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## Towards patient-related information needs

Loes M.M. Braun<sup>a,\*</sup>, Floris Wiesman<sup>b</sup>, H. Jaap van den Herik<sup>a</sup>,  
Arie Hasman<sup>b</sup>, Erik Korsten<sup>c</sup>

<sup>a</sup> MICC-IKAT, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands

<sup>b</sup> Academic Medical Center, University of Amsterdam, P.O. Box 22700, 1100 DE Amsterdam, The Netherlands

<sup>c</sup> Department of Anaesthesiology, Catharina-ziekenhuis, P.O. Box 1350, 5602 ZA Eindhoven, The Netherlands

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### ABSTRACT

The quality of health care depends, among other factors, on the quality of a physician's domain knowledge. Since it is impossible to keep up with all new findings and developments, physicians usually have gaps in their domain knowledge. To handle exceptional cases, access to the full range of medical literature is required. The specific literature needed for appropriate treatment of the patient is described by a physician's information need. Physicians are often unaware of their information needs. To support them, this paper presents a first step towards automatically formulating patient-related information needs. We start investigating how we can model a physician's information needs in general. Then we propose an approach to instantiate the model into a representation of a physician's information needs using the patient data as stored in a medical record. Our experiments show that this approach is feasible. Since the number of formulated patient-related information needs is rather high, it has to be reduced. To reduce the number of formulated information needs we propose the use of additional knowledge. Four types of knowledge are discussed, viz. (a) knowledge about temporal aspects, (b) domain knowledge, (c) knowledge about a physician's specialism, and (d) a user model. Future research has to clarify which type of knowledge (or combination thereof) is most appropriate for our purpose. It is expected that the resultant set of information needs will have a manageable size and contributes to the quality of health care.

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## 1. Introduction

We start with an example that precisely illustrates the need for knowledge of patient-related literature.

An 84-year-old woman was brought into the emergency department of a hospital, suffering from dyspnea and loss of consciousness. Five days earlier she had visited her general practitioner who diagnosed her with suspected respiratory tract infection and prescribed a drug called Clarithromycin. However, instead of improving, her con-

dition worsened. In the hospital the diagnosis pneumonia was considered and she was treated accordingly, but without any effect. Upon her family's request, the patient was not admitted to the intensive care unit and she died one day after she was admitted to the hospital. Surprisingly, an autopsy revealed that the cause of death was not pneumonia, but a case of severe acute pancreatitis. The autopsy also revealed that the most plausible cause for the pancreatitis was the use of Clarithromycin, since pancreatitis is a (rare) side effect of the use of Clarithromycin [1].

\* Corresponding author.

E-mail addresses: [l.braun@cs.unimaas.nl](mailto:l.braun@cs.unimaas.nl) (L.M.M. Braun), [f.j.wiesman@amc.uva.nl](mailto:f.j.wiesman@amc.uva.nl) (F. Wiesman), [herik@cs.unimaas.nl](mailto:herik@cs.unimaas.nl) (H.J. van den Herik), [a.hasman@amc.uva.nl](mailto:a.hasman@amc.uva.nl) (A. Hasman), [korsten@chello.nl](mailto:korsten@chello.nl) (E. Korsten).

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**Table 1 – Number of information needs identified by a literature survey and interviews.**

Identification method	Source	Identification domain	# INs identified
Literature survey	[8]	Outpatient care, inpatient care, internal medicine	16
	[9]	General practice, cardiology, pulmonology, allergology	77
	[10]	Family care	10
	[11]	Primary care	16
	[12]	Various	32
	[13]	Various	10
	[14]	Surgical care	2
	[15]	Primary care	8
Interviews		Anaesthesiology	2
		Cardiology	1
		Neurology	0
		Pulmonology	3
		Surgery	3
		Total number of information needs identified	180

Since the incidence of Clarithromycin-induced pancreatitis is quite low, it is understandable (but still undesirable) that the physician in the example above was not aware of this possible side effect. If the physician had performed a literature search in Medline on the side effects of Clarithromycin, he<sup>1</sup> probably would have found an article by Leibovitch et al. [2], in which another case of Clarithromycin-induced pancreatitis is discussed. If he had read this article, he probably would have ordered additional diagnostic tests to exclude pancreatitis (e.g., blood amylase) and he could have started the appropriate treatment immediately.

We define an *information need* as an expression of missing information needed to perform a particular task. In our example the physician's information need was *What are the side effects of Clarithromycin?* However, the physician was not aware of his information need. Therefore, we call the information need *implicit*, as opposed to an *explicit* information need of which one is aware. Since the physician's information need was implicit, he had no incentive to search for information on the topic. Hence, our conclusion from the example is that information needs should be made explicit automatically in order to perform an appropriate literature search.

The (automatic) retrieval of relevant, patient-related literature is vital to the quality of care (cf. [3]). Information-retrieval (IR) systems that provide such literature are presented in various articles (e.g., [4–7]). Our research roughly follows the contents of these articles. However, in our opinion the overall shortcoming of the systems mentioned in the articles is that the degree of necessary interaction with the systems is too high. This is especially true in the area of making information needs explicit. Therefore, our main research objectives are (1) to investigate to what extent a physician's implicit information needs can be made explicit automatically and (2) to implement our approach together with some filters into a computer system supporting physicians in their daily work.

Section 2 describes how we determine a physician's information needs and how we model these needs. Section 3 presents our approach to formulate patient-related informa-

tion needs (i.e., based on the patient and the physician's current activities with respect to the patient). In Section 4 experiments and results are shown and briefly discussed. Section 5 provides our conclusions and directions for future research.

## 2. Modelling a physician's information needs

Our approach to make a physician's information needs explicit is to anticipate them. As a starting point for this process, we need a set of a physician's potential information needs. However, such a set can never be complete, since it is impossible to capture all of a physician's information needs. Moreover, a physician generates new information needs over time, which should be added to the set. This is hard to facilitate.

One solution is to *model* a physician's information needs. As long as the model represents information needs on a more abstract level it can be considered complete, meanwhile anticipating future information needs. Modelling a physician's information needs involves two steps described below: (1) identifying a physician's information needs (Section 2.1) and (2) abstracting the identified information needs (Section 2.2).

### 2.1. Identifying a physician's information needs

To identify a physician's information needs, we used two methods, viz. (1) a literature survey and (2) interviews. Both identification methods are briefly described below. Table 1 summarizes the sources, the identification domains, and the number of information needs identified.

In our literature survey, we searched for articles presenting information needs that are general, i.e., not specific for a particular group of physicians or for a particular geographical area. We found only eight such articles [8–15]. This set of articles covered a large number of medical domains from which the information needs were identified. In total we arrived at 171 information needs.

To obtain a set of information needs that is as diverse as possible, we succeeded in interviewing five physicians in five different medical specialisms: (1) anaesthesiology, (2) cardiology, (3) neurology, (4) pulmonology, and (5) surgery. The physi-

<sup>1</sup> For brevity we will use the pronoun 'he' ('his') where 'he or she' ('his or her') is meant.

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