The CONTENT project: a problem-oriented, episode-based electronic patient record in primary care

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ABSTRACT

In order to obtain a proper knowledge base in primary care, a form of electronic patient record is needed that takes into account the specific characteristics of the doctor–patient encounter, the patient population, the presentation of diseases and the associated prevalences. However, in real life this has not happened for several reasons. For the most part, existing patient records are determined by invoicing requirements rather than by endeavours to meet the intrinsic needs of primary care. CONTENT (CONTinuous morbidity registration Epidemiologic Network) is an ambitious scientific project in Germany to establish a system for adequate record keeping and analysis in primary care. Based on a classification system designed for the special situation of primary care, a scientific network is being established consisting of participating surgeries, general practitioners, computer scientists and statisticians. The project is supported by the German Federal Ministry of Education and Research.

The aims are strictly scientific and the underlying hypothesis is that the knowledge-gaining process can be accelerated by combining the experience of many, especially with respect to complex interactions of factors and the analysis of rare events. Aside from maintaining a morbidity registry, within the CONTENT framework various prospective and retrospective studies on particular epidemiological and health economic research topics will be conducted.

Keywords: CONTENT, episode of care, ICPC
Introduction

There is a general consensus that computerised primary care records are fundamental components for any national health information system. However, reliable research in primary care is only possible if the specific characteristics of the population as well as the presentation and prevalence of illness and disease are taken into account. Therefore, among other important factors, an appropriate coding structure is indispensable. In general practice, several kinds of coding structure are in use. However, only one system was especially designed to meet the needs in this field: the International Classification of Primary Care (ICPC) published by the World Organisation of National Colleges and Academics (WONCA) in 1987 allows the healthcare provider to classify three important elements in the context of a doctor–patient encounter using the same classification:

- reasons for encounter from the patient’s perspective
- problems and diagnoses in the healthcare provider’s view
- decisions, actions and plans elaborated between patients and healthcare provider.

Table 1 shows the biaxial structure of ICPC. The first axis consists of 17 chapters with an alpha code. Each

<table>
<thead>
<tr>
<th>Table 1</th>
<th>ICPC structure: 17 chapters, 7 components</th>
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<tbody>
<tr>
<td>Components</td>
<td></td>
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<tr>
<td>1 (01–29)</td>
<td>2 (30–49)</td>
</tr>
<tr>
<td>Symptoms and complaints</td>
<td>Diagnostic, screening, preventive</td>
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<tr>
<td>Q Social problems</td>
<td>Q01–29</td>
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chapter corresponds to a body system or a problem area. The second axis is formed by seven components. Each component contains several two-digit numeric codes describing the doctor–patient encounter elements in more detail. An ICPC code consists of the character for the chapter followed by the numeric code for the subcomponent. ICPC reflects the essential elements of each doctor–patient encounter and the linkage of elements, beginning with the reason for encounter and ending with decisions, actions and plans, and the dynamic arrangement of encounters into episodes allows documentation in an ‘episode of care’ structure over time.⁴,⁵

ICPC was accepted by the World Health Organization (WHO) as a related classification to be used for health information recording in primary care. The electronic version of the second ICPC edition (ICPC-2-E) is available for use in electronic medical records.⁶ Moreover, this electronic version includes well-defined conversion tables to map ICPC codes to the widely recognised and used International Classification of Diseases (ICD-10) published by the WHO.⁷

Generally, there is a broad consensus that ICPC exactly meets the needs in primary care both in research as well as in practice and will add knowledge about morbidity patterns in this field. However, the structure of existing electronic patient records is mostly determined by specific national provisions for routine documentation and invoicing. Moreover, conflicting interests of national and international organisations work against a broadly based implementation of ICPC-based electronic records in primary care.

In Germany, primary care documentation is based on ICD-10 since the medical billing system is based on ICD-10. However, ICD was developed as a coding system for detailed mortality statistics and does not focus on the special context in primary care. The CONTENT project is an effort to establish a system for adequate documentation and analysis in primary care based on ICPC. An electronic patient record (EPR) designed for the special conditions in primary care had already been developed in Heidelberg, Germany. Existing primary care software is about to be upgraded to meet the needs of the new EPR.

The basic objects of the CONTENT EPR

The CONTENT EPR consists of several fundamental objects which are described below. To a large extent the objects’ semantics are similar to those defined by Okkes and Lamberts:⁴

Doctor: The essential healthcare provider in primary care.

Patient: Individual with health problems contacting the healthcare provider.

Contact: Contact between patient and doctor or other members of the healthcare team. The contact can be direct (face to face) or indirect (telephone call, letter, and so on). One or more episodes may be dealt with during one contact, therefore one contact may consist of several ‘sub-contacts’.

Episode of care: A health problem from its first presentation by a patient to a doctor until the completion of the last contact for it or presumably death, if the focal problem still exists. An episode of care contains all contact or sub-contact elements related to that health problem. At a particular time an episode can be active, inactive or concluded.

Health problem: Health concern of a patient as determined by the healthcare provider. These problems should be recorded as specifically as possible. The first presentation of a problem leads to an entry of a new problem and a previously assessed continuing problem requires ongoing care (follow-up).

Procedure: Decisions, actions and plans elaborated between patients and their healthcare providers. A procedure may be a prescription, a therapeutic or diagnostic method, a referral or a hospitalisation.

ICPC assignment: For every contact there must be an assignment according to ICPC within the EPR. This assignment may specify a reason for encounter in the patient’s view, a problem/diagnosis in the healthcare provider’s view or a procedure.

ICD diagnosis: In addition to diagnoses according to ICPC, more detailed diagnoses according to ICD-10 can be assigned.

Notification: At regular intervals, the participating surgeries will send CONTENT-specific data concerning a particular observation period to the study centre. This event is documented with a notification object containing the observation period and other metadata. For each notification, patients’ episodes, problems and encounters are linked to a notification object and the consideration of subsequent notification objects with their related objects allows the dynamic documentation in an episode of care structure over time.

For each doctor–patient contact, these objects are generated, updated and logically mapped. Initially, the doctor acquires the reasons for encounter in the patient’s view. These subjective perceptions are objectified by the doctor under discussion as well as by means of medical procedures. All procedures, ICPC- and ICD-assignments that are performed during the
contact are acquired by the doctor. Moreover, the doctor decides if this contact corresponds to an existing episode or if the reasons for encounter correspond to one or more new episodes. Finally, new problems can be acquired and a mapping of episodes to problems can be performed. Basically, contacts, episodes, problems, procedures as well as ICPC- and ICD-assignments and the performed mappings between them can be updated at any time according to new insights concerning the patient.

Software, data transfer and security

A German medical software company with more than 1000 installations in primary care surgeries has extended existing software components to meet the needs of the above-described form of data entry. The close collaboration between the software developer and the Department of General Practice and Health Services Research at the University of Heidelberg has been quite successful so far. The first version of the modified software was evaluated by the German Federal Ministry of Education and Research in the context of a feasibility study and met the strict requirements. The second version has been approved for implementation within surgeries. Moreover, it is planned to gain at least two more medical software companies for the CONTENT project by means of open competitive tendering. After the test stage which started this summer with ten participating surgeries, in 2006 a further 20 surgeries will be recruited. The recruitment of more than 100 surgeries is the ambitious aim in order to obtain a sound and representative database for scientific analyses.

As mentioned above, the participating surgeries will send CONTENT-specific data concerning a particular observation period to the study centre at regular intervals. Figure 1 illustrates the data transfer architecture. The extended medical software features a special function for data export based on eXtensible Mark-up Language (XML). The result of an export is an XML data file corresponding to a well-defined XML schema that defines the structure of the XML data accurately. The XML schema file is independent from any medical software used in the context of CONTENT. Thus, it is guaranteed that XML data files can be processed with the same import software in order to be integrated in the CONTENT database. Besides the actual patient data the files contain metadata with information about the observation period and the surgery. The data may be sent using electronic data media (floppy disk, CD, DVD) or may be attached to an email. Furthermore, an upload option will be established in order to enable an upload of data files onto a dedicated file server via file transfer protocol (FTP) or HyperText Transfer Protocol (HTTP).

By means of a customised import program based on Java and XML Path Language (XPath), the XML data will be validated and imported into the relational CONTENT database. The CONTENT database server, which houses the resulting aggregated database and is located at the University of Heidelberg, is not accessible from external networks.

As a basic principle, only anonymised data will be transmitted. For each patient, the CONTENT EPR contains a case number, the year of birth and the gender.

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Figure 1 Data transfer architecture
but not name or address. Thus, it is not possible to
determine a patient’s identity and the implementation
of extensive data security mechanisms is not needed.
Moreover, the German Data Protection Act allows
the transmission of anonymised patient data for
scientific purposes without the explicit permission of
patients.

Web-based analysis

The scientific aim is to conduct various analyses con-
cerning particular epidemiological and health economics
research topics in primary care within the CONTENT
network. Therefore a framework for web-based analysis
is about to be established in order to answer scientific
questions from authorised researchers from all over
the world.

Figure 2 schematically shows the architecture for
web-based analysis. At regular intervals data relevant
for statistical analyses will be transferred from the
CONTENT database server to a statistics database server.
A dedicated computer hosts both a logical web server
and a logical application server. The web server receives
HTTP requests from client browsers and initiates the
application server to receive the needed data from
the statistics database server and then to perform the
corresponding calculations. Finally, the result is for-
matted and the response is sent back via the web server
to the client browser. In this way reliable components
and technologies (such as Jakarta Tomcat and Java
Server Pages) will be applied.

Some analyses are of general value and will be freely
available to any person who wishes to access them.
More detailed analyses will be available only to speci-
fied authorised users (for instance, comparisons be-
tween a certain subpopulation and the registered
overall population). An initial set of detailed mor-
бинity analyses will provide cross-tabulation of, for
example, incidence and prevalence of specific diseases
and disease groups, tabulated by age and gender.
Moreover, from the very first, analyses concerning
drug prescriptions and relative expenditure will be
available. The analysis framework will be extended
continuously, particularly following evaluation of
user requests.

Related research

In recent years many researchers in several European
countries have established morbidity registers based
on data from EPRs. The UK General Practice Research
Database (GPRD) as well as the UK QRESEARCH
database are among the world’s largest aggregated
databases of longitudinal medical records. Currently,
both databases contain over three million
active patient records from more than 400 primary
care practices throughout the UK and support public
health research internationally.

In contrast to the UK, researchers in the Nether-
lands and Belgium established EPRs in primary care
based on episodes of care and/or ICPC. On the basis of
the Belgian network ‘INTEGO’ (INTEGRated com-
puterized netwOrk), new perceptions to determine

Figure 2 Web-based analysis architecture
the denominator or the ‘population at risk’, a problem which has long been encountered in general practice-based epidemiological research, were obtained. The Netherlands several problem-oriented morbidity registers exist. Within the framework of the Integrated Primary Care Information (IPCI) project, electronic data from participating GPs are downloaded on a monthly basis and aggregated at the study centre (Erasmus University Medical Centre, Rotterdam). Data accumulated in the IPCI database have proven to be of high quality and suitable for epidemiological and pharmaco-epidemiological research. The central goal of the ‘transition project’ (Amsterdam Centre for Health and Health Research) is to formally characterise and describe the domain of family practice, based on episode-oriented epidemiology, in order to develop guidelines for the comparison of national and international data from family medicine. At the University of Maastricht, the RNH (RegistratieNet Huisartspraktijken [Registration Network Family Practices]) network was established in 1988. The RNH database has initially been set up primarily as a sampling frame allowing researchers to identify patients with particular health problems. Meanwhile the database is also used in education. In healthcare research especially, the prevalence and incidence of multimorbidity in a general practice setting and factors related to the occurrence of multimorbidity are focused. The RNH group is very experienced in this field of research and there is a close collaboration between the Department of General Practice at the Maastricht University and the Department of General Practice and Health Services Research at the University of Heidelberg in order to begin work on first international comparisons.

**Conclusions**

Based on sound and representative data with an appropriate classification system, the establishment of a morbidity registry is a promising challenge. The German CONTENT EPR with its logical mappings between patients’ contacts, episodes, problems and procedures as well as ICPC- and ICD-assignments will represent a knowledge base with the potential to approach scientific questions that could not yet be addressed in primary care. Qualitatively and quantitatively sound data about the frequency distribution of reasons for encounter and associated diagnoses appear to be especially interesting in order to determine prior and posterior probabilities for important diseases when patients present a specific complaint or symptom.

Appropriate education for GPs on how to use this sophisticated approach to documentation is an essential premise for good results, as well as encouraging acceptance of the extra time and effort it requires. The increased work may be considered to be justified by a better understanding of the patient’s condition by both doctor and patient.

Finally, the increasing application of ICPC-based EPRs all over the world will allow challenging international comparisons in order to see national differences and regional distinctions and to discover what is generic in family practice and independent from local or national conditions.

**REFERENCES**

CONFLICTS OF INTEREST
None.

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