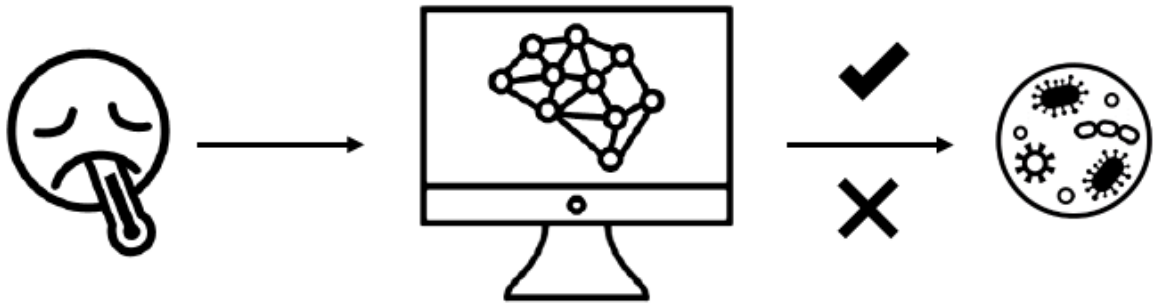
Differentiating bacterial from non-bacterial disease using Machine Learning



Start aspect

This proposal fits well within the scope of this call since the project will aim to develop a novel approach to proactively distinguish bacterial from non-bacterial disease in the emergency department setting with the use of Machine Learning algorithms, in order optimize care for patients with systemic infections. The use of Machine Learning in healthcare has only just started to gain ground and new algorithms and supporting technologies still need to be exploited to see if they can be clinically relevant, which will be one of the aims of this project. The grant will support the development of an algorithm. If successful, the model could constitute the basis of a spin off project with prospective evaluation and prototyping of the clinical implementation of the algorithm. In this prospective evaluation, we would assess the impact of using predictive modelling to assist physicians in choosing an appropriate therapy for either bacterial or non-bacterial diseases, thereby reducing superfluous diagnostic tests, unnecessary antibiotics and unnecessary hospitalization. A plethora of other spin-offs seem feasible when the first project and spin-off turn out to be successful. For example: predicting specific underlying pathogens for bacterial or non-bacterial infections and anticipating susceptibility to certain antibiotics.

Background/relevance

The development of artificial intelligence (AI), and specifically the subfield of Machine Learning, is starting to have an impact on the healthcare sector. These new technologies can be used to detect underlying patterns from the many data points which are being recorded in the emergency department on a daily basis, supporting physicians in the swift assessment of a patient and initiation of an appropriate treatment strategy. Complex situations, where multiple physiological mechanisms interact and substantial sensor data is being logged, seem to be perfect areas to start implementing AI-driven strategies. AI models might be able to identify patterns which can be predictive of certain outcomes, yet undetected by specialists.

The diagnostic work-up of infectious diseases is such an area that is ripe for predictive modelling. Physical examination and laboratory tests are insufficient to distinguish proactively between bacterial and non-bacterial diseases in many cases. This distinction is essential with regards to the initiation of antibiotic treatment. Unfortunately, the information about causative pathogens, which is provided by blood cultures, can rarely aid in this initial work-up since the results will only be available after several days. The decision to start antibiotic treatment has often already been made before any blood culture results are known. This uncertainty likely has substantial influence on the overuse of antibiotics. It is estimated that about 30-50% of patients receive antibiotics unnecessarily, which then leads to a cascade of diagnostic tests, (temporary) continuation of treatment and sometimes hospital

admission. In a recent retrospective observational study only 13.9% of the blood cultures were positive. After correcting for contamination, this number dropped to mere 7.5% true-positives. Knowing, or having a reasonable estimate of the chance of having a bacterial infection early on could greatly help in distinguishing patients who would benefit from antibiotic treatment from those who would likely not benefit from it. AI-driven strategies could be of great value to clinicians by providing these estimates.

Hypothesis: we hypothesize that a Machine Learning algorithm can distinguish bacterial from non-bacterial diseases in the emergency department with reasonable accuracy. After clinical implementation, the algorithm could assist clinicians in distinguishing patients who really could benefit from antibiotic treatment from those who would not. This could then lead to a reduction of the overuse of antibiotics, diagnostics tests and unnecessary hospital admissions.