



The Personalised Risk Tool: Automatic Risk Prediction Using Machine Learning

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Background & Motivation

Fast and effective risk management in hospitals is essential to ensure patient safety. However, patients at higher risks and those likely to benefit from preventive actions need to be identified as early as possible in order to perform interventions on an individual level.

With an increasing amount of electronic health records and longitudinal patient histories, risk prediction models based on machine learning have become popular in healthcare [1]. While rule-based models perform well for some patients, machine learning-based risk prediction can process far more individual and longitudinal information of a patient history.

However, the implementation of such models still faces barriers, and further research is necessary to determine the performance and integration in dynamic clinical settings [2].

Our solution

For the past five years, KAGes has developed the **Personalised Risk Tool (PRT)** together with various research partners, and has implemented it in ten KAGes hospitals.

The PRT combines digitalisation of healthcare and latest technologies in order to support healthcare professionals in personalised risk prediction:

1. For an individual patient, the PRT **automatically predicts the risk** of a disease, complication, or other clinical outcomes within seconds. **No additional data entry** is needed as the underlying machine learning model uses only already available electronic health records from the individual patient history [3].
2. The patient is assigned to **one out of three risk groups** which is presented in the clinical workflow of the hospital information system (Figure 1).
3. The risk prediction can be **verified in a web application** which displays all available risk predictions for this patient depending on his or her treatment path in the hospital (Figure 2).
4. For each risk prediction, **individual patient data** used for prediction can be accessed, including ICD-10 coded diagnoses, previous medication, laboratory results, nursing assessment and hospital procedures (Figure 3) [4].

The following risk predictions are currently available in the PRT:

- Delirium prediction for in-patients (including ICU patients)
- Prediction of an admission to ICU for patients with planned surgery
- Dysphagia prediction for in-patients

Results of Recent Implementation

- Occurrence of delirium was predicted by the PRT with a sensitivity of 74.1% and a specificity of 82.2% [3].
- Risk predictions of the PRT correlated strongly with the delirium risk perceived by clinical experts [3].
- An admission to ICU after a planned surgery was predicted with a sensitivity of 73.3% and a specificity of 80.8% [5].
- Dysphagia prediction was recently implemented in two hospitals of KAGes.
- Physicians and nurses positively evaluated the ease of use and usefulness of the PRT: It did not increase their workload, provided them with additional information and was easy to use [6].

Conclusion

- Personalised risk prediction in healthcare needs to be **accurate and reliable**, and predicted **outcomes have to be actionable** to stage preventive actions.
- Healthcare professionals should be **included in development and implementation** of machine learning tools to raise acceptance and usefulness.
- Machine learning-based should provide information on how individual risks are predicted in order to **support clinical decision-making**.

Pf...	Zimmer	Bett	Patient/Geschl./Alter	Kw	W	MIBI	Prognose
MEA1	A303	A303-1					
		A303-2					
		A303-3					
		A303-4					
A304	A304-1	A304-1					
		A304-2					
		A304-3					
		A304-4					
A305	A305-1	A305-1					
		A305-2					
		A305-3					

Figure 1. Presentation of the risk group in the column *Prognose* in the hospital information system. A red icon symbolizes very high risk, a yellow item high risk and no item low risk.

Figure 2. For the patient Susi Süden, risk predictions for delirium and dysphagia are currently available in the PRT. A click on the box opens individual patient information.

Figure 3. The patient Rudi Rüssel has a very high risk for the occurrence of delirium. The PRT informs healthcare professionals about a past delirium in his patient history.

Open Questions & Future Aspects

- The application of machine learning models in healthcare remains a challenge: Even though there is enough data to develop well performing machine learning models, the application of such models on a grand scale needs to be subject of **more prospective implementation studies**.
- Further questions remain on **how to communicate personalised risk predictions** to patients in order to change behaviour, e.g. for healthier lifestyle.

References

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