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THE CURRENT CONDITION AND FUTURE DEVELOPMENT OF TELEMEDICINE : SYSTEMATIC REVIEW

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ABSTRACT

Objectives: To understand the application condition of telemedicine and discuss its future development strategy.

Methods: A systematic search was undertaken for current application condition of telemedicine. Telemedicine, ehealth and telehealth were used as searching terms to retrieved follow three databases from their establishment to the end of June 2013: PubMed, Cochrane Library, Google Scholar. Studies on patients and consumers, health professionals and family caregivers were involved. Studies such as overview, expert advice, lectures, announcements, conference presentations, project introductions were excluded.

Results: 140 studies met the inclusion criteria which included 86 systematic reviews, 44 literature reviews, 1 evidence-based analysis, 1 original research, 2 evaluation and appraisal system reviews and 6 other types of studies. 18 studies are about mental health, 14 are endocrine gland, 13 are radiology, 12 are burns treatment, 8 are chronicdisease and so on. Telemedicine application types can be divided into the following four types: telemonitor, teleconsultation, telereference, teletherapy.

Conclusion: Telemedicine has obtained great progress development, which could be developed better if following suggestions: more evidence on cost effectiveness of telemedicine in the level of policy are needed, a compromising attitudes to the telemedicine is needed in its initial stage, and telemedicine should be encouraged to be applied in disease prevention and health consultation.

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INTRODUCTION

Telemedicine is defined as a method to exchange medical information from one place to another place through electronic communications with the purpose of improving, maintaining, or assisting patients' health status (Murdoch, 1999). Telemedicine should be distinguished from its thesaurus such as "telehealth, or ehealth" which mean remote health care that not involve clinical services, for example, video-conferencing,

transmission of still images, patient portals, remote monitoring of vital signs, continuing medical education, and nursing call centers (Reported from ICU care LLC.). Telemedicine reported has been having positive effects to improve health care in terms of health care receivers. Telemedicine can improve people's health who lived in remote areas through diseases' early diagnosis and treatment. For example preliminary evaluation predicts improvement of the quality of medical care through intensification of diagnostic-therapeutic process and more prudent use of the labor and physical resources. Additionally telemedicine supports new work places or guarantee their existing and survival, saves money for patients, and increases accessible and quality of healthcare, especially in such important social groups like elderly,

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powdery, children, invalids, and people with tuberculosis, infection and parasite deceases, cancer, AIDS or others (Elena *et al.*, 2006). On the other hand, full-service telemedicine networks or systems provide a broad range of clinical services in various specialty areas, as well as continuing medical education and preventive health (Rashid *et al.*, 2000). Such technology enables an essential redesign of health care approaches, which are based on the usage and integration of electronic communication at all levels. Interest in the studies' introduction of telemedicine for the management of diseases treatment is twofold: (a) to improve patient access in remote areas or where numbers of specialists are limited; and (b) to improve disease control and relapse prevention, thereby improving information and follow-up continuity (García-Lizana *et al.*, 2010). Although telemedicine has the potential to improve health care, the number of clinical applications is still small and constrained by custom, regulatory reimbursement and technical issues (Kim *et al.*, 2004). It is uncertain whether or not telemedicine is a kind of cost effectiveness method for individual patients or health care services supporters, because telemedicine being suggested need more health specialists attending and high price equipments and structures investment.

The attitudes and cost benefits among governments, health care services suppliers and other parts should be analyzed and balanced before widely promoting telemedicine nationally. What's more, the adoption of sound policies and strategic plans that guarantee the provision of high quality, sustained and integrated health services to the population are challenges faced by most governments today (Laouyane, 1994). Economic analysis is of central importance to telehealth because the main rationales for its introduction have been to decrease the cost of delivering health care, make more efficient use of the health workforce, and improve timely and equitable access to services (Wade *et al.*, 2010). To meet these challenges, those telemedicine practitioners and researchers, especially health care policy makers should understand the current conditions and probably challenges appearing in the future. This study tries to answer the question of what kind of clinical settings have been applying telemedicine and its current condition. Then more discussion are focused on why telemedicine was acknowledged by healthcare service suppliers but developed slowly in both developed and developing countries.

METHODS

Search Strategy

The following searching terms were applied in the whole literature searching: "telemedicine", "ehealth", "telehealth". The main literature sources are PubMed, Cochrane Library and Google Scholar. All databases are limited to the core database retrieval. The time frame was from the commencement of the databases until 2013.6. The main search was performed in 2013.8. In addition, studies which included a small component of telemedicine in the review had their reference lists searched for additional articles.

Inclusion criteria

Studies on patients and consumers, health professionals and family caregivers, were involved, and types of disease were

not limited. All tele-medicine interventions, information and communication technologies in health care, Internet based interventions for diagnosis and treatments. Studies comparing telemedicine with usual care or with another type of care. Outcomes were specified as telemedicine application types and areas, health outcomes obtained from telehealth services, tele-medicine process outcomes and costs or resource use.

Exclusion criteria

Studies with participants considered not relevant with telemedicine or animal studies were excluded. Studies on telehealth services that were not about direct patient care i.e. education, administration and social uses of the telehealth infrastructure were not included. Studies without relevant outcomes, i.e. cost analyses with no health outcomes data, economic analyses where the only health outcomes were satisfaction data, or where the health outcomes were not collected equally across comparison groups were excluded. Studies such as overview, expert advice, technical articles, conference articles, news articles, summary of experience articles, lectures, announcements, conference presentations, project introductions and duplicate publications were not involved.

RESULTS

We identified 1250 records (PubMed 320, Cochrane Library 100, Google Scholar 830) through the initial searches and excluded 1110 based on the specified inclusion and exclusion criteria. Finally, we retrieved the screening 140 studies in full text which included 86 systematic reviews, 44 literature reviews, 1 evidence-based analysis, 1 original research, 2 evaluation and appraisal system reviews and other types of studies. The specific studies types are shown in Table 1. According to the technical attributes of telemedicine, telemedicine application types can be divided into the following four types: telemonitor, teleconsultation, telereference, teletherapy. Studies classification based on those types are respective 23, 18, 14, and 8. Application status are shown in Table 2. Telemedicine are using in different areas of clinical medicine. From our searching, 18 studies are about mental health, 14 are endocrine gland, 13 are radiology, 12 are burns treatment, 8 are chronic disease and so on. The exact fields of application are shown in Table 3.

Table 1. Study types

Types of studies	Number of studies
Systematic review	86
Literature review	44
Evidence-based analysis	1
Original research	1
Evaluation and appraisal system	2
Review	3
Other types	3
Totals	140

Table 2. Telemedicine application types

Telemedicine application types	Numbers studies
Telemonitor	23
Teleconsultation	18
Telereference	14
Teletherapy	8
Totals	63

Table 3. Area of application

Area of application	Number of studies
Burns treatment	12
endocrine gland	14
chronicdisease	8
Cardiology	6
Dermatology	5
Emergency department	3
Home care and patient monitoring	6
Medical consultation	3
Mental health	18
Neurology	7
Ophthalmology	1
Pathology	0
Radiology	13
Totals	68

DISCUSSION

From the results, we can see that telemedicine today is no longer the form as its initial appearances. With the advance of technologies and medical conceptions, it has become possible to capture and store or transmit an ever increasing amount of information in the form of medical records, sound, static images, and moving images to different health care specialists in various locations. Additional since the opportunities for information transfer are opening, users are emerging, telemedicine was applied in various medical domains such as endocrine gland, chronic disease, cardiology, dermatology, surgery and so on, with kinds of types mainly including telemonitor, teleconsultation, telereference and teletherapy.

Telemedicine has a great demand for nations and patients, and the use of information technology in health care has grown exponentially for several years (Pagliari *et al.*, 2005), but why telemedicine developed slowly in past and today even having high advanced technologies supporting? It is clear that the main problem in telemedicine is not a lack of technology; rather, it is the organizational issues of capacity building of knowing how to take advantage of the technology. First, the inadequate cost effectiveness analysis of telemedicine did not supply powerful evidence to encourage governments or wealth holders to invest, which means true and stimulating analysis is necessary before promoting telemedicine nationwide. Second, due to the lack of analysis, patients do not realize their large savings from the telemedicine. Resulting in the clients' needs do not play an exact effect role on the promotion of telemedicine.

One study from Russian reported real-time teleconsultation using video-conferencing technology, the total cost varies from 100 to 300 US\$, which cost large amount of money for many Russians, but not when compared to the total costs of a round trip to Moscow including air tickets, housing, professional consultation fee and so on (Elena *et al.*, 2006). One study on the cost effectiveness analysis suggested that the saving was associated with the distance between patients and health care specialties, which means patients and their families living far from big medical center can save more money and time through telemedicine instead of visiting physicians for face to face consultation (Arora *et al.*, 2011). Telemedicine also has the benefit of supplying continue monitor or consultation by medical expert which is impossible with travels. Third, the lack of cost effectiveness of telemedicine

projects analysis for physician continue education is another barrier to public implementing telemedicine supported by government budgets. Telemedicine is useful for post graduated doctors' training in remote or undeveloped areas where less medical resources be accessed. Understanding of economic efficiency of information technologies for cutting the cost associated with training process of each doctor is the first step to promote and disseminate the tele-education throughout the rural and remote districts of the country. There is a significant need for occupational therapy practitioners to document, research, and publish on the efficacy of consultation, intervention, and follow-up services provided using telemedicine technologies (Wakeford *et al.*, 2005). Besides these economics and management problems, the promotion of technology may also be one factor affecting the telemedicine's development. Despite changes in equipment is apparent in these years, there have not been significant changes in transmission methodology. It is interesting to note that the telemedicine application types only have four kinds: telemonitor, teleconsultation, telereference, teleconsultation and teletherapy, which may be the result of the technology limitations.

Although there are some main barriers impeding telemedicine development, telemedicine development will embrace more and more opportunities with the technology development and public realization for its benefits, especially with all countries emphases and contribute to the health care equality. It is wise to promote the development of telemedicine through overcoming those barriers above telemedicine development. First, more evidence on cost effectiveness of telemedicine in the level of policy, not just stayed on research are needed. In fact, the cost effectiveness of telemedicine projects between healthcare professionals are a balance between the cost of equipment, communication, and two healthcare professionals per consultation on one side and convenience of time, travel savings, and educative benefits on the other side. A comparison of the costs of telemonitoring and usual care for heart failure patients found that telemonitoring could reduce travel time and hospital admissions, whilst noting that benefits are likely to be realised in the long term (Seto, 2008). There are two ways proposed to assess the economic efficiency of telemedicine. One is the direct money expenditure comparison between the usual process to obtain a consultation and telemedical ways in those remote areas. It is clear that the farther a patient lives from professional consultations, the more he saves.

The other is the telemedicine's time recovery from the original investment. So the no-film radiology should be encouraged in clinical since the film expense is eliminated, with more efficient distribution of labor resources. Telemedicine costing is one of the influencing factors for implementing it widely; however, evaluation of healthcare structure and long-term outcomes in terms of population health is more important than economic efficiency evaluation mentioned above. Secondly, we should have compromising attitudes to the telemedicine in its initial stage. High quality research evidences on clinical efficiency, safety, is vital for developing telemedicine widely. Any health care interventions first should be guarantee the safety for patients in both short outcomes and long term outcomes. And any misdiagnosis or mistreatments is not

allowable and permissible. But there is no one health care intervention is perfect for everyone patients, which means telemedicine, bringing great contribution to help more patients living in remote areas get more health services, telemedicine should be encouraged first and then identify and deal with its weakness in diseases' treatment and diagnosis. Several reviewers found that research has been somewhat narrowly focused and suggested further research which takes a broader perspective or a different one. They suggested that telemedicine researchers have not yet asked all the important questions, or conducted research in appropriate ways. For example, in the cases of dermatology, wound care and ophthalmology, it was argued that evaluation has explored ICT-based asynchronous services for efficacy, but outcomes or access issues have not been considered (Hersh *et al.*, 2006). Health care policy maker do not get any experience or lessons on telemedicine until encouraging researchers conducting pilot research on it. The implementation of telemedicine in routine health services is being impeded by the lack of scientific evidence for its clinical and cost effectiveness. The British government has stated that, without such evidence, telemedicine will not be widely introduced (Wootton, 1999). Policymakers have been warned against recommending investment in unevaluated technologies (Wootton, 2001).

Thirdly, telemedicine or telehealth should be encouraged to be applied in disease prevention and health consultation. Disease treatments and diagnosis could not possible to help all people keep health unless the disease prevention policies and strategies are highlighted in national level. In one study, a third of people who succeeded in consulting a clinician by telephone would have otherwise gone to an emergency department (Delichatsios *et al.*, 1998). This requires all health care service suppliers conduct more and formal health care educations and consultations through telehealth or telemedicine for high risk populations, which requirement become more apparently with aging periods approaching. Good news is that there are various telehealth resources and agents have been giving guidance or consultations for people inquiring in the market, the bad news is most of those guidance and consultations with no supervising are not professional and formal, because major conductors are not experts in health care, those guidance is lack of research evidence support, and no formal agents are responsible to those health care inquiring. So a formal, professional, and responsible telehealth research consultation organization should be initiated and supervised.

Research is a bridge connecting telemedicine theology and practice. How to narrow the gap between telemedicine systems and services through researches? Taylor outlines an approach to research in telemedicine that is helpful. He distinguishes between research into telemedicine systems and research into telemedicine services. Research into telemedicine systems he divides into three phases. The first involves identifying the technical specification required for the application under consideration; the second involves testing that this is appropriate in practical use; and the third involves establishing a set of standards and guidelines to ensure that the system is used to best advantage. For research into telemedicine services he again divides research into three areas. The first is research

into models of telemedicine comprising treatment services (remote robotic surgery, for example), diagnostic or management services, and information or educational services. The second is research into the implementation and installation of telemedicine services. The third is research into the effects of telemedicine services including user satisfaction, medical outcomes, and financial measures.¹ So areas in which review authors agreed that telemedicine shows therapeutic promise, but still requires further research, include numerous healthy fields (Ekeland *et al.*, 2010). Telemedicine still has more work to do to illustrate its feature. Increasing use of the telemedicine technology in health care represents just one of the range of developments in information technology that are likely to greatly alter the way in which clinical care is delivered in the future (Car and Sheikh, 2003). Individual patient can save money for more health services access until adequate healthcare services be available in the regions. Telemedical education promotion throughout the whole country is decided by the realization of economic efficiency of information technologies for cutting the costs associated with training process of each doctor. So we can say telemedicine is matured in that it has entered the public consciousness and be applied in various clinical fields. More evidence on cost effectiveness of telemedicine in the level of policy are needed, a compromising attitudes to the telemedicine is needed in its initial stage, and telemedicine or telehealth should be encouraged to be applied in disease prevention and health consultation. Telemedicine will not develop before telemedicine research or pilot programs are encouraged in the policy level.

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REFERENCES

- Arora, S., Thornton, K., Murata, G., Deming, P., Kalishman, S., Dion, D., Parish, B., Burke, T., Pak, W., Dunkelberg, J., Kistin, M., Brown, J., Jenkusky, S., Komaromy, M. and Qualls, C. 2011. Outcomes of Treatment for Hepatitis C Virus Infection by Primary Care Providers. *The new england journal of medicine*, 364:2199-207.
- Car, J. and Sheikh, A. 2003. Telephone Consultations. *BMJ*, 326:966-969.
- Delichatsios, H., Callahan, M. and Charlson, M. 1998. Outcomes of telephone medical care. *J Gen Intern Med*. 13:579-85.
- Delivery System. Annu. 2000. *Rev. Public Health*. 21:613-37.
- Ekeland, AG., Bowes, A. and Flottorp, S. 2010. Effectiveness of Telemedicine: A systematic review of reviews. *International Journal of Medical Informatics*. 79:736-771.
- Elena, V., Khasanshina and Stachura, 2006. Socio-economical Impact of Telemedicine in Russian Federation.

- International Journal of Economic Development*. 8(3):748-775.
- García-Lizana, F. and Muñoz-Mayorga, I. 2010. Telemedicine for Depression: A Systematic Review. *Perspectives in Psychiatric Care*. 46(2):119-126.
- Hersh, W., Hickam, D., Severance, S., Dana, T., Krages, K. and Helfand, M. 2006. Diagnosis, Access and Outcomes: update. *J. Telemed. Telecare*. 12 (2):3-31.
- Kim, YS. 2004. Telemedicine in the USA with Focus on Clinical Applications and Issues. *Yonsei Med Journal*. 45(5):761-75.
- Laouyane, A. 1998. Telemedicine and Developing Countries. *Journal of Telemedicine and Telecare*. 4:2.
- Murdoch, I. 1999. Telemedicine. *Br J Ophthalmol*, 83:1254-1256.
- Pagliari, C., Sloan, D., Gregor, P. et al. 2005. What Is eHealth (4): a scoping exercise to map the field. *J Med Int Res*. 7:A9.
- Rashid L. Bashshur, Timothy G. Reardon and Gary W. Shannon, 2008. Telemedicine: A New Health Care Seto E. Cost Comparison between Telemonitoring and Usual Care of Heart Failure: a systematic review. *Telemed. J. E Health*. 14 (7):679-686.
- Wade, VA., Karnon, J., Elshaug, AG. and Hiller, JE. 2010. A systematic review of economic analyses of telehealth services using real time video communication. *BMC Health Services Research*. 10:233.
- Wakeford, L., Wittman, PP., White, MW. and Schmeler, MR. 2005. Tele-rehabilitation Position Paper. *Am J Occup Ther*. 59:656-60.
- What is Telemedicine? Reported from ICU care LLC.
- Wootton, R. 1999. Equipment for Minor Injuries Telemedicine. *Journal of Telemedicine and Telecare*. 5(3):14-19.
- Wootton, R. 2001. Recent advances: Telemedicine. *British Medical Journal*. 323(7312):557.
