

# Decision-making model for the monitoring and identification of risk groups for Type 2 Diabetes Mellitus comorbidities using Fuzzy NN algorithm

Melissa Mello de Carvalho<sup>1</sup>, Waldemar Volanski<sup>1</sup>, Geraldo Picheth<sup>1</sup>,

*1 UFPR*

## Abstract

Type 2 diabetes mellitus (DM2), its comorbidities and complications represent avoidable expenses for patients and public health. Complication prevention can be proposed with a decision model to identify risk groups. The present study aims to study the complications of DM2 from a database with 209 female patients (40 to 87 years) with DM2 at a mean of 12.2 years (1 to 40 years of the diagnosis). The study is approved under the CAAE: 1038112.0.0000.0102. We analyzed 29 attributes arranged in biochemical, anthropometric and monitoring attributes of DM2, such as time of diagnosis in years, presence or absence of comorbidities. The data do not contain missing data, the attributes have multivariate numerical and nominal variability (Y/N). The comorbidities are: coronary artery disease (CAD), retinopathy, neuropathy, nephropathy. They are classified with the Fuzzy NN algorithm from biomarkers. HbA1c = 7% classifies optimal glycemic control in patients with DM2 according to SBD 2015-2016. The choice for fuzzy systems is due to the classification diffusion of attributes with high variability and multicriteria decision. The data were classified with the Fuzzy NN algorithm in the WEKA software, trained and cross validated with the following specifications: using 10 nearest neighbors for classification, Similarity measure 4; Implicator Gödel; T-Norm Algebraic; Relation composition Lukasiewicz. The classes were modified to classify the objects of study: Control, Retinopathy, Neuropathy, Nephropathy and CAD, omitting in each analysis glycemic variables. Fuzzy NN was able to identify all cases of neuropathy and nephropathy as presented in the data with about 93.3% and 94.5% accuracy respectively. With the retinopathy class, it was possible to identify all previously known cases (53 cases) and predict another 5 cases of risk with 72.2% accuracy, 74% specificity. With the Control class, the accuracy was 76% with a precision of 81% and a specificity of 70%. By including the variable insulin use the accuracy increases to 87.5%, precision: 88% and specificity 90%. In all cross validations values the classification coverage of the Fuzzy NN remained above 98%. The classification Control with and without insulin indicates the importance of the medical monitoring in DM2, approximately 32% of the patients besides presenting poor glycemic control do not use insulin nor hypoglycemic agents, which represents a deficit in the follow-up of this portion of patients.

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