# Chapter 13
# A Framework for Detecting Interactions Between Co-Incident Clinical Processes

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## ABSTRACT

*The detection of treatment conflicts between multiple treatment protocols that are co-incident is a difficult and open problem that is particularly exacerbated regarding the treatment of multiple medical conditions co-occurring in aged patients. For example, a clinical protocol for prostate cancer treatment requires the administration of androgen-suppressing medication, which may negatively interact with another, co-incident protocol if the same patient were being treated for renal disease via haemodialysis, where androgen-enhancers are frequently administered. These treatment conflicts are subtle and difficult to detect using automated means. Traditional approaches to clinical decision support would require significant clinical knowledge. In this paper, the authors present an alternative approach that relies on encoding treatment protocols via process models (in BPMN) and annotating these models with semantic effect descriptions, which automatically detects conflicts. This paper describes an implemented tool (ProcessSEER) used for semantic effect annotation of a set of 12 cancer trial protocols and depicts the machinery required to detect treatment conflicts. The authors also argue whether the semantic effect annotations of treatment protocols can be leveraged for other tasks.*

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## INTRODUCTION

The notion of *care-flow management* (Panzarasa, Maddè, Quaglini, Pistarini, & Stefanelli, 2002) has become the focus of considerable research attention in the recent past. It builds on the premise that process management principles and techniques can deliver value in clinical settings as much as it delivers value in settings such as business process management. Clinical process management can help encode clinical guidelines which can provide a reference baseline for clinicians. These can leverage the coordination capabilities of process engines in ensuring that treatment steps are executed correctly relative to reference guidelines. More generally, care-flow management also addresses the administrative aspects of health care, both from the perspective of health care providers and patients (Curry, McGregor, & Tracey, 2006).

Existing techniques/notations for modelling processes, such as the industry-standard Business Process Modelling Notation (BPMN) (OMG, 2006), only model the coordination semantics of processes, but offer no facility for describing the effects of processes (or steps/activities within processes). Thus, we are able to clearly specify the required sequencing of activities, for instance, but cannot specify the effects that these activities would have on the domain/context in which the process would execute (beyond the minimal information that can be conveyed via the nomenclature of tasks). However, these effect descriptions are critical in determining whether process designs have been correctly formulated. As well, much of the analysis required for process compliance management (Ghose & Koliadis, 2007), change management (Koliadis & Ghose, 2006), enterprise process architectures (Koliadis, Ghose, & Padmanabhuni, 2008) and management of a business process life cycle (Koliadis, Vranesevic, Bhuiyan, Krishna, & Ghose, 2006) relies on being able to refer to the *effect semantics* of business processes.

In this paper, we leverage a technique (and supporting tool - ProcessSEER) (Hinge, Ghose, & Koliadis, 2009) that provides a practitioner-accessible means for providing semantics effect annotations of process models to deliver value in clinical process management in a range of different ways. We focus primarily on the use of this machinery in detecting *treatment conflicts* between co-incident treatment protocols, i.e., situations where the application of a treatment protocol on a patient contra-indicates the application of another treatment protocol on the same patient. These are often subtle, and otherwise difficult to detect using automated means. We also argue that semantic effect annotations of treatment protocols can be leveraged for a variety of other tasks, including identifying instances where different specialists arrive at differing interpretations of the same protocol, as well as pedagogical applications.

The language in which these effects need to be specified should ideally be formal, permitting sophisticated tool support for several of the analysis and reasoning tasks mentioned above. Formal languages are typically not practitioner-accessible while informal annotations make substantive tool support difficult to devise. The use of controlled natural language (CNL) (Schwitter & Fuchs, 1996) is an effective compromise between these two extremes, by offering the analyst a repertoire of sentence schemas in which to describe the effects - populating a sentence schema generates a correspondingly instantiated formal annotation. To avoid placing an unduly heavy burden of annotation on analysts, our approach only requires that analysts provide a description of the *immediate effects* of each process task, i.e., a context-independent specification of the functionality (together with relevant associated ramifications) of each task. These are then accumulated into *cumulative effect annotations* in a context-sensitive manner, such that the cumulative effect annotations associated with any task in a BPMN process model would describe the effects achieved by the process were it to execute up to

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