# Simulation modeling for forecasting and managing the cardiovascular risk of individuals

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This study introduces an application that calculates and forecasts cardiovascular risk using lifestyle data. The interface seamlessly integrates with a predictive model, empowering users to make informed decisions. The development of the model and dashboard involved comprehensive literature research and expert interviews to ensure the acquisition of necessary knowledge. The resulting application provides users with insights to manage their cardiovascular health effectively.

## Introduction and Objectives

Cardiovascular disease is the leading cause of death worldwide. Besides exceptions and genetic predispositions, people can reduce their cardiovascular risk with lifestyle adjustments in many cases. Even after a cardiovascular incident, rehabilitation can be accelerated with a healthy lifestyle. With the help of an application, the current risk can be calculated, which enables forecasting cardiovascular health based on individual's data. Thus, the aim of the work was to develop an interface for potential users. The interface is connected to a model that reads in user data and provides a forecast regarding cardiovascular risk and additional indicators. The model is validated by experts, which ensures the quality of the insights.

## Research Design

To generate the required physiological knowledge, a literature search was undertaken. This was executed iteratively together with the creation of the System Dynamics simulation model. Interviews were conducted with experts from the fields of sport, nutrition, and cardiology. These served to create additional physiological knowledge and explore the patient as well as the rehabilitation process. Furthermore, the interviewees supported the validation of the resulting simulation model. Finally, Microsoft Power Automate and Excel VBA were used to automate the simulation process and to ensure the interface between software packages.

## Results

The result is a highly valid simulation model joint by a functioning management dashboard for a potential patient. The model is based on the metabolism of the human body. For instance, Peter, a 40-year-old smoker with high blood pressure, increased his cardiovascular risk from 4% to 6.5% in just two years. By quitting his smoking habit and adopting a healthier diet, his risk decreased to 3%. Together with the therapists, Peter can now define different measures for his health. The model helps to inform and understand how a change in lifestyle could decrease his personal risk. This example shows how different measures can be elaborated by using the dashboard and its simulation model in the background.

## Implication and Recommendation

Future work should include research to also consider psychological factors. Furthermore, I suggest to evaluate whether the model has potential in other areas, such as optimising and controlling fat and glycogen storage/supply in athletic endeavours. The model should be tested on real people to collect data and improve the model. Moreover, future studies should focus on integrating the model with existing applications or smartwatches enhancing individualized predictions and support better decision-making for end-users.

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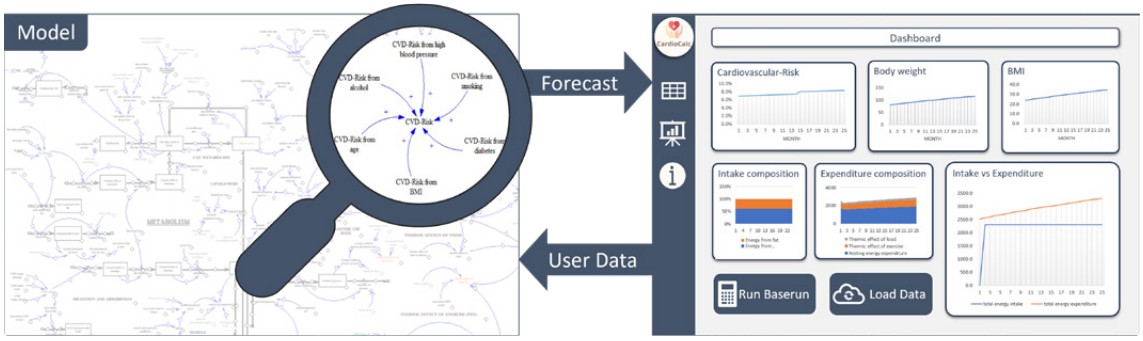


Figure 1: Simulation model linked to management dashboard