Risk Assessment Models for Diabetes Complications: 
A Survey of Available Online Tools

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Abstract. Predictions, risk assessment and risk profiling are among the various 
decision support techniques that medical professionals increasingly rely on to 
provide early diagnose in patients with elevated risks and to slow down the 
rapid increase in prevalence of chronic diseases. The introduction of risk 
assessment tools and applications for chronic diseases in large scale 
longitudinal clinical studies, presents many challenges due to the nature of the 
data (studies last around a decade) and the complexity of the models. In this 
paper, we give an overview of research work on risk assessment tools and 
applications for diabetes complications. We also introduce the REACTION 
project and its vision in the field of risk assessment for diabetes complications.

1 Introduction

Risk factors for diabetes complications have been intensively studied during the last 
decades, and these studies greatly improved the current scientific knowledge about 
the biological processes underlying diabetes. Risk factors have been commonly used 
in risk assessment models for the prediction of diabetes complications. Risk 
assessment models are the backbone of risk assessment tools used in the clinical 
practice. These tools as parts of clinical/medical applications are able to stratify 
diabetes patients according to their probability of developing complications or 
experiencing adverse events.

A risk assessment tool is based on one or more models which could be any type of 
algorithm or mathematical formula (e.g., a set of rules, a decision tree or a weighted 
sum) for assessing the overall statistical probability of certain situations to occur in the 
future. Medical risk assessment may provide probabilistic statements as the likelihood 
that certain complications may occur given the present and historic health status.

Several risk assessment models for diabetes complications have been proposed in 
the literature. In the overall clinical management of people with diabetes special 
attention has to be dedicated to the prevention of short-term as well as long-term 
complications. Even though “short” and “long term” are commonly used terms in the 
context of diabetes complications, there is not a clear and universally accepted
distinction between the two; here thereafter, we indicate as short term complication any pathological process or event related to diabetes that is expected to arise within
weeks or few months, while long term complications may arise even after several
years. In the context of the REACTION project (see Section 5), our research group
work exclusively on long term risk assessment models; thus, we consider short term
models (especially insulin management tools) out of the scope of this paper.

The most common predictive risk assessment models for diabetes complications
are not able to deal with all the major complications, but are mainly focused on
cardiovascular diseases, coronary heart disease and diabetic retinopathy (long-term
complications).

The paper is organized as follows: the major clinical studies for diabetes and its
complications have been reviewed in Section 2, while in Section 3 the risk assessment
tools and applications for diabetes complications have been examined. Advantages
and limits of present tools are discussed in Section 4, while Section 5 presents the EU
funded project REACTION, an ICT based initiative that will develop and integrate
new risk assessment models for diabetes complications.

2 Major Clinical Studies for Diabetes

Long term risk assessment tools and applications are usually built upon data collected
during large scale, longitudinal clinical studies. Such type of studies typically last
around a decade, involve thousands of patients in numerous health centres, and
measure different aspects of patient’s clinical/medical profile. Thus, it is not
surprising that the data collected in each study can be employed for deriving multiple
risk assessment models, differing from each other for predicted outcomes, involved
parameters or analytical techniques.

Some of the well known clinical studies related to diabetes complications which
will be discussed here, are DCCT/EDIC [1], Qrisk [2] and UKPDS [3].

2.1 DCCT/EDIC Study

A study of long term risk assessment related to diabetes and complications is the
Diabetes Control and Complications Trial (DCCT). DCCT [1] is a landmark medical
study conducted by the United States National Institute of Diabetes and Digestive and
Kidney Diseases (NIDDK). The DCCT involved 1,441 volunteers, ages 13 to 39, with
type 1 diabetes and 29 medical centres in the United States and Canada. DCCT is a
multicenter, randomized clinical trial designed to compare intensive with
conventional diabetes therapy with regard to their effects on the development and
progression of the early vascular and neurologic complications. Volunteers had to
have had diabetes for at least 1 year but no longer than 15 years. The study compared
the effects of standard control of blood glucose versus intensive control on the
complications of diabetes. Intensive control meant keeping glycated haemoglobin
(HbA1c) levels as close as possible to the normal value of 6 percent or less.