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Comparison of the Accuracy of Digital Image-based and Patient Visit-based Diagnoses in an Iranian Dermatology Clinic

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ABSTRACT

Teledermatology as one of the Telemedicine applications is used in the diagnosis and treatment of skin diseases. The accuracy of diagnosis made based on the images of skin lesions is among the most important issues in this field. The aim of this cross-sectional study was to compare the accuracy of dermatology diagnosis based on patient's history and lesions' images with that made in face to face visit as the gold standard and also to determine Kappa agreement coefficient between these two types of diagnosis.

Method: A total of 91 patients were enrolled into the study. Patients' identity features and medical history were recorded at admission and lesions' images were taken with a standard method. Then patients were referred to a dermatologist to put his diagnosis on the disease. About two months later the same dermatologist was asked to put his diagnosis based on the patients' recorded medical history and digital images of the lesions. Then the two diagnoses were compared and Kappa coefficient was calculated. Data analysis was performed through SPSS software package.

Results: The correlation rate of diagnoses was 84.6 and kappa coefficient was calculated as 0.77

Conclusion: The diagnosis of dermatological disease based on just patient's medical history and digital images of skin lesions has a high rate of accuracy and it can be confidently recommended for tele-dermatology purposes in Iran.

KEYWORDS: Diagnostic agreement coefficient, Teledermatology, Kappa coefficient

1. INTRODUCTION

The collaboration of physicians, hospitals, medical centers and financial and insurance experts in a virtual environment is a novel field in health care with the aim of providing optimal health care to patients (1). The rapid development of technology and health informatics has urged hospitals to acquire infrastructures and skills required for providing more advanced medical services with higher quality (3). Current developments in information technology and telecommunications have led to a transformation in many aspects of human life (1). These transformations significantly affect health care and medicine fields as well. Today, healthcare organizations are confronted with a new technology called telemedicine (4) that provide channels for diagnosis and treatment of diseases, collaboration, education and teleconsultations (5). Telemedicine is a new field that uses new telecommunications technology to exchange medical data. The relationship can be established between patient and physician (Telediagnosis) or between two different physicians or two medical centers (Teleconsultation) (3). The ultimate goal of using this technology is to increase the efficacy of health care by increasing the continuity of care, increasing the accuracy of diagnoses and reducing the time required for diagnosis (4). During the past decade, telemedicine has been widely used in health care. Since poverty, geographical areas spread and lack of medical experts are considered as the three barriers of access to medical care, this technology can provide health care and consultation services for Different strata of society by overcoming these barriers (5-7). Telemedicine projects increase patients' access to health care in remote areas by integrating different levels of care. This integration improves the accuracy, effectiveness and consequently the optimal use of health care resources. Moreover, it rationalizes the management of requests and reduces the rates of unnecessary clinical examinations, tests and interventions (8). Telemedicine technology can be used in various forms including teleconsultation, teleeducation, distance home care, telesurgery, teleradiology, and other cases (9). One of the most common applications of telemedicine is in the diagnosis and treatment of skin diseases. In most cases, skin diseases are chronic disorders that their care, treatment and follow-up takes a long time. Transportations and

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travels for referring to specialists in hospitals, clinics or private offices are costly and time consuming for patients. On the other hand, due to the increasing trend of different disciplines of medical sciences for using this technology in providing health care services to patients, and also due to the visual nature of this group of diseases, especially after the advent of digital photography, these diseases became an ideal specialty for introducing the application of telemedicine and provided an opportunity to change and transform the traditional physician -patient relationship (10-13). In 1995, Perdina and Allen for the first time introduced the term teledermatology and used combination of information and communication technologies to provide teledermatology services (14). Teledermatology means providing specialty skin cares (diagnosis, treatment and follow-up) using remote information and communication technologies and it provides virtual connection between patient and physician (7,13,15,17,18). In late 1960, the first project of teledermatology linked a medical clinic at Logan Airport in Boston to Massachusetts General Hospital (15). This was the first attempt to use tele-dermatology and was very limited due to the technologic facilities of that time. After the evolution of telecommunications technology and the digital era and the development of Internet and satellite communications, interest in research and use of tele-dermatology has been increased. Surveys conducted in Norway have revealed that dermatology is one of the top priorities among other medical specialties for implementing telemedicine projects in a wide range (14, 16). Diagnosis of a skin disease is done by reviewing the patient's medical records and the results of examination and biopsy. In this way, dermatologist evaluates laboratory and clinical findings of patients using telecommunication technology. For treatment of skin diseases in this way, high-resolution color images of lesions should be provided(15). In this regard, the privacy and security of patient's data and images are very important and secure access to them should be considered. Encryption, confidentiality, identification, authentication, and data integrity are things that must be considered. In our country, since the middle of last decade, attention has been paid to the theoretical concepts and in recent years, some efforts have been done to implement some systems and softwares such as EHR and etc. Currently, many health care providers intend to use telemedicine services in skin diseases (13-14). Therefore, before implementing these systems, the success or failure of these projects need to be reviewed. Although this type of research has been conducted in several countries and different results have been obtained that will be referred to later, according to different requirements and potentials of our country, it was required to conduct this research prior to the planning for implementation of teledermatology in order to determine whether implementation of teledermatology can respond to medical and health needs of the country or not. Reminder of paper organizes as follow: section 2 we describe research method. Finally, research result and discussion and conclusion are presented in section 3 and 4, respectively.

2. RESEARCH METHOD

This descriptive–cross-sectional study was done in order to evaluate the correlation between two methods of distance and face-to face diagnoses in patients with skin diseases in Kerman University of Medical Sciences and it was performed as an introduction for implementing teledermatology in Kerman University of Medical Sciences. Research data were collected using a questionnaire completed by four dermatologists. The questionnaire consisted of three parts; the first part was related to the patient's identification information, the second part consisted important factors for the diagnosis of skin diseases, and the third part was related to the patient's medical history. It was completed for 91 patients referred to dermatology clinics.
After the arrival of the patient to the clinic, patient's identity information, important factors in relation to the diagnosis of skin diseases, and medical history were recorded. Then, lesions' images were taken with a standard method. The patient was sent to the dermatologist and the diagnosis of skin examination by the dermatologist was recorded. About two months later, when the doctor could not remember his previous diagnosis, he was asked to put a diagnosis based on just the recorded history and digital images. This was done on 91 patients and after completion of work, the two diagnoses were compared.
Data were collected by a questionnaire and analyzed through SPSS software. To measure inter-rater agreement, Kappa coefficient was used.

3. RESEARCH RESULTS

Diagnoses were classified into three groups of infectious, noninfectious and cancer diseases. In Table 5, Dig 1 represents Type of disease based on face-to face diagnoses and Dig 2 represents Type of disease based on Tele diagnosis. In 81 cases, the two diagnoses were the same while in 10 cases they were different. According to the 24 cases presented in this table, the type of diseases in both face to face and Tele diagnosis were infectious. In 4 cases, the type of disease was infectious for face to face diagnosis and noninfectious for Tele diagnosis. In 6 cases, the type of disease for face to face and Tele diagnosis was noninfectious and infectious respectively. In addition; in 54 cases in which the type of disease was noninfectious, both diagnosis were similar. In 3 cases in which the type of disease was cancer both face to face and Tele diagnosis were similar.

A total of 91 patients referred to the dermatology clinic of whom, 51 patients (56%) were male and 40 ones (44%) were female. While 54 patients (59.3%) were Kerman residents, 37 ones (37.3%) had come from cities of Kerman province and 3 patients had not completed this field. The rate of agreement between two types of diagnoses was 84.4% (Table 1).

Most Skin problems were in the head (Table 2). From all radiographs, 98.9% had acceptable clarity (Table 3). Mean and Std. Deviation of participants were 28.64 and 19.38 respectively Eczema and vitilligo were respectively the most and the least frequent diagnoses (16.5% vs. 3.3%) (Table 4) .To determine the agreement coefficient between Tele and face-to-face visit, agreement test was conducted. Finally, Kappa agreement coefficient was calculated at 0.77 (Table 6).

Of the total of 91 patients, only 14 cases had incongruent diagnosis in both face to face and Tele_diagnosis. Among this, 4 and 10 cases were men and female respectively. And the lesion location for 2 cases was in the head, 3 cases in the upper part of the body, 5 cases in the whole body, 2 cases in the lower part of the body and finally; 3 cases were present in different parts of the body(Table 7).

Among 14 incongruent diagnosis, 3 cases were present in patients less than 3 years, 3 cases in patients between 12-13 years and 8 cases in patients more than 12 years(Table 8).

Results are presented in eight tables as follow. Data collected by questionnaire were entered into SPSS software and analyzed with descriptive statistics. This study had two limitations. Firstly, we couldn't add another group in our study without taking any history of patients. Secondly, we didn't have multi center studies with a more population size.

Table1: Frequency and percentage of diagnosis correlation in two distance and presence method.

Result	Frequency(valid Percent)
Yes	77(84.6)
NO	14(15.4)
Total	91(100)

Table2: Frequency and valid percentage of lesion location according to lesion location.

Location	Frequency(valid Percent)
Head	27(29.7)
Upper	24(26.4)
Body	9(9.9)
Lower	14(15.4)
Many	17(18.7)
Total	91(100)

Table3: The Frequency and percentage of images according to image resolution

Result	Frequency(valid Percent)
Yes	90(98.9)
NO	1(1.1)
Total	91(100)

Table4: Top ten maximum frequencies of Diagnosis

Diagnosis	Frequency (valid Percent)
Eczema	15(16.5)
Wart	7(7.7)
Tinea	5(5.5)
Dermatophyte	4(4.4)
Lichen Planus	4(4.4)
Acnea	3(3.3)
Fruncolo	3(3.3)
Lishmanusis	3(3.3)
Nevus	3(3.3)
Vitiligo	3(3.3)
Total	91(100)

Table5: Dia1 * Dia2 Crosstabulation

Dig1	Dig2			Total
	1	2	3	
1	24	4	0	28
2	6	54	0	60
3	0	0	3	3
Total	**30**	**58**	**3**	**91**

Table6: kappa agreement

	value	Approx. Sig.
Kappa Agreement	0.77	0.00

Table7: Relation between misdiagnosis cases in terms of gender and location of lesion

	Sex		Location of lession				
Misdiagnosis	Man	woman	Head	UpperL	Body	Lower	Many
	4	10	2	2	5	2	3

Table8: Relation between misdiagnosis cases with in terms of age and type of disease

	Age Group			Type of disease		
Misdiagnosis	<3 Years old	3-12	>12 Years old	infectious	noninfectious	cancer
	3	3	8	4	10	0

4. DISCUSSION AND CONCLUSION

Since the first time that teledermatology has been used up to now, its diagnostic accuracy has been reported from 59% to 80% in different studies which shows the efficacy of this method in the dioagnosis of skin disease (13,15). In two similar studies performed by Masosn et al, digital camera and mobile phone were used to capture images of skin diseases' lesions. Both studies were performed by store and forward method. Compliance rates of diagnoses found in these two studies were respectively 70% and 79% (31,32). According to another study by Wooton et al (2011), use of telemedicine in skin diseases significantly reduces unnecessary travels and compensates costs of implementation (33). Also, different studies have showed that in general patients are satisfied with store and forward method used for the diagnosis of skin diseases and they believe that receiving health care services through face-to-face method, has no significant superiority to receiving these services through distance method. In relation to the imaging of skin lesions, there are valid guidelines that the most valid of them has been provided by US telemedicine association. In order to standardize the transfer of medical data, US telemedicine association has set a protocol asserting that additional information about patient and lesions location should be attached to the images taken from lesions to help the diagnosis. By using current technologies, high resolution images, comparable with color slides that allow diagnosis in most cases, can be transferred. In primary studies Perdina et. al compared skin lesions' slides and digital images with different resolution. They reported that digital images with 498×547 pixel and 24 colors are appropriate for diagnosis.

Dermatology examinations should be typically accompanied with patient's medical history and it should be considered that these components be provided in telemedicine systems as well. For an adequate diagnosis and treatment plan, medical history should be as complete as possible. In a study in the United State, 60 patients with skin problems were evaluated by dermatologists through video conference and then they were examined by a dermatologist through a face-to-face visit. In 78% of cases, the two diagnoses were completely the same, so telemedicine was reported as an effective approach in the diagnosis of skin diseases. Another study was performed in the US in order to determine the diagnostic accordance between clinical consultation and tele- consultation via video conference in 130 patients and the results showed the diagnostic accordance of 80%. Among 11 biopsies performed in the mentioned study, there were seven cases of diagnostic accordance that its value was around 63%. Overall, these studies showed that diagnostic accordance between the face-to-face and video conference methods is about 54% to 80%, which is similar to the results of other studies (49,5).

Studies related to diagnostic accordance show 59% to 93% accordance between distance diagnosis through store and forward method and face-to-face clinical examination method. Although there are several similar studies in this issue in some countries, due to different conditions in our country in terms of facilities, we intended to perform this study before the implementation of teledermatology system at Kerman University of Medical Science. Since the correlation rate of diagnoses and kappa diagnostic agreement coefficient were equal to 84.6 and 0.77 respectively, it can be concluded that diagnosis of skin diseases based on the patient's history and digital images of skin lesions compared with face-to-face visit and in person examination, has high accuracy and it can be recommended confidently for teledermatology purposes.

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