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Factors Influencing the Adoption and Implementation of Teledentistry in the UK

By

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Synopsis

Current UK health policy states key priorities in a healthcare service to ensure quality, access, efficacy, cost effectiveness and patient satisfaction. However, this is challenging in the light of accelerating healthcare costs, increasing patient demands and expectations, and the medical complexities of an ageing population. This requires institutions to adopt technological innovations to enhance health service delivery. Telemedicine and the subspeciality of teledentistry, information and communication technologies able to deliver healthcare at a distance, have been advocated as potential solutions.

Telemedicine is regarded as a method of healthcare service delivery that is patient centred and resource efficient, able to overcome geographical barriers of access. Within the sphere of orthodontics in particular, teledentistry is considered to have massive potential as a valid, efficient and time saving clinical screening tool. This is especially crucial given the poor quality of orthodontic care delivered in the UK.

However, the uptake of teledentistry in the UK has been low. This study draws on Rogers’ diffusion of innovation theory to demonstrate the factors that negatively impact upon the adoption and implementation of teledentistry. The model describes five characteristics of an innovation: relative advantage, compatibility, complexity, trialability and observability. These attributes will then be discussed in the context of key stakeholder groups within a healthcare organisation: dentists / doctors, patients, hospital managers, and healthcare decision-makers and funders. This study thus aims to develop a better understanding of the challenges faced in these kinds of projects as well as suggesting future recommendations to guarantee success.
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Chapter 1: Introduction

Healthcare represents an increasingly important sector of a national economy. The total UK national healthcare expenditure was estimated at 7.7 per cent of Gross Domestic Product (GDP) in 2002, the latest year available. The estimate of healthcare expenditure in the UK as a percentage of GDP has since risen by 0.9 percentage points, from 7.5 per cent in 2002 to 8.4 per cent in 2006 (Office for National Statistics 2008).

Many countries, including the UK, are now however undertaking significant healthcare reforms. The 2006 National Health Service (NHS) white paper, Our health, our care, our say, sets out a strategy to provide more services in the community, closer to people’s homes. It describes a radical change in healthcare provision, shifting services from the secondary care sector to the primary care sector. Key priorities in the national policy include providing a healthcare service that guarantees quality, access, efficacy, cost effectiveness and patient satisfaction. However, this is challenging in the light of accelerating healthcare costs, increasing patient demands and expectations, and the complex medical conditions associated with an ageing population.

To date, various applications of information technology (IT) have been proposed to enhance the efficiency and/or quality of healthcare service provision (Chaiken, Christian and Johnson 2007). However, telemedicine represents an exciting multifaceted innovation with the capacity to increase the quality of care by improving access to services, especially in areas where there are geographical barriers.

Telemedicine can be broadly defined as the use of information technology, telecommunications and medical expertise to enable health professionals to provide consultation and diagnostic services from locations distant to their patients (Wallace, Wyatt and Taylor 1998).

Two different technological systems are utilised within telemedicine applications (Cook, Austen and Stephens 2000). "Store and forward" technology transfers digital images from the referrer to a specialist at a distant location. Digital images of radiographs or clinical / histological photographs are captured, stored and then transmitted to another location. The second widely used technology is videoconferencing. This allows direct interaction between the patient and their
clinician in one location, and a specialist at another location, facilitating an almost “real time” consultation.

Since the early 1990s there has been a steady increase in the number of telemedicine programmes introduced in the UK (Debnath 2004). According to data from the UK Telemedicine and E-health Information Service, the current number of telemedicine projects in the UK stands at two hundred and eighty four (UK Telemedicine and E-health Information Service Website 2008). Currently, the specialities leading in the use of telemedicine are the outpatient specialities of psychiatry, pathology, dermatology, cardiology and radiology (Shore et al. 2008; Della Mea et al.1996; Wootton et al. 2000; Huang T et al. 2008; Maher, Craig and Menezes 2007).

However, despite the advantages demonstrated in these applications, the uptake within other clinical specialties is low. An example of such a specialty is dentistry (Wheeler 1999). Teledentistry can be described as the provision of real time and offline dental treatment such as diagnosis, treatment planning, consulting and follow-up, via electronic transmission from different sites (Chen et al. 2003).

The number of dental projects listed on the UK Telemedicine and E-health Information database is currently only six, out of a total of two hundred and ninety clinical projects (UK Telemedicine and E-health Information Service Website 2008). This is surprising considering the large number successful applications described in the literature. These relate to the diagnosis and possible treatment of patients at sites distant from the specialist health-care provider and generally consider teledentistry a reliable and objective method of assessment. Successful applications described include:

- Oral and maxillofacial surgery assessment (Rollert et al., 1999; Jacobs, Edmondson and Lowry 2002)
- Paediatric dental screening (Kopycka-Kedzierawski, Billings and McConnachie 2007)
- Clinical restorative assessment (Scuffham and Steed 2002)
- Diagnosis of intra osseous bony lesions (Tyndall et al. 1995)
- Orthodontic assessment of new patient referrals (Mandall et al. 2005)
- Pre-implant dental assessment (Nickenig et al. 2008)
The role of teledentistry in dental education (Chen et al. 2003)

The most significant teledental developments in the UK have been made in the specialty of orthodontics. UK National Health Service general dental practitioners (GDPs) are able to obtain free advice from a local consultant orthodontist to aid them in orthodontic case selection and treatment planning, and teledentistry has been recommended as a relatively convenient and efficient way for GDPs to acquire this specialist information. (Mandall, O’Brien, Brady et al. 2005).

Any such referral tool that is able to enhance the transfer of knowledge from secondary to primary care could thus be extremely beneficial. This is especially crucial given the poor quality of orthodontic care delivered in the UK. As a result of an uneven distribution of orthodontic consultants in the UK, many general dental practitioners are placed under pressure to undertake orthodontic treatment for their patients. Subsequently, 40% of NHS orthodontic treatment is thus carried out by GDPs with no formal specialist orthodontic training (Cook, Mullings, Vowles, et al., 2001). This finding is supported by the work undertaken by Richmond, Shaw, Stephens et al. (1993) who stated that although in principal, local specialist consultant advice should be available to a general dental practitioner, in reality, very few GDP orthodontic patients actually receive it. Thus, perhaps not surprisingly, evidence suggests that a large number of inappropriate treatment planning decisions are made by inexperienced GDPs, resulting in a poor orthodontic outcome (Stephens, Drage, Richmond et al. 1993).

Parfitt and Rock (1996) also argue that GDPs are often unable to select appropriate straightforward cases which they could safely treat themselves because they lack this specialist knowledge. For the same reason, GDPs would fail to request treatment planning advice when actually essential. This is also reflected in a high inappropriate referral rate to UK orthodontic consultants (Nicholson and Stephenson 2000), thus unnecessarily increasing hospital waiting lists (Willmot, DiBiase, Birnie et al. 1995).

Mandall, O’Brien, Brady et al. (2005) also suggest that a teledental system could be utilised as a valid screening tool, thus potentially reducing the number of inappropriate referrals made by GDPs. This is particularly important in the light of current Department of Health waiting time directives which require all hospital trusts to decrease referred patient waiting times to eighteen weeks (Department of Health 2004). Thus within the specialty of dentistry, by December 2008, a patient should
not have to wait more than this period from the date of the initial GDP referral to the start of hospital orthodontic treatment. However, Rayner and Neal (2008) argue that it has only actually been possible to achieve these targets by utilising out-of-hours waiting list initiative clinics, at a significant and seemingly unnecessary cost to the NHS.

In view of the limitations of current orthodontic service delivery, it is thus possible that teledentistry could provide a valuable alternative method to address these problems of access, quality of care and rising costs of care. Redistributing resources from the secondary care sector into primary care via teledentistry could generate a service that is resource efficient and patient centred, where decisions are made close to the patient, at a local level.

However, as previously mentioned, despite the clear benefits of teledental applications, uptake in the UK has been low. This paper examines the factors that impact upon the adoption and implementation of teledental applications, attempting to provide an explanation of the low uptake in the UK. Utilising Rogers’ diffusion of innovation theory (Rogers 1995), this study aims to develop a better understanding of the challenges faced in these kinds of projects as well as suggesting factors to guarantee success. This analysis will be carried out in the context of the specific user groups that exist within a healthcare organisation. The following section, Chapter 2, will describe the theoretical background for the analytical framework. It will also outline the methodology used to gather information to explore the factors influencing the adoption and implementation of teledentistry. Chapter 3 will include a detailed application of the academic frameworks to each of the appropriate key stakeholder groups based on findings in the literature within both teledentistry and telemedicine. Chapter 4 will discuss the implications of the findings and provide appropriate recommendations.
**Chapter 2: Methodology**

**Theoretical Framework**

This paper draws on Rogers’ diffusion of innovation theory (Rogers 1995) to outline the factors that impact upon the adoption and implementation of teledental projects, thus attempting to provide an explanation for the low uptake in the UK. This model appears to be generally accepted in the literature as a valid framework to examine such factors (Al-Qirim 2007; Menachemi, Burke and Ayers 2004; Walker and Whetton 2002).

Menachemi, Burke and Ayers (2004) specifically utilise Rogers’ theory (Rogers 1995) to examine the factors affecting the adoption of telemedical applications, however, the main focus of this work concerns solely telemedicine, not teledental applications. This report is specifically examining the utilisation of telemedicine and teledentistry within the area of consultation at a distance, and observations drawn from one speciality are considered equally applicable to the other, and vice versa. Thus, conclusions drawn from the evidence regarding telemedicine applications will be applied to the sphere of teledentistry. Teledental applications of orthodontic consultations will specifically be utilised as it is within this field that the most significant advancements of teledentistry have been made, with the largest volume of supporting literature.

Rogers (1995) academic framework will be applied to the key stakeholder groups of a healthcare organisation: dentists / doctors, patients, hospital managers, and healthcare decision-makers and funders as identified by Menachemi, Burke and Ayers (2004).

Rogers (1995) describes five characteristics of an innovation: relative advantage, compatibility, complexity, trialability and observability. Relative advantage is the degree to which a technological application is perceived as being better than the method it supersedes. Compatibility is the extent to which technology is perceived as being in-line with the present values, needs and experiences of potential users. Complexity is the degree to which an innovation is perceived as being simple to comprehend and utilise. Trialability is the degree to which a technology may be experimented with, on a restricted basis, prior to adoption. Observability is the degree to which the outcomes or effects of using a new technology are apparent to others. Consequently, an innovation that is perceived as: having an advantage over
the current method, being consistent with existing needs and values; being easy to comprehend and use; being experimental, on a limited basis; and being able to easily observe the results of its use, is more likely to be adopted. Rogers (1995) thus suggests that it is the user’s own perception of these characteristics that can determine the extent of uptake of a new technology.

In this report, these users will be divided into specific categories to represent the various stakeholder groups that exist within a healthcare organisation. Menachemi, Burke and Ayers (2004) identify four key groups to consider in the uptake of telemedical / teledental applications: physicians, patients, hospital managers, and government healthcare funders. Clinicians are generally the direct users of a technological application and can thus directly influence the extent of adoption.

Additionally, patients often form part of the telemedicine process and their preferences and perceptions will dictate their choice to participate in a new mode of service delivery. Hospital managers play a major role in resource allocation and are able to control the finances initially put towards an innovative technology, as well as sustaining this input long term. Finally, consideration of government healthcare decision-makers and funders is vital. A new technology requires strong political support as well as sufficient scientific evidence of its clinical and cost effectiveness. It is crucial thus to include each of these user groups into this analysis as any individual opposition to an innovation can impede its uptake of an entire healthcare organisation.

Rogers’ (1995) academic framework will be applied to each of these key stakeholder groups: dentists / doctors, patients, hospital managers, and healthcare funders, based on findings in the current scientific literature on both teledentistry and telemedicine.
Methodology

Information concerning telemedicine and teledentistry was obtained from primary and secondary research sources. Publications were reviewed from the categories of:

- Peer reviewed journals
- Department of Health Policy documents
- National telemedicine information service databases

Articles were identified using an online search of Pubmed and other electronic databases, including EBSCO, JSTOR, Medline and COCHRANE. A hand search of key journals in the areas of Dentistry, healthcare, organisation and management was carried out. Appropriate articles were then chosen from the reference lists of all key articles in the first set of reviewed articles. Individual communications with experts in relevant fields were included, in addition to the author’s existing knowledge.
Chapter 3: Application of the Diffusion of Innovation Framework to the Relevant Stakeholder Groups

In the following section, Rogers' (1995) academic framework will be applied to each of these key stakeholder groups: dentists / doctors, patients, hospital managers, and healthcare decision makers and funders, based on findings in the current scientific literature on both teledentistry and telemedicine. For each user group, only the relevant and applicable characteristics of an innovation will be discussed.

Clinicians: Dentists / Doctors

This section will discuss Rogers’ (1995) framework in the context of the stakeholder group of clinicians, to include dentists and doctors.

Relative Advantage

For clinicians, telemedicine can offer major advantages over alternative methods of conventional service delivery including: improved quality of care, enhanced efficiency in service delivery and increased communication between healthcare professionals (Menachemi, Burke and Ayers 2004).

Firstly, evidence has suggested that telemedicine is capable of providing a better quality of care (Jennett et al. 2003). Mandall et al. (2005) found teledentistry a valid and effective screening tool when used to assess new patient orthodontic referrals from GDPs. It enabled the positive identification of patients who require a referral to a consultant orthodontist. The study also revealed that this effective triage system reduced the inappropriate referral rate to 8%, shortening patient waiting times. Thus only patients who really need to be assessed and treated by a specialist are placed on a waiting list, allowing accelerated treatment decisions and thus enhancing the overall health outcome (Cook et al. 2000).

A worrying find by Tsilimigaki et al. (2001) reveals that delays in the diagnosis and management of patients in rural areas with limited access to specialist facilities, could increase their morbidity and mortality. Thus the quality of the diagnosis, and management of patients in remote areas may be improved by telemedicine. In both
urban and rural areas, the introduction of telemedicine has been shown to accelerate the referral process, to reduce unnecessary referrals, and to improve the consistency and quality of health care (Darkins et al. 1996).

Another significant benefit concerns the enhanced efficiency of service delivery that a telemedical application can provide. Clinicians able to consult with patients at remote sites enable savings in travel time and costs, for both patient and provider (Cook et al. 2000).

More efficient routine work practices and processes are also evident. Work undertaken by Cook et al. (2000) describe pilot studies of a videoconferencing system, “TeleDent”. Advantages include being able to discuss the patient case directly with the consultant due to a ‘live link’. The use of digitised case materials which can be e-mailed, avoids the need to post models and radiographs, avoiding the risk of delays or damage. Additionally, a range of advantages exists for consultants too. Being able to download complete case notes will prevent patients being sent for repeat radiographs when these are delayed or lost in the post. Time will be saved on administrative tasks because a letter will not need to be sent to the referring practitioner as he is able to make appropriate notes during the videoconferencing session.

This finding is not just restricted to teledental applications. Harno et al. (2000) describe the use of an intranet referral system between a hospital and primary-care clinics in Finland. Their evaluation of clinical performance revealed that productivity in the hospital increased over threefold by using email consultations instead of traditional outpatient visits.

The final benefit of telemedicine results from its ability to enhance communications between healthcare providers. Remotely located doctors, using telemedicine, are able to consult more easily with their specialist colleagues, thus reducing professional isolation by increasing access to specialist resources (King et al. 2007). Demartines and Freiermuth (2000) suggest how telemedicine could play an important role in developing hospital alliances and communicating expertise within surgical subspecialties, as well as in increased interdisciplinary patient care. Lobley (1997) observes additional benefits of telemedicine including: improved training and education due to knowledge transfer from the specialist to the remote unit; the reduced need for specialist consultation as a result of knowledge transfer; more interesting referrals of unusual cases for specialist consultants, allowing greater
opportunities to undertake research. Telemedicine techniques would also appear to be applicable in the delivery of continuing professional education in dental specialties as explained by Reynolds, Eaton and Mason (2008).

Despite these perceived benefits of telemedicine and teledentistry, there are many concerns which can impede the adoption of such applications by clinicians. An important consideration is whether the diagnostic information obtained via a teledental application is adequate for the health professional to make a clinically sound and reliable diagnosis. Mandall et al. (2005) identified a risk whereby in some cases, orthodontic patients not accepted for care following an assessment utilising electronic data, were then subsequently accepted for treatment as new patient referrals following a full clinical examination. This identifies a potential flaw in the validity or accuracy of teledentistry to screen orthodontic referrals. These findings are suggested in the current literature where there is a lack of research demonstrating the validity, accuracy and efficacy of telemedicine applications (Wallace, Wyatt and Taylor 1998; Finch et al. 2003). It follows that clinicians may be indeed sceptical about the potential usefulness of such clinical applications of telemedicine, a worry expressed by General Practitioners (GP) included in a study examining adoption of telemedicine in rural Scotland (King et al. 2007).

Another concern detailed by Debnath (2004) and Finch et al. (2003) is the lack of direct patient contact, required by the Consultant to make an accurate diagnosis within particular clinical specialties. Although this information can occasionally be incorporated into the technological capabilities of the telemedical application, there are many clinical situations where such details are wholly necessary to make an accurate diagnosis. King et al. (2007) also reveal GP concerns of a diminished quality of communication as a result of conversing through a videolink.

Mandall, Quereshi, and Harvey (2005) observed that although the majority of GDPs supported a teledentistry system, potential problem areas included the cost of equipment set-up expenses and a lack of an appropriate remuneration system which would take into account the additional time required to collate, download and e-mail patient information to the Consultant (Cook et al. 2001).

Stephens and Cook (2002) revealed that UK Orthodontic Consultants were also concerned about the medico-legal aspects of service delivery. These could potentially include the responsibilities and potential liabilities of the health professional, the duty to maintain the confidentiality and privacy of patient records in
storage and electronic data transfer, and gaining the patient’s informed consent of electronic consultation. These are all important concerns that have not been fully explored yet (Brahams 1995; Stanberry 2006).

Furthermore, the exclusion of all dental services from the National Programme for Information Technology places this speciality outside of the secure N3 broadband network (NHS Connecting for Health 2008). Teledental applications could thus be forced to utilize internet lines for transmission which are more vulnerable to hacking and may also be subject to bandwidth limitations, thus rendering teleconsultation potentially unsatisfactory due to poor audio or video quality (Doolittle and Spaulding 2006).

It is therefore clear that telemedical applications can offer clear advantages related to an enhanced quality of care, and a more efficient method of service delivery. Improved communications between remotely located doctors and their specialist colleagues can also act to reduce professional isolation. However, the limitations in validity and accuracy of a telemedical application as a diagnostic tool may also cause concern, particularly considering the lack of direct patient contact in such a consultation. Clinicians are also worried by the investment of time and finances, especially given that no remuneration system currently exists. Additionally, certain medico-legal aspects of service delivery lack clarification.

Clinicians: Dentists / Doctors - Compatibility

From the earlier discussion, it is clear that in specific applications, telemedicine can yield results which are equivalent to those that clinicians expect from more traditional methods of service delivery. The majority of UK general practitioners now accept that information technology is part of their daily clinical practice (Benson 2002). Previous Dental Practice Board (DPB) surveys have shown an increase in the use of computerised facilities in dental practices throughout England and Wales (Dental Data Services 1977; Dental Practice Board 1997). It was reported in the most recent survey (1997) that the proportion of dental practices with computer facilities was 59%, an increase from an earlier figure of 22% in 1991. Recent communication (Elliot 2008) with the Business Service Authority (formerly the Dental Practice Board) also described an increase in the number of practices electronically submitting dental claims. Thus, there appears to be a convergence between
physicians’ personal experiences with new technology in other aspects of their practice, and with the technology on which telemedicine is based.

However, despite positive developments, many clinicians are slow to adopt new technological measures because they lack the necessary computer literacy skills. A study by Gibson et al. (2007) examined the IT literacy level across the entire dental team in practices throughout Scotland. 43% of respondents considered their IT skills as “moderate” with a further one third reporting “nil” or “low” skill level. The majority of IT competence was self-acquired. The authors considered these findings to be representative of Dental IT competency across the UK.

Many clinicians may also resist change as a result of a potential threat to their role and status. Problems could include a perceived increased in clinical workload, especially during the transitional phase, with a corresponding increase in administration (Brebner et al. 2004). Clinicians, who already consider their workload as high, are thus generally cautious about the introduction of new technologies like telemedicine. It is questionable whether clinicians are willing to accept this extra time investment which may present an important barrier to implementation.

However, Whetton and Walker (2002) suggest that the perceptions of relative advantage and compatibility to users are heavily influenced by the geographic location and professional position of the user within the organization. They observed that within telemedical services linking remote locations to a centralised, specialised unit, the remote sites perceive the application as both having a relative advantage and being compatible. However, in the central unit, telemedical applications are considered as possessing no relative advantage and not compatible with the working process. The explanation offered is that there is a demonstrable advantage in offering a telemedical service in an isolated location where access to such services is otherwise limited. However, at the central unit, the service is performed by a clinician regardless of location or the patient travel involved, thus offering no clear benefit. Furthermore, the successful implementation of a telehealth programme commands a degree of collaboration and teamwork between the professionals involved. This may require an alteration to existing roles and practices which may be perceived as incompatibility.

From the previous discussion it is therefore evident that clinicians clearly acknowledge how telemedical applications are capable of yielding results which are equivalent, or often better, than what is expected from more traditional methods of
service delivery. However, they may feel unable to embrace such a change in service delivery due to concerns regarding a lack of IT literacy skills and a perceived threat to their existing role and status.

**Clinicians: Dentists / Doctors- Complexity**

A significant barrier to the adoption of telemedicine is the complexity of the technology as described by Hjelm (2005). Adding to this complexity is the increasing number and variations of telemedicine applications. This is reflected in the findings of the 1997 DPB survey, which found that although the majority of practices found IT useful for basic challenges of storing patient details (90%), and preparing and transmitting data to the DPB (80%), whereas only 30% of practices actually used the internet. John, Thomas, and Richards (2003) also revealed that across the Thames Valley Region, UK, many dental practices were only using IT to a limited extent. Barriers included a lack of proper and ongoing training, with many clinicians requesting training for staff in a variety of areas including managing databases and setting up web-sites.

It is thus clear that the complexity of a new technology can act as a significant barrier to uptake, compounded by a lack of IT literacy skills. This is reinforced by Yellowlees (1997) who suggests that it is no longer the technology itself that represents the major impediment in the implementation of telemedical applications, but the management of these human factors, thus highlighting the importance of training and education.

**Clinicians: Dentists / Doctors- Trialability**

Rogers (1995) suggests that clinicians are more likely to adopt telemedicine if it can be evaluated on a limited basis. Lobley (1997) suggests that developments in technology compounded by reductions in the cost of equipment allow clinicians to experiment with such applications. The provision of funding for experimental developments combining electrical and medical also facilitates this trialability. In addition, the increased availability of the internet in dental practices, and the increasing trend of computerisation of dental surgeries will enable clinicians to
experiment with technology at their own pace. The 1997 DPB survey found that two-thirds of respondents used a computer at home, approximately two-thirds of whom used their home computers for practice management. This exposure to IT, in combination with technological advancements and reductions in equipment costs could thus facilitate the transition to the enhanced utilisation of more complicated technology applications such as telemedicine.

Clinicians: Dentists / Doctors- Observability

The literature suggests that clinicians are able to acknowledge and comprehend the potential benefits that a telemedical application can offer. Mandall, Quereshi, and Harvey (2005) demonstrated that the concept of a teledentistry system for new patient orthodontic referrals was overall well received by GDPs. Cook et al. (2001) also reported positive findings when investigating dentists’ opinions of an online orthodontic advice service, showing that GDPs felt there were significant educational benefits from an online service. Research from Stephens and Cook (2002) complete the picture, revealing general support from the Consultant Orthodontic Group of the British Orthodontic Society.

Additionally, a study by Brebner et al. (2004) revealed a high degree of user satisfaction of the accident and emergency teleconsultation service. The main perceived benefits were: enhanced convenience; greater professional satisfaction and the ability to use a holistic approach. The authors also suggested that the introduction of telemedicine might act as a recruitment incentive to a remote area, where professional isolation could be a common encountered problem.

However, it is worth noting that the benefits of telemedicine are more obvious in certain specialties than in others (Menachemi, Burke and Ayers 2004). For example successful demonstrations of remote diagnosis have been reported in the out-patient based specialties of:

- Oral and maxillofacial surgery assessment (Rollert et al. 1999; Jacobs, Edmondson and Lowry 2002)
- Paediatric dental screening (Kopycka-Kedzierawski, Billings and McConnochie 2007)
- Clinical restorative assessment (Scuffham and Steed 2002)
• Diagnosis of intra osseous bony lesions (Tyndall et al. 1995)
• Pre-implant dental assessment (Nickenig et al. 2008)

These are dental applications that already rely on the use of transmitting digitalized images for diagnosis, and it is thus understandable why these specialties demonstrate clearly successful applications of teledentistry. Clinicians can thus easily observe these benefits. It then follows that for some dental specialities, service provision by telemedicine would not be appropriate if, for example, a detailed verbal history and clinical examination needs to be undertaken.
Patients

Here, Rogers’ (1995) framework will be discussed in the context of the next stakeholder group, patients.

Relative Advantage

Studies have reported that telemedicine patients are generally very accepting of telemedicine applications (Yellowlees and Kennedy 1996). This may be for several reasons. Telemedicine applications can firstly provide expanded access to specialist services for remotely located patients (Wootton 1999). Mandall et al. (2005) demonstrate how orthodontic patients may be saved a hospital visit if their referral is first assessed via teledentistry. This will be particularly helpful if patients live far from the orthodontic provider. Furthermore, Bynum et al. (2006) indicate that in rural areas, cultural barriers may exist for many poorer and less educated residents, who may be intimidated by urban health-care environments. These rural residents may not have the psychological, physical or financial resources to travel to urban health-care settings. To this population, telemedicine would thus represent an appropriate service alternative, able to address their specific needs.

A travel cost saving can also be realized. Brebner et al. (2004) evaluated an accident and emergency teleconsultation service, and the total avoided patient travel amounted to a total distance of 105,056 km. This minimizes the financial burden associated with patients, and also the family care givers that transport family members to medical facilities. The study also reported high levels of patient satisfaction with the service. The main perceived benefits for patients included: the ability to access services locally; reduced anxiety and a reduced referral time. In a systematic review of the socio-economic impact of telehealth, Jennett et al. (2003) identified better quality of life and enhanced social support as additional patient benefits. However, a systematic review of telemedicine satisfaction studies undertaken by Mair and Whitten (2000) reveal that teleconsultation is generally acceptable to patients in a range of environments, but issues relating to patient satisfaction require a more detailed investigation from the perspective of both patients and healthcare providers, to assist decision-makers in establishing an appropriate and effective use of the technology.
Despite such obvious patient benefits, it is still worth noting that some drawbacks still exist. Paul et al. (1999) and Dick, Filler and Pavan (1999) found that patients were concerned about security and confidentiality issues. Greenhalgh et al. (2008) found that patients were specifically concerned about computer security and inappropriate access of Electronic Medical Records (EMR) within the National Programme for IT, a comparable technological application.

It is therefore evident that applications of telemedicine demonstrate clear patient benefits through enhanced access with the associated reductions in travel costs and providing a more specialised and patient-centred service. However, patients mention concerns of maintaining security and confidentiality.

Patients: Compatability

As technology has developed to facilitate valuable telemedicine applications, practitioners and patients have been forced to undergo a shift in the way they interact. However, telemedicine is fairly compatible with patients’ existing clinical experience of service delivery, due to the similar infrastructure and environment utilized to deliver a telemedicine application.

For example, a teledental videoconferencing consultation may involve the patient and dentist communicating with a Consultant at a distant location through a digital screen set up in the dental surgery. This process would not differ too significantly from a conventional consultation. A “store and forward” technique impacts upon the patient even less, where patient data is e-mailed to the Consultant in the GDP’s own time. Teleconsultation may even enhance the doctor-patient relationship where a psychological “distance” may encourage the patient to be more open and forthcoming in sensitive matters such as sexuality (Frank et al. 1997). This could prove useful if teledental applications were to develop into the field of oral medicine.

However, Hjelm (2005) suggests that a cause of breakdown in the clinician-patient relationship may include challenges of depersonalisation as a result of a consultation being carried out through the indirect format of a video monitor with little opportunity for direct interaction.

Thus, although some aspects of clinical service delivery will remain unchanged within a telemedicine application, other changes will require careful attention. One
such challenge is a lack of direct patient contact during a consultation which may be
difficult for certain patient groups, for example those suffering from dental phobia.

**Patients: Observability**

Telemedicine is a relatively new concept, and as technologies develop to facilitate
valuable telehealth applications, patients will be forced to alter way they relate to
healthcare providers. However, if left to speculate, an image that may come to mind
of a patient is that of the Orwellian robotic clinician in a sterile and impersonal
environment. The reality, however as previously explained, is that patients could
now have access to a vastly improved range of services.
**Hospital Managers**

Here, Rogers’ (1995) framework will be applied specifically to the stakeholder group of hospital managers.

**Relative Advantage**

From the perspective of hospital managers, the principal advantage of telemedicine, as described by Menachemi, Burke and Ayers (2004), relate to cost efficiency and a more efficient service delivery.

Harno et al. (2000) demonstrated that the interactive use of an intranet referral system between secondary and primary care units reduced direct costs and was cost-effective. The system essentially allowed more patients to be treated at a lower cost. The cost–benefit analysis also demonstrated that the use of the intranet consultation was both acceptable and profitable.

Darkins et al. (1996) suggested how telemedicine may facilitate the modification of the skill mix at a periphery hospital, such as the increased utilisation of nurse practitioners. In the study, installing a low cost telemedicine link prevented the need to employ medical staff who would only cover only a small proportion of the overall workload. This had obvious financial and efficiency advantages for the unit concerned.

Telemedical applications can therefore offer significant advantages to hospital managers for reasons of enhanced cost-effectiveness and efficiency of service provision. A modification to the skill mix of clinicians at peripheral hospitals is also a strong contributing factor.

**Hospital Managers: Compatibility**

Managers are generally concerned with to what extent a telemedical application is able to integrate with existing systems of service delivery as stated by Menachemi, Burke and Ayers (2004). Whitten et al. (2001) addresses issues associated with the adoption of telemedicine technologies. It is suggested that when new technological
innovations are not accepted or implemented effectively, generally the failure may be due to a poor strategic fit between the nature of the technology and the vested resources and expectations of its major stakeholders. Thus linking organizational strategic goals with long term telemedicine strategic goals is seen as imperative to achieve a positive synergistic effect.

However, Doolittle and Spaulding (2006) noted that potential conflicts of interest may appear between clinicians and managers. A manager, driven by financial and resource constraints, may wish to provide services to patients locally, whilst the primary care team may feel inadequately trained to provide this care, even with the supervision of a telemedical specialist, regardless of any financial benefits.

Thus the goal of a hospital manager is to ensure integration and strategic fit and between a telemedical application and the existing systems and operations with a healthcare organisation, both within a remote clinic or practice and the local hospital. However, this may be difficult to achieve if the priorities of the manager are not fully consistent with those of a clinician and vice versa.

Hospital Managers: Complexity

The main factor that contributes to the complexity in the role and responsibility of hospital managers is the ambiguity and lack of clarification in national regulations and clinical protocols concerning telemedical applications (Menachemi, Burke and Ayers 2004 and Wootton 1998). As discussed previously, the lack of evidence regarding cost-effectiveness, quality, efficacy and patient satisfaction of telemedical applications complicates the decision making process further. Whitten et al. (2001) also identified a lack of specific knowledge about telemedicine as a key problem area. Until key stakeholders such as referring clinicians and rural managers develop a better understanding of an existing service, it would be considered difficult for them to envisage other uses and benefits. The importance of this specific knowledge about telemedicine technology must not be underestimated, as the failure of some telemedicine projects has been attributed to a lack of information about this technology (Whitten and Allen 1995).

Another important consideration when planning for telemedicine services is reorganisation and this is highly dependent on the types of technologies being
considered. Funding issues further complicate matters. If a programme has limited financial support, external sources may be sought to fund the programme development and personnel activities. This may result in jobs being coordinated by sites that are not part of the same healthcare delivery system. This requires forming partnerships that may not have existed previously, adding to the complex nature telemedicine implementation (Doolittle and Spaulding 2006).

The implementation of a telemedical application is a challenging process. This is further complicated by the ambiguity of national guidelines and a sufficient evidence base to support a new intervention. These factors could therefore act as significant barriers to the uptake of telemedicine.

**Hospital Managers: Trialability**

Much of the growth of telemedicine in UK had been in the form of feasibility studies and pilot trials (Lobley 1997). These programmes would therefore facilitate a limited trial by managers to develop appropriate methods to assess the individual benefits and limitations of each application in terms of cost-effectiveness, quality, efficacy and patient / provider satisfaction.

**Hospital Managers: Observability**

The benefits of telemedicine may not be obvious to hospital managers. According to Whitten et al. (2002) and Hakansson and Gavlin (2000), there is currently little convincing evidence to confirm that telemedicine represents a cost-effective method to deliver healthcare. Indeed true costs can often be difficult to evaluate as many telemedicine interventions to date have been specially commissioned and are thus not subjected to normal budgeting constraints (Lobley 1997). Another consideration in the cost effectiveness of telemedicine systems is the local aspects of the service being evaluated. A telemedicine application that is cost effective in a rural area is unlikely to generate the same cost saving in an urban area (Whitten et al. 2002). The cost effectiveness of a teledental application may also improve with greater familiarity and use of equipment as speculated by Scuffham and Steed (2002). In the literature, the main difficulties in economic evaluation of telemedicine
applications include: continually changing technology; a lack of an appropriate assessment framework and the challenges of valuing health and non-health outcomes.

Thus the main barrier to uptake for hospital managers here would be the challenge of assessing the cost effectiveness of a telemedical application, in addition to the lack of an existing evidence base to support its use within a healthcare organisation.
Healthcare Decision-Makers and Funders

As mentioned previously, a lack of an appropriate reimbursement structure within a teledental or telemedical application is a significant barrier to the uptake of this technology. The challenge involves how to assess an appropriate reimbursement structure for the extra investment of time and effort of services delivered in this way. Lack of reimbursement may then become a sustainability issue. This is demonstrated by Whitten, Eastin and Davis (2001) who identified that a telemedical programme is unlikely to be considered seriously by Senior Management until a reimbursement protocol was incorporated into it. Adding to the issue of a lack of reimbursement, is the complication of a lack of clarification concerning medico-legal issues which could inevitably then dictate medical procedures and service delivery.

Thus, for funders, the main barriers to uptake concern a lack of an appropriate reimbursement structure that takes into consideration the extra investment of time and effort made to clinicians to deliver a service in this way. This is, again, further complicated by the lack of a sufficient evidence base to support such applications.
Chapter 4: Conclusion and Recommendations

Telemedicine, and the specialty of teledentistry, represent an innovative technology that has the potential to address current healthcare delivery problems of access, quality and possibly, cost. However, before this concept can become a reality, several challenges must be overcome. Utilising Rogers’ diffusion of innovations theory (Rogers 1995), this report has illustrated the main challenges of adoption of teledental applications, specific to each user group.

The principal problems faced by dentists focus on ensuring diagnostic accuracy in a consultation. This is complicated by inadequate clinician IT literacy skills and the ambiguous legislative situation. Key challenges for patients involve the transition over to a new method of healthcare service delivery. Issues of maintaining confidentiality and security may also cause concern. Managers face difficulties of assessing and ensuring cost effectiveness of telemedical interventions, as well as guaranteeing integration between new and existing operative systems. Reimbursement issues are the main difficulties for healthcare decision makers and funders, complicated by the lack of a substantial scientific evidence base.

Such barriers must be addressed if telemedicine systems are to be widely introduced within routine health services in the UK. It is clear that each stakeholder group is motivated by different values and experiences which in turn influence their decision to adopt a new technology. Thus the challenges of each stakeholder group must be specifically targeted.

The findings obtained from this discussion suggest the following. Firstly, the attitudes of individual clinicians towards telemedical applications have been identified as being particularly important to programme implementation. It is clearly reinforced in the literature that if users perceive that the utilisation of a telemedical application is vital to enhance their performance, or quality of service provision, then they may be more inclined to learn about a new technological application (Tanriverdi and Iacono 1999). Walker and Whetton (2002) found this to be the case in rural or isolated settings where users demonstrated more enthusiasm for participating in training activities and were more patient when dealing with technical difficulties.

It is thus imperative to develop and encourage positive clinician attitudes towards telemedicine applications. This can be achieved through pilot studies to allow hands-on experience of the technology. Information can also be passed on from
discussions with peers and opinion leaders at scientific meetings, continuing professional development courses and appropriate literature. The decision making process should ideally involve both clinicians and their management because of the disparity between individual professional autonomy and a predominantly decentralised organisational structure.

Gibson et al. (2007) explain how members of the dental team may need training in basic IT skills. It was outlined in the study that the majority of their IT skills were self-taught but yet in daily clinical use. John et al. (2003) suggested that education and follow-up support could encourage dental staff to develop more positive attitudes towards computerisation, and promote the more extensive utilisation of computers in clinical practice. Yellowlees and Kennedy (1996) described the importance and effectiveness of dedicated and ongoing IT training programmes to complement any new technological intervention. The identification of vital “clinical drivers” was also seen as imperative to sustaining the utilisation of a programme in the long term.

For patients, the transition itself will require management. Patients may require time to readjust to a new method of service delivery with appropriate education and support. Both their healthcare provider and the media can play an important role in achieving this, as suggested by Menachemi et al. (2004). Rogers, Entwistle, Pencheon et al. (1998) describe the escalating number of media information campaigns designed to influence demand on healthcare services. In this way, mass media can enhance public knowledge and understanding of effective but underutilised technological applications, contributing to elevated health gains (Sharma et al. 2003; Benelli 2003).

Marketing campaigns should thus emphasize positive attributes of telemedicine, but also act to reassure patients on controversial topics such as confidentiality and security. This approach is utilised by the NHS Connecting for Health Website which specifically addresses patient concerns through a dedicated section dealing with Electronic Patient Records and patient confidentiality (NHS Connecting for Health 2008). Finally, a positive personal experience of the benefits offered by telemedicine applications may be enough to generate patient acceptance (Doolittle and Spaulding 2006).

Whitten and Allen (1995) suggest that the main responsibility of managers and planners of telemedicine programmes is to instigate a re-engineering of the healthcare process to achieve the full potential of a telemedical application,
preferably under the guidance of dedicated management team. Marketing, is viewed as an important part of this transition process as well ensuring simple ergonomic issues are considered.

This new technology cannot be implemented with the view that it should be integrated with the current systems of healthcare provision. This may involve the redefinition of the responsibilities and roles of healthcare staff, in combination with changes in work practices and routines. Priorities would include clinical engagement and consultation with all staff affected by the introduction of telemedicine, in addition to the use of their knowledge in developing programmes.

Doolittle and Spaulding (2006) particularly emphasise the importance of the availability of a dedicated team to take responsibility for the management of telehealth applications. This is particularly essential in remote locations. The coordinator must demonstrate a clear comprehension of the delivery requirements of such a health-care system, whilst also responding to the needs of health-care professionals and their clients.

Marketing, both internal and external, is also seen as key to constantly remind users of telemedical applications and to provide support during difficult transition periods or times of technical difficulty. Whitten, Eastin and Davis (2001) described the full range of promotion and educational efforts that are necessary to enhance the level of specific knowledge of telemedicine. Types of educational marketing outlined included:

(1) Generic education for senior management concerning general information about telemedicine and the required resources.

(2) Generic education taught by a clinician to other referring clinicians to explain and justify the use of telemedical applications in clinical service delivery

(3) Specific education/promotion for telemedicine programmes demonstrating strategic fit between health goals and organisational goals

Specifically within the context of primary care, King, Richards and Godden (2007) explain that if telemedicine is to be implemented successfully, simple ergonomic issues must be considered, including locating telemedicine equipment close to users, and within their working environments. Thus practices, especially in remote areas, will need to be adapted to ensure that there is adequate space for
telemedicine equipment. Professionals may be required to adapt their work processes so that their routines are in line with those utilised in secondary care.

Hospital and practice managers will thus be required to instigate significant changes to organizational structure and administrative procedures to achieve the full potential of any teledental application.

Finally, pressure must be placed on healthcare decision-makers and funders to respond proactively to the developments within telemedicine, as well as the deficiencies. In particular, overcoming the telemedicine reimbursement barrier may be challenging. This may thus require financial incentives by payers and the government. An example in the UK is the introduction of government funding programs to encourage the adoption of Electronic Medical Records. UK GPs’ salaries can now vary according their performance of a set of measures computed by the EMR (NHS Connecting for Health 2008).

With regards to areas of knowledge deficiency, the need for more scientific evidence to support telemedical applications has been clearly highlighted in this study. It has been suggested that it is the lack of sufficient evidence regarding cost-effectiveness, quality, efficacy and patient satisfaction of telemedical applications that is impeding the implementation of telemedicine within routine health services (Wootton 1998). Wootton (1998) also details how the UK Government has stated that telemedicine will not be widely introduced without such evidence. Consequently, policymakers have been advised against investing in unevaluated technologies (Currell et al. 2000). Thus it is imperative that healthcare decision makers endorse further research in these deficient areas.

Another area of concern highlighted in the report was the poor levels of IT literacy within dental professionals. Gibson et al. (2007) observed that a national strategy in IT training and education may be required for all members of the dental team as part of continuing professional development.

Drawing on the diffusion of innovations theory (Rogers 1995), this report has sought a better understanding of the reasons behind the limited uptake of teledental applications in the UK. In conclusion, it is clear that teledentistry, as an application of telemedicine, is a viable method of service delivery. However, implementing a telemedical application necessitates full comprehension and consideration of the healthcare environment and also a commitment to completely integrate telemedicine
within that environment. This is a process that demands strategic alignment with clinical and organisational goals, clinical engagement and strong political support.
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