TELEMEDICINE TEST-BED
A *Tool for Determination of Accuracy in Asynchronous Collaborative Method*

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Abstract: Store-and-forward method has contributed for telemedicine as an efficient method to the clinical diagnosis acquisition. Studies in teledermatology demonstrated important outcomes, such as the use of computer systems based in asynchronous method for long-distance diagnosis, categorization, triage, or clinical outcomes agreements. However, for some issues there is no consensus between studies, such as the image parameters or the data that must be submitted to analyze. The aim of this study is propose the development of a web system that establishing patterns to construct web asynchronous system. A prototype was constructed to test a structure (clinical data and images) to obtain clinical diagnosis concordance in teledermatology. The preliminary outcomes showed that rate clinical diagnosis is nearly when we compare face-to-face method (76.6%) and store-and-forward (70.3%). The most effectiveness occurs to some diseases, who present easy clinical diagnosis in traditional consult. We expect that this system could introduce a numerical method, established in statistical data, to construct store-and-forward system.

1 INTRODUCTION

The telemedicine was developed and based under the concept of the access to health-care using information technology in situations where the long distance is a critical factor (Craig and Patterson, 2005). The Internet extended this concept under the paradigm of the widely collaboration between health professionals.

Due to traditional face-to-face method consultation, using visual observation of the patient and method to obtain date to realize an initial diagnosis hypothesis, specialties such as dermatology and ophthalmology (Finamor *et al.*, 2005) are further adjusted to these requirements, widely documented (Ferguson, 2006).

Several studies based in store-and-forward teledermatology have been performed and the outcomes are:

- higher concordance rates in comparison to outcomes histological diagnosis (Du Moulin *et al*., 2003; Moreno-Ramirez *et al*., 2005; Chao *et al.*, 2003);
- categorization of outcomes (Piccolo *et al*., 2004);
- clinical case triage, according to urgency level (Oakley *et al.*, 2006);
- fast reply (80% of submitted consultations in one day) to requisitions submitted to experts using a non-commercial network based in use of easy platform to teleconsultations services (Massone, 2006);
- number of patients (51%) reduction referral for the consultation with the expert, when teleconsultations (data and image) are submitted from general practioner by email, to expert. This value is similar to the real time cases (Knol *et al*., 2006);
- similar clinical outcomes in comparison to virtual teleconsultation (Pak *et al*., 2007).

However, there is no agreement in several issues as the influence and minimum level of images quality (resolution and compression) for a compose efficient clinical diagnosis, minimum data set to be submitted, the composition of the patients history clinical and reply, the adequate specialties to asynchronous method, the restrictions to use, the level of complexity of the clinical cases that must be diagnostics efficiently, and the influence of expert's experience.

It's necessary to implement a structure and vocabulary to the establishment of a computation system to realize experiments that allows the

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evaluation of the necessary and enough parameters for efficient clinical diagnosis.

The aim of this study is to propose the basis to development of system web multi-specialty and to show the outcomes of a prototype web system, applied to teledermatology, which allows to establishment of a virtual collaborative research environment, to realize tests for the evaluation of the telemedicine accuracy, an important subject for the reliability of the asynchronous method.

2 MATERIALS AND METHODS

The model is the reproduction of a real experimental environment, where a clinical data set and images, of diagnostic performed by face-to-face consultations can be available and evaluated by specialists, whom opinion could be validated according to gold-standard.

The physical architecture will contemplate the client-server model. According to established aims, the use of open source software is necessary.

To assessment of platform will realize experiments: a control group composed for clinical cases recorded in clinical archives with data and images obtained in a face-to-face consultation, selected by the manager health professional for test control, with previously known clinical diagnosis, what it will compose the standard-gold of this tests. The initial focus of study will be dermatology and ophthalmology.

The proposed web platform will provide the manager health professional a computational system to deliberate data set and diagnosis options, including false options (tricks). Besides, it will be able to change images size, resolution, and compression rate. To further reliability, the manager health professional will be able available to randomize for choosing the clinical cases.

Potential data sets to be tried are composed of minimum personal data, clinical history, and clinical data from face-to-face consultation, image quality parameters (minimum resolution, and compression). The combination of these factors will compose other experimental data sets.

2.1 Application

A prototype was performed to application in teledermatology. The aim was the determination of rate diagnosis concordance among initial diagnosis hypothesis face-to-face consultations and store-and-forward in comparison of both cases with gold-standard. The literature (Bowns *et al*., 2006) reveals that the diagnosis concordance rate will must be more than 60 %.

To conduct this study, it was defined two standard users: evaluator (a dermatologist responsible for a test control and access to statistical outcomes) and specialist (two dermatologists analyzed the 64 cases together, according to real environment).

To realize the trials, a control group was performed for 64 randomized clinical cases registered in paper, composed by personal and clinical data, dermatoscopic images, a initial diagnoses hypothesis and a result of clinical analysis (gold-standard), selected by evaluator.

Figure 1: Web environment to dermatologist.

This prototype allowed trial a minimum data set to teleconsultation in dermatology. Personal data (gender and age), clinical (body's part and time of occurrence of lesion) and dermatological images (2-6 images, mean score 2.6). There were two options to resolution: standard (640 x 480) or the captured image. The figure 1 shows the web system environment available to specialist.

The specialist task was choice the option of a diagnoses hypothesis, image's quality, difficulty degree for diagnosis and available data in a list. Commentaries can be performed if necessary.

3 RESULTS

The diagnostic concordance rate in face-to-face consultation (initial diagnoses hypothesis) was 76.6% (49/64) and using web system (asynchronous method) was 70.3% (45/64). This outcome is according to literature (Bowns, 2006) to web system.

The trial allowed to obtain the diagnosis concordance among consultation face-to-face and using web system according to diagnoses hypothesis, showed in table 1. The most significant results occurs in absolutely success in basal cell carcinoma diagnosis (face-to-face: 11 match/11 choices; web: 11 match/11 choices) and atypical nevus failure (face-to-face: 2 match/10 choices; web: 0 match/6 choices).

Table 1: Diagnoses concordance rates in comparison to gold-standard.

Diagnoses Hypothesis	Face-to-face (%)	Web (%)
Basal Cell Carcinoma	100.0	100.0
Haematoma	100.0	100.0
Malignant Lentigo Melanoma or Malignant Lentigo	77.8	75.0
Simple Lentigo	0.0	0.0
Solar Lentigo or Solar Melanosys	100.0	100.0
Malignant Melanoma	70.0	75.0
Atypical Nevus	20.0	0.0
Blue Nevus	100.0	100.0
Congenital Nevus	100.0	71.4
Reed's Nevus	0.0	0.0
Melanocytic Nevus	88.9	80.0
Actinic Keratosis	0.0	0.0
Seborrhoeic Keratosis	100.0	83.3

The specialist's opinion about the available data using the web system was showed in table 2.

This trial allowed us to measure of a specialist opinion about the diagnosis difficulty. It was possible compares the face-to-face and web analysis. Table 3 shows this comparison.

The table 4 shows comparison among the specialist opinion about the diagnosis difficulty and the success of diagnoses hypothesis. This is according our forecast, because the rate for easy diagnosis is major.

Table 2: Specialists opinion rates about data available in web system.

Data was enough to realize a diagnostic?	**Rate (%)**
No, it's very important includes more data.	1.6
Yes, certain.	70.3
Yes, but I had doubt.	28.1
Image's Quality	
Very Nice	47.1
Nice	6.5
Bad	5.3
No important	0.0

Table 3: Diagnosis difficulty degree rates.

Diagnosis Difficulty Degree	Face-to-face (%)	Web (%)
Easy	46.9	43.8
Medium	21.9	28.1
Difficult	31.3	28.1
Sum	**100.0**	**100.0**

Table 4: Success diagnosis hypothesis in relation with the diagnosis difficulty degree.

Diagnosis Difficulty Degree	Face-to-face (%)	Web (%)
Easy	96.7	96.4
Medium	64.3	55.6
Difficult	55.0	44.4

These trials conduct us to basic structure to web system to remote diagnosis web system in dermatology:

- Personal data minimum: gender and age.
- Clinic data minimum: body' part and time.
- Image's quantity: 2.6 (mean-score).

This structure presents more efficiency (around 70%) to diseases with easy diagnosis when traditional consultation.

4 CONCLUSIONS

Studies based on the asynchronous method has not been enough yet to establish it as an greatest choice for the resolution of difficulty access health-care to populations in isolated areas geographically, triage of clinical cases for reduction of specialist access delay, available of the second opinion or discussions

of difficult clinical cases. There is only a potential indication for the use of asynchronous method and the success factors are being established yet, but only for specific specialties (Finamor *et al.*, 2005 and Ferguson, 2006). The studies of the diagnosis agreement performed still not presented a consensus.

This prototype showed us a basic structure to have success in remote telediagnosis in dermatology. We expect that a web system based in these characteristics must have rate success nearly face-to-face consult. This is the aim of test-bed: trial a structure, to obtain data to analyse the outcomes and construct the web systems based in tested values.

In the experiments, found in literature, that use email to submit data and attach images files, it there is not a pattern that it indicates that set data must be submitted. The text is based only on professional common-sense and medical practice. Bergus *et al*. (2006), demonstrated that the quality of information is very important to referral reduce the need for clinic consultation. In this prototype data standardization was used to facility the data input and establish a vocabulary.

In the next trials, we expected that test-bed shows efficiently to obtain a list of another standard indicators that will answer previously to the raised issues: what size, minimum image resolution and compression will be able to realize a diagnosis, minimum personal data, what data will must be compose recent clinical history, the minimum amount of images to diagnosis, that images are essential, the efficiency rate if images and data will be analyzed separately. Indications to the use for specific clinical cases also could be known.

We expect that this study will contribute for the establishment of the asynchronous flexible collaboration as efficient, reliable, comfortable, and economic method for health professionals in specific medical specialty.

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