

Activity analysis of telemedicine in the UK

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Background: Telemedicine is a new way of delivering health care to people, particularly in remote areas. The UK has experienced a surge of telematic projects in recent years. However, there is little information available in the literature regarding the past and present of telemedicine in the UK.

Objectives: To evaluate the state of telemedicine in the UK.

Methods: All the projects that took place in UK since 1991 were considered for the study and evaluated according to the population and area served.

Results: A total of 216 projects were identified. The number of projects was highest in England (172). Emergency medicine, medical specialties, and educational projects received most consideration (9.7% each). With the exception of Wales, the number of projects increased steadily with time. The projects, when correlated in accordance with the area (per 10 000 sq km) and population (per million), were found to be highest in England (49.5%) and Northern Ireland (36.2%) respectively. No dedicated educational project took place in Scotland, Northern Ireland, and Wales.

Conclusions: The UK embraced telemedicine in the early 1990s and the overall growth had been steady. Scotland, in spite of being the most likely beneficiary in UK, has lagged behind in telemedicine schemes and merits more projects. The issue of tele-education needs urgent review. Multisite trials and a combined approach involving the government, health professionals, technologists, and patients' representatives would facilitate such developments and help widen the application of telemedicine.

Telemedicine refers to any application of information and communication technology which removes or mitigates the effect of distance in healthcare.¹ It is a way of delivering healthcare that allows a change from a centralised service to one that is patient centred, resource efficient, and where decisions are made at a local level close to the patient.² This is a relatively new concept and its implications on the health system in the UK are not fully known.

This study aims to evaluate the state of telemedicine in the UK, compare projects according to the population and area served, address relevant issues, and suggest appropriate changes.

METHODS

Telemedicine projects that took place in the UK from 1991 to 2003 were considered for the study. Relevant information was obtained from the UK National Database of Telemedicine Information Exchange.³ An unrestricted Medline literature search was performed and various websites were also consulted. The following data were obtained on individual projects: (i) date of commencement, (ii) nature of project, (iii) clinical discipline, and (iv) any special comments.

RESULTS

The first project took place in Scotland in 1991.⁴ A total of 216 projects were identified in the UK (table 1). The highest number of projects took place in England (n = 172; 79.6%), followed by Scotland (n = 28; 13%), Northern Ireland (n = 10; 4.6%), and Wales (n = 6; 2.8%). The majority of the projects (a total of 61.1%) in the UK took place in the disciplines of dermatology, elderly care, education, emergency medicine, infrastructure development, medicine, and mental health.

Figure 1 shows the yearly frequency of occurrence of projects. However four projects were not included in the figure as dates of commencement could not be ascertained. The number of projects in the UK increased with time but the

reliability of trendline was less than ideal (coefficient of determination $R^2 = 0.29$).

The relative number of projects taking place in each part of the UK was compared with the corresponding population. The number of projects per million population was highest in Northern Ireland (36.2%), closely followed by Scotland (31.8).⁵ However the picture was different when the surface area was taken into account (fig 2).⁶ The number of projects per 10 000 km² was highest in England (49.5%), followed by Northern Ireland (26.4%).

DISCUSSION

The year of 1991 saw the onset of telemedicine in the UK. This was a relatively late start particularly when viewed in the context of the global state of telemedicine. Wilhelm Einthoven, the inventor of the electrocardiograph, started experiments with remote consultations via the telephone network as early as 1906. The 1950s and 1960s saw various individual experiments in the field of medical telecommunication.⁷ However, Dr Cecil Wittson, who initiated telepsychiatry projects in 1961 at the University of Nebraska (Omaha, USA), is widely believed to be instrumental in delivering the first comprehensive telemedicine service in the world.⁸ The National Aeronautics and Space Administration (NASA), as an institution, also merits special mention as it was actively involved in early 1960s in the development and application of telemedicine. The latter took place in the form of biotelemetry, a means of transmitting biomedical or physiological data from a remote location (for example, astronauts in space) to a location that has the capability to interpret the data and affect decision making (for example, ground controllers at Mission Control Centre).⁹

Two different kinds of technology make up most of the telemedicine applications in use today.¹⁰ The first, called store and forward, is used for transferring digital images from one location to another. A digital image is taken using a digital camera (stored), and then sent (forwarded) to another location. Teleradiology is one such example. The other widely

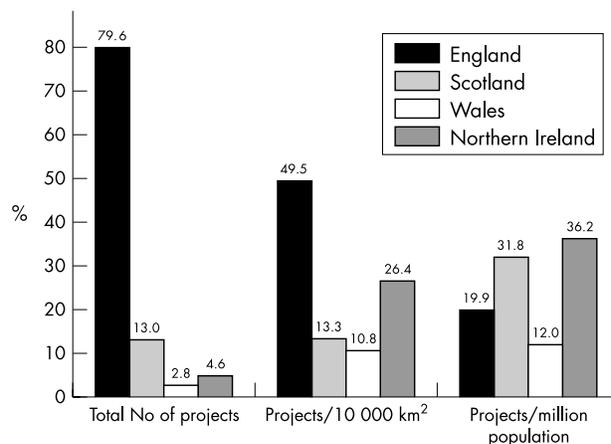
Table 1 Details of the telemedicine projects in UK

	Wales	Northern Ireland	Scotland	England	UK
Dental health	-	-	1	3	4
Dermatology	-	1	1	13	15
Elderly care	-	2	6	9	17
Education	-	-	-	21	21
Emergency medicine	1	-	3	17	21
Infrastructure	-	2	6	12	20
Medicine and allied	2	-	2	17	21
Mental health	-	1	4	12	17
Miscellaneous	-	2	-	33	35
Multidiscipline	2	1	2	3	8
Ophthalmology	-	-	-	4	4
Paediatrics	-	1	-	11	12
Primary care	1	-	3	1	5
Radiology	-	-	-	11	11
Surgery and orthopaedics	-	-	-	5	5
Total	6	10	28	172	216

used technology, two way interactive television, is used when a "face-to-face" consultation is necessary. It is usually between the patient and their provider in one location and a specialist in another location. Videoconferencing equipment at both locations allows a "real time" consultation to take place. The latter was exemplified by pioneering use of video links in 1992 by the University of Aberdeen in providing advice and support to the paramedics on oil rigs in the North Sea, as well as in the Arabian Gulf and Antarctica.¹¹

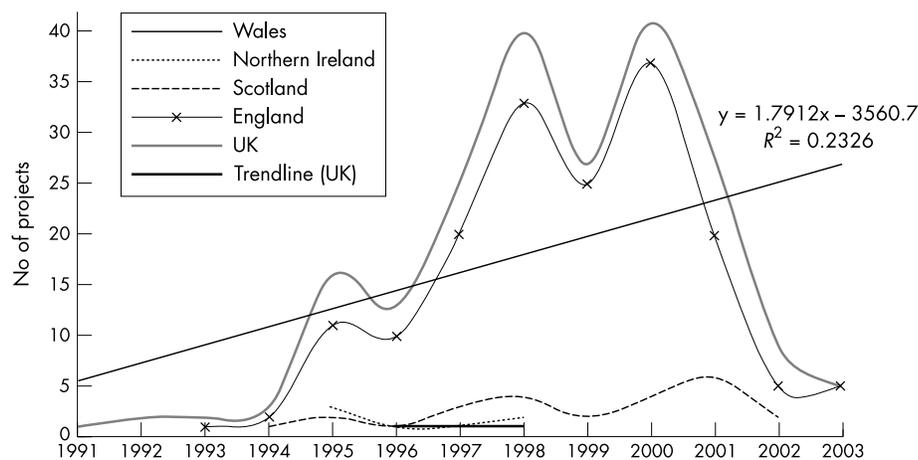
Telemedicine has the potential to provide a wide range of benefits. These include improvement in gaining access to various services and expertise, enhanced assessment and discharge, reduction of the waiting list, and a significant gain in productivity.¹² Staff can benefit by improved decision making, teaching, and research. Patients can directly benefit from reductions in the amount and cost of their time and travel.² Therefore the potential benefits to the health system are high. The efficacy of telemedicine is already evident in the fields of teleradiology, telemental health, home telecare, transmission of echocardiographic images, teledermatology, video conferences, and teleconsultations.¹³

However there is little published evidence to confirm whether or not telemedicine is a cost effective alternative to standard health care delivery.¹⁴ Much of the growth of telemedicine in UK had been in the form of feasibility studies and pilot trials. As a result the assessment of the cost effectiveness of many of the telematic applications remains less than conclusive. Wootton performed a review of the

**Figure 2** Relative occurrences of projects compared with population and surface area.

current literature and described the clinical applications where there was early evidence that telemedicine was not only of clinical benefit but also cost effective. The examples included teleradiology, home telenursing, electronic referrals, teleconsultation at primary care, and dealing with minor injuries by the nurse practitioner. Wootton also commented that safe call centres and online health were unlikely to be cheaper for the NHS.¹⁵ It is important to interpret cost effectiveness studies carefully as unique local aspects of a health system may influence the outcome of such studies. For example, a telemedicine service that is cost effective in the remote highlands of Scotland is unlikely to generate the same cost effectiveness in the middle of Manchester.¹⁴

The barriers of telemedicine include financial constraints, lack of dedicated sessions for such activities, and a resistance to change. Provision of appropriate training of staff remains a key issue.² There should be recognition for dedicated telemedicine sessions in the clinical set up so that regular discussions could take place at regional and national levels. Absence of "hands-on" interaction with the patient, an important factor in certain specialties, can deter some clinicians from active participation.¹⁰ Most patient satisfaction studies, on the contrary, find that patients as a whole are satisfied with the long distance care. Lack of appropriate telecommunication technology can significantly hinder the progress of telemedicine. Regular telephone lines, as encountered in many rural areas, do not support adequate bandwidth for most of the telemedical applications.¹⁰ The latter is particularly relevant in rural Scotland, the most

**Figure 1** Trend of occurrence of various projects in the UK over the last decade.

thinly populated country (6.5 million population per 1000 km²) in the UK and therefore the most likely beneficiary of telematic healthcare in breaking the barrier of remoteness.^{5,6} However the interest of manufacturers can be a mixed blessing. While improvement in technology is necessary for enhancement of telemedicine, the critics have felt that telemedicine can potentially be a playing field for commercial technology companies.¹⁶

Uncertainty over medicolegal issues related to telemedicine continues and the impact of telemedicine on insurance rates remains unclear.^{10,17} Some insurance companies believe that since telemedicine encourages physicians to work together, patient treatment is more comprehensive, and therefore entails less overall risk of malpractice. However cynics have expressed different views—namely, that (i) an improved technology that raises patients' expectations may result in additional medical malpractice claims; (ii) the very nature of telecommunication makes the practice of telemedicine a riskier form of treatment compared with face-to-face consultation and examination; and (iii) technological problems like incorrect or incomplete data transmission may have harmful consequences. Moreover, the insurance premium may vary from one jurisdiction to another and can complicate the matter further.¹⁷

The Department of Health of England and Wales took major decisions on "Information for Health" in 1998.¹⁸ It was decided that (i) from 2000 all health improvement programmes and associated service strategies should specifically incorporate plans and proposals to improve the quality and pattern of services through the appropriate use of telemedicine and telecare; (ii) capital business cases should demonstrate that telemedicine options had been identified and appraised; and (iii) all local health services would have facilities for telemedicine by 2005.¹⁹ Although telemedicine had grown well in the UK over last decade, a low reliability of trendline ($R^2 = 0.29$) would perhaps support the views, raised by the British Medical Association, whether the information technology strategy of the Department of Health is realistic and can be achieved in time!²⁰

Box 1: Summary points

Pros and cons of telemedicine

- Telemedicine entails the application of information and communications technology to remove the effect of distance in healthcare.
- Currently "store and forward" and "two way interactive television" are most commonly in use.
- It is likely that telemedicine will have a significant effect on the way the clinical care is delivered in the future.
- Advantages:
 - Savings on time and travel.
 - Teaching, research, and enhanced decision making.
 - Improved access to services and expertise.
- Disadvantage:
 - Lack of hands-on experience.
- Barriers:
 - Financial constraints.
 - Lack of infrastructure.
 - Uncertainty over medicolegal issues.
 - Resistance to change.

Box 2: Telemedicine in the UK

- Overview:
 - Late start (1991) but good progress.
 - 216 projects had taken place.
 - Highest number of projects in England (79.6%).
 - Maximum projects took place (61.1%) in dermatology, elderly care, education, emergency medicine, infrastructure development, medicine, and mental health.
 - Absence of tele-education project in Scotland, Wales, Northern Ireland.
 - England has the highest number of projects (49.5%), when correlated with area.
 - Northern Ireland has the highest number of projects (36.2%), when correlated with population.
 - According to the information technology strategy of the Department of Health, all local health services would have facilities for telemedicine by 2005.
 - The Scottish Telemedicine Initiative was launched in 2000.
- Potential:
 - Telemedicine has enormous potential in Scotland to cater the remote areas of Scotland.
- Suggestions:
 - More telematic projects for Scotland.
 - Dedicated tele-educational projects for Scotland, Wales, Northern Ireland.
 - Improvement of infrastructure.
 - Dedicated telemedicine sessions in clinical set-up.
 - Multisite trials.
 - Active participation of health care providers, technologists, clinicians, and patients' representatives.

The Scottish telemedicine initiative took place in 2000.¹ It was realised that telemedicine would have a significant effect on the way that clinical care was delivered. The Scottish Executive Health Department set up the Scottish Telemedicine Action Forum (STAF), which comprised clinicians, academics, managers, and technologists. It was decided that a formal evaluation of the progress of STAF would be made at the end of the first year and every third year thereafter. The responsibilities of STAF included (i) gathering information about past and present telemedicine activities in Scotland as well as other countries; (ii) identifying individuals and groups that are active in the field; (iii) developing a strategy for implementing telemedicine; (iv) promoting telemedicine in the NHS in Scotland and disseminating information about its potential through workshops and conferences; (v) setting up and supporting a number of demonstrator projects; (vi) advising on funding projects; (vii) encouraging the health boards and trusts to consider the application of telemedicine in their health improvement plans and trust implementation plans respectively; and (viii) identifying and promulgating standards relating to telemedicine. The impact of STAF on telemedicine in Scotland is yet to be evaluated.

Use of telemedicine varies widely across the globe. It is therefore relevant to compare the activity of telemedicine in the UK with other countries. However, the lack of a

compulsory and comprehensive database of projects makes such comparisons very difficult, if not invalid (N Brown (brown@telemed.org), Telemedicine Information Exchange; personal communication, 23 September 2003). The USA, Canada, and Australia are some of the countries where telemedicine has received immense support.²¹⁻²³ For example, Georgia (USA) has a surface area (152 627 sq km) twice and a population (8.2 million) one and half times that of Scotland.²⁴ In spite of a modest start in 1991, there were 60 telemedicine facilities in Georgia in 1994. It was estimated in 1996 that owing to the improved telecare services, approximately 85% of rural Georgian patients who previously would have been transferred to secondary or tertiary care, were kept in their community.¹⁷ By comparison, only four projects took place in Scotland between 1991 and 1994.^{3,4}

Telemedicine has the potential to redesign the care services around the individual and establish a "network NHS". However the government is aware that this would not be easy and would be a major organisational, cultural, and organisational challenge.²⁵ It is believed that an active participation of the healthcare services, patients' representatives, telecommunication industries, and health professionals would be necessary to improve the present state of telematic healthcare.^{2,4}

CONCLUSIONS

Telemedicine had a relatively late start in the UK but has grown steadily over last decade. The issue of tele-education needs attention as no dedicated project was seen in Scotland, Wales, and Northern Ireland. Scotland, in spite of being the most likely beneficiary in UK, has lagged behind in telemedicine schemes and merits more projects. Technological improvements are essential to expand the current level of usage, particularly in remote areas that are likely to be benefited most.⁴ There is also need for well designed multisite trials that would help establish widespread acceptability of telemedicine in future. The government has a key part to play in supporting such moves and providing the necessary infrastructure. Both the Department of Health and the Scottish Executive have already taken useful steps by formulating an elaborate information technology strategy and forming the Scottish Telemedicine Action Forum respectively. The outcomes are awaited.

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