

# Towards a fall prevention system design by using ontology

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## Extended Abstract

The fall of the elderly is recognized as one of the leading causes of death for the elderly. Falls in the elderly are caused by multiple factors, such as the aging process itself, but also the persons behavior, habits and environment (Bourdessol & Pin, 2008). Falls can thus be prevented by addressing all of these risk factors and identifying interventions that aim to reduce the risk of falling. Various fall prevention systems have been proposed, often based on sensors (Chaccour *et al.*, 2017), but very few are based on a software system. Yet, the efficiency of fall prevention is based on an appropriate and constant follow up of the person through a pedagogical and educative approach, including the falling risk evaluation and adapted recommendations. Considering this context, we have worked on the definition of an ontology in order to be used in the development of a fall prevention system.

To define the ontology, we follow the usual steps to design an ontology : definition of purpose, conceptualization, formalization, and validation (Uschold & Grüninger, 1996; de Almeida Falbo, 2014).

For the *definition of purpose*, we set that the goal of the ontology is to support the evaluation of risks of falls in the elderly in order to prevent falls through recommendations. Moreover, we analyze some scenarios of use of this ontology as follows : supporting a general practitioner to make recommendations to avoid falls in an elderly consultation ; help people in retirement homes in their dealings with the elderly, or giving some recommendation to a family member when planning an outside activity with the elderly. This ontology is the basis for the development of the fall prevention software system.

The *conceptualization* is the longest step and requires the definition of the ontology's scope, concepts, relations and constraints, and a description of a glossary for all concepts and attributes specified. It represents the knowledge modeling itself. First of all, to define the scope of the ontology we set the following competency questions (i.e., requirements in the form of questions that the ontology must answer) :

**CQ1.** What are the important characteristics to be observed for a person at risk of falling ?

**CQ2.** What are the falling risk factors ?

**CQ3.** What are the appropriate recommendations for fall prevention ?

To answer each competence question, we performed interviews with specialized physicians on fall prevention, analysis of a historical database from a hospital unit specialized in the treatment of fall for elderly and the medical literature. Moreover, we had the opportunity to observe the consultations of several elderly in this specialized unit.

For instance, for CQ2, there is no standard classification of risk factors for falls. Nevertheless, analyzing the literature and interviewing the specialized physicians, we organized all the kinds of risk in a taxonomy presented in Figure 1. We distinguish between severity factors and incidence actors. Incidence factors are the elements that could increase the probability to fall. They are classified in environmental factors and several types of individual factors. Severity factors are the elements that could augment the gravity of the consequences of a fall. They have an influence on the consequences of falls and the severity level of related injuries and complications.

The *formalization* of the ontology was made with OWL, using Protégé. The *validation* was done by instantiating the ontology with real cases collected from the historical database of the hospital unit of fall prevention and by physician analysis.

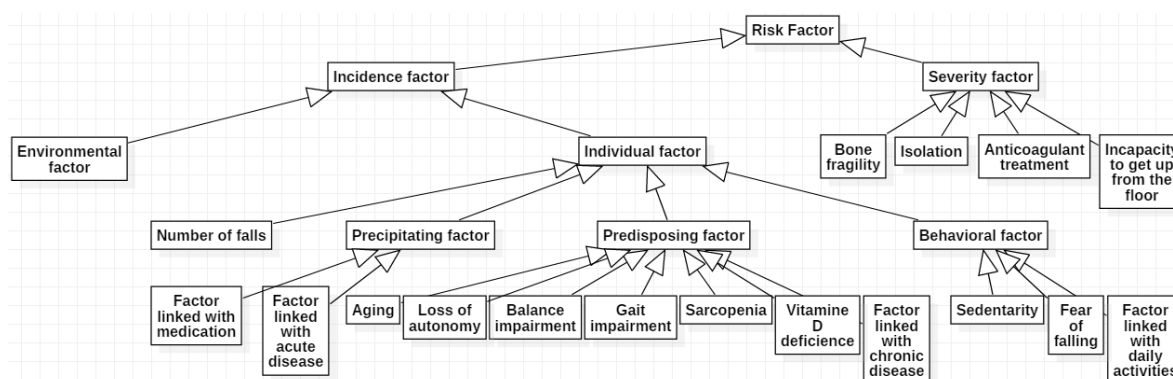


FIGURE 1 – The sub-ontology about elderly person at risk of falling.

Fall prevention aims to reduce the number of falls as well as to reduce the gravity of the consequence of a fall, when it occurs. In that aim, the risk analysis combines the search of the elements that could contribute to a fall together with those that could augment the gravity of the consequences of a fall. The final objective of the fall prevention system is achieved by the selection of the recommendations associated with the actionable risk factors discovered for a patient. To that end, we are currently working on the use of the ontology to support the definition of probabilistic graphical models that embed probabilistic knowledge in the fall prevention system following the ideas of Fenz (2012); Aguilar *et al.* (2016).

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