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Next generation terminology infrastructure to support interprofessional care planning

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ABSTRACT

Objective: Develop a prototype of an interprofessional terminology and information model infrastructure that can enable care planning applications to facilitate patient-centered care, learn care plan linkages and associations, provide decision support, and enable automated, prospective analytics.
Design: The study steps included a 3 step approach: (1) Process model and clinical scenario development, and (2) Requirements analysis, and (3) Development and validation of information and terminology models.
Results: Components of the terminology model include: Health Concerns, Goals, Decisions, Interventions, Assessments, and Evaluations. A terminology infrastructure should: (A) Include discrete care plan concepts; (B) Include sets of profession-specific concerns, decisions, and interventions; (C) Communicate rationales, anticipatory guidance, and guidelines that inform decisions among the care team; (D) Define semantic linkages across clinical events and professions; (E) Define sets of shared patient goals and sub-goals, including patient stated goals; (F) Capture evaluation toward achievement of goals. These requirements were mapped to AHRQ Care Coordination Measures Framework.
Limitations: This study used a constrained set of clinician-validated clinical scenarios. Terminology models for goals and decisions are unavailable in SNOMED CT, limiting the ability to evaluate these aspects of the proposed infrastructure.
Conclusions: Defining and linking subsets of care planning concepts appears to be feasible, but also essential to model interprofessional care planning for common co-occurring conditions and chronic diseases. We recommend the creation of goal dynamics and decision concepts in SNOMED CT to further enable the necessary models. Systems with flexible terminology management infrastructure may enable intelligent decision support to identify conflicting and aligned concerns, goals, decisions, and interventions in shared care plans, ultimately decreasing documentation effort and cognitive burden for clinicians and patients.

1. Introduction

Care coordination requires communicating and tracking of clinical states, such as health concerns, health goals, care decisions, decision rationales, care delivered, outcomes of care, and continuous evaluation of outcomes [1]. Communication and tracking of complex patient care requires care coordination tools that surface summaries of patients' clinical states to display linked, complementary, and conflicting health care concerns, goals, decisions, and evaluations. The current features of Electronic Health Records (EHR) are insufficient to handle the agile linking and association of coded clinical concepts across clinical professions. Traditionally, documentation of care planning by nurses was implemented separately from care planning by physicians. Currently, most vendor-based EHRs cannot associate the medical problem of *Congestive Heart Failure* with the nursing problem of *Impaired Gas Exchange*. In many EHR systems these data are stored in separate modules, limiting the ability to establish necessary linkages or relationships. Such technical constraints serve as significant barriers to designing dynamic summaries of care that assist clinicians in understanding available data in context and in relation to linkages with other data, particularly for longitudinal care planning. Yet, as care models have evolved to patient-centered models of care planning, EHRs struggle to reconfigure shared care plans. One important limitation is the underlying terminology infrastructure within EHRs that are designed to be profession-specific

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and, consequently, unable to handle more dynamic interprofessional terminology requirements. EHRs need to implement a new approach to handle the representation of shared and distinct care planning concepts between professions, specialties, and patients across clinical settings [2].

Integrated interprofessional team-based approaches to care coordination are associated with better patient outcomes [3]. Care plans that align interprofessional care goals are a central component of integrated care delivery [4], and integrated care is associated with increased knowledge sharing between disciplines [5,6]. The design of care plans and decision support that fail to explicitly link interprofessional knowledge will propagate isolated care planning [4,7,8], leading to poor team communication and suboptimal patient outcomes [9–11]. Moreover, problem lists and care plans that fail to support linkages between care delivered (SNOMED CT) and administered processes (ICD-9 billing codes) will result in inefficiencies, billing errors, unrealistic expectations for provider documentation, and likely decreased hospital reimbursement. Effective care planning that is team-based and patient-centered hinges on the development of dynamic care plans with embedded functionality for interprofessional knowledge sharing [4]. We posit that a redesign of EHR terminology and knowledge representation infrastructures are necessary to produce effective patient summaries for continuous care planning that are interprofessional and consensus-driven, and able to promote shared understanding. EHR tools to engage with patient summaries should provide a flexible and dynamic "blueprint" to guide care, while leveraging reference terminologies to ensure interoperability and knowledge sharing.

2. Background

The AHRQ Care Coordination Measures Atlas provides a framework for measuring care coordination that is organized by broad approaches (e.g., Health Information Technology) and coordination activities (e.g., communication and tracking of clinical states) with an important emphasis on measuring patient-centered care coordination from multiple participant perspectives (e.g., patient, provider, and system) [1]. The terminology requirements for clinical documentation in many clinical applications are based on requirements of a single discipline or profession, typically using one reference terminology, and with few linkages between concepts. However, the requirements for interprofessional care planning include support for multiple clinical professions with overlapping clinical terminology needs. The design of a care planning infrastructure must consider how it will be used as a cooperative, shared tool [12] and if existing terminologies are sufficiently robust to support interprofessional care planning content [13]. For example, a single activity may be represented from multiple perspectives including the patient, family, healthcare professionals, and population level metrics. The AHRQ framework provides a critical foundation to evaluate requirements for coordinated care planning tools.

Recent advances related to care planning include the HL7 Version 3 Care Plan Domain Analysis Model (HL7 V3 CP DAM) and the Office of National Coordinator for Health Information Technology's (ONC) Standards and Interoperability Framework Longitudinal Coordination of Care (LCC) Workgroup (WG) [14,15]. Yet, it is critical to recognize that the HL7 V3 CP DAM states that it is intended as an interim solution since "limitations in information system architecture, and healthcare cultural issues such as who 'owns' the care plan, how items are added, deleted updated etc. makes the near term implementation and use of dynamic care plans unlikely" [15]. In fact, the HL7 V3 CP DAM describes a vision for a collaborative care model where the care plan is dynamically updated and maintained as a flexible, accurate, and accessible tool with all information needed by patients and clinicians for cost-effective, high quality care. As noted in the HL7 V3 CP DAM, a standard for dynamic care planning would be ideal, but it is not feasible in the near term due to EHRs' lack of infrastructure to support the terminology and modeling requirements [15].

The collaborative and cooperative activity of documenting on a shared care plan introduces interesting dynamics in that the documenting clinician may not be the direct beneficiary of the information in the future and differing perceptions of responsibility and rewards for completing documentation may exist [12]. HL7 defines care planning documentation as: (a) consensus-driven with prioritized concerns, goals, and planned interventions, (b) a blueprint to organize and guide care and integrate multiple interventions proposed by multiple providers and disciplines for multiple conditions, (c) an artifact that reconciles and resolves conflicts between various plans of care and treatment plans, and (d) a source of truth for a longitudinal coordination of care [15].

Clinical Document Architecture (CDA) representations aligned with the HL7 V3 CP DAM represent static exchanged care plans as a snap shot in time and do not represent dynamic care team participations or reconciliation of data [15]. Reconciliation of the care plans across professions, encounters and content areas, such as health problems/concerns (which include allergies/intolerances), goals and interventions (which include medications) are critical to achieving coordinated care [15]. The HL7 Care Coordination Services (CCS) functional model does address team coordination actions (e.g., find, create, associate, change, close, read, share, synchronize, and publish) for care plans. However, neither of these HL7 models address mechanisms for reconciliation of care plan concepts at the terminology level. A care plan by design is a collaborative, shared and dynamic structure [15] and requires a comprehensive clinical ontology to handle the representation of interprofessional terminology concepts and modeling requirements for reconciling at the concept level to enable dynamic, shared, and consistent care plans across the continuum of care [9,10,16,17].

In this paper we add to the set of storyboards used to define the HL7 V3 CP DAM by defining new clinical care planning use cases, representing the terminology concepts for those use cases, and identifying the terminology infrastructure requirements to support dynamic reconciliation of data for those use cases.

3. Methods

We used a 3 step approach: (1) Process model and clinical scenario development, (2) Requirements analysis, and (3) Development and validation of information and terminology models. Step 3 included the development of an Information Model using Object-Role Modeling (ORM) and a Terminology Model represented using Common Terminology Services 2 (CTS2) (see Fig. 1 and descriptions below).

3.1. Step 1: Development of process model and clinical scenarios

An initial set of requirements for an interprofessional care planning process model were identified based on the HL7 V3 CP DAM, ISO Reference Terminology Model (RTM) for Nursing Diagnoses and Actions, and the AHRQ Care Coordination Measures Atlas. Next, we developed four outpatient clinical scenarios that were used to confirm process model concepts and generate requirements and three inpatient clinical scenarios that were used to validate requirements, i.e. seven clinical scenarios total. Scenarios were selected to reflect complex, but common clinical situations (i.e., such as patients with a chronic disease and socio-demographic risk factors) as these would provide a better basis for our model. The four clinical scenarios for the outpatient setting were: (1) Uncontrolled Diabetes Mellitus Type I, (2) Congestive Heart Failure related to Myocardial Infarction, (3) Diabetes Mellitus Type II and Uncontrolled Depression, and (4) Immune-Mediated Kidney Failure. In addition to the patient and family, four interprofessional roles were represented across the scenarios, specifically primary care physician (PCP), care coordinator (CC), licensed clinical social worker (LCSW), and pharmacist (PharmD). The content was based on care planning concepts from the HL7 V3 CP DAM and included assessment data, past medical history, health concerns, interventions, and goals, as