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A TELEMEDICINE WOUND CARE MODEL USING 4G WITH SMART PHONES OR SMART GLASSES

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ABSTRACT

To determine the viability of a wound-management paradigm based on 4th-generation digital communication industry standards (4G) and smart phones or smart glasses. This wound treatment approach is a real-time, interactive platform for telemedicine, wound dressing changes, and surgeries. It was established in March 2015 between Jinhua, Zhejiang Province, and Shanghai, China, which are separated by 328 kilometers. A video program (APP), 4G internet, smart phones or smart glasses, and a central server were all included. This model service was utilized 109 times in one month on 30 patients with wounds on their lower limbs. The service functioned effectively after a brief learning curve and was considered user-friendly. After the research, two patients (6.7 percent) had healed wounds, while others needed wound dressing changes. This concept was well received by both local practitioners and patients (100 percent and 83.33 percent, respectively). This telemedicine approach is practical and useful since it allows for medical wound healing services in distant regions where experts are rare.

KEYWORDS: *Application, Light, Smart Glass, Smartphone, Telemedicine.*

1. INTRODUCTION

Since its inception in the late 1950s, telemedicine has been widely recognized as a valuable tool in the delivery of health care. Studies have also shown that telemedicine's application (APP) is especially helpful to wound care in isolated populations and distant areas. Smart phones with video APPs are currently quite popular and extensively utilized all over the globe.A smart phone may use a video APP to record, transmit, and save videos, as well as communicate online with people all over the globe. Phones have evolved beyond only making phone conversations to include Internet surfing and a broad range of device-based software applications (APPs). As a result, even in the most distant and resource-poor situations, it is the most popular acquisition terminal for telemedicine. Meanwhile, new wearable computers such as Google Glasses (Google, Inc., Mountain View, CA) and Vuzix Glasses (Rochester, NY) are gaining worldwide attention from a variety of professions. They may be worn like regular glasses and enable video to be captured from the wearer's viewpoint. It also interacts with others and offers an interface for accessing the Internet[1]–[4].

When utilized, it has the benefit of being hands-free and relying mostly on voice instructions. Its potential to influence health care delivery, medical documentation, surgical training, and patient safety has been shown in studies. Since its inception in the 1990s by Gottmp, the wound healing center has grown into a well-known and widely recognized idea based on a multidisciplinary platform. Wound healing has been shown to benefit from telemedicine as a speciality that requires a significant visual component. Hangzhou was the first wound healing center in China, opening in 2004, followed by Xi'an, Lanzhou, and Shanghai. The apparent concentrated distribution of these developing wound healing clinics in major cities is one of their most distinguishing characteristics; nevertheless, there remains a scarcity of wound experts in rural regions. The distance needed to go to these major wound healing clinics in a big metropolis like Shanghai may be challenging for those patients who are unable to walk freely. To address this issue, we created a telemedicine system in 2011 that used fourth-generation mobile communication technology standards (4G) optical cable and high-resolution video to diagnose and treat wounds between the wound healing department at Ninth Hospital and community health care centers throughout Shanghai. It has been utilized over 600 times and has shown to be useful and beneficial. However, since basic infrastructure in rural regions of China is lacking, we devised a plan to utilize the Shanghai telemedicine model to assist improve wound care in these areas, the impact of which is yet unknown. To perform a cohort research, a novel telemedicine wound care model was built up utilizing 4G net with smart glasses or smart phones between Shanghai and Jinhua, which are 328 kilometers away[5]–[7].

Gold nanoparticle (Au NP)-based colorimetric assays are developing as an alternate method for heavy metal detection,1921 with excellent sensitivity, specificity, and simplicity of signal read-out utilizing UVvis spectrometers1921 or glass slide readers, for example. However, owing to their relatively large equipment, higher prices, and lack of wireless connection, which is critical for distributed sensing and spatiotemporal mapping of contamination in distant places and field settings, these current systems that use NPs are still restricted. The detection of subppm quantities of mercury(II) ions has recently been shown utilizing dye-embedded polymer sheets as colorimetric substrates that are digitized using, for example, smart-phone cameras as an alternative to Au NP-based plasmonic methods.However, because of inevitable changes in ambient light conditions and human operation and/or alignment during the picture capture process, this current method does not take use of the phone's processing/computational capacity, and thus has limited detection sensitivity and repeatability.

To provide a field-portable, cost-effective, and wirelessly connected platform for sensitively quantifying heavy metal ion concentration in water samples, we present a battery-powered mobile sensing device that consists of a lightweight (37 g) opto-mechanical attachment to a smartphone, as well as a custom-developed Android application for detection quantification, reporting, and sharing. This lab-on-a-phone gadget uses dual-wavelength illumination using light-emitting diodes (LEDs) at 523 and 625 nm to measure mercury-induced modest transmission variations in a colorimetric assay using citrate-stabilized plasmonic Au NPs and aptamers (Apt) combined in disposable test tubes. We also showed geographic mapping of mercury(II) pollution in California using our cellphones.

The majority of bulky and expensive analytical equipment are used to detect environmental pollution such as trace-level hazardous heavy metal ions. However, there is a significant worldwide need for portable, quick, specific, sensitive, and cost-effective identification techniques that can be utilized in resource-constrained and field environments. The author present a smart-phone-based hand-held platform that enables for the measurement of mercury(II) ions in water samples with a sensitivity of parts per billion (ppb). The author developed an integrated opto-mechanical connection to a smart phone's built-in camera module to digitally measure mercury content utilizing a plasmonic gold nanoparticle (Au NP) and aptamer decorative transmission assay applied in disposable test tubes for this purpose. The author quantified mercury(II) ion concentration in water samples using a two-colourratio metric method using light-emitting diodes (LEDs) at 523 and 625 nm and a custom-developed smart application to process each acquired transmission image on the same phone to achieve a limit of detection of 3.5 ppb with this 40-gram smart-phone attachment. We created a mercury contamination map using our smart-phone-based detection technology by assessing water samples from municipal tap water sources, rivers, lakes, and beaches in California (USA). This sensitive and specific heavy metal detection platform running on cellphones could be quite useful for distributed sensing, tracking, and sharing of increased pollution information as a function of both space and time, thanks to its cost-effective design, field-portability, and wireless data connectivity[8].

The research protocol was approved by both participating institutes' medical ethics committees and followed the Declaration of Helsinki's standards. From April to May 2015, 30 patients with skin abnormalities on their lower limbs visited the First People's Hospital of Wucheng District in Jinhua, Zhejiang Province, China. All of the participants signed the informed consent.Specialists from Shanghai Ninth People's Hospital's Wound Healing Department, which is associated with Shanghai Jiao Tong University School of Medicine, provided remote consultation to the First People's Hospital in Wucheng District in Jinhua. Local surgeons from Jinhua's First People's Hospital's orthopaedic department were in charge of keeping track of each patient's medical data and carrying out the treatment plans suggested by distant experts. Local surgeons got pre-training in fundamental wound healing knowledge, which lasted around four days, to enhance their wound care skills. Under the supervision of wound healing experts in Shanghai, local surgeons were evaluated after a period of training to guarantee they fulfilled the criteria of wound care.

A video APP based on PCs and smart phones or the usage of smart glasses with a central server for multiway communication comprised the telemedicine system. Computers were accessible to specialists, smart phones were available to both experts and local surgeons, and smart glasses were available to local surgeons. The video APP enabled real-time viewing of the patients' wound in Jinhua to experts in Shanghai through a 4G wireless local area network (Wi-Fi). Figure 1 depicts the facilities in question.The ZTE M901C (Zhongxing Telecommunication Equipment Corporation, Shenzhen, Guangdong, China) smart phones utilized in this research featured a 13-megapixel camera and a 6.0-inch display with a resolution of 1280720 pixels. It was able to produce a video with a resolution of 19201080 pixels at a frame rate of 30 frames per second. Lenovo Vuzix M100 Smart Glasses were utilized as the smart glasses (Lenovo NewBusiness Development, Beijing, China). A computerized central processing unit, a display screen, a high-definition camera, a microphone, a conduction transducer, and wireless connection were all included in the smart glasses. It shot movies at a resolution of 1080 pixels at 30 frames per second using a 5-megapixel high-definition camera. The video APP was created by livecast media (Vancouver, BC, Canada), and it allowed for multiway communication, including one-to-many, many-to-one, and many-to-many[9], [10].

In one instance, a person in Shanghai called "shep1" and a user in Jinhua named "shglass2" were both online and able to communicate in real time.

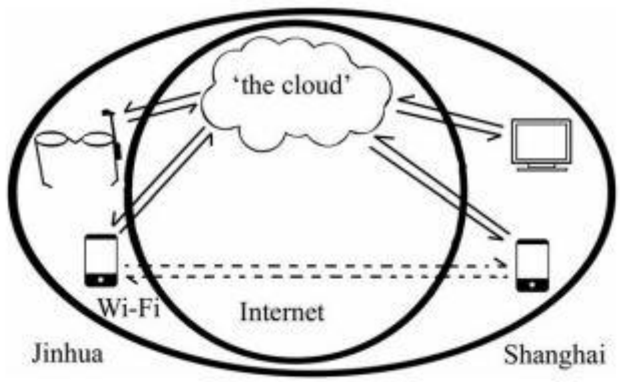

Figure 1: The above figure shows the telemedicine wound care model.

1.1 Adherence and comprehension training for users:

Before launching this model, we tested it in healthy volunteers to see whether it was feasible and to educate both remote experts and local surgeons on how to utilize it.Local surgeons spent an average of three days of training. A YES or NO questionnaire was used to gauge local surgeons and patients' approval of the model.

1.2 The telemedicine system's procedure

When each patient arrived at the clinic, an expert surgeon conducted a physical examination and obtained comprehensive medical information. The surgeon reported the patient's medical record to experts after preparing the patient. Wound healing experts in Shanghai evaluated the wound and provided expert comments via a multiway real-time video conversation. Following a discussion, the expert and the local doctor jointly determined the final treatment choices. Following that, the surgeons and patients decided to meet again for the following session. If patients needed surgery, wound healing experts may use the telemedicine system to offer real-time intraoperative consultation.

2. DISCUSSION

Where there is 4G connectivity, this telemedicine platform with APP for smart phones or smart glasses may be used. Costs were expensive in the late 1950s, when telemedicine was first introduced. Increasing network coverage and lowering prices in developing nations, on the other hand, offer a broad variety of possibilities for smart phone APPs in everyday life, which has been particularly beneficial to telemedicine. Telemedicine is now affordable thanks to modern technology, particularly mobile phones with great mobility and high-speed telecommunication networks. Indeed, telemedicine lowers expenses and enhances the quality of life for patients in distant and rural regions by decreasing transportation and staff time. We described our recent experience with smart phones or smart glasses and 4G for wound treatment in this paper, a wound care model that emerged from talks between Shanghai and the First People's Hospital of Wucheng district, Jinhua, Zhejiang province in China. This wound care approach was considered user-friendly after its debut. This approach was generally well received by both local surgeons and patients.

The advantages of this type are many. To begin with, it offers a platform for popularizing the idea of wound healing while also allowing local health professionals to undergo systematic wound care training. Local surgeons were interested in our research and shown excellent compliance with the usage of smart phones and smart glasses. Second, it guarantees that individuals who are unable to move freely get health treatment as quickly as possible. Local participants in this research got high-quality medical care close to their homes. Third, a wound-care approach is interactive, real-time, and remote, similar to video conferencing. A single case might be presented in multiple clinics, and physicians could debate it and make a conclusion collectively. Telemedicine effectiveness requires effective communication between distant experts and local surgeons. Local surgeons often follow experts' recommendations, although their ideas may be crucial to the treatment strategy in certain instances.

Fourth, telemedicine may reduce the number of needless referrals to specialists, saving time and money.In wound healing, like in dermatology, a significant visual component is thought to be beneficial. The majority of wound diagnosis and treatment is done via morphological observation, which is possible with the telemedicine system. However, the clinical history, physical examination, and, if required, auxiliary examination are still essential. Specialists advised the usage of elastic bandages in one instance owing to varicose veins. Following a physical examination, one patient with sores on their foot and ankle and a filariasis diagnosis dating back over 30 years was sent to a specialist hospital to address lymphatic obstructions. Because the trial lasted just one month, the majority of participants still needed therapy at the conclusion. Because these patients had long-standing wounds and were of an older demographic, their wounds would take longer to heal fully. Telemedicine is not without its difficulties. Smart phones and smart glasses both have fundamental flaws that restrict their use in telemedicine. Because the smart phone is not hands-free, the consultation cannot take place when there is just one local surgeon on site and examining the wound.

Local surgeons using smart glasses must also put their face near to the wound because it fails to gain magnification of regional anatomy, which has the ability to infect patients. Furthermore, in recent years, issues about privacy and security during telemedicine have gotten a lot of attention. Many individuals are concerned that health-related data may be abused. The usage of the telemedicine service is jeopardized by such ethical and legal problems. There were other publications that addressed the necessity of creating legal rules related to telemedicine, with many of them believing that adequate security and privacy safeguards were required. It should not, however, exclude the utilization of telemedicine services. In this research, a telemedicine wound care model was presented using smart phones or smart glasses, and the results were consistent with our prediction. This approach is especially beneficial since it allows for high-quality medical care in distant regions where wound healing experts are rare.

3. CONCLUSION

This wound care approach, in general, is an interactive, real-time, and remote treatment method aimed at improving health care service. It is a novel method of implementing telemedicine that may be used to change wound dressings or perform procedures with the assistance of expert views. This concept was well received by both local surgeons and patients.

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