Review of the effectiveness of educational tools for teaching Telehealth care

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Executive Summary

Background

Telehealth is broadly defined as the delivery of health-related services at a distance. Recent advancements in Telehealth applications are challenging the assumption that physical presence is necessary in some healthcare circumstances. Telehealth applications are rapidly expanding and are already widely deployed in New Zealand. An early review identified that between 2000-2003, the number of telemedicine projects across New Zealand nearly doubled from 12 in 2000 to 22 in 2003 (Kerr & Norris, 2004). These developments have given rise to a need to prepare health professionals for the delivery of Telehealth care.

Purpose

While well established models of face-to-face and hands-on learning exist for healthcare professionals, their applicability in professional preparation for using Telehealth is unclear. In this project researchers from the health and education disciplines sought to address the lack of a pedagogical and professional development model for healthcare workers related to Telehealth applications.

A systematic review of research related to teaching Telehealth care was undertaken. The purpose of this was to identify studies that describe the design and conduct of programmes teaching Telehealth to health care professionals and provide an evaluation of the programme, to identify whether the teaching programme was successful in achieving the teaching or learning objectives. Based on the review of literature, the key components of possible 'best practices guidelines' were developed to support teaching Telehealth to current and future health care professionals.

Methods

Literature on the existing teaching practices of Telehealth aimed at health care practitioners was reviewed using a standard approach of framed research questions, identification of relevant studies based on specific conditions of inclusion and exclusion, appraisal of the literature, and summarization of results.

The research questions considered in the review were 1)What specific teaching programmes are reported in peer reviewed literature aimed at physicians, nurses, and other healthcare workers or professionals to teach or learn Telehealth? 2) Where available, what is the relative effectiveness of one training method over another?

The inclusion criteria for the review were (1) English language peer-reviewed articles published in the period between 1999-2009, (2) description of training programmes aimed at teaching Telehealth to health care professionals in practice, (3) a process of evaluation of the training programme. All other studies, including those for which full text abstracts were not available, were excluded from this review.

Studies that met the criteria were critically appraised and coded according to a modified version of the PICO (Participants, Intervention, Comparator, and Outcomes) framework, which is commonly used in evidence based appraisal of health care literature (Richardson, Wilson, & Nishikawa, 1995).

Qualitative interpretive data analysis and synthesis techniques facilitated by the use of NVIVO were used to identify common themes occurring in the literature that would be useful in guiding Telehealthcare education.

Results of the literature review

Ten studies met the inclusion criteria and are reported in this review; no study from New Zealand was identified. The studies available in the published literature were predominantly case studies of specific courses or programmes, some of which included course evaluations from participants or stakeholders.

Findings from the interpretive analysis

Qualitative review of the content of the studies revealed four themes that are important for designing any Telehealth educational initiative:

Role of context

The availability of resources and the professional or occupational context within which Telehealth is to be practiced are significant factors. The problems of geographical distance, population sparseness, poor communication infrastructure, and connectivity issues that often drive the implementation of Telehealth projects may also make teaching and learning Telehealth difficult (Amarsaikhan, Lkhagvasuren, Oyun, & Batchulun, 2007; Atack, Luke & Sanderson, 2004). It is important that courses/programmes for learning Telehealth are designed to acknowledge these contextual realities (for example: slow internet connections) as well as exploring the higher specification, or more advanced state of the science technologies (Amarsaikhan et al., 2007).

Learning transfer from the educational environment to the practice environment has been found to depend more on the work context and work climate than on other factors (Atack et al., 2004; Glinkowski & Ciszek, 2007; Kobb, Lane & Stallings, 2008). Kobb et al. (2008) identified four factors that enable the learner to apply the skills to their job: relevant content (33%), supportive co workers (26%), work environment (25%), and work schedules (18%). Blignault & Kennedy (1999) note the impact of staff turnover on Telehealth education which presents issues related to retaining a skilled Telehealth workforce.

Role of learner characteristics and preparedness

Learning for Telehealthcare needs to relate to the user's situation, their characteristics, and readiness for learning in this field. Learner's individual characteristics, as well as their interaction with the context of learning and the practice in which they will use Telehealth knowledge and skills, have a significant impact on their learning (Atack et al., 2004; Blignault & Kennedy, 1999). Underpinning learners' capacity for Telehealthcare training is their computer literacy. Training may be required for users to attain the appropriate level of technical competence before embarking on learning technology and practice specific to Telehealthcare.

Relevance of content

Although the literature identified courses for learners from differing health professional groups, there was some consistency in the content they recommend as being relevant. Relevant general content areas, applicable to all health professional groups (to be used with discipline specific knowledge and skill requirements) include:

- the technology, tools, and applications (including troubleshooting)
- client related topics (such as privacy, ethics, legal issues)
- practitioner related knowledge and skills (for example diagnostics and patient outcomes, documentation, communication skills in the Telehealth environment)
- in some instances, information about starting up projects and project implementation may be useful depending on the purpose of the course

Course design and teaching and learning methods

Most of the studies included in this review imply, rather than provide specific recommendations for, course design. Atack et al. (2004) noted that learners need easy access, an online orientation, rapid access to technical support during the course, clear 'help' features, and use of non-technical language to help them understand the technology. They suggest keeping online course design and navigation simple.

Accepted principles of effective teaching and learning that apply in any course for developing knowledge and skills for application in a practice context are also required for Telehealth courses. Of specific interest to health professionals are preparation for practice, not just knowledge acquisition. Building on John Dewey's theory of experiential education (1938), this suggests that the learner's ability to apply knowledge requires an integration of practice and knowledge, or life and education.

A range of teaching and learning methods were utilised in the studies reviewed. Evidence from the studies showed a clear learner preference for methods that focused on experiential learning and the practical acquisition of knowledge and skills, such as simulation, demonstration, and practice experience, aligned with methods that supported learning (for example, discussion with providers and users, and support from other learners).

Discussion

Telehealth education as learning for workplace practice

The findings of this review reinforce that Telehealth related training is essentially learning a workplace practice skill. These findings highlight that learning Telehealthcare is not solely about learning a new technology; it is also about adapting practice within a new technology and engaging with that technology. Therefore, it is useful to discuss teaching and learning Telehealth in the context of workplace learning. Studies outside health professional education have shown that the workplace offers learning outcomes that cannot be obtained in formal courses (Billet, 1994; Boud & Garrick, 1999; Candy & Mathews, 1999). Billett's (2001, 2002) work notes the significance of participation in

workplace learning and suggests the process of the construction of vocational knowledge depends on interaction with the work environment. Apprenticeship learning practices including **coaching, modelling**, o**bservation**, s**caffolding**, and fading assist the learner towards increasingly independent practice and expertise. These concepts appear useful and applicable in the teaching of Telehealthcare. In addition, the principles of cognitive apprenticeship are likely to be important for the consultation and case management aspects of learning teleconferencing for Telehealth; skills that are vital in health professionals' practice.

Identified gaps in Telehealth education research

Several significant gaps in the research and current knowledge emerged from this review of educational programmes for Telehealth practice. These related to a focus on the technology, a lack of an underpinning education framework guiding the programme, and the importance of practical hands-on training facilities and opportunities to enhance learning transfer.

Limitations

The findings of this study and its recommendations need to be interpreted in the light of several limitations. Firstly, filters and criteria for selection of literature were based on best practices in integrating research evidence translated from traditional systematic reviews in healthcare. Application of such filters may miss some studies. Secondly, with education for Telehealth being an emergent field, few materials were available for review despite extensive searching. Thirdly, because technologies mature and change rapidly, we limited our searches to only the past ten years. Finally, the recommendations for guidelines that we propose are based on the little empirical evidence available as well as contemporary thinking on educational research.

Recommendations for teaching guidelines for Telehealth

This review of literature shows there is little information available in terms of formal preparation of health care professionals whose main roles are to provide healthcare services over distance based networks or asynchronously delivered services. Evaluations of curricula reported in the literature have been based on student satisfaction or self-reported competence surveys, rather than measuring changes in competency or knowledge, attitudes or skills between pre implementation and post implementation of the programmes. As a result, there is little formal empirical evidence (or sufficient level or quality of evidence) to help in the formulation of a model of most effective Telehealth training practices.

However, within the limitations of quantity and quality of data available in this review, the following recommendations are made as a basis for guidelines for teaching Telehealth care:

Learning in practice

- Incorporate existing communities of practice of Telehealth professionals to scaffold and mentor learners as they move to independent Telehealth practice.
- Provide workplace learning and on-the-job training to maximise the application of skills in a relevant context.

- Provide ongoing practice opportunities so practitioners can develop and maintain competence.

Teaching practice

- Focus teaching and support on optimising the practitioner's transfer of professional skills to the new medium.
- Incorporate apprenticeship models of learning whenever possible.
- Emphasise hands-on learning and practical experiences.
- Utilise multiple teaching methods to ensure learner needs are met.

Educational strategies

- Develop Telehealth-based training in undergraduate training of health care professionals.
- Design Telehealth training that reflects and utilises the modalities used by the healthcare professional in their practice.

Technology

- Undertake needs assessment to assess the level of technical support the practitioner will require.
- Provide training to increase computer literacy when necessary.
- Deliver training that is appropriate for the technological constraints of the work context.

Conclusion

This review points out that (a) there are significant gaps in research around the evidence based good practices in Telehealth teaching programmes worldwide that may have important implications for New Zealand; (b) experience from the review of limited studies and training description show that a programme on Telehealth teaching and training can work only when teaching and learning modalities and training sessions are contextualized with practice; (c) training for Telehealth should be tightly coupled with students' everyday practice and must be associated with ongoing practice opportunities to retain competence.

An additional benefit of this project is the presentation of an applied example of a systematic review that may be relevant to other professions in the tertiary education sector. Systematic reviews are extensively used in healthcare to underpin evidence-based practice and provide guidelines for best practices. This project provides an example of using the systematic review method in the educational context that gives a model for educators, and potentially other disciplines, to use in their own fields.

Finally, educational practice spans many fields and disciplines. Many of the findings of this review may also be of interest, and use, to professionals beyond the health professions, particularly those in

applied fields (such as teaching) or fields in which new information and communications technologies are increasingly impacting on practice.

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Introduction

Traditionally, the delivery of healthcare requires patients and providers to be physically present in the same place and able to communicate with each other at the same time. Accordingly, traditional pedagogical and professional development models that teach clinical procedures and modes of delivering healthcare services are largely based on the assumption that the caregiver and patient are physically co- present. However, there are situations when the two requirements of co-location and synchronous timing put constraints on the effective and efficient delivery of care. For instance, people living in remote places might require urgent healthcare that necessitates care delivery from a distance, requiring a method such as Telehealth. Furthermore, recent advancements in Telehealth applications are challenging the assumption that physical presence is necessary in some healthcare circumstances. These developments have given rise to a need to prepare health professionals for the delivery of Telehealth care. In this project researchers from the health and education disciplines sought to address the lack of a pedagogical and professional development model for healthcare workers related to Telehealth applications.

Background

Telehealth is broadly defined as the delivery of health-related services at a distance. Various health professions may provide Telehealth care, for example: Telemedicine is a subset of medicine (literally medicine practiced at a distance). Telehealth involves the use of modern information technology, especially two-way interactive audio/video communications, computers, and telemetry to deliver health services to remote patients, and to facilitate information exchange among physicians, specialists, nursing staff, and patients who are distant from each other (Darkins & Cary, 2000). Telehealth applications are rapidly expanding and are already widely deployed in New Zealand. An early analysis of the repeated surveys of Telemedicine and Telecare providers in New Zealand have revealed that between 2000-2003, the number of telemedicine projects across New Zealand nearly doubled from 12 in 2000 to 22 in 2003 (Kerr & Norris, 2004).

Telehealth is distinct from traditional models of healthcare delivery. . While well established models of face-to-face and hands-on learning exist for healthcare professionals, their applicability in professional preparation for using Telehealth is unclear. From the perspective of instructional design, Telehealth education must enable providers to be well versed not only in the principles and processes of healthcare delivery, but also in the principles of computer based health care information systems supporting health care delivery processes. Skills such as core competency in clinical disciplines, knowledge about prevention and cure for individual diseases, and adherence to disease-specific clinical guidelines are necessary, but in the environment of health care where Telehealth is administered need to be supplemented with skills and knowledge of informatics.

The purpose of this project is to review evidence about teaching Telehealthcare to underpin development of teaching guidelines for Telehealth, relates to the national information and communication technology (ICT) strategy in New Zealand. A comprehensive national 'Digital Strategy' has been underway since 2004, and a strategy discussion document was released in 2006 (Ministry of Economic Development, 2008). In this strategy discussion document the government noted the need to "review progress, look at what gaps still need to be filled and what new actions can be implemented to help create our digital future" (Ministry of Economic Development, 2008, p.

39). Within this climate of reviewing and refining the digital strategy of New Zealand, the tertiary sector's role is seen as critical to support national development goals and respond to the challenges of globalisation, accelerating technological change and the knowledge society. Furthermore, the current draft of the Strategy recognised that users need other skills to apply digital technologies in the workplace and the community, ranging from basic digital literacy through to more advanced applications in specific industries. The outcomes of this project (the review of evidence and teaching guidelines) will directly contribute to the national strategy and system capability in the tertiary sector though its goal of strengthening both teachers' and students' learning and teaching abilities and confidence in ICT skills.

Driving the adoption of ICT in the health sector is the New Zealand Health Information Strategy 2005 (Health Information Strategy Steering Committee, 2005). Within the field of healthcare in New Zealand the use of ICT is seen as an effective and efficient method to transfer information to deliver clinical, health administration, and health education services. However, current evidence suggests that although Telehealth applications are now widely used in health care delivery systems, healthcare providers in New Zealand are only using 25-30% of its potential (Al-Qirim, 2005). In healthcare, as in others areas of work and study, it is possible that the availability of technology is not enough of a motivating factor for technology uptake and utilization. Research into the low and limited adoption of technology in the workplace suggests that a lack of exposure to relevant and realistic experiences with Telehealth applications during education or professional development may be a significant reason for this (Allan, 2007; Brown, Collins, & Duguid, 1989)

The relationship between learning, teaching, and work skills is not merely one of content but is also about the learning processes and development of skills. How to best create and nurture this relationship was the life's work of educational theorist John Dewey, and his suggestions serve as a theoretical foundation for this approach. Instead of separating one's education from the community, he sought to have education become a part of the community. Part of this transformation would involve bringing in all parts of the community and its practices into education and vice versa. Thus, he believed that by using a real instrument and real practices, in this case the tools of Telehealthcare, learners would be engaged physically, intellectually, creatively, and socially (Dworkin, 1959).

For Dewey then, effective teachers use teaching methods that promote learning and prepare students for the workplace. Health professionals' education is a specific example of the generalisation that professional knowledge cannot be characterised independently of how it is learned and how it is used (Eraut, 1994). Professional training in healthcare provides a unique situation where learning outcomes focus on applying declarative knowledge in practical contexts. Thus, in the professional preparation of healthcare workers, two major learning outcomes for professional programmes, as described by Biggs and Tang (2007), are relevant:

1. They should be able to integrate their learned knowledge and skills to real life professional settings, and

2. They should be able to work collaboratively with all parties in multidisciplinary workplace settings (Biggs & Tang, 2007).

Learning by distance, sharing information, and consulting by Telehealth are work and professional skills for health professionals in the same way that writing is for academics. For an academic at any

level, development of writing skills is a core competency to communicate with others and facilitates self expression and learning in other areas. In a similar vein, some skills required for Telehealth are also skills needed for distance learning and it is believed that these skills can be woven into the teaching of health professionals to aid learning and empower future practice. Medical and nursing schools prepare professionals to blend theoretical principles of human anatomy, physiology, pathology, pharmacology, biology and health with practical aspects of care. This education is typically grounded in work-integrated teaching approaches that help achieve Dewey's goal of better integrating school with society instead of setting it apart in an ivory tower (Dworkin, 1959). However, in the context of Telehealth, it is unclear which models of teaching are most effective (Caudell et al., 2003; Jennett et al., 2000).

The purpose of this project was to conduct a systematic review of research related to teaching Telehealth care. Specifically, this review was aimed at (1) identifying studies that describe the design and conduct of programmes teaching Telehealth to health care professionals that also provide an evaluation of the programme to identify whether the teaching programme was successful in achieving the teaching or learning objectives, and (2) based on the review of the body of literature, outline the key components of a possible 'best practices model' that can be used to teach Telehealth to current and future health care professionals.

Methods

Steps in the literature review

A systematic review of the available literature was conducted. The following steps were undertaken in the literature review:

1. A set of relevant questions were framed based on background research.
2. A systematic search of the literature databases was planned and conducted.
3. A set of inclusion and exclusion criteria were applied to the retrieved literature; additionally, wherever possible, the literature data were critically appraised.
4. A research report was then, on the basis of step 3, included or removed from further consideration.
5. The results of the studies finally included in the review were synthesized and key findings were presented.
6. The results of the review were used to develop a model of best practices for teaching or organizing instruction in Telehealth.

Research questions underpinning the review

The following research questions were considered in the review:

- What specific teaching programmes aimed at physicians, nurses, and other healthcare workers or health professionals to teach or learn Telehealth are reported in peer reviewed literature?
- Wherever available, what is the relative effectiveness of one training method over another?

Databases searched

The following literature databases were searched to identify studies (electronic or other resources): ISI Web of Science, Pubmed and associated family of databases from the US National Library of Medicine, Cochrane Register, Cumulative Index to Nursing and Allied Health literature (CINAHL), Google Scholar and Google.

Table 1: List of databases searched

Name of the Database	**Location of the resource**	**Purpose and description**
Bank of databases maintained in the University of Canterbury Library website related to health	http://tinyurl.com/uclibraryhealth	A comprehensive list of different online databases and repositories related to health care literature.
NLM Databases	http://www.pubmed.com http://gateway.nlm.nih.gov	Largest medical and healthcare literature related database for identifying articles related to medical and health care.
CINAHL	http://www.ebscohost.com/cinahl/	CINAHL is abbreviation of the Cumulative Index to Nursing and Allied Health Literature, and is the most comprehensive resource for nursing and allied health literature.
Google and Google Scholar	http://www.google.com http://scholar.google.com	Generic searches and subject related searches.
Education Databases in addition to Eric and others identified by the University of Canterbury Library resources	http://tinyurl.com/uclibraryeduc	University of Canterbury Library has catalogued websites and search engines related to educational research.
Specialist telehealth journals	Within databases	Content pages of specialist telehealth journals (for

searches		example Journal of Telemedicine and Telecare) were searched for relevant articles.
Hand Searches	Manual searches based on full text appraisal of the journal article or resources. This could involve contacting the original authors, or visiting a local library to obtain paper copies.	

Inclusion and exclusion criteria

Criteria for inclusion of study in the review:

- The study was published between 1999-2009,
- The study was peer reviewed prior to publication,
- The study was published in an English language journal, and
- The objective or primary goal of the study was about teaching Telehealth to health care professionals in practice.

A study was excluded from further review if any one of these criteria was not fulfilled. Studies that were descriptions of websites or resources that were not peer-reviewed were also not considered. Studies that gave no indication, or studies that made no attempt to provide an indication, of the evaluation of the teaching were not considered in this report.

The search terms in this systematic review were based on considering health care practitioners as population/participants, education/teaching as interventions, and practice of Telehealth/student satisfaction with the teaching component as outcomes.

The search terms and lists of studies retrieved with this process are listed in Table 5 (see Appendix 1). Titles and abstracts of each study obtained using the above strategies were initially examined for their eligibility to be retained in the review. Studies selected on the basis of titles and abstracts were then critically appraised and coded according to the PICO framework.

The PICO framework (an acronym for the Participants, Intervention, Comparator, and Outcomes framework) is commonly used in evidence based appraisal of health care literature (Richardson, et al., 1995). According to this framework, internal validity of research that aims to investigate the association of an exposure or a particular health care related intervention with a specific outcome (or a set of outcomes) is evaluated according to how the research addressed each of the four components; participants, intervention, comparator, and health outcome. In this framework, 'participants' indicates whether individuals who took part in a study were appropriate for the target population to which the results of the research would be applied or whether they closely matched with specific characteristics of the target population. The term 'intervention' is a broad concept that encompasses both exposure or intervention related variables under study (for example: environmental variables such as air quality, or specific health behaviours). For the purposes of

interpreting the internal validity of specific health care interventions (for example: specific drugs, surgery, or public health interventions such as smoking cessation programme or health education), studies must contain a clear and specific description of the exposure or intervention variable under study. The 'comparator' indicates an alternative or comparable exposure or intervention to that under evaluation. Often, participants themselves can serve as their own comparison group in cases where the study involves repeated measurements in the same population. In other cases, a dummy or placebo is used for comparison. In still other situations, either no specific comparison group is used, or usual care is used for comparison. Finally, the term 'outcomes' indicates the end results for which the intervention and the control conditions are compared with each other. In the context of healthcare, for example, such outcomes may be specific disease outcomes, or health outcomes, or outcomes such as hospital stay or other health related events or situations. In general, the PICO framework provides a structure to effectively and reliably reproduce studies or enable standardization of reviews whenever they are applied to health care intervention or review of primary studies.

Since the purpose of this review was to summarize information from studies related to how Telehealth was taught to practitioners, it was primarily aimed at how the education process enhanced their practices or affected their learning outcomes. Therefore, these concepts were further modified to enable application to health educational studies. In this study, the term participants in the PICO framework referred to health care practitioners. The term intervention referred to the establishment of Telehealth educational activities, and the term outcomes referred to educational or learning outcomes achieved as a result of educational intervention. In this review, no specific comparator was used as the aim was to integrate diverse studies and different approaches and educational interventions related to Telehealth and telecare (see Table 2).

Table 2: Description of search terms

Terms in PICO Framework	**Description of corresponding terms adopted in this literature review**
Participants (P)	In this review, the concept of 'participants' indicated learners. Therefore, for participants, the reviewers included medical and nursing students, or trainee physicians (this included descriptors of commonly applied terms such as residents, interns, & house officers) or nurses.
Intervention (I)	Intervention in this review was used to denote any programme that was used to teach Telehealth to learners.
Comparator (C)	In this review, comparator was used to describe any comparison that was used. Such comparisons could be another programme to teach Telehealth (relative to the programme whose effectiveness was studied, or time frame, or performances of the students at the beginning of the programme or other baseline data).

Outcomes (O)	Outcomes in the context of this review indicated generally accepted learning outcomes in teaching and learning contexts. In the context of Telehealth, such learning outcomes in the context of this research included responses on student surveys, indicative scores in performances, or the acquisition of skills relevant to Telehealth practice

Searching the literature: Strategies

The search terms were set up based on the concepts discussed in Table 2.

Based on the research questions underpinning the review, a search algorithm was developed and the literature databases outlined in Table 1 were searched. Additionally, hand searches were conducted to identify additional studies. This was done based on appraisal of full texts of the already retrieved resources (for example: journal articles). The following search terms were used in this review to identify and locate studies for further appraisal.

Exhibit 1. Search terms used for this review

(Student* OR resident OR intern* OR "house officer*"OR pgy* OR nurs* OR train*) AND (teach* OR curr* OR pedagog* OR syllab*) AND tele*

Inclusion and exclusion of the studies: Preliminary screening

The preliminary screening of the studies was undertaken based on scanning of titles and abstracts of each retrieved search result. In general, the principles followed were:

A study was included in this review if it contained as a main focus:

1. Teaching Telehealth to healthcare workers (defined as nurses, physicians, or healthcare workers involved in patient care)
2. Use of teaching tools, software, approaches, or use of non-conventional tools for the purpose of teaching Telehealth related practices and equipment
3. Relevant learning outcomes for physicians, nurses, and healthcare workers; however, this learning outcome should be related to the usage and adoption of Telehealth or distance based healthcare delivery
4. English language texts, or readily available reliable English language translation of a text (the researchers did not attempt to translate non-English articles)
5. Research relevant to healthcare delivery where the lessons or themes from the study might be applicable to New Zealand health care.

If a study did not fulfil any of the above conditions it was excluded. This strategy was iterated with the full texts of studies. After the final review of the full texts, the available evidence was summarized for presentation in the form of narrative summaries and tables.

Review workflow

In addition, a workflow was established integrating bibliographic data management software, word processor, and qualitative data analysis software – the NVivo version 8 (QSR, 2008). These processes are described graphically in the following diagrams (Figures 1 & 2) and in detail below.

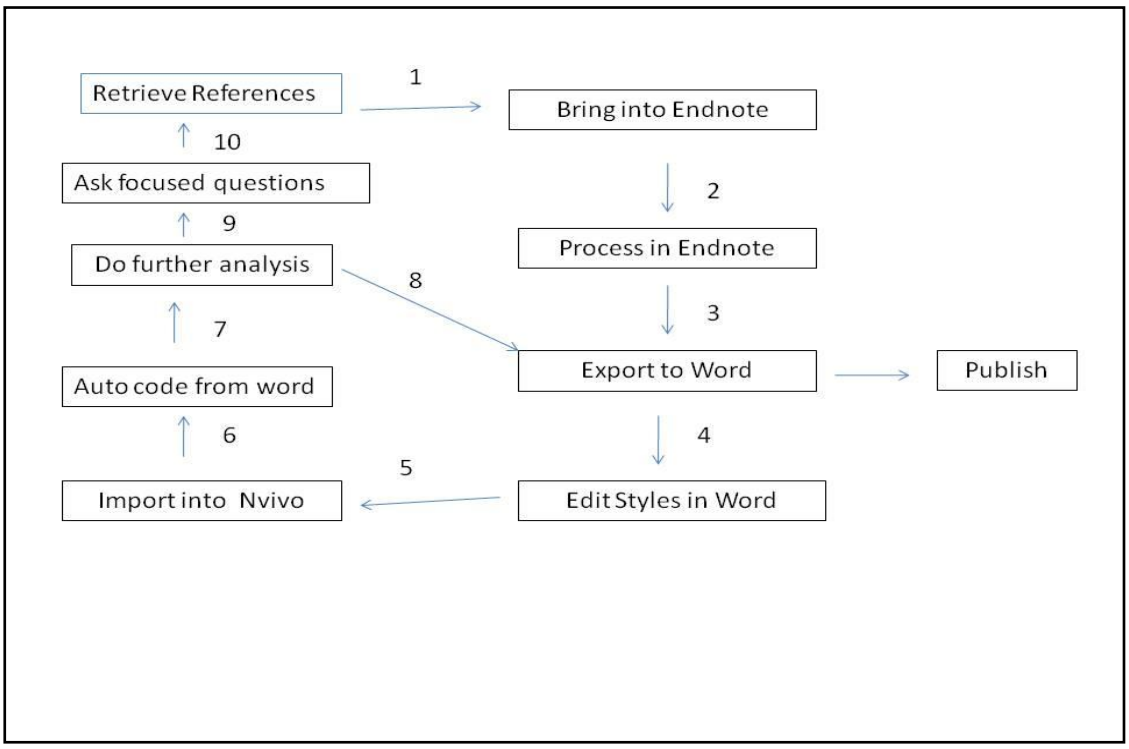

Figure 1: Workflow of the review

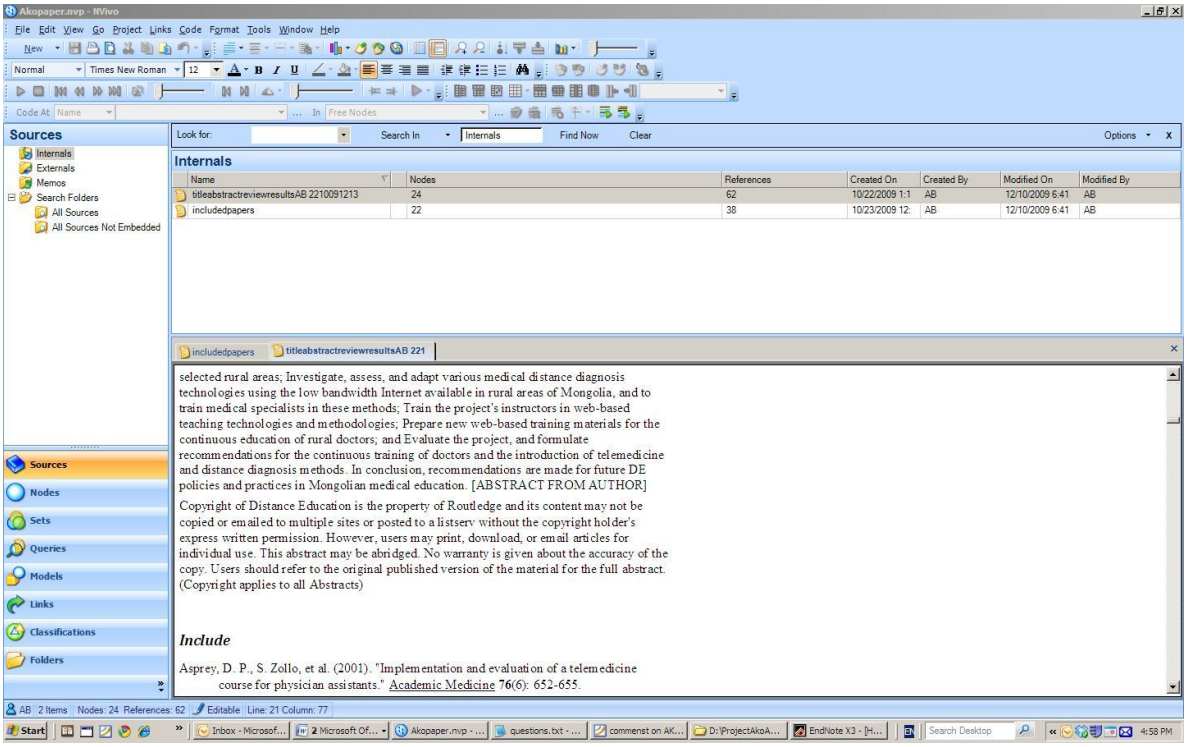

Figure 2: Screenshot of NVivo in action

In step one, literature databases were searched and citations were entered into Endnote (version X2). In step two, the Endnote programme was used to review, identify, and format the references. In steps three and four, the word-processed document was marked up using the notations agreed upon by the research team for this systematic review. A list of auto codes was set up in the document as shown in Table 3:

Table 3: List of autocodes used for marking up the document

Autocode symbol	**Expanded form**
Incl + F3	Included
Xs + F3	Wrong study type
Xp + F3	Wrong population
Xi+ F3	Wrong intervention
Xc + F3	Wrong comparison group
Xo + F3	Wrong outcome
Xna + F3	Excluded because no abstract available
Xne+ F3	Excluded because no English version available

In steps five and six, the resulting document was imported into NVivo qualitative data analysis software as an internal resource. Further annotations and observations were added to the document following importing from full text, and iterative reading of the documents was performed to identify individual themes that emerged from the document. In steps seven and eight, further coding and thematic analyses were done.

Data analysis

The studies available in the published literature were predominantly case studies of specific courses or programmes, some of which included course evaluations from participants or stakeholders. Given this constraint of study design in the published literature available, qualitative interpretive data analysis techniques were the appropriate method for the analysis of these studies.

The aim of the qualitative analysis was to identify common themes occurring in the literature that would be useful in guiding Telehealthcare education; accordingly, analytic strategies for both induction and interpretation (Dixon-Woods, Cavers, & Agarwal, 2006) were employed in the analysis. The qualitative data analysis software, NVivo Version 8 was used to facilitate this process. Strategies for analysing the literature involved iterative reading of the studies, analysis of individual studies, and comparison of findings between the studies (Dixon-Woods et al., 2006; Thomas & Harden, 2008). Initial scrutiny of findings from each individual study led to the development of codes. The subsequent comparison of the codes across the studies enabled recognition of themes and relationships within the data (Whittemore & Knafl, 2005) resulting in an integrative review. Following guidelines from Thomas and Harden (2008) thematic synthesis of the concepts occurring in the studies was undertaken. This involved recognising concepts occurring in various studies even when different words describing the concepts may have been used (Thomas & Harden, 2008, p. 4). This process was limited by the level of evidence contained in the published studies available, and the resulting themes are descriptive rather than explanatory. This analytic process did, however, aid in identifying components of Telehealth education programmes that would support subsequent development of best practice guidelines from the systematic review.

With a view to ensuring rigour in the interpretation, two members of the research team separately examined the included studies for emergent themes. Other team members read the literature and the review findings with a view to clarifying and/or challenging these interpretations and themes as needed. A graphical model was developed to illustrate the findings.

Development of the 'best practice' guidelines

The second aim of this research was to determine a set of 'best practice' guidelines for teaching Telehealthcare based on critical appraisal of the studies. This was done following the thematic interpretation and synthesis and critical review of the themes that emerged from the studies, and the development of the graphical model indicating the key concepts and conceptual interrelationships that might optimize teaching of Telehealth to health care practitioners. The themes and the dynamic relationships depicted in the model were examined in relation to salient literature about healthcare professional education and workplace learning. Pedagogical and professional guidelines and recommendations were then developed to guide best practice in Telehealth education.

Results of the literature search

Summary

The initial search resulted in 68 studies. Review of the titles and abstracts of these studies resulted in the identification of 20 studies for full text appraisal for data abstraction and subsequent use in developing the best practice guidelines. Out of the total of 20 studies thus identified, only nine studies (10 out of 20 studies; 50%) met the criteria for inclusion for final appraisal (see Table 4). Further details of excluded studies are available in Appendix 2 of this report (Table 6).

Table 4: Summary table of the number of studies retrieved and reasons for their exclusion

Based on title/abstract appraisal		**Based on full text appraisal**	
Criterion for rejection	**Count (%)**	**Criterion for rejection**	**Count (%)**
Initial selected papers on searches	68 (100)	Initial selection	20 (100)
Excluded because of irrelevant research question	28 (41.2)	Excluded because of irrelevant research question	None
Excluded because wrong intervention or wrong concept being studied	3 (4.41)	Excluded because wrong intervention or wrong concept being studied	7 (35)
Excluded because wrong or inappropriate outcome	18 (26.5)	Excluded because wrong or inappropriate outcome	3 (15)
Articles finally selected for full text review	20 (27.9)	**Final set of articles included in review**	**10 (50)**

Included studies

The key findings from ten selected studies selected above are summarized below. These studies are presented in alphabetical order (see also Table 5 in Appendix 1).

Amarsaikhan, Lkhagvasuren, Oyun and Batchuluun (2007) described a study investigating and educating rural physicians in Mongolia about telediagnosis. The programme used a home grown Learning Content Management System (LCMS) to deliver the content to teach basics of telediagnosis (distance based diagnosis of diseases for physicians at rural outposts). The study distributed a survey among 231 physicians and medical workers throughout Mongolia who took part in the online distance education programme. The student satisfaction with the programme was poor according to the results of the survey (about 56% of respondents expressed a desire to access e-learning if they had Internet connection, but about 68% of respondents had poor to intermediate levels of computer knowledge. In the research it was not defined what level was considered to be intermediate or low). It was not reported whether there was improvement (perceived) in learning or competency levels. A

conclusion drawn from Amarsaikhan et al. study was that there was a need for training in distance-based curriculum design for medical education (Amarsaikhan, Lkhagvasuren, Oyun, & Batchuluun, 2007).

Asprey, Zollo and Kienzle (2001) described the operations and evaluation of a programme targeted at physician assistants based at the University of Iowa Medical School. This was a four-week four module training programme. An evaluation of the course was conducted at the end of administration of the training programme. The four core modules were based on basic didactic materials on Telemedicine aimed at physician assistants; demonstrations of Telemedicine in the classroom; discussions about Telemedicine with stakeholders; and a field visit with hands-on training sessions. The students expressed satisfaction with the course experiences and analysis of the course evaluations showed that the students liked the hands-on training sessions best for helping them to learn the core competencies. The students gave least points (indicators of satisfaction) to the didactic component of this course (Asprey, Zollo, & Kienzle, 2001).

Atack, Luke and Sanderson (2004) described a plan for development of a team teaching programme for Telehealth for nurses. The course was developed in consultation with domain experts and health professionals with various levels of expertise and experiences (including expert and experienced physicians, nurses, and Telehealth practitioners). In developing their training programmes they held several focus group interviews to identify themes and topics and developed the content of their course and delivery modes based on these interviews. However, they did not administer the course to any specific group but distributed a survey based on the course content to identify the responses of potential course students. The responses to the course contents were satisfactory (Atack, Luke, & Sanderson, 2004).

Blignault and Kennedy (1999) described the Queensland Telemedicine Network (QTN) and its historical development with detailed description of the training of the personnel who were involved in the operations of the Telemedicine network. Training for physicians and end users of the QTN was provided using two main channels - promotional videos and poster materials to prime participants. This was followed by a series of videoconference based presentations on various aspects of managing a videoconference and patient management for physicians and other healthcare personnel involved in managing Telehealth practices. Although no formal statistics were provided, the authors commented that these procedures were well received by the recipients of these programmes (Blignault & Kennedy, 1999).

Brebner, Brebner, Ruddick-Bracken, Wootton, and Ferguson (2003) described a project that delivered an accident and emergency medicine teleconsultation training programme to health care providers in the UK. They provided a brief report of the survey of users that evaluated user satisfaction and competency levels following the training course. The course was developed by a team of physicians, nurses, educators, and telemedicine researchers. A total of 11 topics were prepared for the course that included camera manoeuvre, image processing and use of videoconferencing such as video calls and turning off equipment. All tasks that were designed and tested were manual tasks. The effectiveness of the training programme, measured on the basis of self reported perceived changes in the levels of skills and competencies reported by students was based on a postal survey. The survey was administered 90 days post completion of the programme. The survey showed that students gained most competency when the training programme was accompanied by study

booklets and practice opportunities (35% of respondents reported higher competencies with training alone, as opposed to 56% with training accompanied by study booklets and 73% with training, study booklet, and practice opportunities). Further, retention of competencies learned in the course was highest when there were frequent opportunities to practice what they were taught in their work settings as opposed to lower frequency of practicing. Competency was based on self report. Nearly 100% of respondents who had daily or weekly practice following training reported maintaining the competence level they gained immediately after training when reviewed 90 days post training, whereas the self reported competence levels were about 60% (based on skills learned) for those students who had monthly practice and 43% percent for those students who had less than monthly practice. Based on these findings, the researchers commented on the importance of regular practice or application opportunities for learners following completion of training programmes and the need for additional materials when Telehealth related training was offered (Brebner, Brebner, Ruddick-Bracken, Wootton, & Ferguson, 2003).

Giansanti, Castrichella, and Giovagnoli (2008) described a training programme for the Technicians of Biomedical Laboratories (TBLs) in Italy for training in Telepathology practices over and above their regular curriculum on biomedical sciences (pathology, cytology, and practical procedures). However, in the study there were no reports of process or course evaluations. This was a description of introducing Telepathology practices for the technicians in different laboratories to introduce them to the concepts of using digital slides (digital slides are specially prepared pathological glass slides whose contents can be converted to digital images and stored in local or distance based internet based servers. The slides can be accessed on computers running specialized programmes for diagnosis and imaging analyses). The instructors and students were engaged in the same process of preparing the digital slides and viewing the results of digital slides using the specially designed software to impart to students the required digital maintenance and browsing skills. The authors reported results of a satisfaction survey among the students to indicate that this process increased their levels of understanding and benefitted their practices rather than unsupervised self learning practices (Giansanti, Castrichella, & Giovagnoli, 2008) .

Glinkowski and Ciszek (2007) developed a website on anatomical study materials, text, digital images, X-rays, tutorials, and quizzes aimed at medical students and physicians with a view to facilitate uptake of Telemedicine if the students were familiar with the processes of learning online. They used this intervention to analyze the website usage statistics and distributed questionnaires among the students to assess their satisfaction with this teaching module and their willingness to adopt Telemedicine. The investigators found that there was a progressive increase in the number of unique site visits between 2003 (34, 534), 2004 (45, 771), and 2005 (67, 120). They also noted that there was a sharp rise of interest in this form of e-learning in 2005. In their survey, a total of 539 students took the survey and 82.4% expressed satisfaction with the webpage content. A total of 103 students were surveyed to identify the extent to which this website creation contributed towards their increased interest in Telehealth or telemedicine adoption. In that survey, they identified that about 60% of students (N = 62) had fair knowledge about the term “Telemedicine” and 10.7% students (N = 11) knew nothing about Telemedicine. About 85.4% of students believed that information obtained using the class web page would enhance their practice of telemedicine (Glinkowski & Ciszek, 2007).

Kobb, Lane, and Stallings (2008) described a programme and results of an evaluation of a web based curriculum to ensure a standardized competency among its home Telehealth practitioners affiliated

with the United States Veterans Health Administration (VHA). The curriculum for this training programme was jointly designed by the VHA's Employee Educational Services and the Sunshine Training Centre (STC-EES) and was administered to over 675 VHA employees to enable them to develop competencies for delivering home Telehealth care services. The training programme was delivered entirely online using e-learning strategies. A process evaluation of their learning competence (based on self reports from the students) was conducted 90 days post-completion of the programme. The STC-EES developed a 12 item process evaluation survey questionnaire (7 likert scale type questions ranging from never to great extent OR not applicable; 2 questions were related to their improvement in work performance following the training and the extent to which they were confident about their skill levels. There was one open ended question). Out of 675 enrolled students, 500 responded to the online survey set up for the evaluation. In general, the majority of the learners showed positive responses. Eighty seven percent of the respondents indicated that they had a 50% or more performance increase in both the objectives (attained desired competency levels), and their job duties. The top five skills that learners learned and applied to their work settings were: Telehealth operations (32%), Telehealth roles/duties (22%), marketing strategies (18%), programme implementation (17%), and enhancement in competence in patient selection methodologies (13%). The learners stated that the factors that would enable them to apply the skills to their job were relevant content (33%), supportive co workers (26%), work environment (25%), and work schedules (18%). Overall, they found a high level of student satisfaction with their programme (Kobb, Lane, & Stallings, 2008)

Seifert, Veronin, Kretschmer, McBeath, Stanford, Turner and Ontai (2004) described the design and evaluation of a training programme in Telepharmacy for graduate students in Pharmacy programmes in Texas. The Telehealth care delivery model was based on a hub and spoke model. The students were taught through didactic components of organizing a Telehealth care programme as well as a field based practical programme where their performance was evaluated using review of log books. The course was evaluated using standard course evaluation questionnaire surveys. The students expressed high satisfaction with the didactic components but gave poor ratings to the practical and field placement component. The students scored poorly for the log book based evaluation (Seifert, et al., 2004).

Zafar et al. (2008) described the operations of a Telemedicine education project in collaboration with US hospitals and a regional hospital in Pakistan training rural medical practitioners in four modules of Telemedicine delivery. Although details of student feedback were not described in the evaluation, the authors stated that the establishment of the telemedicine training programme was very beneficial in facilitating medical relief operations during a major earthquake disaster that struck the area of Telemedicine training programme (Zafar et al., 2008).

Findings

This section presents the themes from the integrative review of the literature.

Role of context

The context in which Telehealth delivery and training are undertaken is an important consideration in planning Telehealth education. Two factors that emerged as significant were the availability of resources, and the professional or occupational context within which Telehealth was to be practised.

The problems of geographical distance, population sparseness, poor communication infrastructure, and connectivity issues that often drive the implementation of Telehealth projects may also make teaching and learning Telehealth difficult (Amarsaikhan et al., 2007; Atack et al., 2004). Lack of technology infrastructure has also been noted to be a significant barrier to implementation of knowledge and skills in practice (Kobb et al., 2008). Therefore, it is important that courses/programmes for learning Telehealth are designed to acknowledge these contextual realities (for example: slow internet connections) as well as exploring the higher specification, or more advanced state of the science technologies (Amarsaikhan et al., 2007).

Secondly, learning transfer from the educational environment to the practice environment has been found to depend more on the work context and work climate than on other factors (Atack et al., 2004; Glinkowski & Ciszek, 2007; Kobb et al., 2008). A needs analysis undertaken by Atack et al. (2004) highlighted potential problems in the work environment that should not be overlooked when planning for, and providing, a Telehealth course or programme. These problems included a lack of even a basic understanding of Telehealthcare by clinicians and managers, clinicians concerns about changes in their workflow generated by using Telehealth, and concerns about patient acceptance of Telehealthcare. Consistent with Atack et al.'s (2004) findings that there is potential for a lack of understanding among clinicians about Telehealth, Amarsaikhan et al. (2007) found that perceptions of distance education and Telehealth care as 'inferior' ways of learning and practicing in health care needed to be addressed with the learners (physicians) in their Mongolian study. Such perceptions can have a detrimental effect on learning Telehealth care and on the transfer of knowledge and skills into practice.

Kobb et al.'s (2008) survey of over 500 participants in a Veterans Health Administration programme for home Telehealth reinforced the importance of the work climate with their finding that several aspects of a supportive work environment were in the top five factors that supported the application of skills and knowledge from the Telehealth care education programme. The factors that would enable the learner to apply the skills to their job were: relevant content (33%), supportive co workers (26%), work environment (25%), and work schedules (18%). Sharing knowledge of the practices of Telehealth care between practitioners and learners also enhances transfer of knowledge to the workplace (Atack et al., 2004). Another relevant feature of the work context highlighted by Blignault and Kennedy (1999) was the impact of staff turnover on Telehealth education. As with the technology issues that drive a need for Telehealth, but are themselves detrimentally affected by distance from main centres (Amarsaikhan et al., 2007), retaining staff in rural areas is also often a challenge that, while providing a strong impetus for Telehealth, also presents issues related to retaining a skilled Telehealth workforce. Blignault and Kennedy (1999) recommend that education for

Telehealth therefore needs to be continual, and ideally, that awareness be brought into the mainstream of staff education (such as orientation sessions) to ensure Telehealth is sustainable.

Role of learner characteristics and preparedness

A number of factors related to learners were apparent in the literature review. Learning for Telehealthcare needs to relate to the user's situation, their characteristics, and readiness for learning in this field. Employing a needs assessment has been shown by Atack et al. (2004) to be beneficial in planning for Telehealthcare training. Learner's individual characteristics, as well as their interaction with the context of learning and the practice in which they will use Telehealth knowledge and skills, have a significant impact on their learning. Additionally, it may be beneficial to discern the needs of learners related to Telehealth care generally as well as their needs related to specific Telehealth care programmes and their intended use (Atack et al., 2004; Blignault & Kennedy, 1999).

Underpinning learners' capacity for Telehealthcare training is their computer literacy. It cannot be assumed that practitioners will possess the required basic computer literacy and familiarity with technology required. Lack of computer literacy and internet skills may be a significant problem, and training may be required for users to attain the appropriate level of technical competence before embarking on learning specific to Telehealthcare technology and practice. Amarsaikhan et al. (2007) noted this particular learning need in their Mongolian study. Zafar et al. (2008) also note the inclusion of basic computing skills in their telemedicine course in Pakistan. In their Canadian study, Atack et al. (2004) noted that while the learners had some basic computer skills, such as emailing, they were less confident about other skills such as file downloads and online video viewing. It is evident that planning for effective teaching and learning of Telehealth care needs to address end users' unfamiliarity with the basic computing and information and communication technology prior to teaching Telehealthcare specifically. Amarsaikhan et al. (2007) noted that onsite provision of this type of technical training was valuable.

Distance education methods may enhance use of Telehealth care by increasing familiarity with using online learning technologies (Amarsaikhan et al., 2007). However, learner preparation for online learning may be required if this is to be an integral part of developing Telehealth care skills. Although not specifying how they gained the information, Amarsaikhan et al. (2007) reported that the physicians learning to use telemedicine in Mongolia gave evidence of their need for expanded online delivery of materials to support their ability to provide effective telemedicine consultations. Glinkowski and Ciszek (2007) examined this link with 103 medical (n= 85) and dental (n=18) students in Poland, surveying their knowledge of, and predisposition towards, using telemedicine following an experience with online anatomy education. Of these students, 22.3% (n=23) claimed to know the term telemedicine well, 60.2% (n=62) to have fair knowledge, 4.9% (n=5) claimed limited knowledge and 10.7% (n=11) knew nothing at all about telemedicine (Glinkowski & Ciszek, 2007, p. 540). Following the course, 85.4% of the students perceived they had gained skills that enhanced their abilities to use telemedicine through undertaking the online anatomy course, 21.4% were unsure, and 12.6% were sure that the online learning experience would not influence their future involvement with telemedicine (Glinkowski & Ciszek, 2007, p. 540).

Raising awareness about Telehealth care was noted as an important part of Telehealth education by several authors (Asprey et al., 2001; Blignault & Kennedy, 1999; Glinkowski & Ciszek, 2007). Glinkowski and Ciszek (2007) found that 88.4% (n=91) of the students thought telemedicine was

necessary in healthcare; however, widespread use of telemedicine by the beginning of the students' careers was expected by only 16.5% of the students, considered possible by 30.1%, unlikely by 6.8%, with 33.3% of the students unsure. These results suggest that health professionals may not have extensive or well developed understandings of Telehealthcare prior to undertaking education, and that the preparedness of the learner should be taken into consideration in educational courses/programmes for Telehealthcare.

Relevance of content

Descriptions of the development of the Queensland Telemedicine Network (QTN) (Blignault & Kennedy, 1999), the West Texas telepharmacy network (Seifert, 2004), the Pakistan national telemedicine curriculum (Zafar et al., 2008), the University of Iowa physician assistant telemedicine course (Asprey et al., 2007), a US Veterans Health Administration course for Telehealth care (Kobb et al., 2008), a Canadian team-based home telecare course (Atack et al., 2004) and a teleconsultation course for accident and emergency staff in the United Kingdom (Brebner et al., 2003) include summaries (albeit with varying degrees of detail) of the content provided for the learners to prepare them for the operation of these networks. Although based on courses offered for learners from differing health professional groups, these summaries show some consistency in the content they recommend as being relevant.

Recommendations were made by Asprey et al. (2007) that relevant content for a telemedicine course for physician assistants would include: definitions, discussion of uses and the place of Telehealthcare in the healthcare system generally, information about the technology and the applications used in Telehealthcare, information about access, security and privacy issues, and ethics and confidentiality. Students also undertook observation sessions at central and remote telemedicine sites. Seifert et al. (2004) outlined content for telepharmacy education that includes: an overview of telemedicine, a review of differing operating models of telemedicine (such as that available to provide primary care or specialist care), information about the technology (includes equipment and technology requirements), a practical issues section addressing topics such as digital transmission and accessibility, legal issues, and diagnosis, outcomes and patient satisfaction. Furthermore, the telepharmacy programme includes 'hands-on' experience. Subsequent to this learning session, students undertake a week long rural clerkship where they observe and practice telepharmacy in both the central location and the remote location.

Zafar et al. (2008) provided little detail of content but modules included basic computer training, basic telemedicine training and a telemedicine practicum. Blignault and Kennedy (1999) focused on videoconferencing and included introductory content describing telemedicine and its potential uses, managing an effective videoconference meeting and managing multipoints. Their experience with a statewide network has shown it is essential that staff have good working knowledge of Telehealth equipment's features and functions (Blignault & Kennedy, 1999).

Kobb et al. (2008) described results of an evaluation of an online curriculum designed to ensure a standardized competency among its home Telehealth practitioners in a United States Veterans Health Administration (VHA). In general, of the 500 participants, the majority of learners showed positive responses. Eighty seven percent of the respondents indicated that they had a 50% or more performance increase in competency levels and confidence, and their job duties. The top five skills they learned and applied to their work settings were: Telehealth operations (32%), Telehealth

roles/duties (22%), marketing strategies (18%), program implementation (17%), and enhancement in competence in patient selection methodologies (13%).

In the Canadian study, Atack et al. (2004) developed a Telehealth course using a participatory design approach that evaluated the course in cycles of consultation with health care professionals who brought varying Telehealth experience (from novices to highly experienced practitioners). The recommendations of relevant content from this study included ordering the content into four topic areas of change management, clinical aspects of telecare, patient issues and technology aspects (Atack et al., 2004). Within the relevant module, there was information related to "orientation to online learning skills, introduction to home telecare, orientation to a start-up project, home telecare tools, delivering home telecare, documenting home telecare, advanced troubleshooting, frequently asked questions, continuing professional development in home telecare, hand-on training in the workplace with specific technology" (Atack et al., 2004, p. 358). In contrast to the other studies, Brebner et al. (2003) narrowed the focus of their accident and emergency teleconsultation course to the technology, and the skills required to operate the Telehealth videoconferencing equipment.

Content creation based on modularity and case based approaches to reflect clinical practice was helpful for learners. Most of the studies modularised the content and attended to sequencing information to provide the most useful delivery. Atack et al.'s (2004) iterative process produced five versions of the course developed and reviewed by the learner-advisors before the final version. A major limitation of Atack et al.'s (2004) study, however, was that the respondents reviewed, rather than participated in, the course during its development. Despite individual differences in courses examined in this review, there were similarities in the modules presented. For example, the technology and applications tended to be dealt with as one topic, patient related activities as another.

Thus, relevant general content areas, applicable to all health professional groups (to be used with discipline specific knowledge and skill requirements), that can be derived from these studies include:

- the technology, tools, and applications (including troubleshooting)
- client related topics (such as privacy, ethics, legal issues)
- practitioner related knowledge and skills (for example diagnostics and patient outcomes, documentation, communication skills in the Telehealth environment)
- in some instances, information about starting up projects and project implementation may be useful depending on the purpose of the course.

Course Design and Teaching and Learning Methods

Communication skills and expertise in curriculum design are desired skills required of those who are responsible for designing Telehealth training programmes. Amarsaikhan et al. (2007) have noted that at a curricular level ongoing education in online curriculum design is needed to support wider development of courses and/or programmes for teaching and learning Telehealth. Most of the studies included in this review imply, rather than provide specific recommendations for, course

design. Atack and colleagues (2004) do provide some course development and design guidelines for teaching and learning Telehealth online. They noted that learners need easy access, an online orientation, rapid access to technical support during the course, clear 'help' features, and use of non-technical language to help them understand the technology. Furthermore, they suggest keeping online course design and navigation simple. The courses reported ranged from whole day workshops to courses with weekly classes (either online or face to face). There was no information in the studies that indicated the comparative effectiveness of either delivery methods or schedules.

Accepted principles of effective teaching and learning that apply in any course for developing knowledge and skills for application in a practice context are also required for Telehealth courses. Of specific interest to health professionals are preparation for practice, not just knowledge acquisition; the development of effective communication between patients and professionals; and the promotion of team functioning. A range of teaching and learning methods were utilised in the studies reviewed. These included didactic lectures, videoconferencing, online materials, printed materials, videoed materials, discussion forums, simulations, and experience in the practice context. Evidence from the studies showed a clear learner preference for methods that focused on experiential learning and the practical acquisition of knowledge and skills, such as simulation, demonstration, and practice experience, aligned with methods that supported learning (for example, discussion with providers and users, and support from other learners).

Authors such as Atack et al. (2004), Glinkowski and Ciszek (2007), and Kobb et al. (2008) recommend including online teaching and learning methods to familiarise learners with that learning environment in preparation for Telehealth. It is evident, however, that for learning Telehealth this needs to be combined with experiential learning in an actual or simulated practice setting. Several of the studies (Atack et al., 2004; Asprey et al., 2001; Blignault & Kennedy, 1999; Brebner et al., 2003) reported participants were least satisfied with didactic presentations as these were insufficiently practical or interactive, reinforcing the need to include experiential learning in Telehealth education. Learning for practice can be further supported by a case-based approach that reflects clinical practice and helps health professionals to learn, test their learning, and apply knowledge (Atack et al., 2004). Most of the studies used a variety of teaching and learning methods, and several found the provision of a variety of supporting materials was beneficial and well received by the learners (Atack et al., 2004; Blignault & Kennedy, 1999; Brebner et al., 2003). Use of 'just in time' learning with resources and help are beneficial. The presence of training manuals in print form close to the hardware was found to be beneficial, as were online resources that could act as a refresher (Atack et al., 2004; Blignault & Kennedy, 1999).

Opportunities for discussion were recommended in a number of the studies. Atack et al. (2004) suggest online discussion forums to support learning. In planning their course they included asynchronous discussions to accommodate learners' work and home responsibilities. The authors noted that if discussions were to be part of learning Telehealth, then learners need time assigned in the workplace to participate. Feedback from those involved with their course identified the value of connecting learners. Similarly, Blignault and Kennedy (1999) noted the supportive function of the QTN for exchanging information and problem solving among new and more experienced practitioners.

Few of the studies examined outcomes other than learner satisfaction. For health professional learners however, competence to practice is an important requirement. Two of the studies provide useful information about teaching methods in relation to assessment of learning and competence. Atack et al. (2004) noted that empowering learners to assess their own progress was beneficial in engaging learners and improved student satisfaction with the course. Providing self testing promoted this assessment of their learning through the instant feedback available and enabled learners to gauge their own learning (Atack et al., 2004). Brebner et al. (2003) provided a measure of the students' assessment of their competence. Brebner et al. (2003) described a study that evaluated both user satisfaction and competency levels based on a training course for accident and emergency medicine teleconsultation for health care providers in the UK. They conducted a survey that showed that students gained greatest competency when the training programme was accompanied by a training manual and practice opportunities. Based on self reporting, 35% of respondents felt fully competent with training alone. When training was accompanied by a training manual this rose to 56%, and to 73% with training, study booklet, and practice opportunities. Furthermore, retention of competencies learned in the course was highest when there were frequent opportunities to practice in their work settings as opposed to lower frequency of practicing. Nearly 100% of respondents who had daily or weekly practice following training reported maintaining the competence level they had gained immediately after training when reviewed 90 days post training. In contrast, the self reported competence levels were about 60% (based on skills learned) for those students who had monthly practice and 43% percent for those students who had less than monthly practice. Based on these findings, the researchers commented on the importance of regular practice or application opportunities for learners following completion of training programmes and the need for additional materials when Telehealth related training were offered.

Interpretation and synthesis of these four themes; the role of the context, the role of the learner's characteristics and preparedness, the relevance of content, and course design and teaching and learning methods, reveals the dynamic nature of relationships that have the potential to enhance the practices of teaching and learning about Telehealth care. Figure 3 illustrates these relationships, showing the centrality of the learner and their context, and the interactions between the learner and the context (both of learning and of Telehealth practice). A similar two way interaction is evident between the learner and the teaching and learning methods employed. The educationally well established interaction between course design, content, and teaching and learning methods is also noted. While the importance of these themes is not confined to the teaching of Telehealth care and health professionals, and could provide a basis for developing guidelines for educational practice for other applied disciplines and professional practices, the vital 'application' component is particularly relevant in Telehealth education. This is noted in the pathway to effective education and increased use of Telehealth that is provided by experiential learning opportunities, strategies for supporting learning transfer, and ongoing practice opportunities following education, that were a significant finding in this review (see Figure 3).

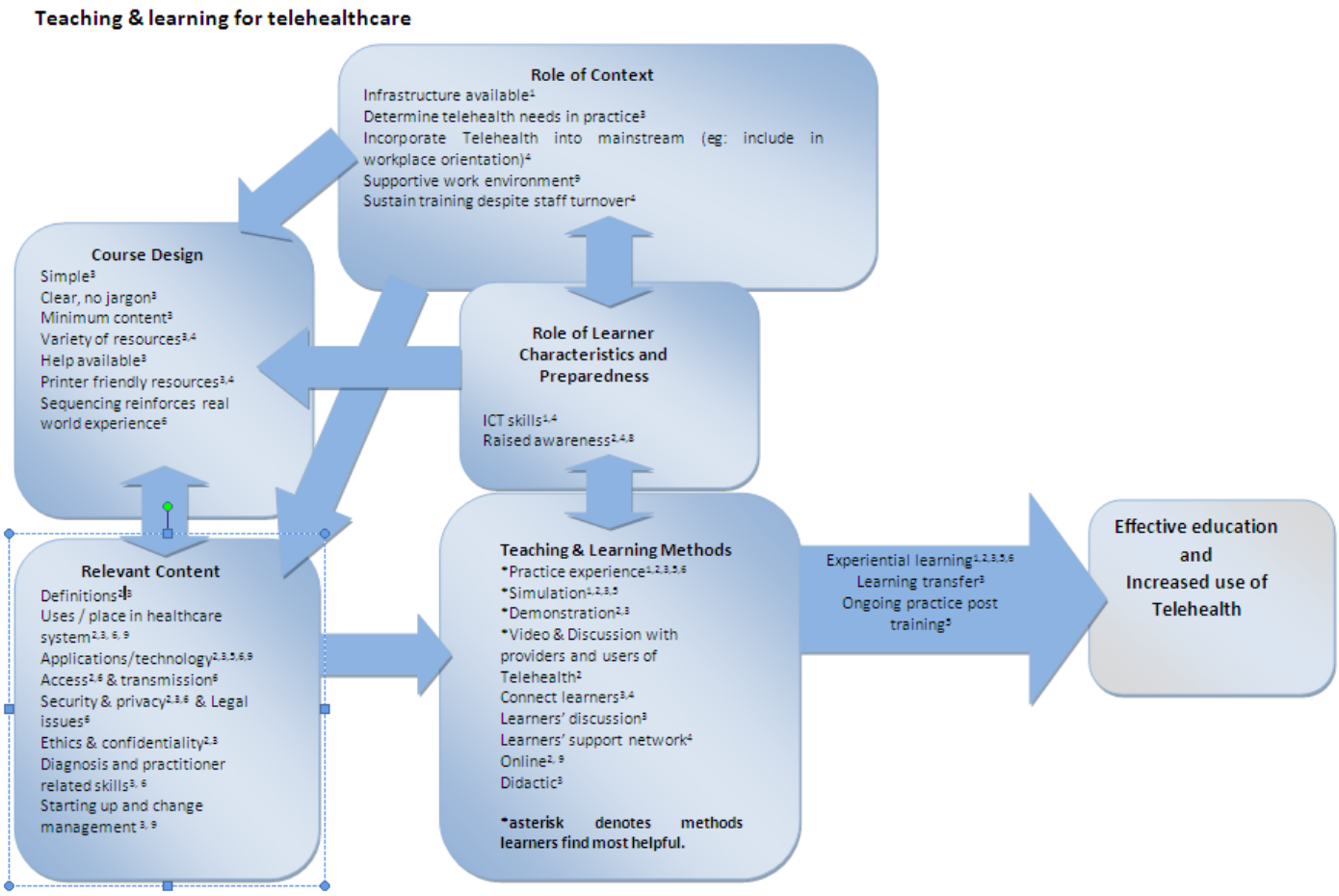

Figure 3: Relationships of educational themes for teaching Telehealth care

Note: the numbers in the superscripts are as follows:

1. Amarsaikhan et al. (2007)
2. Asprey et al. (2001)
3. Atack et al. (2004)
4. Blignault & Kennedy (1999)
5. Brebner et al. (2003)
6. Siefert et al. (2004)
7. Giansanti (2008)
8. Glinkowski & Ciszek (2007)
9. Kobb et al.(2008)
10. Zafar et al. (2008)

Discussion

Telehealth education as learning workplace practice

The following themes emerged from the review of studies (each number in the parentheses refer to the studies indicated in Figure 3).

1. The benefit of prior consultation with the learners either by formal needs assessment or consultation (See in particular 3).
2. Taking a non didactic approach (1, 2) Web, print based instruction was seen as less helpful.
3. Teaching and learning strategies seen as helpful were the use of promotional material and posters (4), videoconferencing with a focus on patient management (6), hands on practice in the workplace with accessible support (5), and providing immediate and frequent opportunities for practice early on in the skill development .
4. Learning transfer depends as much on the context and work climate as any other factors (8).

The findings of this review reinforce that Telehealth related training is essentially learning a workplace practice skill. These findings highlight that learning Telehealthcare is not solely about learning a new technology; it is also about adapting practice within a new technology and engaging with that technology. Therefore, it is useful to discuss learning and teaching for Telehealth by considering and applying models of workplace learning. Studies outside health professional education have shown that the workplace offers learning outcomes that cannot be obtained in formal courses (Billet, 1994; Boud & Garrick, 1999; Candy & Mathews, 1999). Billett's (2001, 2002) work notes the significance of participation in workplace learning and suggests the process of the construction of vocational knowledge depends on interaction with the work environment. Similarly, in John Hattie's synthesis of over 800 meta-analyses relating to student achievement, he singled out a particular educational program, Outward Bound, as having an excellent model of teaching in its out-of-the-classroom approach. "Outward Bound programs have an emphasis on the immediate quality of the experience, as well as aiming to have these immediate experiences have an effect on later experiences. That is, there is a planned and intentional transfer of experiences, knowledge, and decisions during the earlier learning experiences to later experiences (Hattie, 2009, p. 24).

Several findings from this review (for example: sharing knowledge between experienced Telehealth practitioners and learners (Atack et al., 2004), preferences for simulation and practice experience (Asprey et al., 2001), and development of practitioner networks (Blignault & Kennedy, 1999)) serve to show the influence of the workplace on learning Telehealth care, and reinforce the need to include workplace learning with more formal course offerings. That the requirements for performance are shaped by the requirements of the particular work practice was evident in the theme examining the role of the context. In part, this means that to become an expert requires participation in a workplace and development of the capacities to meet those requirements.

Apprenticeship learning practices have been tested and refined in a number of areas of work (Billett, 2001; Collins, Brown, & Newman, 1989). **Coaching** is the thread running through the entire apprenticeship experience. The master coaches the apprentice through a wide range of activities: choosing tasks, providing hints and scaffolding, evaluating the activities of apprentices and diagnosing the kinds of problems they are having, challenging them and offering encouragement, giving feedback, structuring the ways to do things, working on particular weaknesses. In short,

coaching is the process of overseeing the student's learning. In this model of workplace learning, the expert (as coach) makes the target processes visible by explicitly showing the apprentice what to do. In **modelling**, the apprentice observes the master demonstrating how to do different parts of the task often using techniques such as backward chaining designed to break down complex tasks into manageable chunks. **Observation** plays a key role; Lave (1988) hypothesizes that it aids learners in developing a conceptual model of the target task prior to attempting to execute it. Giving learners a conceptual model - a picture of the whole - is an important factor in apprenticeship's success in teaching complex skills without resorting to lengthy practice of isolated sub skills (Lave, 1988). In the field of telehealth where practitioners are reinterpreting their existing clinical practice through the new medium, modelling and observation are clearly helpful teaching and learning strategies in the early stage of learning.

Scaffolding is the support the master gives the apprentice in carrying out a task. This can range from doing almost the entire task for them to giving occasional hints as to what to do next. Support is withdrawn incrementally until the learner achieves independent performance. **Fading** is the notion of slowly removing the support, giving the apprentice more and more responsibility. The interplay between observation, scaffolding, and increasingly independent practice through fading aids novices in developing self-monitoring and correction skills and in integrating the skills and conceptual knowledge needed to advance toward expertise. These concepts appear useful and applicable in the teaching of Telehealthcare. In addition, the principles of cognitive apprenticeship are likely to be important for the consultation and case management aspects of learning teleconferencing for Telehealth; skills that are vital in health professionals' practice.

Figure 4 shows the relationship between clinical supervision and technology support for learning Telehealth. Note that in this process as the level of learner independence increases, the level of clinical supervision decreases and level of technical guidance increases. The first step is the observation period when the learner observes an expert practitioner modelling the required procedures. During this period the learner requires less technical support to use the technology as the expert retains responsibility for managing technical requirements. 'Shared practice' indicates the phase when the learner in combination with the expert and with fellow learners gets hands-on practise. 'Supervised practice' is undertaken with limited independence; it can be seen at this point that the learner requires increased technical knowledge and support as they manage the technology and adapt their practice to the new technology. 'Independent practice' is unsupervised practice.

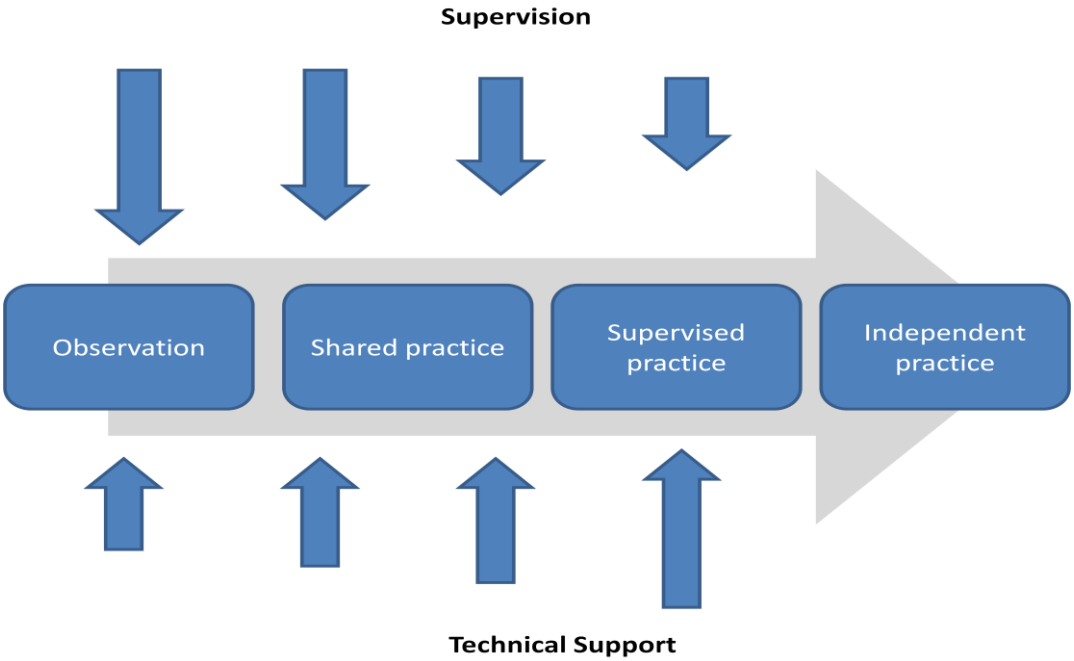

Figure 4: Relationship between clinical supervision and technology support.

The elements of workplace learning discussed above have important connotations for developing Telehealth related training programmes. It may be inferred from these principles that for successful Telehealth training programmes, selecting students for training who are 'in service' will maximise learner readiness and impact. Frequent context-based training is beneficial (i.e. using web applications or videoconferencing), and such sessions are especially useful for actual practical training sessions. Furthermore, availability of clearly written training guides was found to be beneficial.

Thus, in brief, learner and context sensitive training, use of supplementary materials, and opportunities to practise along with support to transfer learning to practice, were found to be important components of a successful Telehealth training programme, although it was unclear from existing research as to what extent each component might enhance competence and aspects of student learning outcomes.

Identified gaps in Telehealth education research

Several significant gaps in the research and current knowledge emerged from this review of educational programmes for Telehealth practice. These related to a focus on the technology, a lack of explicit pedagogy, and the importance of practical hands-on training facilities and opportunities to enhance learning transfer.

Despite advances in technology and the wide deployment of Telehealth for diagnosis of diseases in patients in distant settings, this literature search and review has shown that much research around Telehealth has related primarily to the technology, narrative reviews of the technology and implementations, and protocols for distance communication. In contrast, there was less emphasis on the process of educating staff who are responsible for handling the equipment effectively, and using

it effectively for diagnosis and treatment of patients. Clearly there is a need for further research in this area.

Secondly, although there have been significant advances in research methods, technologies related to teaching and learning, and expansion of the knowledge base of best educational practices in professional training (in medical and nursing education in particular and health professional education in general), these have not been reflected in the available literature that has described the experiences and design of educational curricula for Telehealth teaching and practice. While the courses and programmes we have reviewed in this report have generally described their content and some teaching and learning strategies, and listed their equipment, the pedagogy underpinning the practice of teaching and learning Telehealth care has not been discussed in any detail. Furthermore, they have not elaborated on the details of their evaluations, nor presented their findings in detail in ways that conform to established study designs to address internal validity issues pertaining to evaluation of the effectiveness of their approaches. Further, none of the studies actually compared the competence levels of students prior to taking the Telehealth course with post training competence. Instead, they depended on self reported competence levels and student satisfaction to indicate the perceived effectiveness of the programmes. There were no attempts to compare alternative training practices for Telehealth. Research designed to move beyond learner satisfaction to investigating actual outcomes and impacts on practice of various pedagogies and educational strategies would be provide a stronger basis for determining best practice guidelines.

Thirdly, the programmes reviewed here described accounts of training Telehealth professionals using either web based implementations or hands-on videoconferencing sessions. Based on student satisfaction and self reported competency on student surveys, a programme was perceived to be successful if it relied more on hands-on, relevant, and practical training rather than dissemination of didactic materials through either web based sessions or video conferencing sessions. Further, a programme would be successful and beneficial for the students if the programme was tied to an existing programme or was otherwise associated with frequent opportunities for the student to practice what he or she had learned.

Limitations

The findings of this study and its recommendations need to be interpreted in the light of several limitations. First, we applied filters and criteria for selection of literature based on our current understanding of best practices in integrating research evidence translated from traditional systematic reviews. Application of such filters may miss important studies that might not have been captured and resulted in high false positive rates of rejecting too many studies. Second, studies reviewed here were mostly reports with little detailed analysis of primary data or presentation of primary data on student satisfaction; even then, because of the paucity of data and this being an emergent field, few materials were available for review despite extensive search. Third, because technologies mature and enhance rapidly, we limited our searches to the past ten years. Earlier studies may have indicated the need to conduct evaluative research, and were missed. Finally, the recommendations for guidelines that we propose are based on the little empirical evidence available as well as contemporary thinking on educational research.

Recommendations for teaching guidelines for Telehealth

This review of literature shows there is little information available in terms of formal preparation of health care professionals whose main roles are to provide healthcare services over distance based networks or asynchronously delivered services. Evaluations of curricula reported in the literature have been based on student satisfaction or self-reported competence surveys, rather than measuring changes in competency or knowledge, attitudes or skills between pre implementation and post implementation of the programmes. As a result, there is little formal empirical evidence (or sufficient level or quality of evidence) to help in the formulation of a model of most effective Telehealth training practices.

However, within the limitations of quantity and quality of data available in this review, the following recommendations are made as a basis for guidelines for teaching Telehealth care:

Learning in practice

- **Incorporate existing communities of practice** of Telehealth professionals to scaffold and mentor learners as they move to independent Telehealth practice.
- **Provide workplace learning and on-the-job training** to maximise the application of skills in a relevant context.
- **Provide ongoing practice opportunities** so practitioners can develop and maintain competence.

Teaching practice

Focus teaching and support on **optimising the practitioner's transfer of professional skills** to the new medium.

Incorporate apprenticeship models of learning whenever possible.

Emphasise hands-on learning and practical experiences.

Utilise multiple teaching methods to ensure learner needs are met.

Educational strategies

Develop Telehealth-based training in undergraduate training of health care professionals.

Design Telehealth training that reflects and utilises the modalities used by the healthcare professional in their practice.

Technology

Undertake needs assessment to assess the level of technical support the practitioner will require.

Provide training to increase computer literacy when necessary.

Deliver training that is appropriate for the technological constraints of the work context.

Conclusion

The apparent paucity of research on the best practices of Telehealth teaching and lack of experimentation with different approaches may either underlie, or be the result of, poor uptake of this new technology in distance-based healthcare provision and therefore needs to be addressed. Delivery of health care at a distance requires a complex range of clinical skills, as well as skilled handling of Telehealth equipment, to facilitate delivery of care. While the majority of the studies have focused on using Telehealth equipment such as videoconferencing equipment, it is unclear from the papers presented here to what extent the teaching and learning process has enhanced or modified the communications skills of the clinicians (if at all). These issues need to be addressed in future studies.

This review points out that (a) there are significant gaps in research around the best practices in Telehealth teaching programmes worldwide that may have important implications for New Zealand; (b) experience from the review of limited studies and training description show that a programme on Telehealth teaching and training can work only when teaching and learning modalities and training sessions are contextualized with practice. Thus, if the Telehealth practice will be based on videoconferencing, the training is best based on videoconferencing facilities, or if the context of practice will be web based, then web based education is beneficial; (c) training for Telehealth should be tightly coupled with students' everyday practice and must be associated with ongoing practice opportunities to retain competence. Finally, there is a need for development of further innovative programmes to teach physicians, nurses, and Telehealth providers how to deliver Telehealth most effectively and to integrate telehealth technologies into undergraduate and postgraduate programmes.

An additional benefit of this project is the presentation of an applied example of a systematic review that may be relevant to other professions in the tertiary education sector. Systematic reviews are extensively used in healthcare to underpin evidence-based practice and provide guidelines for best practices. This project provides an example of using the systematic review method in the educational context that gives a model for educators, and potentially other disciplines, to use in their own fields.

Finally, educational practice spans many fields and disciplines. Many of the findings of this review may also be of interest, and use, to professionals beyond the health professions, particularly those in applied fields (such as teaching) or fields in which new information and communications technologies are increasingly impacting on practice.

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Appendices

Appendix 1: List of included studies

Table 5: Summary of articles included

(Note: figures in the parentheses correspond to numbers in explanatory diagrams and text in the discussion section for easy referencing)

Author (year)	Study Question	Study Design	Model	Findings
Amarsaikhan et al. (2007) (1)	Descriptive study of the organization of a distance education based programme for physicians in remote rural Mongolia for Telediagnosis	Description of the programme and presentation of data on student feedback on the education programme based on a cross sectional survey	Web based learning content management system (LCMS) driven, static content on the website, some training of the teachers and students	The model was based on static presentation of selected medical topics on a website using learning content management system. The offline component of the training required blending of real life experience with professional experience and learning not here. Student response was poor to the programme
Asprey et al. (2001) (2)	This was a descriptive study of the initial implementation and evaluation of a new curriculum at the University of Iowa's college of Medicine, targeted at physician assistants.	The primary goal of the module was to teach first year physician assistants the value, efficacy, risks, and challenges of Telemedicine. Evaluation of the course was done through an end of the course survey of 25 students	Four week course work each lasting 2 hours; in the first week, definition, applications, and theoretical discussions were held; in the second week, a demonstration of the Telemedicine for patient transfer was done; in the third week, there were discussions on Telemedicine and a videotaped presentation of resource Link was provided to the students, and in the fourth week, the students were led to a field visit to a rural or primary care perspective of Telemedicine implementation and students were encouraged to ask questions and interact with staff	Out of 25 students, 19 (76 %) returned the questionnaire. High scores denoted high satisfaction and low scores denoted low satisfaction (details not stated in the paper). Highest scores were obtained by speakers and demonstrations, simulations and hands on sessions; lowest scores were given to didactic sessions; In addition, the study also conducted a one sample pre test post test evaluation of knowledge obtained by the students on participating in the programme. Out of 18 students, 15 (83.3%) students did not have any knowledge about Telehealth prior to the programme, whereas 17 out of 18 students (94/4%) students reported having gained significant knowledge as part of participating in the programme, and 16 out of 17 students (94/1%) of the students stated that they were interested to pursue a career in Telehealth

				and Telemedicine
Atack et al. (2004) (3)	Online team based telecare course development with team teaching where target audience were nursing students and nurses Goal of the course was to prepare health care professionals in Telecare, support team based care, develop a multidisciplinary community of practice of nurses engaged in Telehealth care delivery projects	The course was developed in collaboration with health care professionals and managers and a team of students, physicians, nurses and health care professionals was developed who guided the course development. Focus group based needs assessments → development of the course --> evaluation of the course based on stakeholder evaluation. Point to note: there was no actual delivery of the course and the evaluation is not based on participation in the course	Participants were health care professionals with four levels of experiences – novices and first timers, some years of experience as surgeons who dealt with patients with cardiac bypass surgery, some years of experience with Telecardiology, and Telehealth care nurses. In developing the course, a formal needs assessment was done and a participatory approach was taken to develop the essential formats of course content delivery. The course was run for 6 weeks and consisted of online tutorials, online forums, case studies, video conferences, and field observations in two sites during the duration of the course. The course developed an extensive library of videotapes of different manoeuvres and procedures.	The formal needs assessment revealed five themes – most students had basic computer skills to begin with (exact numbers not provided), they were familiar with emails but no experience with online course, high prevalence of anxiety about learning online, they had no knowledge about online file downloads and video viewing, and reported low interest to seek help from technicians. Overall, the participants in the study found the modules that were planned in the course to be beneficial and topical for their daily practices and would add value. This observation was based on evaluation of the course contents but not on actual participation in the course
Blignault & Kennedy (1999) (4)	This was a description of the Queensland Telemedicine Network where the aim of the study was to provide staff good working knowledge of Telemedicine and assist staff to improve their	Detailed narrative review of the Queensland Telemedicine Network and how the different users were trained to use the network but the paper did not have any mention of a formal evaluation of the	There were four components to the training programme – first to raise awareness, the programme officials distributed promotional videos and poster materials to prime participants, second, several series of videoconference based presentations on various aspects of	No formal findings from any evaluation of this initiative was presented in the study although there were indications (based on statements but no clear mention of a study was done) that hands on training was well received.

	communication	effectiveness of their educational activities.	managing videoconference and patient management were provided, and these were well received although no formal evaluation of client satisfaction was done, third, to enable the learners quickly refer to materials, several well designed and well developed manuals were kept close to the equipments relevant to where they were going to be used, and finally, a Telemedicine interest group that originated the ideas of training were fostered.	
Brebner et al. (2003) (5)	Aim of the study was to develop a training programme and evaluate the user satisfaction and competency levels based on a training course for accident and emergency medicine teleconsultation health care providers	A training course was developed for the use of teleconsultation equipment. The course was developed by a combination of physicians, nurses, educators, and Telemedicine researchers. A total of 11 topics were prepared for the course that included camera manoeuvre, image processing and use of videoconferencing such as video calls and turning off. All tasks that were tested for and designed for were very manual tasks.	A total of 107 out of 130 trainees responded to the postal questionnaire (79% completion rate). Insufficient opportunity to practice was identified as a weakness of the programme. On a five point semantic differential scale, the satisfaction level for the training programme was 3.98 and for booklet for the programme was 4.12 Competency (based on self report) 35% after training alone 56% after training and studying booklet	In terms of research design, it was a very weak research design (a one shot post test only study) and showed that a combination of instructions, hands on training and follow up practice opportunities can be effective in increasing competencies for specific task oriented learning processes such as videoconferencing for clinicians and healthcare professionals. Based on these findings, the authors commented the following: Training programme backed up by written instruction Training programme provide regular practice opportunities Works best where there is regular practice opportunities Measure levels of user competence

		The effectiveness of the programme was evaluated by means of a postal survey to the students who took part in the programme. The programme was offered in the form of videoconsultation from one base station and 140 individual training sessions were conducted. The postal survey was conducted two months after the training	73% after training, studying booklet, and practice 100% competence level attained by students who had daily or weekly practice (measured two months after completion of training) 60% competence level for those students who had monthly practice 43% competence level for students who had less than monthly practice	
Seifert et al. (2004) (6)	Question To describe the operations of a "hub and spoke" Telemedicine programme where the hub was located in a central rural Texas county with one physician (Dr Sidney Ontal) and six spokes around the hub. However, there is also a system for training of Telepharmacy doctoral students during their rural training	Design The telepharmacy model is designed to deliver over distance what a community pharmacy would deliver. There are linkages between the remote site with the central pharmacy site at Lubbock, Texas, where all data from the remote site are stored for drug utilization review. Additionally, labels are generated for each patient for initial prescription and refill and transmitted to the remote site for dispensing. All these activities are co-ordinated by the use of DSL	Model In the Hub and spoke model of organizing Telehealth. The hub is located in one place and there are six spokes within 35-85 mile distances around the hub. The centres are equipped with audio and video conferencing equipments.	Findings The course was evaluated using standard course evaluation questionnaire surveys. The students expressed high satisfaction with the didactic components but gave poor ratings to the practical and field placement component. The students scored poorly for the log book based evaluation.

		connection between the remote site and the central site, presence and utilization of a drug inventory at the remote site, use of still camera image to capture the labels at each individual sites and use of store and forward technology for the transmission of data.		
Giansanti et al. (2008) (7)	The purpose of this study was to describe re-designing of a course of study for the training of biomedical laboratory technicians (TBLs). This study did not include any evaluation beyond presentation of student satisfaction and did not compare any strategies	The students were trained in addition to histology, pathological anatomy, cytology, skills in informatics so that at the end of their training they would be familiar with virtual glass technology, storage of virtual glasses in servers, and accessing and interpreting virtual glass slide based pathology imaging and health information systems and familiar with intranet, extranet, internet and other ways of accessing information. The teachers and students simultaneously used the system and responded to	No formal evaluation of the teaching component was done, but the authors indicated by way of informal student satisfaction survey at the end of the course.	The authors presented this as an instantiation of how to train technicians (or students in a professional skill building course) for practical or real life training situations which although required for their job, is not part of their traditional training curriculum.

		each other using the system on which the technicians were supposed to be working		
Glinkowski & Ciscek (2007) (8)	The purpose of this study was to develop a module on teaching anatomy for medical students and using the usability statistics and a survey to identify to the extent to which the students would then accept and practice telemedicine	The authors developed an anatomy website through which they assessed the access pattern of students and distributed a survey among the students to identify to the extent to which access to this website affected their propensity to practice telemedicine and attitudes.	The educational model was based on e-learning and creating resources and making them available to students enticing to use them.	The investigators found that there was a progressive increase in the number of unique site visits between 2003 (34, 534), 2004 (45, 771), and 2005 (67, 120). They also noted that there was a sharp rise of interest in this form of e-learning in 2005. In their survey, a total of 539 students took the survey and 82.4% expressed satisfaction with the webpage content. A total of 103 students were surveyed to identify the extent to which this website creation contributed towards their increased interest towards Telehealth or telemedicine adoption. In that survey, they identified that about 60% students (N = 62) had fair knowledge about the term “Telemedicine” and 10.7% students (N = 11) knew nothing about Telemedicine. About 85.4% of students believed that information obtained using class web page would enhance their practice of telemedicine
Kobb et al. (2008) (9)	The Veterans Health Administration's Employee Educational Services (EES) in combination with Sunshine Training centre (STC) developed an elearning training programme for home Telehealth providers. This	The STC-EES developed a 12 item process evaluation survey questionnaire (7 questions likert scale type questions ranging from never to great extent OR not applicable; 2 questions were related to their improvement in work performance following the	About 675 VHA employees were invited to take part in the training programme, and 500 employees completed the questionnaire (74%). For all the seven likert type questions, majority of the learners showed positive responses. Eighty seven percent of the respondents indicated that they had a 50% or more performance increase in both	E-learning is popular because: Flexible, convenient low cost or free The overall conclusion was that e-learning in the context of Telehealth delivery worked well in the setting of a workplace

	was a web based curriculum to ensure a standardized competency among its home Telehealth practitioners.	training and the extent to which they were confident about their skill levels. There was one open ended question. VHA staff were enrolled in a web based educational programme related to Home Telehealth care and 90 days after completion of the training, they were asked to complete this questionnaire. online	the objectives (attained desired competency levels), and their job duties. The top five skills that learners learned and applied to their work settings were: Telehealth operations (32%) Telehealth roles/duties (22%) Marketing strategies (18%) Program implementation (17%), and Patient selection methodologies (13%) The factors that would enable the learner to apply the skills to their job were: Relevant content (33%) Supportive co workers (26%) Supportive work environment (25%) Supportive work schedules (18%) Supportive supervisor (10%)	
Zafar et al. (2005) (10)	Question Describe and evaluate a collaborative Telehealth training programme between a teaching hospital in Pakistan (Rawalpindi) and a US Center based in Virginia (Virginia Commonwealth	Design Collaborative Telemedicine education project with US hospitals and a regional hospital in Pakistan that was focused on training rural medical practitioners in four modules of	Model This was baed on formation of a consortium of experts from Pakistan and the US, establishment of a remote hospital (remote from Rawalpindi) to serve as a test facility where Telemedicine would be delivered; the joint faculty	Findings Although details of student feedback was not described in the evaluation, the authors described that the establishment of the Telemedicine training programme was very beneficial in facilitiating medical relief operations during a major earthquake disaster that struck that particular area of Pakistan

	University)	Telemedicine delivery.	drafted a syllabus and taught a wide variety of theoretical and practical topics through software implementation. The students learned basic computing, basic topics on Telemedicine, and they had an 18 hour practicum Collaboration between Telemedicine experts from Pakistan (Rawalpindi) and from the US (Virginia Commonwealth University)	

Appendix 2: List of excluded papers

Table 6: Summary of articles excluded

Result Number	Place of Study	Author/s Publication	Purpose of research	Reason for exclusion
1	Norway	Aas (2002) *Journal of Telemedicine and Telecare*	To investigate learning in Telemedicine.	Focus on telemedicine as a teaching strategy, not its application to Telehealth.
2	Tokelau	Adam (2000) *Pacific health dialog : a publication of the Pacific Basin Officers Training Program and the Fiji School of Medicine*	Telehealth as a critical issue in the development of health services for Tokelau; distance education for health care staff.	Distance education as a teaching strategy, not its application to Telehealth.
3	Central Europe	Anogeiananki et al. (2004) *Journal of Telemedicine and Telecare*	Internet based virtual classrooms to provide a training course in medical informatics.	Not related to delivery or teaching of Telehealth.
4	USA	Boulos, Taylor, & Breton (2005) *Telemedicine Journal and e-health*	Online distance learning using live virtual classrooms	Not related to delivery or teaching of Telehealth.
5	Canada	Boutin et al. (2006) *Journal of Nursing Care Quality*	To evaluate the effect of a continuing education activity on the clinical evaluation and advice provided by nurses working for a telephone triage service with an asthmatic client base, and to measure the number of referrals to Asthma Education Centers (AECs).	Not related to delivery or teaching of Telehealth.
6	USA	Cardall, Krupat, & Ulrich (2008) *Technology and Medical Education*	To assess medical students' perceptions, evaluations, and motivations concerning live lectures compared with accelerated, video-recorded lectures viewed online.	Not related to delivery or teaching of Telehealth.
7	Brazil	De Godoy et al. (2004) *Journal of Telemedicine and Telecare*	Use of videoconference to train nurse auxiliaries in a Brazilian hospital in intramuscular injection.	Not related to delivery or teaching of Telehealth.

8	Italy	De Lieto et al. (2002)	Evaluated the effectiveness of teledidactic applications in the first Italian project in conventional and computerized telecardiotocography (TOCOMAT).	Focus on computer-aided education for distance education programmes.
9	USA	American Council on Education (2001, 2002)	Series on distributed education in the USA.	Not related to delivery or teaching of Telehealth.
10	NZ	Grant et al. (2008) *Journal of Paediatrics and Child Health*	To describe the delivery of a teaching programme that helps paediatricians in training in both peripheral and regional centres in NZ to successfully prepare for their specialist written examinations.	Not related to delivery or teaching of Telehealth.
11		Gschwendtner et al. (1997) *Journal of Telemedicine and Telecare*	What do students think about telemedicine?	Not related to delivery or teaching of Telehealth.
12	Canada	Jennett, Hunter, & Husack (1998) *Telemedicine Journal*	Telelearning projects associated with the 13 established Canadian Telehealth centers in order to describe the nature of their activities, outline enablers and barriers to these activities, and present key action plans to move the Canadian agenda on telelearning in health forward.	Focus on telelearning as a teaching strategy, not its application to Telehealth.
13	Brazil	Kavamoto et al. (2005) *Journal of Telemedicine and Telecare*	Interactive education model in rehabilitation using videoconferencing, internet, and 3D animated models.	Not related to delivery or teaching of Telehealth.
14	Canada	Kroeker et al. (2000) *Telemedicine Journal and e-health*	Telelearning technology may provide a way to improve access to continuing medical and residency education through	Focus on telelearning as a teaching strategy, not its application to Telehealth.

			better use of limited resources, including medical specialists.	
15	Canada	Langille et al. (1998) *Journal of Continuing Education for Health Professionals*	Assessment of the acceptability and costs of interactive videoconferencing for Continuing Medical Education in Nova Scotia.	Focus on videoconferencing as a teaching strategy, not its application to Telehealth.
16	Canada	Lieff (2009) *Academic Medicine*	Curriculum design using a learner-centred collaborative method.	Not related to delivery or teaching of Telehealth.
17	USA	Loera, Kuo, & Rahr (2007) *Telemedicine Journal and e-health*	Telehealth distance mentoring of students.	Not related to delivery or teaching of Telehealth.
18	UK & USA	Mangrulkar et al. (2002) *Telemedicine Journal and e-health*	Use of telemedicine technology for teaching medical/health education at all levels.	Focus on telemedicine as a teaching strategy, not its application to Telehealth.
19	India	Mukherjee et al. (2001) *IETE Technical Review (Institution of Electronics and Telecommunication Engineers, India)*	A telemedicine system for the treatment of tropical diseases.	Doctor-to-doctor consultation, not teaching of Telehealth.
20	USA	Neuman (2006) *Nursing Education Perspectives*	Envisioning the evolution of e-Nursing education.	Not related to delivery or teaching of Telehealth.
21	USA	Stevens et al. (2005) *Proceedings of the Human Factors and Ergonomics Society*	VR training of medical students to diagnose and treat a patient avatar experiencing a serious head injury.	Not related to delivery or teaching of Telehealth.
22	Hong Kong	Tse & Lo (2008) *Telemedicine Journal and e-health*	The development, utilization, and evaluation of a Web-based e-learning course for nursing students, entitled Integration of Pathophysiology into Pharmacology.	e-learning as a teaching strategy, not related to Telehealth.
23	International	Van der Werf (2004) *Studies in health technology and informatics*	A study of the characteristics that drive successful and unsuccessful telemedicine programs.	Not related to delivery or teaching of Telehealth.
24	USA	Varkey et al. (2008) *Journal of*	Examined the use of telemedicine for	Not related to delivery or teaching of

		Telemedicine and Telecare	improving access to care in a work-site clinic.	Telehealth.
25	USA	Whitten et al. (1998) *Journal of Continuing Education for Health Professionals*	Physicians participating in continuing education delivered via interactive video and those in a traditional classroom setting did not differ in their attitudes toward the attributes of content, speaker, and program in the two methods.	Not related to delivery or teaching of Telehealth.
26	Australia	Yellowlees (2001) *Journal of Telemedicine and Telecare*	Issues associated with the future of Telehealth in Australia.	Not related to delivery or teaching of Telehealth.