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Expert System for Nutrition Care Process of Older Adults

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Abstract. This paper presents an expert system for a nutrition care process tailored for the specific needs of elders. Dietary knowledge is defined by nutritionists and encoded as Nutrition Care Process Ontology, and then used as underlining base and standardized model for the nutrition care planning. An inference engine is developed on top of the ontology, providing semantic reasoning infrastructure and mechanisms for evaluating the rules defined for assessing short and long term elders' self-feeding behaviors, to identify unhealthy dietary patterns and detect the early instauration of malnutrition. Our expert system provides personalized intervention plans covering nutrition education, diet prescription and food ordering adapted to the older adult's specific nutritional needs, health conditions and food preferences. In-lab evaluation results are presented proving the usefulness and quality of the expert system as well as the computational efficiency, coupling and cohesion of the defined ontology.

Keywords: Expert system, Nutrition care, Inference engine, Malnutrition, Ontology

1. Introduction

Over the past decade, healthcare systems have under-gone a paradigm shift from being a solely treatment-based focus towards a more personalized, person-centred, and prevention-oriented approach. Such change is driven by the increasing health cost burden to non-sustainable limits, of treatment-based systems, due to the overall ageing of the population, sedentary life-styles and poor nutrition habits, which has led to the increased proliferation of chronic illnesses (e.g. diabetes) (Antos et al., 2013).

Studies have shown that in Europe more than 15% of the older population is affected by poor nutrition including malnutrition caused by age-related risk factors such as sensory changes (taste, smell, eye sight), poor dental health, lack of transportation, physical difficulties, forgetfulness and other issues (Sieber, 2010). Malnutrition is defined as a state of nutrition in which a deficiency, excess or imbalance of energy, protein, and other nutrients causes measurable adverse effects on body form (body shape, size and composition), function, and clinical outcome (Elia, 2001). According to the British Association for Parenteral and Enteral Nutrition (Elia&Russell, 2008), malnutrition affects over 3 million people in the UK alone, and of these, about 1.3 million are over the age of 65. If unman-aged, malnutrition may significantly impact on the older person's health (such as exacerbation of chronic conditions, delayed recovery from illness, etc.), thus causing significant increases in related healthcare costs. In fact, the cost associated with malnutrition in Europe is estimated to amount to a

staggering 170 billion Euro each year (Ljungqvist and Man, 2009). The rapid identification of malnutrition and early prevention through the provision of nutritional assistance to the elderly would thus help to avoid such high public health costs, and enhance both the mental and physical conditions of older adults including their quality of life. It is generally agreed that the best strategy for malnutrition prevention is to lead a healthy lifestyle which can be enacted through a personalized nutrition care process. In Europe, it has been estimated that 77% of the disease burden can be ac-counted for disorders related to unhealthy lifestyle and furthermore, 70% of stroke and colon cancer, 80% of coronary heart disease, and 90% of type II diabetes could be prevented and managed through nutrition care (Brown, 2013). Lifestyle behavioural factors (poor nutrition habits, physical inactivity, tobacco and alcohol use) are classified as modifiable indirect risk factors which can be influenced by individuals and if not managed, could lead to metabolic and physiological changes including high blood pressure, high blood glucose, overweight, obesity and high cholesterol, which all represent direct factors for the development of chronic diseases (Willett et al., 2006). At the same time targeting obesity and overweight, promoting healthy eating, physical activity, smoking/alcohol cessation have been shown to reduce the incidence of "type 2" diabetes (Knowler, et al., 2002).

In this context, advances in the ICT (Information and Communication Technology) sector have made feasible the development of solutions for nutrition care through prevention and self-management. Most contemporary nutrition

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