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ORIGINAL ARTICLE

New approaches for improving cardiovascular risk assessment

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KEYWORDS
Cardiovascular risk assessment;
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Abstract
Introduction and Objectives: Clinical guidelines recommend the use of cardiovascular risk assessment tools (risk scores) to predict the risk of events such as cardiovascular death, since these scores can aid clinical decision-making and thereby reduce the social and economic costs of cardiovascular disease (CVD). However, despite their importance, risk scores present important weaknesses that can diminish their reliability in clinical contexts. This study presents a new framework, based on current risk assessment tools, that aims to minimize these limitations.
Methods: Appropriate application and combination of existing knowledge is the main focus of this work. Two different methodologies are applied: (i) a combination scheme that enables data to be extracted and processed from various sources of information, including current risk assessment tools and the contributions of the physician; and (ii) a personalization scheme based on the creation of patient groups with the purpose of identifying the most suitable risk assessment tool to assess the risk of a specific patient.
Results: Validation was performed based on a real patient dataset of 460 patients at Santa Cruz Hospital, Lisbon, Portugal, diagnosed with non-ST-segment elevation acute coronary syndrome. Promising results were obtained with both approaches, which achieved sensitivity, specificity and geometric mean of 78.79%, 73.07% and 75.87%, and 75.69%, 69.79% and 72.71%, respectively.
Conclusions: The proposed approaches present better performances than current CVD risk scores; however, additional datasets are required to back up these findings.

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PALAVRAS-CHAVE
Avaliação de risco cardiovascular;
Combinação de modelos;
Personalização;
Sistemas de apoio à decisão clínica;
Classificadores de risco

Novas abordagens para a melhoria da avaliação do risco cardiovascular

Resumo
Introdução e objetivos: As recomendações clínicas prevêem o uso de ferramentas de avaliação de risco cardiovascular para determinar o risco de um evento, p. ex. morte cardiovascular, pois podem auxiliar a decisão clínica reduzindo assim os custos sociais e económicos da doença cardiovascular (DCV). No entanto, esta avaliação de risco apresenta algumas fragilidades que podem comprometer a sua aplicação em contexto clínico. Este trabalho, tendo por base ferramentas de avaliação de risco aplicadas na prática clínica, pretende minimizar as limitações identificadas.
Métodos: A exploração/combinação de conhecimento existente é o principal foco deste trabalho, no qual são desenvolvidas duas metodologias: i) a criação de um esquema de combinação que permita a extração e processamento de dados de diversas fontes de informação: ferramentas de avaliação de risco aplicadas na prática clínica, literatura e/ou contribuições dos cardiologistas; ii) sistema de personalização baseado na criação de grupos de pacientes, com o objetivo de identificar a ferramenta de avaliação de risco mais adequada para um paciente específico.
Resultados: A validação foi efetuada com base num conjunto de dados reais: i) Hospital Santa Cruz, Portugal, 460 pacientes com síndrome coronária aguda sem elevação do segmento ST (SCAsEST). Nas duas abordagens foram obtidos resultados promissores, sendo registados respetivamente valores de sensibilidade, especificidade e média geométrica de (78,79%, 73,07% e 75,87%); (75,69%, 69,79% e 72,71).
Conclusões: As metodologias propostas apresentaram melhores resultados quando comparadas com as ferramentas individuais de avaliação de risco aplicadas na prática clínica; no entanto são necessários conjuntos de dados adicionais para reforçar estas conclusões.

Introduction

More people die annually from cardiovascular disease (CVD) than from any other cause, representing approximately 30% (17.3 million) of all deaths worldwide.According to World Health Organization (WHO) estimates, the number of people dying from CVD will increase to 23.3 million by 2030, remaining the single leading cause of death.[1] Furthermore, in Europe, the number of elderly will increase, making this scenario even more severe as age is a key risk factor for CVD development.[2]

Evidence of the mounting social and economic costs of CVD is forcing a change in the current health care paradigm, obliging health systems to move from reactive towards preventive care. According to the European Heart Network around 80% of coronary heart disease (CHD) is preventable, indicating that improvements in preventive health care can produce important benefits and reduce the incidence of CVD.[3] Research lines in information and communication technology (ICT) also reflect this approach; the ICT in disease prevention project (PREVE) states that the main goal should be ''having the individual as a co-producer of health'' and empowering individuals to take responsibility for their health with personalized ICT.[4]

This new approach involves transferring care from the hospital to the patient's home, where health telemonitoring systems can assume critical importance in improving healthcare, as in the HeartCycle project.[5 a] These systems enable patients to be monitored remotely, using devices (interfaces and sensors) installed in the patient's house that can collect and process clinical data such as weight and ECG readings and send them to the care provider. Feedback, which may include the triggering of alarms, can be provided directly to the patient as well as to the care provider. Interfaces such as smartphones are used to obtain additional subjective information from the patient as well as to provide feedback to both patients and professionals, creating a patient loop and a professional loop.

In this context, in the hospital or in the patient's home, the assessment of the risk of an event due to CVD (which can be classified as a hard endpoint such as death or myocardial infarction or a soft endpoint such as hospitalization or disease development[6]) is a critical issue.

CVD risk assessment tools allow physicians to assess the probability of an individual suffering an event based on a set of risk factors.[7,8] These tools can be characterized in different ways: long-term (years) applied to primary prevention[9–12] or short-term (months) for secondary

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