

# A web-based teaching resource to prepare for final undergraduate examination: a French pilot study

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**ABSTRACT** Access to accurate and quality-controlled health information on the Internet for medical students is not an easy task. CISMeF is the search tool of a MeSH-indexed directory of medical Internet resources in French. Since 2004, a new French Pre-Residency Examination (PRE) is compulsory for all medical students in the 6th year of the curriculum. The goal of this study is to evaluate CISMeF as a tool to provide teaching resources available on the Internet covering PRE material. The CISMeF terminology and the PRE CISMeF module are described. To assess the CISMeF performance in covering PRE program, its precision (number of relevant resources/number of overall resources extracted by CISMeF) and coverage (number of PRE questions covered by at least one resource in the CISMeF gateway) were computed. The CISMeF module for the new French Pre-Residency Examination is efficient as it already covers 95.7% of the program with a precision of 82.2%. Our data demonstrates that CISMeF is acceptable to guide students' learning and should be a useful teaching resource for the preparation of the French Pre-Residency Examination.

## Introduction

Information and communication technology (ICT) is becoming a central part of medical education in many countries. It is obvious that Internet tools and services are and will be of the utmost importance to pass on and disseminate knowledge for medical students (Brunetaud *et al.*, 2002). Students regularly attend online classes while amphitheaters are nearly empty. Even if the students are now convinced of the interest of ICT, most of the medical teachers are not yet sure that these technologies can be the appropriate means to pass on science and know-how (Poliakov *et al.*, 2000). Nonetheless, medical schools have substantially altered their attitudes with respect to ICT for students (Ward *et al.*, 2001; Duque, 2003). The Internet is already widely used by residents (91.5%) at least in the USA (Delzell *et al.*, 2003). It becomes urgent to develop methods and tools that will be appropriate for storing, manipulating and managing teaching material, in order to make it shareable and easy to (re)use. Moreover, easy handling and large access to the resources—both local and distant—are features that must be optimized by basing these methods and tools on ICT.

Access to accurate information on the Internet is not an easy task; therefore, there are a great number of directories and search engines available in this new media (Flannery, 1995).

## Practice points

- The study demonstrates that the Catalogue and Index of Health resources in French (CISMeF) is a useful teaching resource for the preparation of the new French Pre-Residency Examination.

However, directories, such as Yahoo [<http://www.yahoo.com>], or search engines, such as Google [<http://www.google.com>] do not allow the end-user to obtain a clear and organized range of available useful health information. Therefore, there is a need to develop quality-controlled health subject gateways to disseminate relevant health information. Koch (2000) defined quality-controlled subject gateways as Internet services, which apply a rich set of quality measures to support systematic resource discovery. Considerable manual effort is used to process a selection of resources, which meet quality criteria, and to display a rich description and indexing of these resources with standards-based metadata. Regular checking and updating ensures good collection management. An important goal is to provide a high quality of subject access through resources manually indexed by medical librarians using controlled vocabularies and by offering a deep classification structure for advanced searching and browsing during the information retrieval process.

CISMeF (French acronym for Catalogue and Index of health resources in French) is an online catalogue and index of health Internet resources for French-speaking health professionals and consumers (Darmoni *et al.*, 2000, 2001). Since February 1995, CISMeF has provided access in an organized fashion to the websites of institutions and scientific societies and their documents: technical reports, practice guidelines, consensus development conferences, and educational resources. CISMeF is a quality-controlled subject gateway initiated by the Rouen University Hospital (RUH). Its Universal Resource Locator (URL) is <http://www.chu-rouen.fr/cismef> or <http://www.cismef.org>. In April 2004, more than 13,000 resources have been indexed, with an average of 55 new resources indexed each week. CISMeF has

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three top priorities in terms of editorial process: teaching resources for medical students ( $n=2,800$ ; +900 in one year), evidence-based medicine information (guidelines and consensus conferences) for healthcare professionals ( $n=1,413$ ; +400 in one year), and consumer health information for patients, their families and more broadly the general public ( $n=1,745$ ; +300 in one year).

A large-scale final examination will be introduced this year (2004) for all French medical students at the end of their undergraduate training programs (6th year of the curriculum). To be involved in a speciality residency program, candidates must pass the exam. This Pre-Residency Examination (PRE) is a written exam founded on simulation and critical appraisal (respectively with 80% and 20% of the final mark). Three hundred and forty five assessment questions were specifically developed for this final examination. They were designed to measure clinical reasoning and problem solving skills, which are major educational objectives of undergraduate training programs.

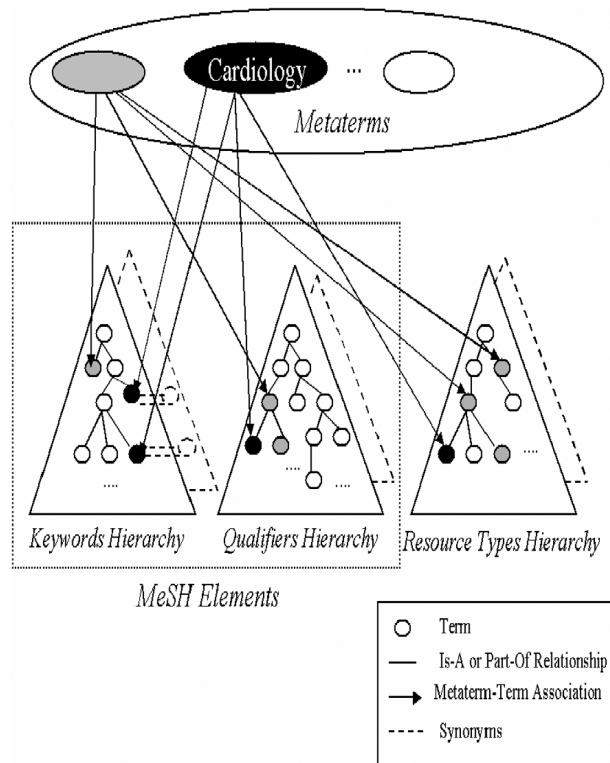
In this context, the objective of this paper is to present the results of the evaluation of CISMef as a useful tool to provide French medical students with reliable teaching resources available on the Internet covering PRE material. This study is conducted under the French Medical Virtual University (FMVU) consortium umbrella (URL: <http://www.umvf.org>) (LeBeux *et al.*, 2000). CISMef has been tested as the search engine of the FMVU consortium. The FMVU consortium is more globally connected with 11 'Digital Campuses' in charge of developing teaching content funded by the French Ministry of Education (each campus developed content for one medical speciality, e.g. medical imaging and microbiology) and a specific e-learning health school also funded by the same Ministry.

**Material and methods**

*CISMef terminology*

The CISMef team is composed of five medical librarians, two medical informaticians, one engineer, and two PhD students majoring in Computer Science. CISMef uses two standard tools for organizing information: the MeSH (Medical Subject Headings) thesaurus from the US National Library of Medicine, and several metadata element sets (Thirion *et al.*, 2003): (a) the Dublin Core metadata format to describe and index all the health resources included in CISMef; (b) some elements from IEEE1484 Learning Object Metadata for teaching resources; (c) specific metadata for evidence-based medicine resources which also describe health content and (d) the HIDDEL metadata set (Eysenbach *et al.*, 2001) from the European Union funded MedCIRCLE project [URL: <http://www.medcircle.info>]. HIDDEL is used to enhance transparency, reliability and quality of health information on the Internet.

The MeSH thesaurus contains approximately 22,600 MeSH terms and 84 qualifiers in its year 2004 version as well as 11 classification levels. MeSH subheadings allow a focus on a sub-field of a MeSH term, e.g. chloride/toxicity. We also use the French translation of this thesaurus, produced by the French Medlars Centre, the National Institute for Health and Medical Research (INSERM, and more specifically the DISC-DOC Network). We have chosen



**Figure 1.** The CISMef terminology structure.

the MeSH thesaurus because it is the most acknowledged thesaurus among health professionals, including France. The CISMef terminology enhances the MeSH thesaurus in adding two concepts: meta-terms ( $n=104$ ) and resource types ( $n=173$ ) (see Figure 1). A 'meta-term' is generally a medical speciality or a biological science, e.g. cardiology or bacteriology. In most cases, these medical specialities are MeSH terms. The idea of using meta-terms came up to cope with the relatively restrictive nature of MeSH terms. For instance, the queries 'guidelines in cardiology' and 'databases in virology' where cardiology and virology are only MeSH terms get few or no answers. Introducing cardiology and virology as meta-terms is an efficient strategy to get more results. The list of meta-terms is available at the following URL: <http://www.chu-rouen.fr/ssf/santspeeng.html>.

The resource types are a generalization of the publication types of Medline. We have also introduced the concept of 'resource types', which takes into account the specificity of the resources available on the Internet, such as association, patient information and community networks. For medical education ( $n=2,800$ ), the CISMef team has developed 19 different resources types, such as 'lectures', which catalogues purely descriptive resources with no problem solving elements ( $n=2,397$ ; 85.6%) and 'problems and exercises' resource type, which catalogues resources actually addressing clinical reasoning and problem solving ( $n=360$ ; 12.9%). The list of resource types is freely available at the following URL: <http://www.chu-rouen.fr/documed/typeeng.html>. The keywords, headings and resource types are organized as a hierarchy of terms exploiting the most powerful capabilities of this thesaurus: its ability to explode headings to capture narrower terms beneath them in the 'encapsulated' MeSH tree structure. Each meta-term has one semantic link with

one or more keywords, subheadings and resource types. Each term can have a set of synonyms, can belong to several trees in the MeSH thesaurus, and have links with several meta-terms. For example the MeSH term 'skin tumour' is associated with the meta-terms 'dermatology' and 'oncology'. A term can be a keyword, a subheading and also a meta-term (e.g. Virology). CISMef uses both MeSH major and minor topics. Indexing an Internet resource in CISMef with a MeSH major topic means that this MeSH term is very important for that resource (if it is not the case, it will be indexed as a minor topic).

#### *CISMef and the Pre-Residency Examination*

To help medical students of the FMVU consortium to retrieve teaching resources, the CISMef team developed in July and August 2002 a CISMef module for the new French Pre-Residency Examination. The main objective of the (above mentioned) CISMef module is to automatically map the 2,800 teaching resources in French that were previously described and indexed in CISMef to any question of the PRE program, optimizing the retrieval of quality-controlled teaching resources. These teaching resources are mainly produced by medical schools and medical societies. The automatic mapping is based on manual queries elaborated by the CISMef chief medical librarian. This task is complex and crucial, that is why it was performed by the best information scientist in the team. Nonetheless, some of the queries are rather simple: e.g. for question 57 'arthrosis', the request is: *arthrosis [MeSH term](Major Topic)*. Most of them are almost impossible to build for medical students: e.g. for question 3 (see above), the request is:

((decision making [MeSH term](Major Topic) or Evidence-Based Medicine [MeSH term](Major Topic) or problem solving [MeSH term](Major Topic) or therapeutic\* hazard\* [title/abstract] or ((physician-patient relations [MeSH term] (Major Topic) or patient education [MeSH term]) and therapeutics [metaterm]))).

Designing requests takes from 10 minutes for the simplest questions to one hour for the most complex questions. The CISMef module was completed in December 2002 when the request for the last question was written.

Based on the requests defined by the medical librarian, we developed a generic request for question number (x): *((request of the librarian) or (question (x)) and (education (resource type))*.

We added a new field called 'question(x)' in the CISMef database in order to indicate that a resource was specifically written for the PRE program and more precisely for question (x). Education is a resource type, which has several terms below it in the resource type hierarchy (e.g. teaching material, problem based learning, multiple choice quiz, ...). For example, for question no. 57 'arthrosis', the generic request is: *((arthrosis [MeSH term](Major Topic) or (question (57)) and (education (resource type))*.

Any generic request for one specific question can be limited by the end-user to the resources specifically developed for PRE. The limited request is then: *(question (x)) and (education (resource type))*. Any generic request may also be extended to all the resources indexed in CISMef covering

the question material, which are not teaching resources (e.g. clinical guideline, technical report, ...). The extended request is then: *(request of the librarian) or (question (x))*.

#### *Evaluation methodology*

Within a classical framework of evaluation, we attempt to find the relevant resources covering PRE questions. In computer science, the standard measures of performance are precision and recall, where recall is the ratio between the number of overall resources extracted by CISMef and the number of overall relevant resources and the precision is the ratio between the number of relevant resources extracted by CISMef and the number of overall resources extracted by CISMef. In information science, the standard measures of performance are silence and noise, where silence is the CISMef false negative rate and the noise is the CISMef false positive rate. Another important criterion is the coverage, which measures the number of PRE questions covered by at least one resource in the CISMef quality-controlled health gateway.

The evaluation was performed on all the 345 questions of the program and we have evaluated the number of answers for generic, limited and extended requests to calculate the coverage and the precision. A medical teacher of the CISMef team (SJD), who did not participate in the creation of the requests, evaluated the true positive rate of the CISMef module. To measure the recall (silence) of this CISMef module, we used the Google search engine to find teaching resources for every question not covered by the generic requests of CISMef. In a study on a million queries submitted to Altavista, Silverstein *et al.* (1998) showed that 95.7% of the users did not look beyond 30 results. Hence, we focused the measure of the recall (silence) on the first 30 results.

#### **Results**

The Laboratory of Information and Communication Technologies in Health of the Rouen Medical School (French acronym: L@STICS) developed a specific home page for this new French Pre-Residency Examination with the following main links: (a) the PRE detailed Program of the 345 questions; (b) a correspondence list where students will find how and when in the Rouen curriculum they will be taught the material of each question; (c) the CISMef page listing all the clinical cases resources already indexed in the CISMef database ( $n=185$ ); (d) the CISMef page listing all the critical appraisal resources already indexed in the CISMef database ( $n=4$ ) and last but not least (e) the CISMef module for the PRE (URL: <http://doccismef.chu-rouen.fr/servlets/Internat>) (see Figure 2). This module is intended to be as simple as possible: medical students enter the number of the question (see Figure 2) and the CISMef module displays a result page with the teaching resources fitting the MeSH query designed by the medical librarian.

Points (c) and (d) are important because clinical case and critical appraisal will be the basis of the PRE. In CISMef terminology, clinical cases and critical appraisal are both resource types, which are located below the 'education' resource type in the hierarchy.

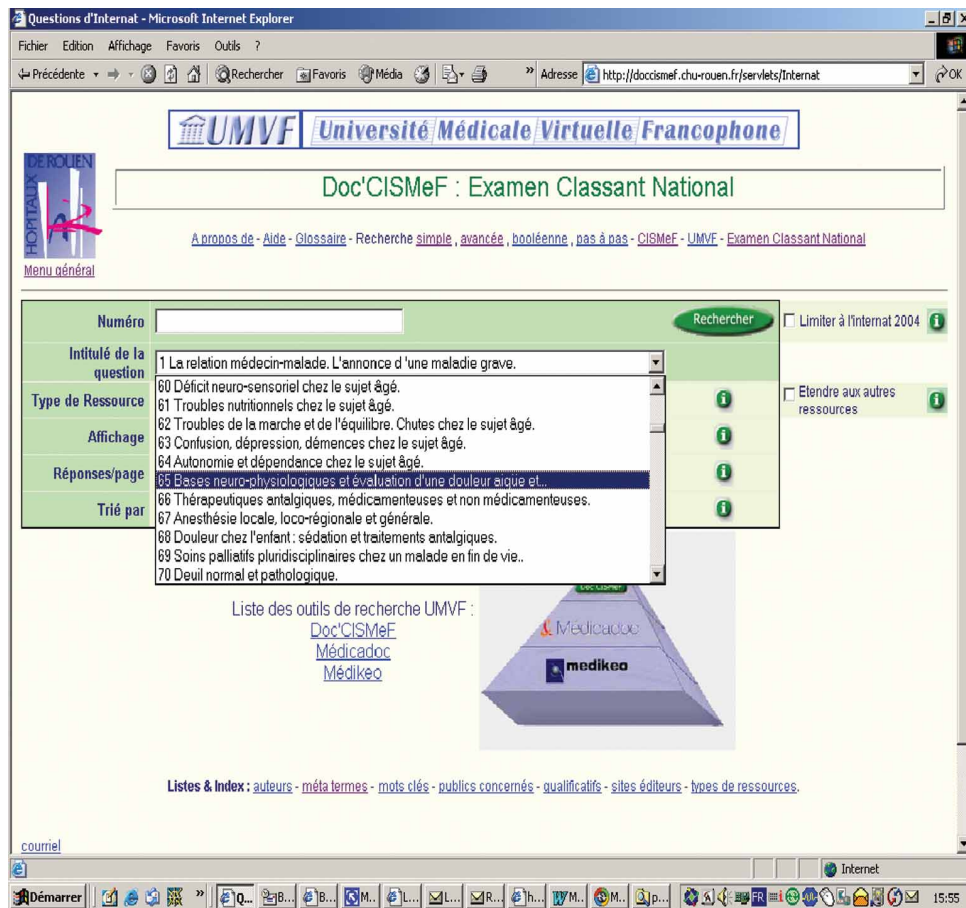


Figure 2. PRE CISMeF module home page.

Table 1. Coverage of PRE material by the CISMeF module.

	Total of CISMeF teaching resources (values are mean ± SD)	Coverage <sup>a</sup>
Generic request	2070 (6.01 ± 6.61)	96.2% (332/345)
True positives of the generic request	1801 (5.23 ± 1.82)	95.7% (330/345)
Limited request	554 (1.61 ± 1.82)	68.1% (235/345)
Extended request	7783 (22.6 ± 41.2)	98.6% (340/345)

<sup>a</sup>The coverage is the number of PRE (Pre-Residency Examination) questions covered by at least one resource in CISMeF.

The coverage of the CISMeF module (generic request) which measures the number of PRE questions covered by at least one resource in CISMeF is 96.2% (332/345) (95.7% if taking into account only the true positives) (Table 1). Although the first examination will be held in June 2004, the coverage of the questions specifically devoted to the PRE is only 68.1% (235/345) (limited request). The coverage of the resources indexed in CISMeF covering question material, which are not teaching resources is 98.6% (extended request). But the average number of answers per question (22.6 ± 41.2) is also too important and too noisy. Therefore, this extended request should be limited to the questions that cannot be answered with the generic request.

To measure the precision of the CISMeF module (generic request), we have used the following formula:

$$\frac{\text{(Number of relevant resources - number of teaching resources specifically written for the PRE)}}{\text{(number$$

of overall resources - number of teaching resources specifically written for the PRE)}.

Then, the precision of the CISMeF module is: (1,801-554)/(2,070-554) = 82.2% and the noise is 17.8%.

Nonetheless, based on these results, some refinements were added on specific requests to reduce an outstandingly high noise: e.g. question 65 (neurophysiologic basis and assessment of acute pain and chronic pain) with 18 answers and only five true positives (see Figure 3). Therefore, taking into account the number of CISMeF answers, the refinement mainly consisted in modifying several requests by limiting their scope using nearly systematically MeSH major topics. More rarely, to refine some requests, we used the non-explode function, in order to focus the request on one MeSH term and avoid retrieving resources indexed with narrower terms. This is useful for very general questions, such as question 138 'Epidemiology of cancers' where the request is: *tumors[Major Topic][nonexpl] AND epidemiology[Subheading]*.

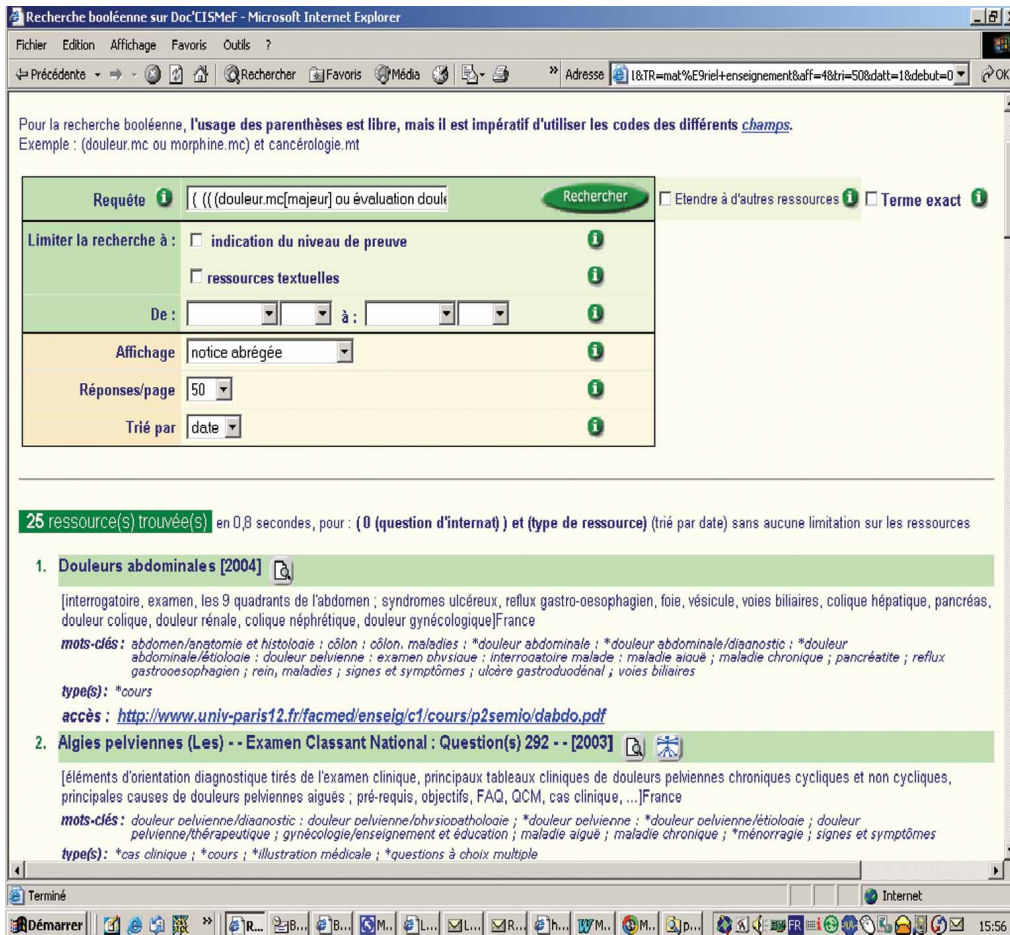


Figure 3. Example of PRE CISMéF module results page.

The average number of answers for the generic query is acceptable ( $6.01 \pm 6.61$ ); furthermore, only 14.2% of the questions (49/345) produced more than ten answers (with a maximum of 58 answers). A large majority (73.9%; 2,070/2,800) of the teaching resources included in the CISMéF health gateway matched at least one question of the PRE. If the average number of answers for the extended query is too high ( $22.6 \pm 41.2$ ), there may be potential information overload issues. That is why the extended query should be limited when the generic query provides to few resources.

In several cases, some answers were teaching material written for another question of the program but nonetheless useful for the other question(s) it was retrieved for. The CISMéF module was then able to underline the transversality of several teaching resources, which may be relevant for more than one question of the program.

We used the Google search engine to evaluate the silence of the CISMéF module. We ran a request for the 15 questions not covered by the generic requests of CISMéF (including the false positive) and found in the first 30 answers of Google three teaching resources not yet included in CISMéF. Therefore, the silence of the PRE CISMéF module can be estimated at 20% (recall = 80%).

Every working day, an average of 40 students uses the PRE CISMéF module, most of them from the Rouen Medical School.

## Discussion

This study mainly measured the CISMéF coverage and precision for the new French Pre-Residency Examination. A previous measurement on a sample of the first 88 questions showed poorer results: coverage of 76% and precision of 63.5% (Darmoni *et al.*, 2003). Currently, the coverage of the PRE CISMéF module (generic request) is 95.7% vs. 68.1% for the teaching resources specifically written for this examination. Furthermore, this better coverage is associated with a rather acceptable precision (82.2%). This precision is comparable with the previous study of Lim & Ho (1999) (73.3%) when studying the Internet as an aid in preparing professional anaesthetic examination. The evaluation of the recall of the PRE CISMéF module at 80% emphasizes the necessity of an efficient information watch based as far as possible on automatic tools. One librarian of the CISMéF team is half time devoted to this major task.

Similar measurements should be performed periodically to refine specific requests bearing excessive noise because new teaching resources are periodically included in CISMéF. The capacity of CISMéF to systematically include new teaching resources specifically written for PRE should have a positive impact on the online curriculum. CISMéF could improve the link between learning objectives and the course content (Harden, 2001). Nonetheless, in the near future, this specific CISMéF module will be less useful because a lot of

teaching resources will specifically be dedicated to this new examination and indexed in CISMef as such. On the contrary, this CISMef module will not only map 'old' teaching resources (previously included in the CISMef database) but also new teaching resources coming from France but not specifically devoted to a question of this examination or coming from other French speaking countries (e.g. Canada, Belgium and Switzerland), giving medical students the opportunity to access other resources. Moreover, it was more efficient to develop generic requests for 345 questions instead of indexing 2,800 teaching resources according to these 345 questions. This flexible, less labour intensive approach not only generated good results, but because of its inherent dynamic nature (new resources will automatically be included) is automatically scalable.

We still have a lot of work ahead of us. The CISMef terminology may also include specific thesaurus terms such as those developed in UK (the METRO project <http://srv1.mvm.ed.ac.uk/metro>) (Haig *et al.*, 2004). We have already planned a formal evaluation of this CISMef module by the Rouen Medical School students of the fourth and the fifth year of the curriculum in the first semester of 2005. Nonetheless, medical students outside the Rouen Medical School may already use it, as the Rouen PRE home page appears in the first five results of a Google search for 'Pre-Residency Examination' in French ('Examen Classant National'). However, with a silence of the PRE CISMef module on 4% of the PRE questions, free access Internet does not provide an exhaustive coverage of the PRE program just yet as opposed to a full coverage of book collections edited by private publishers.

Finally, another relevant point of discussion is the fact that, when querying one simple PRE question, the link between several PRE questions as a result, may not only improve acquisition of factual knowledge but also organization of knowledge. This hypothesis warrants further specific research to explore the efficacy of on-line learning resources, such as CISMef, in the organization of knowledge development during the medical curriculum.

## Conclusion

Our data show that the CISMef module for the new French Pre-Residency Examination is efficient as it already covers 95.7% of the program and the precision is 82.2%. This indicates that CISMef is acceptable to guide French students' learning and can be a useful teaching resource for the preparation of their Pre-Residency Examination.

The implementation of a large-scale Pre-Residency Examination underlines the urgent need for teaching resources harmonization for all the French medical students at the undergraduate level. Virtual medical education initiatives such as the PRE CISMef Module under the French Medical Virtual University umbrella, warrants consideration in the current context of medical training program harmonization throughout European Union faculties.

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