

Comparison of intensive care databases and transferability of AI-methods for the ARDS detection

(Master Thesis)



TAUSEEF AHMAD AWAN

Motivation

In intensive care units, a large amount of data is collected to monitor a patient's condition and detect life-threatening conditions such as the acute respiratory distress syndrome (ARDS). ARDS is a serious medical condition in which gas-exchange is severely impaired and fluid accumulates in the lung tissue. In the past years, various machine learning (ML) methods for the detection of ARDS have been developed. These algorithms are often just validated internally and not well tested on other datasets (external validation), disregarding the possible lack of transferability. Thus, leading to low performance when using these trained algorithms on new data.

State of the Art

Heterogeneous publicly available clinical research databases (such as MIMIC and eICU) are often used for the training of such ML methods. For the comparison of these databases convex hull analysis has been developed. Furthermore, methods such as transfer learning or learning from combined cohorts are applied to improve transferability of ML methods. In addition, various algorithms (such as Bayesian Net, Random Forest or a Support Vector Machine) have been evaluated on different datasets as part of final theses at the Informatik i11 chair. However, no specific concept or method for the evaluation of the transferability of these methods has been conducted. Therefore, a systematic analysis to compare ICU databases and the robustness of AI methods for ARDS detection is proposed.

Objective

The first objective of this thesis is to use convex hull analysis for making an in-depth comparison between different publicly available intensive care databases and data available from university hospital Aachen. The second objective is to develop a transferability-concept for evaluating machine learning models using different datasets. The concept will be applied to the methods already implemented at the chair and tested with different intensive care databases. Finally, it is evaluated to what extent the transfer concept improves the transfer of ML methods for the detection of ARDS.

Planned Procedure

During the initial literature review, different approaches of transferability of machine learning methods will be analyzed and the optimal approach will be selected. Additionally, the available intensive care databases will be compared based on features (spread, distribution etc.) and convex hull. Then, the existing methods are trained using the selected method and applied to the different databases. Results are evaluated and analyzed to determine if the performance has changed and higher transferability can be achieved. Finally, the comparison of databases, implementation details for transferability and results will be discussed in the written thesis report.