

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

Maria Hägglund,<sup>1</sup> Rong Chen,<sup>2</sup> Sabine Koch<sup>1</sup>

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<sup>1</sup>Health Informatics Centre, LIME, Karolinska Institutet, Stockholm, Sweden

<sup>2</sup>Department of Biomedical Engineering, Linköping University, Linköping, Sweden

## Correspondence to

Maria Hägglund, Health Informatics Centre, LIME, Karolinska Institutet, Berzelius väg 3, SE 171 77 Stockholm, Sweden; [maria.haggglund@ki.se](mailto:maria.haggglund@ki.se)

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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.<sup>1</sup> This complexity requires collaboration between and integration of health and social care.<sup>2</sup> Care planning is often discussed as a means of improving quality of care and providing structure to the care process.<sup>3–5</sup> 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.<sup>6</sup> Family carers also contribute to homecare of

elderly patients. The action research project OLD@HOME<sup>7</sup> 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.<sup>8–9</sup> 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.<sup>3–5–10</sup> HHS plan activities, documented in the *HHS care plan*, based on patients' need of social services, yet they also often perform delegated healthcare tasks.<sup>11–12</sup> 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.<sup>13</sup>

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

## 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)<sup>15</sup> and an electronic health record (EHR) reference information model, ISO/EN 13606 Health informatics - Electronic health record communication,<sup>16</sup> 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.<sup>17</sup> This standard has been further specified by the *openEHR* Foundation.<sup>18</sup> 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: Archetypes<sup>19</sup> 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 EHR<sup>16</sup>

(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 CONTSYS 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 carer 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.

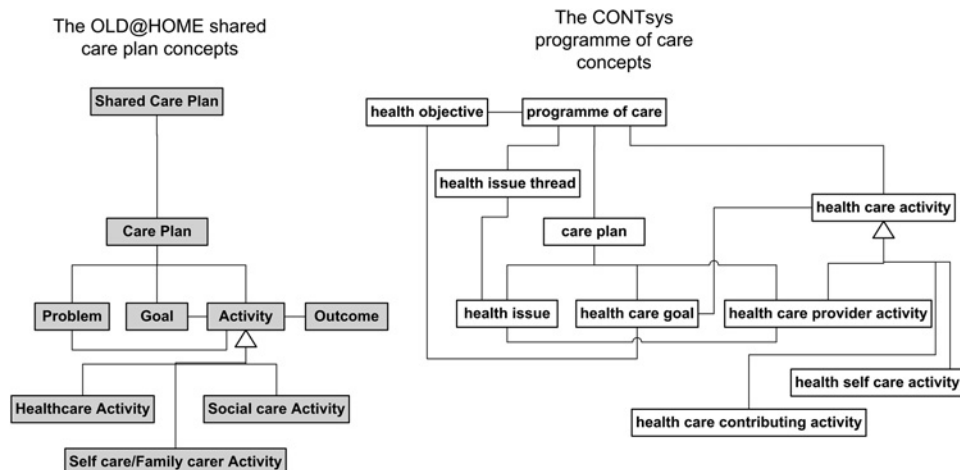
### REPRESENTING THE SHARED CARE PLAN USING *OPENEHR*

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).

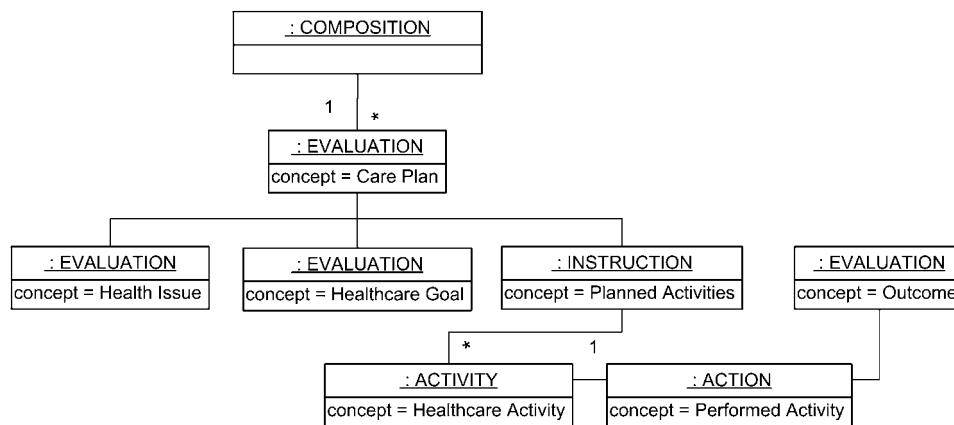
Initially, it was decided which subtype of ENTRY class (see online appendix I) to use for representing different shared care plan concepts. EVALUATION was chosen to model the concepts *care plan*, *health issue/problem*, *healthcare goal/goal*, and *outcome*, as they were all deemed to be assessments, or clinical judgments made from observations of a patient's health. INSTRUCTIONS are specifications of activities that are to be performed,<sup>18</sup> 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,<sup>18</sup> 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

**Figure 1** Simplified concept models of the Old@Home and CONTsys care plan concepts.



**Figure 2** The OLD@HOME shared care plan expressed according to the *openEHR* reference model.



EVALUATION instances, to ensure quick access to the long-term content of a shared care plan, including material from several care plans used in a shared care context.

### Shared care plan archetypes

The *openEHR* archetype repository<sup>20</sup> and the National Health Service (NHS) clinical models archetype repository<sup>21</sup> were explored in search of potentially reusable archetypes. The *openEHR* repository contained generic archetypes representing *health issues*<sup>22</sup> and *healthcare goals*.<sup>23</sup> Reusable INSTRUCTION archetypes were also available, for example generic procedures<sup>24</sup> and medications.<sup>25</sup> A similar situation occurred for ACTIONS, where archetypes representing, for example, medication actions<sup>26</sup> and generic procedures,<sup>27</sup> may be reused. Such archetypes are likely reusable directly in the care plan or can be further specialized to meet special homecare 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 associated 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 COMPOSITION<sup>28</sup> 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 shared 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 interpretation explicit. This could be accomplished through closer integration between process model, concept model, and information 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/EN 13606* based approach 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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