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Abstract Information

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Abstract Content 100%

Daily acquisition and analysis of vital sign data and clinical symptoms in chronic heart failure patients allow for early recognition of an emerging decompensation. Artificial Neural Networks (ANN) are a statistical model, which is able to learn probability distributions of a dataset by inductive example training. Here, the capability of a personalized ANN was tested to predict the progression of chronic heart failure in the individual patient.
Methods: In 169 patients hospitalized due to chronic heart failure decompensation, a multiparameter telemonitoring was performed after discharge for up to 3.5 years with 150.000 patient days in total. Daily recording of vital signs (ECG, bodyweight, blood pressure (BP), O2-saturation, thoracic impedance, symptoms, drug adherence, request of contact) generated 1.5 million telemonitoring datapoints, which were used to predict the primary endpoint "new heart failure hospitalization" by ANN.
An ANN to predict the probability of a health state change was trained based on recent vital measurements. Therefore, 80% randomly chosen datapoints of all patients were used to train the ANN (group1). The remaining 20% were used to test the predictive value of the trained model (group2). Doing that, the last 7 measurements of weight, systolic and diastolic BP and heart rate as well as time intervals were used as input parameters. Target output values were based on the study endpoint, e.g. 0 for a "stable health state" and 1 for the primary endpoint "new heart failure hospitalization". An ANN with 255 hidden neurons within 3 hidden layers, backpropagation training and squared error function was used. The network topology has been determined experimentally. Network training lasted 4000 iterations and has been stopped as training root mean squared error (RMSE) converged towards 1.6%, indicating a good adaption to the training set.
Results: RMSE on the group2 data was 9.5%, indicating a reasonable generalization of the training data onto this group. Mean value measurement data by the ANN classified for the primary endpoint "new heart failure hospitalization" were 0.80(± 0.17), classified as "stable health state" were 0.20(± 0.25). Measurement data hinting towards "unstable health state" have been assessed with mean of 0.44(± 0.24) allowing for good group separation.
Summary: Out of the data of daily multiparameter telemonitoring recordings in patients with chronic heart failure an ANN was trained to predict the most probable healthstate of the monitored patient. This model analyzing telemonitoring data for heart failure deterioration may be used for decision support and alerting.

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