Sustainable development of digital telemedicine in diabetic retinopathy screening

Lu Yang
Shanxi Eye Hospital, China
Email: 1279286674@qq.com

Abstract

Diabetic retinopathy is the leading cause of blindness in working-age adults. Multicenter prospective randomized clinical trials such as the Early Treatment of Diabetic Retinopathy study (ETDRS) have demonstrated that appropriate treatment can significantly reduce the risk of vision loss due to diabetic retinopathy. The role and value of regular fundus examination in preventing blindness caused by diabetes has long been recognized. However, there are still a large number of diabetic patients who do not accept the recommendation of regular fundus examination. The reasons for patients' poor compliance with regular fundus examination were analyzed, mainly including: no vision change in the early stage of the disease, social and economic factor s,geographical conditions, lack of necessary health education for patients, etc. Regular and orderly eye examination and digital remote diabetic retinopathy screening are effective methods to improve the detection rate of diabetic retinopathy, greatly reduce the economic cost of screening, and make diabetic retinopathy screening affordable personalized medicine for diabetic patients. For a long time, the serious short of grassroots medical resources, lead to patients to community health diagnosis and treatment level and service quality of medical institutions, so whatever ailment of a serious illness are flocking to big hospital, appeared a few patients with community health medical institutions, and the phenomenon of big hospitals are crowded, the resulting " slow to see the doctor, the doctor is difficult". In order to improve the difficult and bad medical treatment situation, the new medical reform proposed: the firs tcommunity treatment, then graded medical measures, the goal is to diagnose and treat common diseases and preventable diseases in grassroots community medical institutions, diversion of patients with difficult diseases for large hospitals. In line with the demands of the new medical reform, this study transferred the professional eye disease screening work from large hospitals to community medical institutions, effectively diverting patients with eye disease

and conforming to the policy of the new medical reform. Screening for diabetic retinopathy is an important method to improve the detection rate of diabetic retinopathy, and digital remote screening can significantly reduce the cost of screening, making screening truly affordable medical services for the people. Under the guidance and participation of government departments at all levels, the remote screening system for diabetic retinopathy needs to innovate organizational structure, effectively integrate resources, and establish relevant standards and certification systems for remote screening institutions and work systems.

Keywords: digital telemedicine; Diabetic retinopathy; Screening; Sustainable development.

In Europe, digital medical care is the only way to develop comprehensive and ideal medical services [1]. The current model of health care includes in-hospital care, invalescent care services, and home or community health services. Traditional family medical treatment requires the ratio of medical staff to patients to be 1:1, while the manpower of community medical institutions is gradually decreasing and can only barely cope with the daily patients [2]. In the face of the government's possible payment system, the increasingly serious shortage of medical staff and the increasing number of patients, the relevant departments are turning to engineering technology to solve the problem, hoping to expand the existing medical resources through engineering means without reducing the quality of medical treatment. Telemedicine is one of the solutions, which is welcomed by both patients and medical staff in home medicine [3-4]. Telemedicine, also known as telemedicine and remote monitoring technology, can greatly reduce the travel time required by medical staff to visit patients and also help evaluate the effect of medical programs [5]. Telemedicine can be thought of as remote communication providing medical information and medical services. Telemedicine does not have to be expensive. These solutions can provide valuable medical services to patients who have difficulty accessing care with low-end technologies. A larger amount of vital information is easily collected by doctors. When these data are combined with electronic medical records stored in medical institution information systems, telemedicine technology becomes even more attractive and promising.

1.1 Research progress of screening for diabetic retinopathy

Diabetic retinopathy is the main cause of blindness in adults of working Age [6]. Multicenter prospective randomized clinical trials such as the Early Treatment of Diabetic Retinopathy study (ETDRS) have demonstrated that appropriate treatment can significantly reduce the risk of vision loss from diabetic retinopathy. The role and value of regular fundus examination in preventing blindness caused by diabetes has long been recognized. However, there are still a large number of diabetic patients who do not accept the recommendation of regular fundus examination. In the United States, it is estimated that 50% or more of people with diabetes in the population do not follow recommendations for regular eye exams. In China, according to the investigation of diabetes clinic of Beijing tongren hospital, 82.71% of diabetes patients do not have the concept of regular examination of fundus [7-8]. The reasons for patients' poor compliance with regular fundus examination were analyzed, mainly including: no vision changes in the early stage of the disease, social and economic factors, geographical conditions, lack of necessary health education for patients, etc.

Diabetic retinopathy can be easily detected by examination, and diabetic retinopathy screening program can significantly improve the detection rate of diabetic retinopathy. In the past decade, a large number of screening programmes for diabetic retinopathy of different sizes have been launched in some European and American countries. It is estimated that screening programs can reduce U.S. health care expenditures by more than $4 million per year [9]. In recent years, digital fundus photography has become an important tool for clinical examination and research of diabetic retinopathy, and remote ophthalmology based on digital retinal images also shows great prospects for improving the screening rate of diabetic retinopathy. Designing, constructing and implementing remote ophthalmic screening for diabetic retinopathy has become a very challenging task. In collaboration with the American Association of Telemedicine (ATA), the Ophthalmological Tele-Health Special Stock Group (OTsIG), and the National Institute of Standards and Technology (NIST), a net work of guidelines has been developed to establish efficient, consistent, and sustainable tele-diabetic retinopathy care programs.

1.2 Research progress of digital telemedicine technology

Wireless technology is advancing at a tremendous pace in healthcare IT, along with other technologies such as laptops and palmtops that allow data collection and management to take place at point-of-care. The rising cost of care in healthcare facilities and the gradual decline in the cost of engineering are driving the growth of telemedicine in Europe. With the widespread use of digital communications, increasing capacity, and declining costs of remote monitoring and management devices, it is now becoming increasingly possible to transmit medical data in digital format. Such telemedicine systems can be ideally designed to be used with a wide range of disciplines and can collect a large amount of data from virtually any vital information monitor and electronic medical record, including existing systems in a healthcare facility [10]. Wireless technologies bridge the gap between patient-site monitors and information systems in a variety of ways, such as portable wireless phones, the Internet or Bluetooth. A number of companies have entered the market in recent years, offering hardware or software, or both. Medical device manufacturers compete with telecommunications companies to produce low-cost devices and the bandwidth required [11]. One limitation is in the evaluation of investment, since most devices that can be used for telemedicine can also be used for point-of-care services. In Europe, the rapidly growing telemedicine market needs to be given due consideration and is being continuously tracked by leading health services, as telemedicine is indirectly linked to all medical disciplines. Patients' need for continuous monitoring and the desire not to spend too long in hospital is driving the development of telemedicine [12]. The architecture of telemedicine technology needs corresponding information management. Home care is expected to represent a significant market opportunity in Europe over the next decade. Among the most disciplines using telemedicine facilities, in addition to radiology, which is clearly in the lead, are cardiology, psychiatry, dermatology, pathology and ophthalmology. Although not all telemedicine applications are profitable, they are taking off across the board because of cost savings, promising market prospects, increased referral options for hospitalized patients and the extension of medical care to rural areas.

1.3 Status quo of digital telemedicine technology for screening diabetic retinopathy

The main screening methods for diabetic retinopathy include ophthalmoscope, fundus photography, OCT, OCT-A and fundus fluorescein angiography. Ophthalmoscopy includes direct fundus ophthalmoscopy, indirect ophthalmoscopy and indirect ophthalmoscopy with split lamp. Although these methods are simple and easy to use, their sensitivity and specificity vary greatly with the experience of the examiner. Even experienced ophthalmologists often have different results for the same patient at different times. In addition, this method requires more human input, so it is not suitable for large-scale population screening. Fundus photography is widely used in ophthalmology epidemiology and population disease screening due to its accuracy, objectivity, sensitivity and specificity [13]. The 7-field, 30-degree fundus stereoscopy and its graded diagnostic system developed by ETDRS are the gold standard for the diagnosis of diabetic retinopathy (Figure 1). However, traditional film photography is difficult to be popularized in large-scale population screening due to its high cost, complicated and time-consuming diagnostic procedures. With the development of digital imaging technology, digital fundus photography is gradually replacing ETDRS standard 7-field stereo fundus photography and becoming the main method for screening diabetic retinopathy [14-15]. Its sensitivity and specificity for lesion detection, consistency with ETDRS gold standard and diagnostic consistency among different radiographers are high [16]. However, a unified and standardized digital fundus photography method for screening diabetic retinopathy has not been established so far. Most foreign studies have adopted the method of taking a fundus image with a 45° field of vision centered on the macula for intensive film diagnosis [17] (FIG. 2) . Based on the review of historical literature, the American Academy of Ophthalmology concluded that macular-centered single-field fundus photography is not a substitute for comprehensive ophthalmological examination, but can be used as a screening tool for patients requiring referral for treatment of diabetic retinopathy [18-19]. However, some scholars believe that single field, non-dilated pupil and 45° digital fundus photography are not sufficient for screening diabetic retinopathy. The false negative rate is as high as over 20% even for doctors specializing in fundus diseases [20].

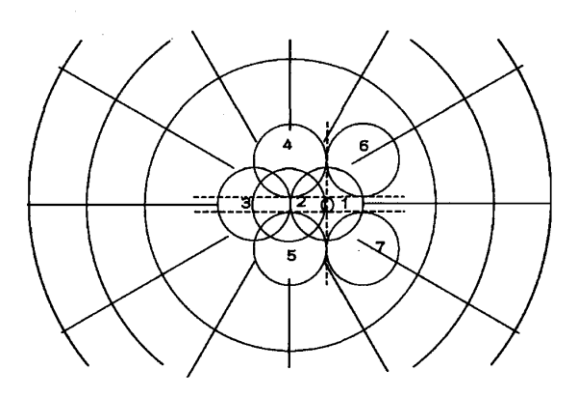

FIG. 1 Schematic diagram of fundus photographic partition in 7 EDTRs fields

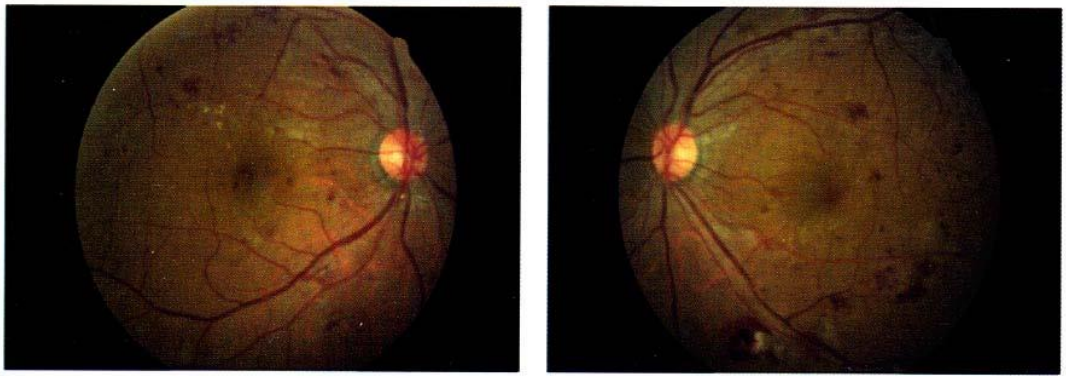

FIG. 2 Fundus photograph with macula as the center

The first optical coherence tomography (OCT) system was proposed by HUANG et al in 1991. In the past 20 years, OCT technology has rapidly developed from the original time-domain OCT(TD-OCT) to the frequency-doma in OCT(SD-OCT) based on Fourier domain detection, and then to the recent scanning OCT(SS-OCT) also based on Fourier domain detection [21]. Although current commercial SD-OCT systems can achieve scanning speeds of 27,000 to 70,000 A second, SS-OCT can achieve scanning speeds of up to 10,000 A second compared to the latest technology. This allows SS -- OCT to obtain dense raster scans, resulting in a THREE-DIMENSIONAL OCT dataset. At the same time, the scanned data set can be processed by the corresponding procedures to obtain the cross-sectional images of any diameter line of the fundus, as well as the hierarchical perspectives of the retina, such as the images of the cone rod cell layer, the ganglion cell layer, the choroid capillary layer and the ethmoid plate layer of the optic disc. Such planar perspective images make retinal microstructure visible, which is currently impossible with other images. In addition to faster scanning, SS-OCT has the advantage of

deeper detection. The SS--OCT angiography (SS-OCTA) and EN FACE OCT imaging system obtained by the corresponding procedures [22] can perform multiple B scans on the same truncated surface and rapidly stratified images on the layers of each capillary network of retina and choroid. At the same time, it can also image the microcirculation of macular area and optic disc clearly, and accurately locate the position and depth of blood vessels, ensuring intuitive pathological observation of retinal blood vessels.

In the past decade, with the rapid development of ophthalmology at home and abroad, the diagnosis and treatment of various ophthalmic diseases has become more and more accurate. The emergence of optical coherence tomography (OCT) not only revolutionized the diagnosis and treatment concept of retinal diseases and glaucoma, but also promoted the diagnosis and treatment level and research level of clinical ophthalmic diseases to a great extent. Although OCT images of optic disc, macula and nerve fiber layer can provide effective help for the diagnosis and diagnosis of many ophthalmic diseases, they cannot provide clear information about choroid and retinal blood vessels. In order to solve this problem, As A new quantitative tool for measuring blood flow in the eye, OCT-A measures blood flow based on the comparison of motion generated by repeated transverse scanning at the same location of the retina [23]. Then a certain area of the fundus was scanned repeatedly to form three-dimensional volume data of Angio--OCT. These data showed structural changes after multiple transverse scans, from which blood flow, blood cell movement signals and de-correlation signals were obtained. Oct-A is A fast imaging method for constructing retinal vascular network images based on the detection of blood flow. The principle of this technology is based on the presence of red blood cells flowing in the retina and choroid blood vessels, the same plane of coherent optical tomography scanning; Optical coherence tomography (OCT) of each point on the retina was obtained by SSADA algorithm, and the change signal was detected by comparing the images generated by blood perfusion red blood cells moving in the blood vessel and static surrounding tissues at different times. Based on this, OCT images were repeatedly collected at the same location to obtain and calculate, and 3D reconstruction of vascular structure was carried out. The images of vessels in the fundus were displayed layer by layer in the form of EN face.

By evaluating the signal differences between several OCT images, pixel changes caused by large changes in RBC flow in blood (blood flow) at different times can be identified. It is difficult to see the same blood cells in two consecutive OCT images, given the physiological velocity of the perfusion vessels in the eye and the millisecond interval between consecutive OCT images. Thus, the OCT signal inside the perfusion vessel varies randomly over time, and this variation is far greater than the residual change caused by measurement noise from static tissue. In order to provide a direct visual correlation between the structure and blood flow information, the OCT sectional images of the structure and the corresponding blood flow information can be combined into a fusion image. In this fusion image, OCT-A signals are superimposed on the OCT sectional image of the structure, and the relationship of each information is displayed.Oct-a and OCT sectional images provide detailed and precise correlations between retinal microstructures and perfusion vessels. En Face images look best at the retina and the associated vascular network (or vascular plexus) within the corresponding retinal layer, as defined by stratification. These delimited boundaries determine the tissues and corresponding vascular systems represented in a two-dimensional coronal image. The Heidelberg SPECTRALIS OCT-A algorithm calculates the probabilit y that a given pixel follows the OCT signal distribution of the perfusion Vascular system (blood flow) rather than the static tissue distribution. As a result, SPECTRALIS OCTA images are binary and high-contrast. Increasing the number of repeated scans at each location increases the determinism of the algorithm, thereby increasing the contrast between perfusion vessels and static tissue. High-quality OCT-A images can be obtained with four repeat scans, while contrast can be greatly improved with up to seven repeat scans. OCT-A offers a flexible selection of scan modes, with a wide selection of scan densities and ranges depending on the needs of the lesion. The scan mode of 30° x 15° (8.8 mm x 4.4 mm) provides a relatively large overview of retinal and choroid circulation.

Diabetic retinopathy is retinal microvascular lesions caused by long-term sugar metabolic disorder, along with the progression can result in severe visual impairment and even blindness, so early diagnosis and timely treatment to protect the patient's vision is very important, but because of a lack of typical symptoms, early diagnosis is difficult, diabetic retinopathy funduscopic

examination alone is often difficult to meet clinical needs. Fundus fluorescence angiography (FFA) is a commonly used examination method for fundus diseases at the present stage, which can clearly observe the fine structure and circulation status of capillaries and provide guidance for the diagnosis, differentiation and photocoagulation treatment of diabetic retinopathy [24]. With the improvement of people's living standards and the rapid growth of the number of T2DM patients, the incidence of diabetic retinopathy, a common complication of diabetes, is increasing significantly. It is reported that the prevalence of diabetic retinopathy in China is 37%, and the incidence of diabetic retinopathy in patients with more than 10 years is as high as 54%. High incidence of diabetic retinopathy is not only, and the diagnosis and treatment is difficult, is the important cause of blindness patients, early diagnos is and treatment to prevent visual function damage and improve the patients quality of life has a positive role, FFA for eye disease check for nearly half a century, in recent years in the diabetic retinopathy screening and also gradually to the attention of the clinical diagnosis value. FFA is a method to evaluate the changes of fundus vascular structure and function by injecting fluorescein contrast agent into peripheral vein and collecting dynamic characteristics of fluorescence signal through filter in intraocular circulation. The results are more accurate and specific than traditional methods such as ophthalmoscope. According to the characteristics of FFA image, the lesion type and severity can be accurately determined. The main manifestations of macular edema are fluorescence leakage and spot cystic fluorescence accumulation in the middle and late stage of contrast. Retinal microhemangioma showed strong fluorescent spot in early angiography. Retinal neovascularization was more common with late irregular patchy strong fluorescence. , indicating that FFA has high accuracy in the evaluation of the severity of diabetic retinopathy, which has important guiding significance for clinical selection of reasonable treatment plan and prognosis judgment. Confirmed in a previous study, diabetic retinopathy early pathological changes mainly for retinal vascular structure changes caused by the leakage or edema, FFA examination by observing the distribution of fluorescein judge the vascular lesions, in compliance with the onset of diabetic retinopathy and pathophysiological process of progress, thus not only early diagnosis value is higher, and can also according to the situation around

vascular perfusion accurate staging.

In order to better meet the diverse medical service needs of urban and rural residents and social masses, conform to the situation of medical and health system reform, and reduce the medical burden of patients, this topic is formulated. This research topic is divided into two parts: 1. A comprehensive analysis of the limitations of the current traditional fundus neovascularization technology and a full study of the characteristics and advantages of advanced OCT vascular imaging technology. 2. To study how to apply angiography technology to the examination of neovascularization disease, evaluate the therapeutic effect of patients, reduce the cost and frequency of examination, and avoid the possible risks of traditional examination. With the great progress of IT wireless technology and digital communication in medical care, the continuous expansion of data capacity, and the reduction of the cost of remote monitoring and management equipment, medical data transmission in digital format is now widely used. In this way, digital telemedicine systems can be designed to be used in a multi-disciplinary manner, including the collection of a large amount of relevant medical data from the original systems of medical institutions.

1.4 Relevant elements of digital telemedicine technology

Equipment and data transfer: The performance level of the remote technology equipment should match the clinical requirements. The technical specifications and requirements of the equipment vary greatly according to the objectives of each specific project, but the medical Digital Image Communication Standard (DICOM) must be implemented [25]. In order to facilitate the transfer and storage of large data files such as retinal images, data compression is often used. However, compression operations must be fully clinically certified and regularly reviewed to ensure appropriate image quality and diagnostic accuracy.

Legal requirements: The remote screening program for diabetic retinopathy should be carried out under the premise of legal permission. Patients have the right to know and choose the situation of remote screening, allowing patients to decide whether to participate or not. At the same time, patients should be informed that remote ophthalmology is not a substitute for comprehensive

ophthalmology.

Certification of procedures: The US "Diabetic retinopathy Telemedicine Practice recommends that certification of telemedicine diabetic retinopathy care programs is necessary. ETDRS 300, 7 field, stereoscopic color slide photographs are considered to be the gold standard for evaluating diabetic retinopathy. Since there is currently no widely accepted standard for the use of digital images in the evaluation of diabetic retinopathy, the telemedicine program for diabetic retinopathy should have results comparable to ETDRS film photography.

Quality control: All tele-health projects should have specific policies and appropriate procedures to monitor and continuously evaluate project performance. Elements of the project need to be reassessed periodically, intermittently, and the results reviewed periodically to ensure quality. Review results and identify problems to guide appropriate interventions. The performance of fundus photographers and readers should be analyzed according to the random sampling results of the quality of images taken and the quality of image interpretation respectively. The results of this analysis can be used to evaluate the technical proficiency of staff and provide a basis for carrying out targeted training and improving training methods and contents. Continuing education is an integral part of any quality assurance program and is a fundamental way to improve existing capabilities and promote circular training. Continuing education programs need not follow a specific format, but should be adapted to maximize effectiveness and efficiency.

1.5 Institutional certification of remote screening for diabetic retinopathy

The large-scale population-based screening program for diabetic retinopath is a complex and systematic project involving many institutions, including community clinics, district and county hospitals, and central hospitals. ETDRS 300, 7 field of vision, stereoscopic, standard and color fundus photos are used as reference for "Practice Recommendations for remote health care of diabetic retinopathy" in the United States

Four types of certification for standard diabetic retinopathy telehealth progr ams [26] :

Type 1 certification: This certification allows patients to be classified as having no or only minimal diabetic retinopathy, and having more than minimal diabetic retinopathy. Programs or institutions designed for category 1

accreditation refer all patients with more than mild diabetic retinopathy for further evaluation.

Type 2 certification: refers to the institutions and systems that can accurately identify patients with vision-threatening diabetic retinopathy. Vision threatening diabetic retinopathy includes macular edema of any degree, severe non-proliferative diabetic retinopathy, and proliferative diabetic retinopathy. Patients with vision-threatening diabetic retinopathy need to be referred as soon as possible for possible treatment, such as laser photocoagulation.

Type 3 certification: This certification refers to the organization and system that can determine the severity classification of non-proliferative diabetic retinopathy, proliferative diabetic retinopathy, and macular edema, and develop appropriate disease management strategies. In addition, the certification level also requires the ability to detect clinically significant macular edema.

Type 4 certification: a system that meets or exceeds the ability to distinguish the severity of diabetic retinopathy and macular edema by ETDRS photography. Although digital imaging systems are approaching the quality of film photography, they have not yet reached or surpassed the level of ETDRS stereofundus photography in detecting diabetic retinopathy damage. At present this type of certification is only a theoretical type of certification.

1.6 Organizational structure and resource integration of remote screening program for diabetic retinopathy

Diabetic retinopathy remote screening project is a project with wide coverage and multiple disciplines involved, which involves complex issues such as the establishment of new medical models. Therefore, system integration, clear division of labor, integrated innovation of service models, standards and assessment indicators are the keys [14]. Telemedicine, with medical imaging as the core technology, uses the development of information technology to realize information exchange between hospitals and promote the coverage of advanced medical technology to communities and rural areas, bringing unprecedented opportunities for the development of medical and health in China in the new era. However, in order to achieve this goal and ensure the quality of medical service, it is necessary to establish an integrated system of

service mode, operation process, technical standard, monitoring and evaluation, and government, industry, university and research. To realize the coverage of technology to the grass-roots level, can not do without the support of governments and departments at all levels. The CDPF has a comprehensive network of community primary health care and rehabilitation, and the Ministry of Health has set up guidance centers for blindness prevention in major hospitals around the country. Through remote consultation and electronic health system, the advantages of the two will be integrated to promote the development of remote screening programs for diabetic retinopathy in China. This project should be based on local hospitals and government agencies that already have basic knowledge of blindness prevention, combined with the prevention activities of China Disabled Persons' Federation, and at the same time communicate with the medical insurance department of the Ministry of Labor and Social Security to obtain policy and financial support, so as to run healthily [18].

1.7 Efficient and low-cost remote screening mode for diabetic retinopathy

China is a country with a large population. The key to the current reform of China's medical insurance system is to establish a strategic priority, low-cost and efficient prevention and treatment mode. Therefore, remote screening for diabetic retinopathy must be carried out step by step and with priority according to specific conditions. According to WHO's prevention of blindness priority strategy [21], cataract prevention and treatment should be given priority in rural areas at present, while glaucoma and diabetic retinopathy should be given priority in urban areas. On the platform of telemedicine, the remote screening of diabetic retinopathy should be combined with the construction of tertiary medical network in the community. The community health personnel should distribute the information of eye health education at home, establish electronic health records of high-risk groups, and be responsible for online referral, treatment appointment and follow-up after screening. According to the electronic medical record of primary eye care provided by the community health worker, the regional blindness prevention center assigns technicians to carry digital cataract camera or digital fundus camera to the community or the patient's home for eye disease screening, and the image data will be uploaded

to the Internet image database; Ophthalmology remote consultation center and ophthalmology experts carry out primary consultation on ophthalmology images and remote consultation on difficult cases.

1.8 Establishment of qualifications and standards for remote screening institutions for diabetic retinopathy

Telemedicine is still a new thing in China and lacks a perfect working system. In order to ensure the quality of telemedicine and promote the standardized development of tele-ophthalmology, the most important work is to establish the certification system of telemedicine service institutions. It may be considered that the Telemedicine Certification Committee of ophthalmology shall be jointly formed by the Department of Advanced Science and Technology of the Ministry of Science and Technology, relevant departments of the Ministry of Health and ophthalmology Society of The Chinese Medical Association, and a certification system that conforms to China's national conditions shall be established according to the relevant certification system standards of the United States. For the remote screening programme for diabetic retinopathy, three accreditation levels could be considered:

Level 1 certification, that is, remote eye service station, equivalent to the United States certification system level 1 certification;

Level 2 certification, that is, remote ophthalmic base, equivalent to the us certification system of secondary certification;

Level 3 certification, or regional remote eye center, is equivalent to level 3 certification in the United States certification system.

On this basis, the Certification Committee for Telemedicine ophthalmology must also standardize the related business and technical standards of tele-ophthalmology [13], such as: software standards: International Statistical Classification of Diseases and Health-related Problems (ICD-10), Medical Digital Image Communication Standard (DICOM), medical Information Exchange Standard (HL7), etc. Remote ophthalmic service standards: such as remote imaging consultation, video conference + remote imaging consultation, intelligent software remote consultation, difficult diseases remote consultation, network consultation, network registration, network referral, mobile phone registration and other standards; Screening modes and standards for eye diseases:such as cataract, glaucoma, diabetic retinopathy and other screening

standards; Other standards include equipment and network standards of remote eye centers, bases and service stations, technical personnel training standards, service process standards, management evaluation standards.

Digital telemedicine technology is a high-tech and interdisciplinary new systematic cooperation platform integrating medical treatment, data and communication technology. With the support of Internet data transmission, it can effectively connect and connect the client terminals of corresponding community health institutions with remote servers of specialized support hospitals. As long as the community health institutions conducting screening have network conditions, they can directly connect to the remote system platform. With extensive coverage, flexible operation and low investment cost, a group of corresponding specialists in a related specialized hospital can provide diagnosis and treatment services of eye disease screening for enrolled patients in different locations at the same time to meet the needs of patients. This kind of model is more in line with the actual characteristics of community operation,provides a greater possibility for the promotion of screening, and has long-term good social and economic benefits. In the community medical eye disease screening, the wide application of digital telemedicine not only complies with the requirements of the new medical reform, but also greatly improves the service capacity of community health institutions. For a long time, the serious short of grassroots medical resources, lead to patients to community health diagnosis and treatment level and service quality of medical institutions, so whatever ailment of a serious illness are flocking to big hospital, appeared a few patients with community health medical institutions, and the phenomenon of big hospitals are crowded, the resulting "slow to see the doctor, the doctor is difficult". In order to improve the difficult and bad medical treatment situation, the new medical reform proposed: the first community treatment, then graded medical measures, the goal is to diagnose and treat common diseases and preventable diseases in grassroots community medical institutions, diversion of patients with difficult diseases for large hospitals. In line with the demands of the new medical reform, this study transferred the professional eye disease screening work from large hospitals to community medical institutions, effectively diverting patients with eye disease and conforming to the policy of the new medical reform. The preventive effect of regular fundus screening on

diabetic retinopathy and even blindness has been very clear, but there are still most diabetic patients who do not accept regular screening. The reasons include socioeconomic conditions, geographical factors, no obvious vision loss in the early stage of the disease, and lack of relevant disease education. The detection of diabetic retinopathy can be achieved through screening, and the effective detection rate of diabetic retinopathy can be significantly increased by carrying out a large-scale screening program for diabetic retinopathy. In the implementation of this project, the digital telemedicine diabetic retinopathy screening model has greatly brought into play the counterpart technical advantages of relevant specialized hospitals, and made up for and improved the professional technical level and service capacity of grassroots community medical institutions. At the same time, it greatly facilitates diabetes patients, meets the medical needs of nearby examination and expert diagnosis and treatment, makes reasonable use of medical resources for early detection, early diagnosis and early treatment, and effectively improves the quality and efficiency of screening work and the detection rate of eye diseases.

In conclusion, regular and orderly eye examination and early detection of diabetic retinopathy are important measures to effectively prevent blindness caused by diabetes. Digital remote diabetic retinopathy screening is an effective method to improve the detection rate of diabetic retinopathy, and can greatly reduce the economic cost of screening, making diabetic retinopathy screening affordable personalized medicine for diabetic patients. The diabetic retinopathy remote medical screening system needs a lot of support from the government departments at all levels and the positive participation, the integration of effective resources, organization innovation architecture, create and develop diabetic retinopathy of remote medical system and screening institution accreditation system and the related standard, orderly health effectively really serve the people with diabetes. Regular examination of fundus and timely detection of diabetic retinopathy are important methods to prevent blindness caused by diabetes. Screening for diabetic retinopathy is an important method to improve the detection rate of diabetic retinopathy, and digital remote screening can significantly reduce the cost of screening, making screening truly affordable medical services for the people. Under the guidance and participation of government departments at all levels, the remote screening system for

diabetic retinopathy needs to innovate organizational structure, effectively integrate resources, and formulate and establish relevant standards and certification systems for remote screening institutions and work systems, so as to carry out the system in a healthy and orderly manner and truly serve the common people.

References

1. Eresch J, Stumpf M, Koch A, Vutukuri R, Ferreirós N, Schreiber Y, Schröder K, Devraj K, Popp R, Hattenbach LO, Pfeilschifter J, Pfeilschifter W, Sphingosine Kinase 2 Modulates Retinal Neovascularization in the Mouse Model of Oxygen-Induced Retinopathy, Invest Ophthalmol Vis Sci, 2018, 59(2): 653-661.

2. Lee JY．Residency training for general practice in China[J]．Education for Primary Care，2014， 25(3)：163．

3. Chaet D, Clearfield R, Sabin JE, et al. Ethical practice in telehealth and telemedicine. Journal of General Internal Medicine, 2017,32(10):1136-1140.

4. Sood S, Mbarika V, Jugoo S, et al. What is telemedicine? A collection of 104 peerreviewed perspectives and theoretical underpinnings. Telemedicine Journal and e-Health : the Official Journal of the American Telemedicine Association, 2007,13(5):573-590.

5. Romina N, Patrick H, Sophie S, et al.Telemedically augmented palliative care:empowerment for patients with advanced cancer and their family caregivers. Wien Klin Wochenschr, 2019,131(23/24):620-626.

6. Bates M. Technological innovation comes to palliative care: with a shortage of palliative specialists, telemedicine and remote monitoring offer relief. IEEE Pulse, 2016,7(6):25-29.

7. Bonsignore L, Bloom N, Steinhauser K, et al. Evaluating the feasibility and acceptability of a telehealth program in a rural palliative care population: tapcloud for palliative care. Journal of Pain and Symptom Management, 2018,56(1):7-14.

8. Jud SM, Fasching PA, Maihoefner C, et al.Pain perception and detailed visual pain mapping in breast cancer survivors. Breast Cancer Research and Treatment, 2010,119(1):105-110.

9. Brown LF, Kroenke K, Theobald DE, et al.The association of depression and anxiety with health-related quality of life in cancer patients with depression and/or pain.Psycho-Oncology, 2010,19(7):734-741.

10. Shaffer KM, Kim Y, Carver CS. Physical and mental health trajectories of cancer patients and caregivers across the year postdiagnosis:a dyadic investigation. Psychol Health, 2016,31(6):1-22.

11. Chih MY, DuBenske LL, Hawkins RP, et al. Communicating advanced cancer patients' symptoms via the internet: a pooled analysis of two randomized trials examining caregiver preparedness, physical burden,and negative mood. Palliative Medicine,2013,27(6):533-543.

12. Shin JY, Kang TI, Noll RB, et al.Supporting caregivers of patients with cancer: a summary of technology-mediated interventions and future directions.American Society of Clinical Oncology Educational Book, 2018,38:838-849.

13. Lustbader D, Mudra M, Romano C, et al.The impact of a home-based palliative care program in an accountable careorganization. Journal of Palliative Medicine, 2017,20(1):23-28.

14. Calton BA, Rabow MW, Branagan L, et al.Top ten tips palliative care clinicians should know about telepalliative care. Journal of Palliative Medicine, 2019,22(8): 981-985.

15. Donelan K, Barreto EA, Sossong S, et al.Patient and clinician experiences with telehealth for patient follow-up care.American Journal of Managed Care, 2019,25(1): 40-44.

16. Mathew C，Yunirakasiwi A，Sanjay S．Updates in the mall agement of diabetic maeular edema[J]．J Diabetes Res，2015：794036．

17. Mackenzie S，Schmermer C，Chamley A，et a1．SDOCT imaging to identify macular pathology in patients diagnosed with diabetic maculopathy by a digital photographic petinal screening programme[J]．PLoS One，2011，6(5)：e14811．

18. Dmuchowska DA，Krasnicki P，Mafiak Z．Can optical COherence tomography replace fluorescein angiography in detection of ischemic diabetic maculopathy[J]．Graefes Arch Clin Exp Ophthalmol，2014， 252(5)：731-738．

19. Augustin A，Loewenstein A，Kuppermann BD．Macular edema．General pathophysiology[J]．Dev Ophthalmol，2010，47：10—26．

20. Badaro E，Novais E，Prodocimo LM，et a1．Spectral domain optical coherence tomography for macular edema[J1．Scientific Wodd Journal．2014：19 1847．

21. Hatef E，Khwaja A，Rentiya Z，et a1．Comparison of time domain and spectral domain optical coherence tomography in measurement of macular thickness in macular edema secondary to diabetic retinopathy and retinal vein occlusion[J]．J Ophthalmol，2012：354783．

22. Agarwal D，Gelman R，Ponce CP，et a1．The vitreomacular interface in diabetic retinopathy[J]．J Ophthalmol，2015，2015：392983．

23. Kang SW ，Park CY ， Ham DI ． The correlation between fluorescein angiographic and optical coherence tomographic features in clinically signiicant diabetic macular edema[J]．Am J Ophthalmol， 2004，137(2)：313-322．

24. Tomkins—Netzer O，Ismetova F，Bar A，et a1．Functional outcome of macular edema in different retinal disorders[J]．Prog Retin Eye Res，2015，48：1 19-136．

25. Rabbani H，Allingham MJ，Mettu PS，et a1．Fully automatic segmentation of fluorescein leakage in subjects with diabetic macular edema[J]．Invest Ophthalmol Vis Sci，2015，56(3)：1482-1492．

26. Park YG，Kim EY，Roh YJ．Laser—based strategies to treat diabetic macular edema：History and new promising therapies[J]．J Ophthalm01．2014：769213．