INFORMATION SECURITY METHODOLOGICAL PROPOSAL, FOR SENDING BIOMEDICAL SIGNALS IN RURAL TELEHEALTH SYSTEMS

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ABSTRACT

Information and communication technologies are revolutionizing the different areas of knowledge, and medicine is an area where the uses of new technologies are put into practice for the well-being of people. But these new ways of using technology produce a high risk when information is required to be transmitted, either due to the loss of information also due to the risk that the information may be altered for different reasons and due to the theft of information. It is for these reasons that it is necessary to have certain mechanisms to be able to achieve the maximum integrity of the information, in this work a methodology is presented to be able to safely transmit information from the different medical teams to medical information based on an organization of the information, in order to present in a practical way its possible implementation in the development of systems to develop TELESALUD, the protocol is based on the good practices provided by the HL7 standard for the management of clinical information as well as the interoperability between the systems of information and medical equipment that are operating remotely, as results a proposal is presented to be able to carry out rural TELESALUD, oriented to the measurement of patients using various equipment and their transmission to other hospital centers for their diagnosis.

KEYWORDS: Integrity, Interoperability, Biomedical Signals, HL7

Original Article

INTRODUCTION

Telemedicine is one of the techniques that is being widely used in these times, due to the effects of the pandemic caused by COVID-19. The social distancing that occurs caused by the social confinement in which the population finds themselves, has caused the suspension of many medical appointments in the different medical specialties, causing, for the most part, many of these consultations to be developed virtually, through the use of the different platforms that allow the interaction of the patient with the doctor, such as videoconferences, phone calls, among other applications dedicated to this purpose.

These events allow TELESALUD to develop rapidly, moving from an alternative proposal in patient care to a clinical care methodology, in this continuous development many works related to the evolution of TELESALUD-based systems are presented, As the constant growth of these techniques used in the best care of patients [1], in most health centers implementations were made based on the functionalities and on the design of the protocols for the teleconsultation service dedicated to improving the teleconsultation services [2]. For the

benefit of using information and communication technologies, many infrastructure models are designed in order to improve patient service performance [3]. Society is gradually accepting the new patient care protocols, but this process was moving slowly, but the effect of the pandemic is causing the acceptance of remote care [4]. All the development of technologies applied to Health is due to Information and Communication Technologies, which allows its evolution over time and as technology advances, TELESALUD services will accompany its evolution [5].

METHODS & MATERIALS

The methodology presented is constituted by a series of previous steps from the acquisition of the signal from the medical equipment, its processing and adaptation of the signal and the articulation with the development of a protocol for the generation of a file that contains all patient information so that it can be transmitted, received and interpreted by hospital information systems. The methodology and its development are developed below.

Blocks Diagram
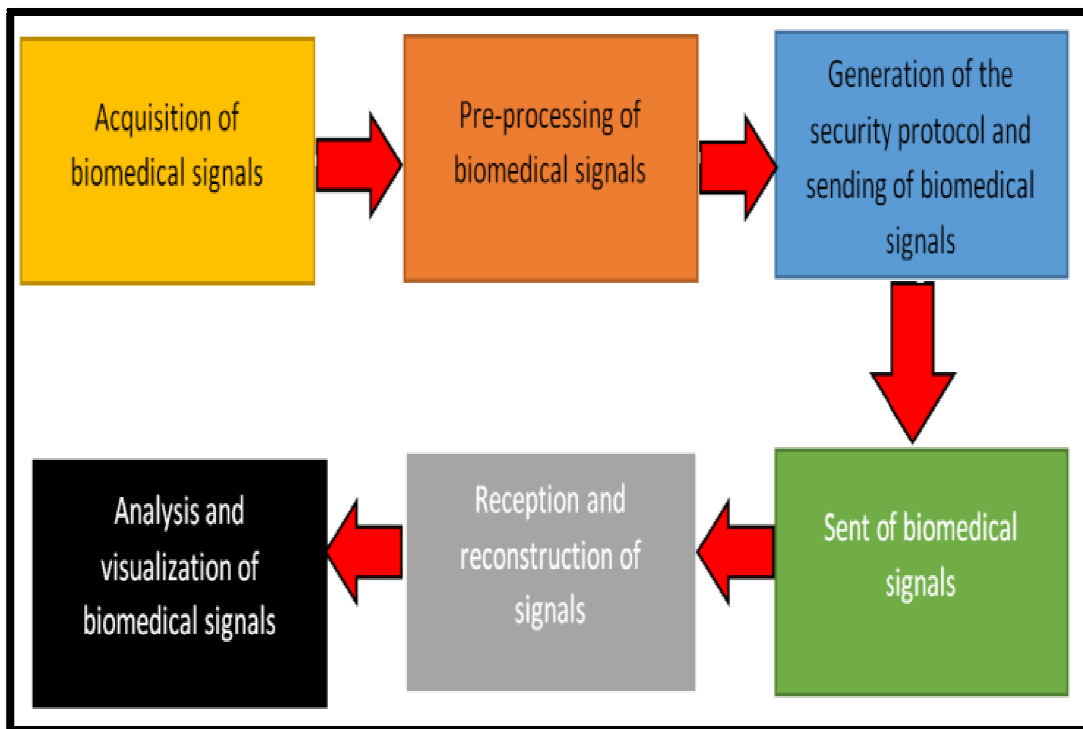
Figurer 1: Block Diagram of the Proposal.

Acquisition of Biomedical Signals

The first step for a TELEHEALTH system based on the transmission of signals from medical equipment, is related to the acquisition of the signal, there are different ways to obtain information, one method is indirectly, where it is obtained through the reports of the equipment, and the second way and the one that interests us is to obtain the signals directly through the communication ports that can be found in medical equipment, among these ports we can mention the serial communication protocols such as RS232, RS-485, USB, among others. Obtaining the signal we can store it in a file either its own format or proprietary format, the proposal of the methodology is to be able to obtain a file with the patient's signals.

Pre Processing of Biomedical Signals

The pre-processing of the information is one of the vitally important tasks in the methodology that is presented. It consists of being able to label the file name with the respective patient data in order to ensure the integrity of the information. At this stage, the integrity of the file generated in the acquisition stage is verified. This verification consists of verifying that the file name corresponds to the patient and that the file is in good condition for use. The error in this stage consists in being able to send the file and that it is defective and the data cannot be accessed and in the next case it is that the file does not correspond to the patient. The following is the structure of the file name.

Information available to label the file: patient information, health center information, center location, type of exam performed and date of exam.

Conformation of the file name: Patient name + health center + place + type of examination + date of examination.

Name of patient: Juan Paredes **(JP)**

Document number: 4251452 **(4251452)**

Clinic: San Juan Bautista **(SJB)**

Place: Piura **(PIU)**

Type of exam: ECG **(ECG)**

Day of exam: 17/08/2020 **(17082020)**

File name: **JP_4251452_SJB_PIU_ECG_17082020**

Generation of the Security Protocol on Sending of Biomedical Signal

Security is an important part in the transition of medical information, for this reason, the generation of the delivery protocol, where the file and patient data are considered. Security allows the integrity of the file data to be sent as well as the integrity of the patient data.

Due to the security mechanism it is based on the interoperability of systems, therefore it is necessary that there is conformity of the information to be sent, when it is put into practice, this security mechanism can be implemented manually as well as automatically. The choice will depend on the technological development and technical availability of the health center.

Sent of Biomedical Signals

He sent the signals, it is carried out following a communication protocol based on an XML file as a message accompanied by the file that contains the signals, with this form of sending the integrity of the information is achieved, so that it can be interpreted at the time of reception. Below is the information to consider in the message in XML.

Information to consider in the message in XML:

- information of the patient
- Name
- Last Name

- Document number

- Information regarding the exam performed

- Type of exam

- Date of shipment and completion of the exam

- Shipping date

- Health center sending the test

- Name of the health center

- Health center location

- Name of the file to send

- File name

Reception and Reconstruction of Signals

The reception of the message in XML is done by decoding the message and recording the information together with the file, in the reference health center who will perform the interpretation and diagnosis. Using the same protocol for sending the signals together with the patient information, the message will be transformed into clinical information and the data in the file will be viewed and interpreted by the doctor for diagnosis.

Analysis and Visualization of Biomedical Signals

Each medical team has its own format to store and save the signals of the examinations performed, that is why the medical team works with two components, the hardware component that is responsible for recording the physical phenomenon present in the patient and the software component Its purpose is to display the signals for subsequent analysis. In the present proposal, it is considered that both the rural health center and the reference health center can both have the software that performs the visualization of the signals, with which the images can be observed and thus the doctor can perform a correct diagnosis.

RESULTS

The results presented in this proposal are related to being able to collaborate in the diagnosis of many diseases, with the help of medical teams, with the methodology it is possible to reach remote towns where access is very difficult and in the worst case They do not have an equipped medical center and the corresponding specialists, which makes it impossible to care for people and even more so to make a good diagnosis with medical equipment.

The proposal presents a TELESALUD mechanism capable of carrying a medical team for local care in a community and this can be diagnosed remotely, thanks to a portable medical equipment and a wireless connection signal that can be via Internet, Mobile, or other.

The conceptual model of the proposed methodology is presented below, with much application in populations of South America, where the technological gap can be verified and even more so the gap in the provision of health services by governments and Private Companies. Where a population is considered neglected in health that can be cared for in its place of origin by health personnel, and that can be evaluated with medical equipment and diagnosed remotely, which considerably improves the diagnosis and treatments to be followed by part of patients.
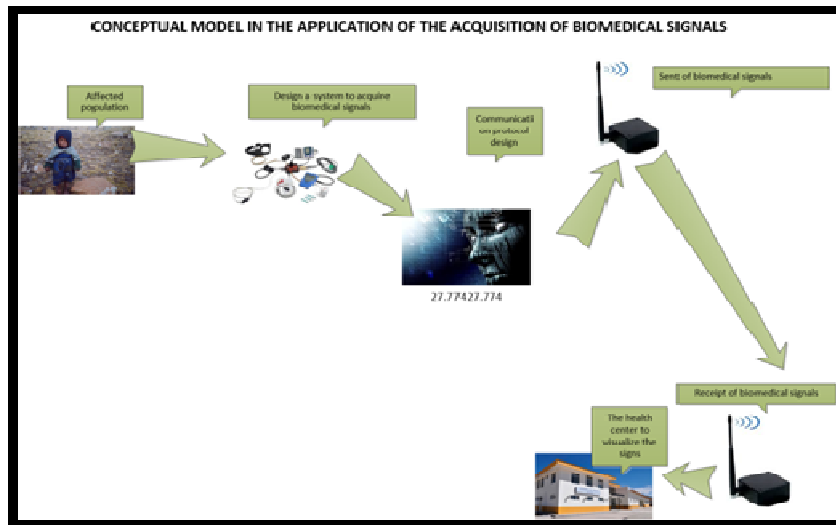
Figure 2: Conceptual Diagram of the Proposal.

As a result of security, an example of the message content is presented in XML, with information about the patient and the exam performed.

Message Content in XML

<information of the patiente>
<personal information>
Juan_Paredes_ 4251452
</personal information>
<test information>
<type of test>
ECG
</type of test>
<date>
17082020
</date>
<clinic>
San Juan Bautista
</clinic>
<place>
Piura
</place>
<name the file>
JP_4251452_SJB_PIU_ECG_17082020
</name the file>
</test information>
</information of the patiente>

CONCLUSIONS

The conclusions that are reached at the end of this research are related to the possibility of being able to carry out tele-diagnosis with the help of TELEHEALTH theories and thanks to information and communication technologies and the XML language. That make possible the design of the different communication protocols for the sending of all kinds of information and that guarantee their integrity and interpretation.

One of the recommendations that should be considered is when it is necessary to send many results, for this situation, a message must be considered for each patient and if we have a patient with many examinations, we require a message for each exam, in conclusion it is required a message for each exam performed.

The proposed methodology is of practical use, and can be applied, for which it is required to review the software of the medical team and verify the file, as well as the implementation of XML messaging, which can be manual or automated.

We conclude by stating that the methodology presented helps to democratize health, bringing health to underserved populations with the help of information and communication technologies. With the help of the XML format, we can ensure the integrity of the patient information and the information contained in the file, which is the signal of the measurement of the equipment used.

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