Information Systems with Algorithmically Implemented Medical Protocols

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Abstract. In this paper the concept of Information Systems with Algorithmically Implemented Medical Protocols - ISAMP, a Medical Information system (MIS) incorporating methods and tools of Medical Information Retrieval Systems (MIRS) for handling Medical Protocols, is presented and discussed. More precisely, we focus on Medical Protocols and study the related Nosocentric medical files that share a common structure. Such protocols are organized in ordered text paragraphs. Then, we propose the use of Syptomcentric preoperative care protocols that have an "active" attitude of each surgical case. Eventually, the selection of the relevant Medical Protocols in MIS is based on well-known techniques of MIRS.

1. Medical Protocols for Medical Information Systems

Our experience with Hospital Information Systems (HIS), available in the Greek market, drives us to the conclusion that most HIS construct Electronic Patient Records (EPR) in a passive manner, usable only to list information about diagnosis, medical treatment, medicine and nursing. There are some attempts for more active Medical Files which are based on stable Nosological knowledge (text books) and consequently can be characterized as Nosocentric. These Medical Files can not distinguish perioperative care phases.

Although the implementation of Nosocentric Medical Files can not offer complete and specialized, for Surgical cases, medical services it can be understood as a base to extract some interesting conclusions. We have considered some implementations of Nosocentric Medical Files ("cancer of the colon", "breast cancer" and "liver cancer") [1] and concluded that they share a common structure. This structure organizes all of them in some ordered paragraphs. More specifically, they have, at least, the following sections: "patient population characteristics", "Histologic Classification of tumor", "Clinical data",

"Laboratory Results", "Laboratory Tests", "Staging", "Surgical Findings", "Postoperative complications", "Pathologic – Cytologic Examination", "Postoperative treatment".

The above mentioned, implementations of Nosocentric Medical Files, since of their common structure, can be considered as refinements or descendants of a more general group. The specialization of each descendant is based in the insertion of new supplementary paragraphs between the group's paragraphs or with the differentiation of the information presented in paragraph. In the implementation of "breast cancer" this is applied with the insertion of paragraphs "Patient History" and "Preoperative chemotherapy". In the implementation of "liver cancer" this is applied with the insertion of paragraph "therapeutic treatment". On the contrary, the differentiation of the protocols "cancer of the colon" and "breast cancer" is based on the differentiation of information presented in paragraph "Laboratory Tests" of both. The contents of Paragraph "Laboratory Tests" of Protocol "cancer of the colon" are: CT, Endoscopy, UltraSound, Barium enema. The contents of Paragraph "Laboratory Tests" of Protocol "breast cancer" are: Chest X-Ray, Chest MRI, Mammography, Bone Scanning, Biopsy, CT Scan.

In contrast with the above Protocols, the perioperative care protocols that we suggest are Symptomcentric and have an "Active" attitude of each surgical case.

2. Suggested implementation methodology of Medical Protocols that offer Local and Remote Assistance

As we have mentioned the suggested protocols are "Active" and can help medical experts to conclude differential diagnosis. These protocols can also be used through communication lines to help a medical expert to diagnose some remote patient. To avoid ad hoc design and implementations of protocols we have to define a basic algorithmic approach, which will be different for each protocol group and will be implemented (Hard Coded) in telemedicine systems able to learn. Each protocol will be an instance of its (parent) group protocol and consequently will follow the basic algorithmic approach implemented for his parent but it will also incorporate more specific acquired medical knowledge. The most simple method to "train" protocols can be conducted with learning by being told [2], in other words, with the insertion, from Medical experts, of the complementary knowledge into slots for complementary knowledge. Learning by being told can be repeated often, in order to improve protocols and include more specialized and recent Medical Knowledge, according to the progress of Medical science. Some other learning solutions can also be investigated and whenever our model become acceptable we will first investigate the possibility to train protocols on the basis of learning by analogy [3].

In order to create a basic algorithmic approach we have to note down of the most outstanding steps, at least for some protocols, of the group and thereafter to observe (discernment) and find their common topics (common structure). The bigger problem in this approach is the subjective opinion (viewpoint) that each Physician can have and the emphasis given to objects that are details for some other. This problem can become more heavy and in some cases we can discover that the same doctor, in different periods, note down different things as the most interesting, for the same protocol.

Each physician comprehends the medical cases from an interior to the case point of view. Thus, if we ask more than one physician to select the most significant paragraphs that should compose a protocol handling the same symptoms, we will discover that there is no guarantee that we will get the same answers.

If we investigate carefully their answers, we will find that the differences between them arise from the influence each physician has from his/her most recent relative cases. This situation creates an extra overhead in our effort of selecting (writing down) the most plausible and acceptable common algorithmic structure of protocols of the same group.

The existence of well-written textbooks is a counterbalance to the subjective selection of significant paragraphs for creating the algorithmic structure of protocols.

3. Triggering the correct protocols

Medical Information Retrieval Systems have been designed to offer, to physicians and students, the ability to select Medical Information from a variety of sources, to organize it and to search and retrieve it, in a very simple way. Such a system is CAIRN [4] that permits the selection of relevant documents that match with a submitted natural language query. In other words, users can submit simple phrases that describe the investigated subject and rely on the system to select and present the relevant documents (information).

In Medical Information Systems the selection of the relevant Medical Protocol can be based on traditional methods (e.g. lookup into lists) or to benefit from Medical Information Retrieval Systems. Search methods [4] and moreover medical text classification methods [5] are documented and tested and consequently can be incorporated in Information Systems with Algorithmically implemented Medical Protocols (ISAMP).

The incorporation of such methods into an ISAMP permit Medical users to submit a few words describing the symptoms or other information of the handled case and to automatically retrieve the relevant protocol(s).

4. Communication between Patient and Medical Expert

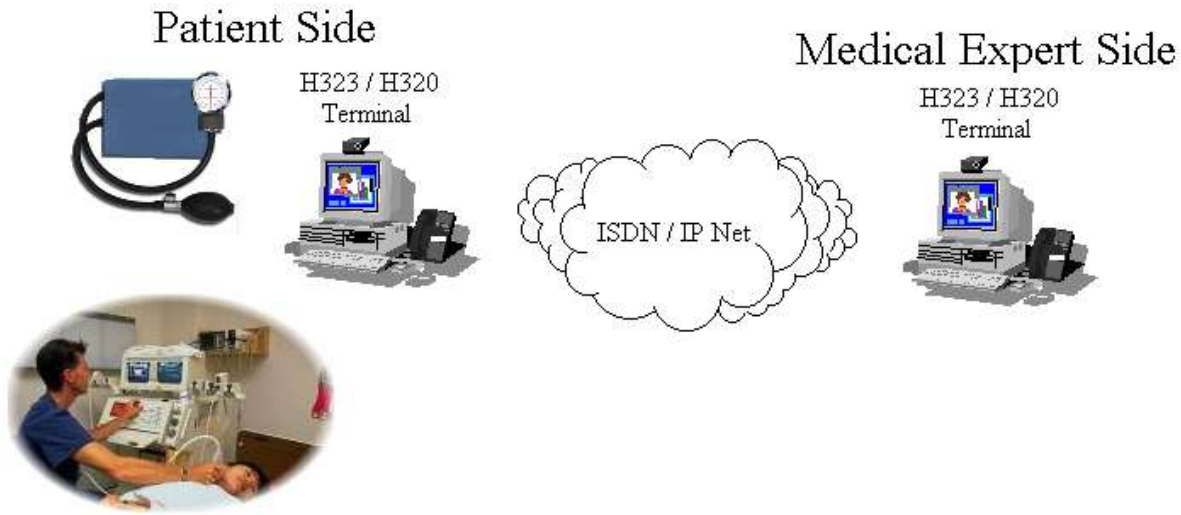
As we have earlier mentioned ISAMP can help a medical expert to diagnose some remote patient. The ITU-T Standards H.320 [6] and H.323 [7] can constitute the communication base between Medical Expert and Patient.

The ITU-T Standard H.320 specifies terminals and equipment for multimedia teleconferencing (transfer of voice, data and video) between two and more parties based on ISDN lines. The ITU-T Standard H.323 specifies almost the same thing with the difference that is based on Internet (IP) communication instead of ISDN lines. Both of them use the Standard T.120 for data transfer.

It must be clear that Information Systems with Algorithmically implemented Medical Protocols demand audiovisual communication between Patient and Medical Expert or between a not Expert (Paramedical or Nurse) and a Medical Expert. There is also demand for transfer of data from:

- Body physical signal measurement equipment (Oximetry monitors, pulse manometers, cardiographs, etc),
- Biochemical and hematological parameters (analyzers and testing strips),
- Radiological equipment (X-Rays, CT, MRI, U/S, etc)

For the above reasons Information Systems with Algorithmically implemented Medical Protocols must support both H.320 and H.323 and provide an integrated environment for audiovisual communication between Patient and Medical Expert and transfer of data from the above mentioned equipment. The system must be able for both manual data entry of equipment's measurements and also automatic capture without human intervention.



5. Conclusions and future work

We have presented and discussed the main concepts of Information Systems with Algorithmically Implemented Medical Protocols (ISAMP). We have also presented some specifications for the communication between the medical expert and the (remote) patients. Our evaluation is based on a partial implementation of the system. The adopted methods include learning by being told, free text retrieval, automatic bilingual key-phrase extraction and automatic text classification.

From our experience with the partially implemented ISAMP system, we can conclude that bilingual thesaurus creation could also improve the conveniences for selecting and triggering the correct protocol. We are currently investigating methods for automatic or semiautomatic bilingual thesaurus creation.

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