Modeling shared care plans using CONTsys and openEHR to support shared homecare of the elderly

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ABSTRACT
This case report describes how two complementary standards, CONTsys (European Standard EN 13940-1 for continuity of care) and the reference model of openEHR, were applied in modeling a shared care plan for shared homecare based on requirements from the OLD@HOME project. Our study shows that these requirements are matched by CONTsys on a general level. However, certain attributes are not explicit in CONTsys, for example agents responsible for performing planned interventions, and support for monitoring outcome of interventions. We further studied how the care plan conceptual model can be implemented using the openEHR reference model. The study demonstrates the feasibility of developing shared care plans combining a standard concept model, for example CONTsys with an electronic health records (EHR) interoperability specification, that is the openEHR, while highlighting areas that need further exploration. It also explores the reusability of existing clinical archetypes as building blocks of care plans and the modeling of new shared care plan archetypes.

INTRODUCTION
Current economic, political, and socio-demographic changes in society are moving modern healthcare towards provision of coordinated services to ensure continuity of care for those with chronic conditions. Elderly patients constitute a large part of this population and often have complex, inter-related, and chronic problems, comprising physical, psychological, and social health issues.3 This complexity requires collaboration between and integration of health and social care.4 Care planning is often discussed as a means of improving quality of care and providing structure to the care process.3–5 It is important to share both a conceptual model of care planning and a common information model to facilitate sharing of care plans between different actors in homecare. The objective of this study is to investigate the feasibility of modeling a shared care plan to support cooperation in shared homecare of elderly patients, based on Comité Européen de Normalisation/European Committee for Standardization (CEN) standards and openEHR specifications.

CASE DESCRIPTION
Homecare of elderly patients encompasses health-care services, for example provision of medical treatment by trained medical and nursing personnel, and home help (or social) services, for example domestic work and personal services.5 Family carers also contribute to homecare of elderly patients. The action research project OLD@HOME7 focused on supporting collaboration in shared homecare. An extensive user needs and work analysis performed in a Swedish homecare district revealed a lack of overview of the care process, and a lack of feedback on the outcome of performed activities.8 9 Both district nurses and home help service personnel (HHS) plan interventions in relation to individual patient’s specific health problems and document these in their respective care plans. The nursing care plan is a key tool for nurses.3 5 10 HHS plan activities, documented in the HHS care plan, based on patients’ need of social services, yet they also often perform delegated healthcare tasks.11 12 By sharing access to planned interventions within the cross-organizational care team, including patients and family carers, overview of and involvement in the care process and cooperation and coordination of work can be improved.13

A shared care plan model was developed and a tool for shared care planning was designed and implemented in the OLD@HOME project.13 The tool was introduced and used in a homecare district serving approximately 40 patients, and evaluated.14

METHOD
The OLD@HOME shared care plan was compared to a standardized conceptual model, EN 13940-1 Health informatics - System of concepts to support continuity of care – Part 1: Basic concepts (CONTsys)15 and an electronic health record (EHR) reference information model, ISO/EN 13606 Health informatics - Electronic health record communication,16 to determine how well these standardized models meet the identified clinical requirements. We chose to use European and international ISO standards. A contribution of the ISO/EN 13606 standard is a two-level modeling approach, which distinguishes a reference model to represent the generic properties of health record information, and archetypes (conforming to an archetype model) which are constraints on the underlying information model used to define patterns for specific characteristics of the clinical data.17 This standard has been further specified by the openEHR Foundation.18 The openEHR reference model is nearly a super-set of that of the EN/ISO 13606 reference model, and the archetype model in ISO/EN 13606 Part 2: Archetypes15 is equivalent to that published by openEHR. Due to the close relationship between the two models, we performed an initial investigation to determine which reference model to use.
Both reference models define a set of classes that form the generic building blocks of the EHR16
(see online appendix I). In both models, COMPOSITIONs are the components where the main data of the EHR are found, but openEHR distinguishes between event COMPOSITIONs (recording occurrences, that is, things that were true or did happen but have no longevity) and persistent COMPOSITIONs (recording items of long-term interest in the record). In both models each COMPOSITION consists of a number of ENTRYs, but the openEHR reference model also specifies different subtypes of ENTRY (see online appendix I), which have built-in clinical meaning. It was concluded that the extensions in the openEHR reference model merited the use of the openEHR reference model in this study.

The modeling was performed in three steps: (1) an analysis of how the CONTsys care plan concepts correspond to the requirements of the OLD@HOME shared care plan concept model, (2) representation of the OLD@HOME shared care plan model using the openEHR reference model, and (3) reuse and creation of openEHR archetypes to represent shared care plan concepts.

COMPARISON WITH THE CONT SYS MODEL
The OLD@HOME shared care plan model represents an aggregation of several organization-centered care plans. Since the aim of the OLD@HOME shared care plan is to support collaboration between separate actors, who each have their own specific view of the patient’s care represented in, for example, the nursing care plan and the HHS care plan, it is important to keep the separate care plans intact while at the same time enable collaboration through a common level, that is the shared care plan. In the CONTsys model, a care plan is restricted to one actor, and is limited to contain healthcare provider activities. A programme of care in CONTsys can, however, store several care plans and corresponds to the aggregated shared care plan level in OLD@HOME (figure 1). In the OLD@HOME case, it was considered important to include self care activities, family care activities, and social care activities in a care plan, in order to increase the involvement of these actors in the care process. The CONTsys model’s care plan can only contain healthcare provider activities, and health self care activities need instead to be addressed by a programme of care. In addition, in CONTsys the concept health issue thread can be used to associate health issues identified by several healthcare actors (which may include the subject of care in health self care activities).

Since the OLD@HOME shared care plan is a tool for coordinating distributed work, each planned activity needed to be assigned a ‘responsible agent.’ This would enable one actor to plan an activity and delegate the responsibility for performing the activity to another actor (or group of actors). The CONTsys model does not provide explicit support for this.

Feedback, or outcomes, of performed activities need to be documented, especially in long-term shared care of chronic patients. Health issues and goals should be evaluated and updated over time based on the outcome of performed activities. To improve follow-up of a care plan, or programme of care, a connection is needed between the care plan and the documented activities. According to discussions with members of the ContSYS committee, this issue is not explicitly handled in CONTsys part 1, but will be included in part 2 of the CONTsys standard, currently a work in progress.

REPRESENTING THE SHARED CARE PLAN USING OPNEEHR
An important step towards achieving semantic interoperability is to share a common information model. The OLD@HOME shared care plan model was therefore mapped against the openEHR reference model (figure 2) and archetypes were designed to represent the concepts of the shared care plan (see online appendix II).

Initially, it was decided which subtype of ENTRY class (see online appendix I) to use for representing different shared care plan concepts. EVALUATION was chosen to model the concepts care plan, health issue/problem, healthcare goal/goal, and outcome, as they were all deemed to be assessments, or clinical judgments made from observations of a patient’s health. INSTRUCTIONs are specifications of activities that are to be performed, and were therefore chosen for representing planned activities. In openEHR, the ENTRY subtype ACTION is used to model the information recorded due to the execution of an ACTIVITY by some agent, and was therefore chosen to represent the documentation of performed activities. Both documentation of performed activities and their outcome may be recorded as separate EHR entries; however, the connection to the care plan is important for follow-up.

There is no high level grouping class dedicated to care plans in the openEHR reference model. It would be possible to group parts of a care plan under a COMPOSITION or SECTION and to create a single archetype for the whole care plan. However, it is expected that some content could already exist when a care plan is created which needs to be logically associated when the plan is authored. For this purpose, the openEHR LINKs are useful. In this study, a persistent COMPOSITION was used to organize a shared care plan consisting of multiple care plan
EVALUATION instances, to ensure quick access to the long-
term content of a shared care plan, including material from
different care plans used in a shared care context.

Shared care plan archetypes
The openEHR archetype repository and the National Health
Service (NHS) repository contained generic archetypes representing
health issues and healthcare goals. Reusable INSTRUCTION
archetypes were also available, for example generic procedures and
medications. A similar situation occurred for ACTIONs, where archetypes representing, for example, medication actions may be reused. Such archetypes are likely reusable directly in the care plan or can be
further specialized to meet specialized care requirements.
Nevertheless, ACTIONs as well as their outcomes in the form of
OBSERVATIONs or EVALUATIONs may not be included in the
care plan itself, but rather as entries in an EHR that are associ-
ated with planned activities in the care plan.
The openEHR repository contained no reusable archetype for
the care plan concept. In the NHS repository a plan COMPO-
SITION was found. However, the archetype was only a container and offered no possibility to add necessary attributes. Therefore, a new EVALUATION care plan archetype was modeled (see online appendix II). Attributes from CONTsys were included in the care plan archetype, and LINKs were used to group different archetypes with the care plan EVALUATION.
Finally, a persistent COMPOSITION was used to group the
shared care plan concepts, to create a long-term care plan.
The shared care plan archetype can include one or more care plan
instances, linked to problems/health issues, goals, and different
types of instructions.

DISCUSSION
The CONTsys and openEHR models were not compared to each
other in this study, but considered complementary; CONTsys
provides a common conceptual model for continuity of care, while openEHR's models enable a standardized and computer-
interpretable implementation of the care plan model.
Some major differences exist between the modeling of a
shared care plan according to OLD@HOME and the CONTsys
programme of care, that is the possibility to associate healthcare activities directly with a programme of care, whereas the shared care plan only acts as an aggregation of available care plans. We chose to model archetypes based on the OLD@HOME shared care plan concepts, yet future work should further explore
different possibilities available in CONTsys, for example health
issue threads. Other concepts used in CONTsys are not available in
the OLD@HOME model, for example clinical guideline, protocol, and health objective. The impact of implementation of
such concepts in openEHR should be further explored. The
interpretation of certain CONTsys concepts required extensive
discussion among the authors and with standardization experts.
A formal computerized model is needed to make the interpre-
tation explicit. This could be accomplished through closer
integration between process model, concept model, and informa-
tion model (eg, between CONTsys and openEHR).
The experiences from the work in the OLD@HOME project are an important first step in validating the results; however, the
results of the new shared care plan model according to the
standards have not yet been evaluated clinically. Future work,
therefore, includes studies to validate the openEHR reference
model and archetypes based shared care plan models. The study
lacks attention to Health Level Seven International (HL7) as an
alternative. HL7 handles the linkage of goals and outcome in the
reference information model (RIM), but a further comparison of
HL7 with the openEHR model was not within the scope of this case study. To further analyze and compare the different international standards’ usefulness in case studies such as this would be of great interest.

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None.

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REFERENCES
1. Alaszewski A, Billings J, Coxon K. Integrated health and social care for older
2. Leichsenring K. Developing integrated health and social care services for older
3. Reed J, Stanley D. Improving communication between hospitals and care homes:
the development of a daily living plan for older people. Health Soc Care Commun
4. Lee T-T. Nursing diagnoses: factors affecting their use in charting standardized care
5. Voutilainen P, Isola A, Muurinen S. Nursing documentation in nursing homes -
state-of-the-art and implications for quality improvement. Scand J Caring Sci

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