USING TELEMEDICINE TO PROVIDE MOBILE VIDEOCONFERENCING TO DELIVER SIMULTANEOUS MULTI-CENTRE HEALTH EDUCATION TO ELDERLY PEOPLE: A PILOT STUDY ON ACCEPTANCE AND SATISFACTION

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Abstract

Background: Improving the health literacy of elderly people is an important means of promoting preventive care by empowering self-health management. While talks and workshops are common ways of delivering health education, their scale and coverage are limited by practical constraints. In this regard, a mobile multi-centre videoconferencing (VC) approach is proposed to connect elderly people at different elderly care centres, so that healthcare promotion activities conducted at one centre can be multicast simultaneously to others. The aim of this pilot study is to evaluate the acceptance and satisfaction of users with this approach. Methods: Three VC sessions were conducted to evaluate users' acceptance and satisfaction of the proposed approach in different settings from a technical perspective. Healthcare promotion activities concerning healthy diets and health-promoting exercises were delivered using a commercial videoconferencing system and a cellular 4G network. User acceptance and satisfaction were measured at the end of each session using a 10-item 5-point Likert questionnaire, with 5 indicating the most positive response. Results: A total of 96 participants aged 60 years or above were recruited, with 12, 30, and 54 participants taking part in the three sessions, respectively. The mean scores of the items for the three sessions were within the ranges of 4.3–4.8, 4.4–4.8, and 3.7–4.5, respectively. Conclusion: The results show that the multi-centre videoconferencing approach was accepted by the participants from a technical perspective. It is potentially a feasible approach for promoting health literacy to elderly people.

Keywords: videoconferencing; telemedicine; aged; health education; mHealth; technology enabled learning

Introduction

How to care for ageing populations, which are placing an increasing burden on healthcare systems that are already struggling to cope, is a critical issue worldwide. One approach that can help to alleviate the burden is to improve preventive care by raising the health literacy of elderly people, empowering them to better manage their own health. Knowledge on how to care for oneself can help elderly people to lead a healthier lifestyle and maintain their well-being. It can also raise their awareness of potential health problems, allowing them to act before these problems develop into more serious illnesses.

Previous research has shown that there is a link between health literacy and health. For example, inadequate health literacy was found to be related to ignorance of preventive services,[1] poor physical and mental health,[2] and even to cardiovascular mortality.[3] Health talks and workshops are common ways of delivering health education. They are relatively efficient in the sense that basic healthcare knowledge can be delivered to multiple people in an activity room or lecture hall. However, their scale and efficiency can be limited by the availability of space and instructors.

The use of videoconferencing (VC) to support healthcare promotions among the elderly has been explored. For example, 52 patients from a rural town in Northern New South Wales, Australia, with a mean age of 74 years and an average of four chronic conditions participated in a 5-week home-based group education programme by VC.[4] The results show that telehealth can improve the delivery of knowledge about the self-management of chronic diseases. An Internet-based remote video consultation for elderly people living in their homes in Seoul, South Korea, was adopted in an 8-week controlled study of hypertension management. In the study, 49 low-income elderly subjects with hypertension, aged 65 years or above, were recruited.

The 25 subjects in the experimental group received a remote video consultation. It was found that the approach was effective at reducing systolic blood pressure levels and levels of depression.[5]

The use of VC was also extended to tele-exercises. In Burlington, Vermont, USA, a group of 17 elderly subjects with a mean age of 81 years (14 of whom lived alone) and who had fallen at least once in the past year, participated in a 15-week tele-exercise. Supervised remotely by an instructor using broadband Internet-based VC, the subjects practised Tai Chi individually in their homes while seeing and hearing each other through VC.[6] The programme was well accepted and was found to be an effective way to improve balance and reduce the fear of falling.

Furthermore, a controlled trial involving 57 cognitively able nursing home residents in Taiwan was conducted through a 3-month VC programme.[7] In addition to regular care, the 24 subjects in the experimental group, with a mean age of 74.2 years, were provided with a weekly 5-minute VC session with their family members. They were able to interact using laptop computers connected to the Internet via a wireless modem and running generic videoconferencing software. The approach was found to be effective at reducing the depression and loneliness of nursing home residents.

VC can be readily arranged with the technologies that are available nowadays, for example, using broadband Internet with generic software such as Skype.[7,8] Robotics-integrated VC systems, e.g., Kubi and Beam, have also been developed for use in home care, where a video camera can be oriented or navigated via a wheeled base from a remote location.[8] Furthermore, telepresence systems designed for business use, such as Vidyo[9] and Cisco WebEx,[10] can also be applied to telemedicine. They are well suited for large multiparty VC, and can attain a high level of video quality of 1080p at 30fps.

The foregoing VC-enabled telehealth approaches have demonstrated feasibility and effectiveness in their respective applications. This paper presents an alternative VC approach that involves multiple elderly care centres. Healthcare promotion activities were simultaneously delivered to elderly people in the centres by VC over a 4G mobile network. Mobile videoconference facilities were installed at six geographically separated elderly care centres, so that the centres did not need to provide extra network resources. Elderly people went to the care centres to take part in the videoconference programme. This approach simplified the logistics involved in installing hardware/software, making it possible for more elderly people to participate, and also promoted social engagement by enabling elderly people to interact face-to-face with peers locally while communicating with those in the remote centres at the same time.

A focus of the videoconference programme was concern about the provision of healthcare to the elderly from the perspective of traditional Chinese medicine (TCM). TCM has broad acceptance among elderly Chinese, who generally regard it as a form of cultural wisdom and heritage, which gives them confidence in its efficacy.[11,12] In the pilot study, information about healthy diets and health-promoting exercises from a TCM perspective was delivered to elderly people through VC. Examples of physiotherapy exercises that were suitable for promoting the health of elderly people were also included. The aim of this pilot study was to evaluate the extent to which the users accepted and were satisfied with the proposed VC approach, with a focus on the efficacy of the technical process and on perceptions of the instructor in the VC process.

Methods

Design

Acceptance of the proposed multi-centre mobile VC health education approach was evaluated with a three-session pilot study, namely, S1, S2, and S3, as shown in Table 1. The scope and connectivity of the sessions were progressively scaled up. A total of six different elderly care centres were involved, namely C1 to C6. The subjects in the three sessions were all different. In session S1, a talk on healthy diets from the TCM per-

Table 1. Arrangement of the three VC sessions.

Session	S1	S2	S3
Content	Healthy diet from the TCM perspective	TCM-based exercise	Exercises
Instructor	TCM practitioner	TCM practitioner[a]	Physio-therapist
Number of VC sites	2	3	3
VC sites	C1, RC[b]	C2, C3, RC[b]	C4[c], C5, C6

[a] The same TCM practitioner as in session S1.
[b] RC: Research centre, where the instructor was located.
[c] The instructor was located at elderly care centre C4.

spective was delivered remotely by VC to elderly people in care centre C1 by a TCM practitioner located in a research centre (RC).

In session S2, VC was conducted simultaneously for two groups of elderly people, located at two geographically separated centres C2 and C3. Focusing on health-promoting exercises from the TCM perspective, the session was delivered by the same TCM practitioner as in S1 from the remote RC, who instructed and interacted with elderly people in the two care centres by VC. The participants in the two centres could also see and hear each other. In Session 3, the VC was further scaled up to include three elderly care centres, i.e., C4, C5, and C6, where another exercise session led by a physiotherapist was arranged. The therapist instructed the elderly people face-to-face in C4, as well as those in C5 and C6 through VC. The hardware setting for session S3 of the multi-centre VC is shown schematically in Figure 1. Photographs of the participants during the study are shown in Figure 2.

Subject recruitment

Subjects were recruited by convenience sampling from current members of the participating elderly care centres. The care centres provide day care services, nursing care, rehabilitation services, and recreational activities for community-dwelling elderly people. Participation in the study was voluntary. The study was approved by the institutional review board. Before the start of the pilot study, written consent to take part in the study was obtained.

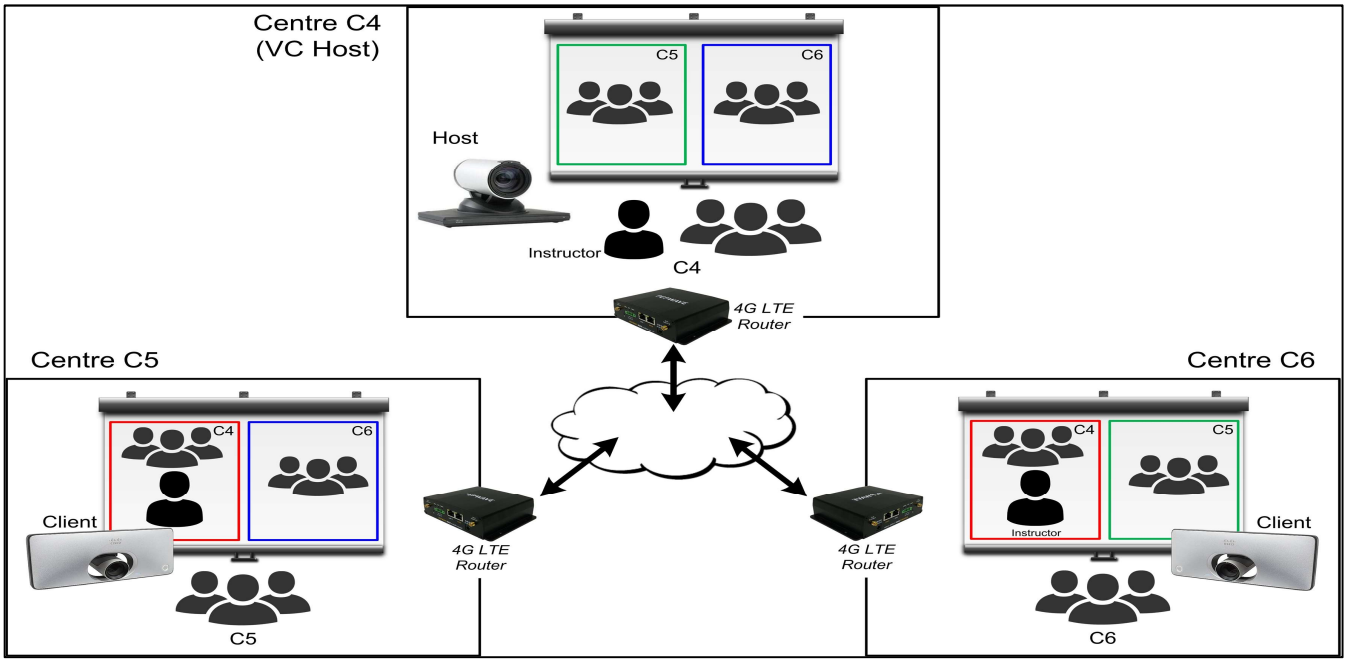

Figure 1. Schematic diagram illustrating the setting of session S3. In centre C4 (top), the subjects interacted with the instructor face-to-face, and with elderly people in C5 and C6 through VC.

Figure 2. Images of the videoconference programme: elderly people practising exercises (left) by following the demonstration of the instructor (middle), who was in the remote research centre; the instructor communicating with an elderly woman about her health problem (right).

Mobile videoconference system

The videoconference system that was adopted consisted of one host device (Cisco Telepresence SX20) that supported multiparty conferencing, and two client devices (Cisco Telepresence SX10). The system can deliver high-definition video quality for conferencing with up to three separate locations. Instead of connecting to the Internet through a local area network (LAN), a cellular 4G mobile network was exploited, where the host and client devices were each connected to a cellular 4G LTE router (Pepwave MAX) operating with a subscriber identity module (SIM) card. This configuration does not require elderly facilities to provide network resources, and thus would not disturb their normal operations. In addition, as the devices and cellular routers are relatively small and lightweight, they can be conveniently moved to different elderly centres, making the proposed approach a more dynamic, portable, and flexible way of promoting health literacy to greater number of elderly people.

Measurements

At the end of each VC session, the subjects were asked to fill in a questionnaire about their level of acceptance and satisfaction with the approach. The questionnaire was designed by referring to the Telemedicine Satisfaction and Usefulness Questionnaire (TSUQ)[13] and the Telemedicine Satisfaction Questionnaire (TSQ).[14] It contains 10 items and uses a 5-point Likert scale, with '1" indicating strongly disagree and "5" strongly agree; thus, the maximum total score of the questionnaire is 50. The subjects were also asked to provide their after-use comments.

Procedures

Prior to the sessions, a site inspection was carried out at each of the elderly care centres that were involved, in order to plan for the optimal placement of the devices and cellular routers, the location of the audio/video system, and the seating and space arrangements, e.g., to ensure that enough space was provided between the subjects for the group exercises. In the meantime, the quality of the audio and video signals was also evaluated.

At the beginning of each session, the videoconference facility was set up and tested in advance by research assistants, one for each elderly care centre involved. Student assistants were also employed to serve as facilitators at the centres. Each session lasted for about one hour. The instructor spent the first 40 minutes delivering the health education content. This was then followed by a 20-minute question-and-answer session, in which subjects from each centre took turns raising questions for the instructor (except in the first session, which involved only one centre). At the end of each stage, the subjects responded to the questionnaire and provided their feedback on the proposed VC approach.

Results

A total of 96 elderly people aged 60 years or above participated in the study. They were all able-bodied people recruited from the six elderly care centres. The distribution and demographic background of the subjects in the three VC sessions are shown in Table 2.

The results of the questionnaire on the participants' acceptance of and satisfaction with the multi-centre mobile VC approach are summarized in Table 3, where the mean, standard deviation (SD), and 95% confidence interval (CI) of each item are shown for each session.

The mean total score for all three sessions was over 40. The mean total score for session S3 (41.7) was lower than the scores for S1 (45.3) and S2 (46.0).

The mean score for each item rated by the subjects in sessions S1 and S2 exceeded 4.0, with the range of scores for the items being 4.3–4.8 and 4.4–4.8, respectively. The mean scores in session S3 were lower, within the range of 3.7–4.5. The standard deviation (SD) of the score for each item was less than 1.0 for S1 and S2, with the range being 0.4–1.0 and 0.4–0.7, respectively; the variation in scores for S3 was wider, with the SD being in the range of 0.8–1.4.

The mean scores of the items for session S3 appeared to be lower than those for S1 and S2. The difference was relatively large for item Q1 (video quality) and item Q3 (ease of understanding the process), where the mean scores were 3.7 (SD = 1.38) and 4.2 (SD = 0.99), respectively. In other words, the three groups gave generally similar responses to the questionnaire.

Discussion

The feedback from the subjects on the proposed VC approach was positive, as shown by the high score on overall satisfaction (item Q10) for the three sessions (4.6, 4.8, and 4.4). In their after-use comments, the subjects stated that they found the approach to be acceptable and considered it to be innovative, interesting, and impressive. Some subjects mentioned that, although conducted through VC, the healthcare

promotion activities could convey the knowledge clearly to them, which was consistent with their responses to item Q4, on the instructor's response to questions.

While the mean score for item Q6 was quite high, i.e. the level of satisfaction with the videoconference programme was similar to that for a face-to-face approach, the feedback that was received from six subjects indicated that face-to-face interactions were still preferred. Generally speaking, it would be best to use a face-to-face approach because interactions are most direct and immediate in such an approach. However, given the increasing demand for health education from ageing populations, it is necessary to

Table 2. Distribution and demographic background of the subjects in the three VC sessions.

Session	S1	S2	S3	Overall
Number of subjects at each elderly care centre	C1: 12	C2: 15 C3: 15	C4: 6 C5: 19 C6: 29	-
Total subjects	12	30	54	96
Gender				
Male	4	2	9	15
Female	8	28	45	81
Age (years)				
60-69	1	6	14	21
70-79	5	14	17	36
80-89	4	7	20	31
90 or above	2	3	3	8

Table 3. Summary of the responses to the acceptance and satisfaction questionnaire. Data are presented in terms of the mean and one standard deviation and 95% confidence intervals.

Session		S1	S2	S3
Number of elderly care centres involved		1	2	3
Number of VC sites		2	3	3
Total number of subjects		12	30	54
Video quality	Mean±SD	4.5±0.7	4.7±0.6	3.7±1.4
	95% CI	4.07-4.93	4.44–4.89	3.35–4.10
Audio quality	Mean±SD	4.4±0.5	4.5±0.7	3.8±1.3
	95% CI	4.09–4.74	4.23–4.77	3.48–4.18
Ease of understanding the process	Mean±SD	4.8±0.6	4.7±0.5	4.2±1.0
	95% CI	4.36–5.00	4.53–4.87	3.90–4.44
Clarity of the instructor's response to the questions	Mean±SD	4.3±1.0	4.5±0.7	4.1±1.1
	95% CI	3.64–4.86	4.25–4.75	3.84–4.42
Satisfaction with instructor's services	Mean±SD	4.8±0.5	4.8±0.5	4.5±1.0
	95% CI	4.46–5.00	4.58–4.95	4.20–4.72
Same level of satisfaction as in a face-to-face interaction	Mean±SD	4.3±0.9	4.5±0.7	4.0±1.2
	95% CI	3.77–4.90	4.19–4.74	3.66–4.30
Ability to save time	Mean±SD	4.8±0.4	4.4±0.7	4.4±0.9
	95% CI	4.59–5.00	4.18–4.69	4.19–4.67
Willingness to join the videoconference programme	Mean±SD	4.6±0.7	4.6±0.6	4.3±1.0
	95% CI	4.16–5.00	4.35–4.78	4.00–4.56
Helpfulness for healthcare management	Mean±SD	4.3±0.6	4.5±0.7	4.3±1.0
	95% CI	3.86–4.64	4.21–4.72	4.02–4.58
Overall satisfaction	Mean±SD	4.6±0.5	4.8±0.4	4.4±0.8
	95% CI	4.26–4.91	4.69–4.97	4.20–4.65
Total Score	Mean±SD	45.3±3.6	45.9±3.4	41.7±7.8
	95% CI	42.95–47.55	44.64–47.16	39.60–43.84

develop new approaches and telemedicine is a promising alternative. During the three sessions, it was observed by researchers that VC appeared to be particularily appropriate for activities that were dynamic and interactive, such as those involving body movements in the physical exercise activities in sessions S2 and S3. In such activities, the participants needed to follow the body movements being demonstrated by the instructor on-the-fly through the video. While the participants at local centres could see each other doing the exercises, they also saw other participants at the remote centres doing the same exercises on the screen. However, further research is necessary to evaluate the effect of VC on the level of engagement in multi-centre group exercise. Four participants commented that they were not able to fully follow the instructor in performing light exercises, because the pace was too fast for them. Two asked for more space to be provided when doing exercises in a group.

On the other hand, the ratings for session S3 were lower than those for sessions S1 and S2, with the items concerning video quality, audio quality, and understanding of the session and the process appearing to be much lower. This observation may suggest that the arrangements for S3 need to be improved. In this session, three centres were involved and the number of participants was the highest among the three sessions, which might have increased the complexity of the process for S3, leading to lower ratings for "ease of understanding" (Q3). Regarding visual quality (Q1), since the same screen was used to show images of the different centres, when more centres were involved, the size of the frame that a centre could occupy on the screen was reduced, and thus also the size of the video frame showing the instructor. This could potentially undermine the clarity of the images and the interactions between the participants and the instructor.

Audio quality might also be affected when more parties are involved, due to the confusion caused by multiple participants speaking at the same time. The order of who gets to speak becomes critical when more centres are involved. In the pilot study, the care centres took turns letting elderly people ask questions and interact with the instructor. Furthermore, during the didactic session, when the instructor is speaking in one centre, it is advisable to mute the sound produced from the other centres, since removing background noise will help to enhance the quality of the instructor's voice.

In the middle of session S3, the quality of the video and audio signals degraded momentarily, possibly due to an unanticipated environmental disturbance that interfered with the mobile signals, although those signals were of good quality at the prior site inspection. This is believed to be another reason that led to lower scores on items Q1, Q2, and Q3 for session S3. In fact, the poor connectivity of the 4G mobile network was also reported in a previous study.[4] The degradation of the signals might also be associated with the relatively lower scores that were accorded to the other items. To address the problem, technical support can be sought from providers of mobile communication services to optimize or temporarily boost the quality of the signals in those areas where the elderly care centres are located. For large multiparty medical VCs, it is crucial to conduct a final check one hour before the VC and to have engineers in attendance during the VC to avoid technical issues.[9]

Limitations

With the proposed mobile VC approach, the required equipment can be shared among elderly care centres. The system is relatively simple to set up and operate, and these processes can be handled by the existing staff of the centres after undergoing training. The potential overhead would be from the coordination work that is required, and from the site-inspection and transportation of equipment. A cost-benefits analysis will be conducted following this pilot study.

The number of subjects in this study was constrained by the amount of physical space available at the elderly care centres, making it not possible to use of the sample size determined by statistical principles. In fact, the difference in settings among the three sessions precluded a statistical comparison. In this pilot study, the aim was to understand if elderly people would accept and be satisfied with the proposed VC approach from a technical perspective. Further research following a rigorous research methodology shall be conducted to evaluate the effectiveness of the approach in promoting health literacy among the elderly, e.g., by using a true-or-false test or a multiple-choice test to assess the extent of their knowledge acquisition, or by using Likert scales and questionnaires with open-ended questions to test their level of self-confidence.

Conclusion

This study proposed an alternative VC approach to delivering health education, which allows elderly people located at multiple care centres to attend a session at the same time, through mobile VC. The

mobile videoconference facilities were easy to install and did not consume local network resources. As community care centres can accommodate a large number of elderly people, healthcare promotion activities that are implemented using the multi-centre mobile VC approach have the potential to reach a larger audience than current approaches, thereby facilitating the adoption and popularization of this approach for promoting preventive care. This pilot study showed that the multi-centre mobile VC approach was feasible and accepted by elderly people. Further research will be conducted to determine the optimal group size and number of elderly care centres for the proposed approach, and to address the limitations of this pilot study, before implementing a large-scale study in the community.

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