

## **TELEMEDICINE IN SCOTLAND**

*David J Godden and Nessa Barry*

### **BACKGROUND**

‘... liberal extension of telephone communication in connection with the medical service would be a great public boon ... a trained nurse ... could discuss a case with the doctor and take his instruction.’

A quote, not from a recent health strategy document, but from the Dewar Report (1912) (The Highlands and Islands Medical Service Committee 1912) that examined delivery of healthcare in the Highlands and Islands, and recognised the potential value of remote diagnosis and treatment. Technology has advanced enormously since that was written, but its full potential in health care has yet to be realised, despite a number of telemedicine pilot projects in Scotland over the past two decades. Until recently there has been little coordination or central funding.

Almost one century after Dewar, the Kerr Report on the future of the NHS in Scotland (NHS Scotland 2005a) acknowledges the central role for information and communications technology (ICT) in the modern health service. It recognises the potential for remote imaging, diagnosis and treatment, and envisages a universal electronic patient record to facilitate clinical management by a range of professionals. It also acknowledges future

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*Professor David Godden MD FRCP(Edin) FRCP(Glasg) is Director of the Centre for Rural Health, an academic department specialising in rural health research and policy ([www.abdn.ac.uk/crh](http://www.abdn.ac.uk/crh)), and is Honorary Consultant Physician at NHS Highland. Nessa Barry RGN, BSc (Health Science) has, since graduating from University of Aberdeen, worked as a researcher in Aberdeen, Glasgow and Edinburgh and for the past number of years, while based at NHS Education for Scotland, has worked for the Scottish Executive Health Department supporting and advising on telemedicine and e-Health initiatives.*

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increased capacity for individual citizens to access health care and information electronically, via internet-based or other mechanisms. The momentum for incorporating ICT into health service planning is also evident in a concerted policy impetus by the Scottish Executive Health Department that now has a clinical lead within the computing and IT strategy department and a clear e-Health strategy. Work in primary care, general practice and acute settings is being pursued to improve the technology platform that is essential for telemedicine, along with work to improve the uptake of the national patient identification number, the Community Health Index number (CHI). This, in turn, is pivotal to the development of a single electronic patient record in Scotland.

In the European context, a position paper from the European Health Telematics Association (European Health Telematics Association 2004) summarises issues that the European Union must consider if it is to achieve EU-wide provision of digital applications and services. As well as technical and professional issues, this report recognises the importance of governments and politicians in facilitating the development of e-Health.

Globally, the World Health Organization (World Health Organisation 2004) has considered the role of e-Health technology in promoting population health. It comments that e-Health:

understood in this context to mean use of information and communication technologies locally and at a distance presents a unique opportunity for the development of public health. The strengthening of health systems through e-Health may contribute to the enjoyment of fundamental human rights by improving equity, solidarity, quality of life and quality of care.

Health professionals and politicians alike therefore recognise the potential for telemedicine applications, and the much more broadly defined e-Health, in all areas of health and social care. Whether the problems being debated are about spiralling costs of health provision, chronic disease management, demographic change and the time bomb of ageing that faces western industrialised nations, equity of access and outcomes or citizen mobility across the EU, telemedicine and e-Health are often cited as universal solutions.

This article discusses the issues surrounding telemedicine, which include technical, clinical, legal and ethical considerations. It is necessary to

understand and address these before organisational acceptance and widespread implementation can occur.

## **THE TECHNOLOGY**

Perhaps the simplest form of telemedicine is the telephone, used for communication between health professionals, and increasingly between the public and the health system. Examples of the latter include telephone advice services, such as NHS Direct in England, or tele-triage systems, such as NHS24 in Scotland, from which people access acute services via a 'call-centre'. In the latter, trained nurses use decision support software algorithms combined with their clinical knowledge to direct callers to the most appropriate health provider. In recent years, FAX has been used for transmission of health documents or data; that is now being supplanted by e-mail.

The development of local area networks and the internet then allowed transmission of files including clinical images, such as pictures of skin and dental lesions, radiographs and other scans, either in real time, or as 'store and forward' files for review by a remote expert. In recent years improvements in speed of transmission and compression technologies have allowed transmission of complex images of sufficient accuracy and quality for diagnostic purposes.

Videoconferences and teleconsultation can be conducted across telephone lines, such as ISDN, assuming compatible videoconferencing units. These communications can be point-to-point, i.e. connecting two sites, or multi-point, where multiple units are linked by means of a 'bridge'. The camera can be as simple as a small desktop camera or a complex model with remote control pan and zoom features. Some degree of training is necessary for users and a clear protocol for appropriate technical support is essential for successful implementation and system maintenance. The use of this type of technology is increasing in both clinical and educational scenarios. Rather than being the preserve of one or two users at a particular site, the most successfully integrated are multi-modal systems where, for example, a videoconference network will be used variously to support Managed Clinical Network (MCN) meetings, staff educational activities and regular doctor-patient appointments for certain specialties. The wide range of uses has fostered a change in perception of telemedicine from isolated enthusiasts experimenting with technology, to placing information and communication

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technologies, including telemedicine, at the heart of the NHS modernisation agenda. As numbers of users from multidisciplinary backgrounds increase, research on telemedicine applications has also shifted from technical feasibility towards the wider implications for the system and for users.

Studies on use in specific clinical scenarios – e.g. emergency care, homecare and chronic disease management – and the costs, benefits and clinical effectiveness of telemedicine applications are now becoming more frequent. Other types of study have focused on acceptability among users, both patients and health professionals. Despite doubts expressed by many clinicians prior to use, there is growing evidence that patients find many telemedicine applications acceptable and that there are benefits identified by health professionals.

In addition to relatively simple videoconferencing and image transfer systems, much more sophisticated systems are now available for performance of telesurgery. These combine high-speed connections with robotic instruments that can permit levels of surgical precision greater than those of the unaided surgeon. Virtual reality (VR) has been described as the leading edge of an evolution in communication interfaces and has obvious potential, not only for use by professionals in areas such as remote surgery and surgical training, but also for patient use in assessment and rehabilitation. (Riva, Gamberini 2000)

### **CLINICAL APPLICATIONS**

A broad range of clinical situations may be appropriate for teleconsultation. Among the best established are dermatology, orthopaedics, emergency medicine, mental health and cardiology. More complex diagnostic and therapeutic procedures can also be performed via telelinks, e.g. remote real-time ultrasound screening and telesurgery, in which the surgeon is physically remote from the patient. Telemedicine is most often used to overcome geography, i.e. where the practitioner and the patient are remote from each other. However, it can also be used to create 'remoteness', for example, in clinical psychology consultations with children or other vulnerable individuals.

Enthusiastic clinicians have driven many of the clinical applications of telemedicine. However, healthcare today expects new developments to be formally evaluated, assessing clinical risks and outcomes, together with

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economic costs and benefits. A systematic review of literature published to year 2000 examining the benefits of telemedicine (Hailey, Roine & Ohinmaa 2002) revealed only 66 scientifically credible studies (from 1323 articles). These studies reported mixed results, with just over half showing a benefit over an alternative, but more than one third describing negative aspects of telemedicine. The most convincing evidence of benefit was found in studies of teleradiology (especially neurosurgical applications), mental health, echocardiography, teledermatology and home telecare. A later review by the same authors (Hailey, Ohinmaa & Roine 2004) of literature from 2000-2, found a further 44 articles (from 605) and identified geriatric care and intensive care as additional areas where benefit was shown. However, it is generally recognised that much research is yet required to fully establish the use of telemedicine in clinical settings. Rigorous examination of the efficacy of telemedicine for making diagnostic and clinical management decisions reveals that the best evidence for efficacy comes from psychiatry and dermatology, but there is still a lack of high quality published evidence in other clinical fields. (Hersh et al 2002) Even in psychiatry, a comprehensive review of literature from 1965-2003 confirms that the feasibility and acceptability of telepsychiatry is well documented, but data are limited with regard to clinical outcomes and cost effectiveness. (Hilty et al 2004) It should be noted that the absence of evaluation in many disciplines, the stop-start approach to telemedicine in the past, the endless small scale studies and lack of strategy or integration of developments into routine care have encouraged this situation. The result is that, until very recently, obtaining large enough datasets and long enough follow-up periods for evaluation was almost impossible.

‘Telesurgery’ is a broad term covering educational techniques such as teleproctoring, in which surgical trainees are monitored and evaluated from a remote site, surgical presentations with remote participants, and telementoring, where in real-time a surgeon may be guided through a procedure by a remote expert, through to the actual performance of surgery using telemanipulation (the extension of a person’s movements to a remote location) and telepresence (telemanipulation with added sensory information to make the operator feel that they are physically present at the remote site). As in other fields of telemedicine, legal, ethical and cost implications of telesurgery have to be further explored. (Eadie, Seifalian & Davidson 2003) Furthermore, as is the case with diffusion of all new technologies into social settings, the availability of a potentially very useful but complex technology does not in itself result in uptake and widespread use. The working practices,

culture of the organisation and challenges of supporting the system must also be considered.

## **ORGANISATIONAL FRAMEWORKS**

As the use of telemedicine and e-health technologies grows, coordination and administration will become increasingly important. A survey conducted in one mature telemedicine network of 221 videoconference facilities revealed a number of operational problems (Wootton et al 2002). Thirty per cent of sites within the network were not contactable, 78% kept a diary of bookings but only 35% kept a record of videoconference usage, and 13% volunteered that their equipment was not operational at the time of the survey. Although not necessarily generalisable, this illustrates potential issues for those developing telemedicine networks. These 'minor' hurdles are often the most challenging. In telemedicine, organisation and coordination of sessions, technical support for equipment at all times and simple knowledge of the location of equipment in a given hospital can challenge the keenest clinical minds. One potentially very useful application recently has been a database of videoconferencing facilities at NHS sites hosted by the Scottish Executive's website.

## **LEGAL AND ETHICAL CONSIDERATIONS**

Overriding issues in the application of telemedicine and other e-health initiatives include privacy and data protection, legal responsibilities and obligations and organisational issues.

In a review of current legal and ethical concerns in telemedicine and e-medicine, which addressed both United States and European statutes, Silverman (2003) identified four main areas of concern: doctor-patient relationship; malpractice and cross border licensure; standards; and reimbursement. The doctor-patient relationship could be compromised by poor quality communication or by inadequate consent procedures, which in conventional medical practice often underlie complaints and litigation. Theoretically, the risks of malpractice claims relating to telemedicine procedures are significant, although in practice this has seldom arisen to date. Cross border licensure has however proved to be an issue in the USA, where state licensing boards have taken action against 'e-medicine' providers (i.e. those using the internet to provide patient services) working across state lines. At present there are no international universal standards to govern practice

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across a worldwide network such as the Internet. Finally, reimbursement may be an issue, particularly in the USA, where Silverman recognised that telemedicine and e-medicine would lack support from professionals, patients and regulatory bodies until these issues were resolved, almost certainly by high level agreements, federal or international. In 2000, a Directive of the European Union described some issues related to telemedicine as part of its provisions (Callens 2003).

Another area of concern is the quality and ethical basis of on-line health-related sites. Information on such sites should be accurate and reliable, and ideally compatible with the highest quality standards of evidence-based professional advice. Where patient-specific advice is dispensed electronically, issues of privacy and confidentiality become important, and users need to be reassured that appropriate security protections are in place (Bovi & Council on Ethical and Judicial Affairs of the American Medical Association 2003). This issue will become more important as the mobility of EU citizens grows and expectations of access to personal records from any geographic region become the norm. Interestingly, at a recent 2004 European-sponsored e-Health conference, many of the most supported and prize-winning presentations were from Internet based public health portals (<http://www.e-Healthconference2004.ie/>).

### **FUTURE DEVELOPMENTS**

In 1997, Yellowlees described core principles for the development of a successful telemedicine system (Yellowlees 1997). The author concluded that despite the evolution of technology, human factors still tend to determine the success or otherwise of telemedicine projects.

However, the rapid expansion of the telecommunications industry offers many opportunities for applications to health. Wireless local area networks (LAN) are already with us and offer the opportunity to create clinical data networks that can be used in hospitals and in the pre-hospital setting (Chen et al 2004). Web-based systems can be used via PC web browser or appropriately configured mobile phones to facilitate chronic disease management, e.g. diabetes (Ferrer-Roca et al 2004) or hypertension (Nakamoto et al 2004), and to support home based social care (Ogawa et al 2005). Mobile camera phones can be used to support wound and trauma management (Tsai et al 2004, Lam, Preketes & Gates 2004). Bluetooth technology is being developed to allow multichannel biomedical signal

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transmission via mobile phone networks (Rasid, Woodward 2005), and complex mobile teletrauma systems, in which clinical images, including video and electrocardiograms, can be transmitted are being developed using 3G networks (Chu & Ganz 2004).

Long-distance telesurgery is also now a reality, and has been used for a variety of procedures, such as removal of the gall bladder of a patient located in France by a surgeon in New York. A range of technical factors such as the transmission speed of the telelink and the precision of instruments become critical here. However, robotic instruments are now available that have greater precision in fine movements than the human hand, with the absence of tremor as an added bonus. When combined with scaling factors that allow large amplitude movements of the surgeon's hand to be scaled down to very fine movements of the robotic instrument, new avenues in microsurgery are opened up. By gating images, a beating heart can be made to appear motionless from the surgeon's perspective, allowing surgery to be performed without the need to induce a cardiac arrest for the period of the surgery. Fatigue of the surgeon may be reduced by the use of robotic systems, and surgical errors can potentially be reduced. On the other hand, there is a potential for failure of technology or the development of complications, such as haemorrhage, control of which might be outwith the scope of the telesurgery system. Thus there is a need for manual override of the system and for local backup by an appropriately trained individual. Telesurgery holds great potential, but a broad range of technical developments in relation to instrumentation, tactile feedback and more widespread availability of systems with high transmission speeds will be required before more widespread use of telesurgery will occur.

Web-based health information systems provide an opportunity for health care workers and members of the public to access high quality validated information, either from conventional web connections at bedsides, nursing stations or mobile units, or from touch screen kiosks which can be situated in libraries, health centres and other public locations. In Scotland, such a system has been established in the Western Isles. Online surveys of users can be used to develop the style and content of such sites, which may serve a useful public health function, providing local, as well as generic national information ([www.intouchwithhealth.co.uk/pphis/clients/Westernisles](http://www.intouchwithhealth.co.uk/pphis/clients/Westernisles)).

The EHTEL report (European Health Telematics Association 2004) suggests that evolving technologies could be divided into 'technologies for the masses'

and ‘technologies for the few’, and, as well as highlighting potential benefits and novel provision of e-Health technology, draws attention to potential risks. For example, mass-produced electronic support devices could be constructed or used in an unsafe manner. Security and protection of privacy may be an issue with devices that are small and may be easily stolen. Moving to very large trans-institutional records systems will require integration platforms that have only recently been developed and further development and refinement will be essential.

### **SOCIOECONOMIC IMPACT**

The socioeconomic impact of tele-Health has not been consistently studied, although a systematic review identified individual studies that provide local examples relating to access, cost effectiveness, outcomes and quality of care and contribution to social networks (Jennett et al 2003). In rural and remote health services, videoconsultation appears to be effective and efficient, and can enhance access, e.g. to specialists for those with rare diseases. Cost savings depend on the number of patients and distances involved, and often depend on a wider societal approach to cost being taken in which personal costs for patients (travel and lost working time) are included. The authors advise that, in the future, studies of the socioeconomic impact of tele-Health should use validated and standardised tools for data collection and should address client and health-provider perspectives. Similarly, at a more strategic level, gaps in the evidence on economic evaluation have been a key feature in a number of policy documents which highlighted this area as requiring further work and consensus, not only on the relevant data, but also on methods of data collection and analysis (Department of Health 2003). Benefits of telemedicine applications can often be more widely experienced than standard cost-benefit models allow. These wider benefits can include the value of locally based access to expertise for patients and associated reassurance; the impact on health professionals working in remote locations; and wider effects on the NHS in terms of recruitment and retention. These are often overlooked.

### **THE SCOTTISH PERSPECTIVE**

In Scotland in 1999, the Scottish Executive Health Department established the Scottish Telemedicine Action Forum (STAF), a fixed-life initiative to develop new clinically driven technological solutions to underpin operational

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modernisation. During the period 1999-2003, applications for funding were submitted and over the lifespan of the initiative 12 projects were funded, as detailed in Table 1. Members of the STAF secretariat and assessment panel determined the philosophy behind the demonstration projects. The key principles were that funded projects should:

- work clearly within the framework of modernisation and redesign of services such as managed clinical networks; this approach was seen as fundamental to sustainable developments
- demonstrate a principle of solving existing operational difficulties through innovation
- move the development beyond individual clinical and IT enthusiasts and be implemented and operated with a multidisciplinary project team
- represent wide-ranging elements of health service provision, i.e. from immediate diagnostic support through to core services such as patient management, audit and delivering educational programmes
- contain a defined plan for local support beyond external funding period

The overwhelming focus for all the funded applications was that they have the time and funding to demonstrate how a particular telemedicine application could improve communication, sharing knowledge and access to services for all the users.

The projects were varied incorporating acute care; patient advice and management; supporting managed clinical networks; and supporting educational activities. Managed Clinical Networks (MCNs) comprise groups of health professionals in a given discipline, e.g. gynaecological oncology. The goal of MCNs is to improve communication, management and care planning for patients by involving all the health professionals in that planning and review. Implementation and evaluation advice for all projects was provided and the approaches taken by the projects to evaluation were varied. Evaluation in general concentrated on feasibility and patient and staff satisfaction, and some of the evaluations have been published in academic journals (Brebner et al 2004, Barry et al 2003).

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**Table 1**  
**Demonstration projects funded 1999-2003 by the Scottish Telemedicine Action Forum Initiative**

No.	Title	Status of application
1	Distance No Object: Integrated Telemedicine Service for Argyll and the Islands, teleradiology & Distance No Object: videoconferencing for education network	Ongoing.
2	Role of Telemedicine Provision in Emergency Care in Remote Communities (Grampian wide)	Ongoing. Now also participating in North of Scotland Tele-education Network
3	Royal Alexandra Cardiovascular Health Electronic Links (RACHEL)	Completed.
4	Development of a Telemedicine electronic patient record system for CLEFTSiS. Supporting the Scotland wide managed clinical network for Cleft Lip and Palate.	Ongoing. Developed to support an existing Managed Clinical Network. Initially 5 sites in Scotland, now being rolled out to all members of the managed clinical network.
5	Telemedicine Support for West of Scotland Managed Clinical Networks in Cancer – videoconferencing and image capture software network.	Ongoing. Developed to support the existing gynaecology Managed Clinical Network and now used by other oncology networks.
6	BabyLink – improving communication among clinicians and with parents in a neonatal intensive care unit	Ongoing.

*continued*

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*Table 1 continued*

7	Interactive telephone based system for patients with rheumatoid arthritis	Ongoing.
8	Clinical Psychology – eating disorders service	Ongoing. Utilising the Grampian A&E network videoconferencing system to facilitate a clinical psychology service.
9	North of Scotland Education Network	Ongoing. Multidisciplinary network that operates across geographic regions and provides educational access to users.
10	Orthodontic Telemedicine Service	Ongoing. Technical issues and workload implications limiting use
11	Scottish Paediatric Videoconferencing Programme	Ongoing, initially used in 4 pilot sites and now being rolled out to support paediatric emergency referral at up to 10 sites across Scotland.
12	Pathalba – Using telemedicine to support a national Managed Clinical Network in Pathology	Project commenced 2005.

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For example, an accident and emergency service in Grampian was established linking 14 community hospitals with an Accident and Emergency department based in a central teaching hospital. Telemedicine advice was available 24 hours a day, 7 days per week from consultants or other support staff, via a videoconferencing unit equipped with a document camera to permit transmission of clinical photographs and radiographs. A total of 1392 teleconsultations took place during a 12-month study period. Remote sites varied in their use of the system from zero (two sites) to 417 consultations.

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Most consultations occurred on weekdays during office hours and related to limb injuries. The number of teleconsultations grew during the study period, perhaps indicating increasing familiarity with the system, and there was a small fall in the proportion of cases transferred to the main hospital, though this was not adjusted for case mix nor statistically tested. Reported levels of user satisfaction, both from professionals and patients, were high. Unfortunately the study had no control sites, although there were some indications that those with high levels of usage had local clinical champions and better technology than the low users.

A number of important operational lessons were learned from the Scottish Telemedicine Action Forum initiative, allowing recommendations to be made as follows:

- System implementation is achieved by multidisciplinary team working. This typically involves a clinical lead, project manager/administrator, local IT staff (across participating sites) and provider IT company staff.
- Clearly defined service needs, clinical priority and willingness to participate on the part of local staff (clinical and non-clinical) should be determined prior to funding.
- Ongoing support from a representative of the department is essential to keep momentum going and can be very timely in allaying fears, sorting out minor problems that threaten to derail projects and to ensure new developments are in line with NHS technology and infrastructure standards and strategy.
- This kind of support is also essential if developments are to be linked into national initiatives and developments, thereby avoiding so many 'stand-alone' and eventually limited projects.
- Incremental rather than 'big-bang' approach to implementation is most likely to be sustained.
- National priorities around Information Management and Technology should be the determining framework for new initiatives or projects, not distinct 'telemedicine' funding.
- Evaluation should be integral to the implementation process, 'owned' locally with expert advice available if necessary. Evaluation

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of outputs, i.e. numbers of patients seen for example, is relatively easy to collate and document.

- Evaluation of 'outcomes', clinical results or a change in patterns of care delivery takes a long-term commitment to data collection and analysis. This and the support it requires are often absent from these demonstration projects.
- Evaluation should consider the quality of service provision, innovation, and a wider appreciation of benefit. If appropriate, encouragement to write up findings, publish in peer-reviewed journals or attend conferences can motivate data collection.
- Experience indicates that support for recording and analysis of long term outcomes (particularly clinical) beyond the initial funding period is necessary to fully understand the impact these applications may have at clinical, system and user levels.
- Successful demonstration projects (particularly pilot projects) are encouraged to build upon their momentum and success and roll out the system across service.
- Although the initial aims of STAF were achieved by March 2003, robust arrangements need to be put in place to ensure the continued monitoring and evaluation support (such as the activities described here) for the established demonstration projects and projects in development.
- A large number of Scottish Executive departments and initiatives do have e-Health and elearning elements. There is little attempt to present a 'joined-up' picture of these elements or to consider new initiatives and whether or how e-Health or elearning might be appropriately used – drawing on lessons learned from previous initiatives such as STAF.
- Existing videoconferencing resources owned by NHS Scotland should be actively co-ordinated to improve efficiency and minimise costs.

It is important to recognise that the momentum generated by all those involved in the demonstration projects could be built upon and exploited, e.g. in areas such as remote provision of education and health care, recruitment

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and retention policy across the NHS in Scotland, and in the ongoing strategic policy framework on service redesign and modernisation. However, there have been difficulties in establishing continuing funding, even for successful demonstration projects, and this will be an issue for health and social care administrations. It is recognised within the Kerr Report (NHS Scotland 2005b) that ICT spend per employee in the United Kingdom is lower in the health sector than in any other major economic sector (e.g. manufacturing, utilities, distribution, finance etc).

### **CONCLUSION**

The history of telemedicine over the past several decades has been one of phases of innovation and testing followed, to the disappointment of enthusiasts, by phases of inactivity with accompanying debates about costs and reliability. The current status, and in turn the potential, for telemedicine can be understood in the recognition it now receives as a realistic element in addressing the management of health systems worldwide. The thrust of the debates has moved beyond feasibility and reliability issues into equally complex debates about standards. The standards debate has a number of strands: technological interoperability and infrastructure of applications; evaluation of effectiveness; economic evaluation of applications; security and confidentiality of data transmission; and emerging ethical and legal standards (Bend 2004). The evidence of this shift is seen most clearly in reports of successful projects in the relevant journals but also, crucially, in high level policy documents (House of Commons Health Select Committee 2005) and in local health planning for telemedicine applications to underpin clinical priorities and support modernisation of care delivery. However, it is important to acknowledge that the full potential of these services cannot be achieved without a ubiquitous information and communication technology (ICT) infrastructure. This ICT platform, which adheres to commonly accepted and clearly delineated technical standards and protocols, is the key component of inter-operability and will provide the required platform for further development and integration of telemedicine across healthcare systems.

The internal and external drivers which have made telemedicine an option in the provision of services, such as the availability and reliability of the technology, issues of isolation due to geography and distance, pressures related to demand on services, clinical guidelines and the importance of

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access to expertise in diagnosis and treatment for all patients wherever they are located, are now being joined by new pressures to provide services which are accessible not only by health professionals but by citizens, and to provide clear, content-approved health information and access to resources for self-care using new technologies. The shifts in society as a whole and in the availability and reliability of technology have created a new momentum around telemedicine applications. Caution should be applied in widespread use without a clear clinical or educational priority and without evidence of clinical or social benefit. Future developments should be exposed to evaluation of the wider impacts, not just technical feasibility or short-term outcomes. Health professionals and policy makers have an obligation to consider the use of telemedicine and the more widely defined e-Health applications as a core part of service modernisation and improvement.

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