

Original article

A framework for decision making on teleexpertise with traceability of the reasoning

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Abstract

This paper provides a methodological framework for decision making process to ensure its traceability generally in the context of telemedicine and particularly in the act of teleexpertise. This act permits to medical professionals and/or health professionals to collaborate in order to take suitable decisions for a patient diagnosis or treatment. The main problem dealing with teleexpertise is the following: *How to ensure the traceability of the decisions making process?* This problem is solved in this paper through a conceptualisation of a rigorous framework coupling semantic modelling and explicit reasoning which permits to fully support the analysis and rationale for decisions made. The logical semantic underlying this framework is the *argumentative logic* to provide adequate management of information with traceability of the reasoning including options and constraints. Thus our proposal will permit to formally ensure the traceability of reasoning in telemedicine and particularly in teleexpertise in order to favour the quality of telemedicine's procedure checking. This traceability is to guarantee equitable access to the benefits of the collective knowledge and experience and to provide remote collaborative practices with a sufficient safety margin to guard against the legal requirements. An illustrative case study is provided by the modelling of a decision making process applied to teleexpertise for chronic diseases such as diabetes mellitus type 2.

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1. Introduction

Telemedicine is a kind of remote medical practice, in which there is the possibility of making multiple actors working together and allowing their collaborations in the diagnosis or treatment of a disease, by the means of telecommunication and information technologies. The telemedicine involves either patient with one or several health professionals (HP) and among them a medical professional, or a collaboration between a group of health professionals (HP) and among them at least one medical professional (MP). Telemedicine permits to [1]:

- establish a diagnosis,
- provide for a risky patient a medical monitoring in the context of prevention or a therapeutic monitoring,
- require expert advice,
- prepare a therapeutic decision,
- prescribe products, prescribe or perform acts or services,
- monitor a patient.

This practice is very useful in several domains of application where medical expertises are needed, for example:

- **Rural area** [2], where there is difficulty in health care for remote rural areas because they are unable to attract, afford or retain speciality providers. So telemedicine can help solving these issues by allowing access to specialists regardless of location.

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- **Corrections** [3], in this area telemedicine allows prison facilities to deliver high medical quality without the cost and dangers of inmate transportation and the need for clinical specialist to enter the facility.

There are also many fields of telemedicine application such as schools, mobile health, disaster relief, industrial health, . . .

The practice of telemedicine is divided into these five acts listed below [1]:

1. **teleconsultation**: a doctor gives a remote consultation to a patient, the latter can be assisted by a health professional. The patient and/or the health professional gives information for their side, the remote doctor then performs the diagnosis.
2. **teleexpertise**: a doctor seeks remotely the opinion of one or more of his colleagues on the basis of the diagnostic and therapeutic needs to foster concrete discussions aimed at solving the medical problems related to a patient's care.
3. **telemonitoring**: a doctor monitors and interprets remotely a patient's medical parameters. The recording and the data transmission can be automated or performed by the patient himself or by a health care professional.
4. **teleassistance**: a doctor attends remotely other health professional performing a medical act.
5. **medical regulation**: this is specific to the French telemedicine specification where doctors of centre 15 establish by phone first diagnosis to determine and trigger the best answer suitable to the nature of the call.

In this paper we are interested in the **teleexpertise** act which is used by health care provider to make and take decisions concerning a patient's treatment. Because important decisions are made in this act, then the responsibility of each participant is engaged. Currently, due to the lack of interoperability of Hospital Information System (HIS) or absence of computerised patient records in facilities, the traceability of decisions and information that are used for decisions is ensured by a telemedicine information system. Within this telemedicine information system, it is some forms to be completed that can be specific to certain specialities. The content is structured according to the process in the medical procedure. This helps assisting the applicant in making its request for an opinion to the expert, and to facilitate the processing of the application by the expert. Some forms can sometimes perform by calculations for knowledge discovery in databases. Unfortunately, some health providers not always take the time to complete these forms. But whatever the means of communication used, the most important point is the traceability of decisions. This is our problem, in other words, how to ensure the traceability of the decisions taken by health providers?

To achieve this goal, we propose in this paper two main contributions. First, the paper presents the architecture that we propose to show the interaction between participants and some ontological concepts. This architecture includes an important component called *argumentative logic*. This component is used in our architecture to ensure the traceability of the decisions in

teleexpertise to favour the checking of the telemedicine's procedures quality. Second, the paper will focus on the component where we detailed by a use case its purpose.

This integrated approach includes a semantic formalisation of collaborative information models that assists medical actors at all levels to share knowledge and integrate ethical needs in their telemedicine services: this shows the novelty and originality of our work i.e. integrating semantic modelling and laws concepts for aiding in decision making.

2. Objective

The main purpose of this paper is to propose a methodological framework coupling semantic modelling and argumentation for aiding medical professional in their decision making process. In fact, the proposed framework will permit to medical professionals to manage medical information concerning their patients. So by our proposal we want to give innovative solutions in the practice of telemedicine which will lead to increase telemedicine programs' effectiveness. In fact our proposal combines conceptual graphs and Dung's argumentation system (argumentative logic). With this approach, we aim to propose a rigorous modelling framework since it includes argumentative reasoning which have a mathematical foundation and conceptual graphs based on ontological mechanisms. This argumentative logic will permit to ensure reasoning traceability in a structured manner while the ontological models (conceptual graphs) will permit reasoning visualisation (by the use of CoGui software) and see more ensuring semantic interoperability. By making this tool easy to use we can encourage medical professionals to change their habits by using these new technologies in the practice of medical acts. We aim also to provide a tool which will permit a strong communication among medical professionals and in the same occasion to share knowledge and experiences. For example, when a medical professional cannot take decisions in front of specific diagnosis, by using the system he can make some queries in order to know if there has been a similar case in the past. If yes, then he can know what decisions have been taken for this diagnosis, if no, he can then contact other medical professionals who are specialised in a particular domain and have a thorough understanding to remotely share experienced knowledge during the teleexpertise activity.

3. State of the art

In this section, we start with a state of the art to show what has been already done for the argumentation and the traceability of the decisions in the literature.

3.1. Related work

In our team many works dealing with conceptual graphs for visual knowledge representation have been achieved. However, the global research approaches are not the same and each is useful for different purposes. The work of Potes Ruiz et al.

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