. The caller would then transmit a standard 12-lead ECG signal. A brief consultation followed, discussing diagnosis and patient management, and a full report, with ECG printout, was mailed or faxed to the GP.

Over 18 months 2,563 consultations were carried out. After studying the GPs' reasons for seeking consultation (see figure left), out-patient clinics were

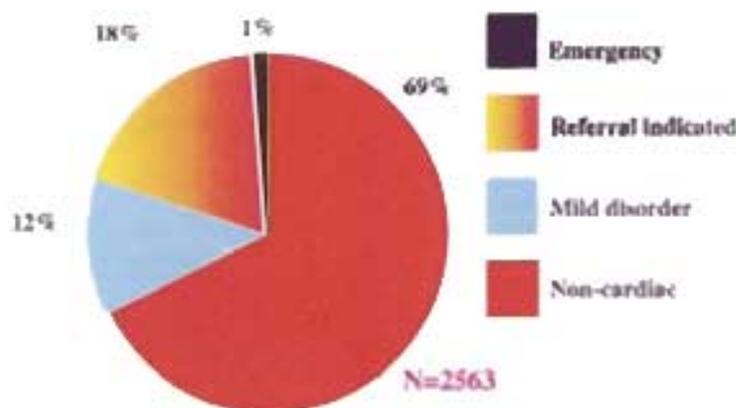
reorganised to meet specific demand for assessments. Clinics were divided into arrhythmia (palpitation), ischaemia (chest pain), risk factor stratification/secondary prevention clinic and clinics for the investigation of cardiac failure and murmurs. Teleconsultation results helped filter appointments to the appropriate clinic and appointments were made instantly, on-line, during the teleconsultation. Instant admission for AMI patients was arranged when indicated, involving pre-warning of in-hospital medical teams. However, of the 2,563 management decisions made regarding patients upon teleconsultation, 81 per cent were found suitable for management entirely by the GP without need of further referral to the hospital (see figure below). The remaining 19 per cent were patients requiring referral for further investigation and patients where urgent or immediate hospitalisation was indicated.

Feedback was obtained from GPs through a questionnaire asking them to define their use of the service, grade its quality and to consider and grade the benefits the service may offer their daily practice. The questionnaire revealed that the GPs tended to use the service for the general management of cardiac patients, to obtain ECG interpretation with cardiologist's opinion and for differentiating cardiac/non-cardiac situations. The greatest benefits were gained by the alteration of management i.e. the opportunity to manage the patients in the GP practice instead of referring them to the A&E department or requiring an out-patient assessment. (Table 1.)

## Benefits

The case study illustrated some key factors and advantages of adopting telecardiology as a routine support for the primary healthcare environment. GPs in the study view the maximum benefit gained by the use of transtelephonic cardiology services as the improved capacity for GPs to remain in control of patient management. The importance of

## Patient management following consultation



this is heightened when it is remembered that cardiovascular disease remains the leading cause of morbidity and mortality in developed countries and is commonly seen by GPs in daily practice. Concomitant to this, general public awareness and fear of cardiac disease is relatively high, creating a pool of disease free patients who seek reassurance as to their condition as well as patients in various stages of disease. With increasing pressures on hospital resources, the enhanced capacity of GPs to manage more of their cardiac patients in the primary healthcare environment is of clear benefit to the health system infrastructure.

Telemedicine facilitates real-time discussions between physicians in primary and secondary healthcare. It is essentially this ability to overcome the problems of access that makes these technologies so potentially useful. With the rapid expansion of medical knowledge in all disciplines, it is unrealistic to expect that the individual primary healthcare physician can keep abreast of all developments and diagnostic procedures individually. Technology together with existing highly trained hospital personnel can be used to enhance GPs' diagnostic services and patient management capacity. They can satisfactorily assess and treat patients at the primary level, accurately identifying those who require referral for consultant opinion and intervention.

Experience has shown that simple problems can be dealt with over the telephone by GPs and specialists. Agreement reached regarding a management strategy which, in many cases, obviates the need for patient referral. This maximises the use of the

*Telecardiology is simple, reliable and efficacious in routine primary care as well as for monitoring of high-risk cardiac patients. It offers instant access to cardiac assessment and supports the decision-making process of GPs, results in early detection of heart disease and shortens the symptom-to-intervention interval for suspected acute events.*

GPs' clinical and management skills, enhancing the knowledge of both GP and specialist through increased interaction.

At the same time the patient has had ready access to specialist expertise without having to leave the primary care setting. In this way, telecardiology contributes to a meaningful change in referral trends reducing the number of non-urgent and unnecessary referrals while substantially increasing assessments resulting in diagnosis of severe pathology.

The case study dealt only with tele-electrocardiography. Extension of the telecardiology service to include tele-echocardiography has become practicable with the use of a group of 30 ISDN lines which allow the rapid transfer of real time images at an acceptable frame rate. The hospital physician will be able to interact in the investigation carried out in the GP's practice, by giving directions and comments to the technician or GP as the

echocardiogram is taken. In developed countries, this is likely to find greatest application in the assessment and management of patients with known or suspected heart failure, the one area of cardiology where the prevalence of a condition is increasing.

#### The future

Advances in telecardiology are such that a telecardiology diagnosis and ECG interpretation service is simple, reliable and efficacious in routine primary care as well as for the purpose of close monitoring of high-risk cardiac patients and the disabled population. It offers instant access to cardiac assessment and supports the decision-making process of GPs. It results in early detection of heart disease. It shortens the onset of symptom-to-intervention interval for suspected acute events. It allows adequate filtering and priority grading of referrals for patients requiring further investigation while reducing the load of unnecessary referrals for primary diagnosis. The rapid development of today's communication technologies should widen the scope of such services to incorporate further telecardiac assessments routinely. ■

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A full list of references for this article is available on application to Dr Agnès Leotsakos, Deputy Editor, *European Hospital Management Journal*.

**Table 1: Rating of consultation service by GPs**

Quality	Rating	Application	Rating	Benefits	Rating
Efficiency	6	Control of Arrhythmia	3	Alteration of management practice instead of A&E	6
Accessibility	6	Hypertension	2		
Response time	5	Reassurance	2	Enhance doctor/patient relationship/ Improved care of patients	5
ECG analysis	6	Supporting decision making process	3	Boon to the practice	4
Cardiac consultation	5	Confidence in acute situations	2	Saving of patients' time	6
Appropriate response to acute situations	6	Diagnosis of emergencies	2	Saving of referrals	5
		General management of cardiac patients	4	Speeding of referrals	5
		ECG interpretation+	4		
		cardiologist's opinion	4		
		Differentiating cardiac/ non-cardiac situations	4		
<b>KEY</b>					
6= very satisfied		0= not used		1= strongly disagree	
5= fairly satisfied		1= almost never used		2= moderately disagree	
4= a little satisfied		2= used sometimes		3= slightly disagree	
3= a little dissatisfied		3= used fairly often		4= slightly agree	
2= fairly dissatisfied		4= used very often		5= moderately agree	
1= very dissatisfied				6= strongly agree	