Challenges of Trustable AI and Added-Value on Health
B. Séroussi et al. (Eds.)

doi:10.3233/SHTI220419

Prediction of Acute Kidney Injury in the Intensive Care Unit: Preliminary Findings in a European Open Access Database

Michael FUJARSKI [a,1*], Christian PORSCHEN [b,*], Lucas PLAGWITZ [a]
Alexander BRENNER [a], Narges GHOREISHI [c] Patrick THORAL [d],
Harm-Jan DE GROOTH [d], Paul ELBERS [d], Raphael WEISS [b],
Melanie MEERSCH [b], Alexander ZARBOCK [b],
Thilo Caspar VON GROOTE [b,**] and Julian VARGHESE [a,**]
[*] *the authors contributed equally to this work and share the first authorship*
[**] *the authors contributed equally to this work and share the coordinating authorship*
[a] *Institute of Medical Informatics, University of Münster, Germany*
[b] *Department of Anesthesiology, Intensive Care and Pain Medicine, University Hospital Münster, Münster, Germany*
[c] *Federal Institute for Risk Assessment, Berlin, Germany*
[d] *Department of Intensive Care Medicine, Laboratory for Critical Care Computational Intelligence. Vrije Universiteit, Amsterdam, The Netherlands*

Abstract. Acute kidney injury (AKI) is a common complication in critically ill patients and is associated with long-term complications and an increased mortality. This work presents preliminary findings from the first freely available European intensive care database released by Amsterdam UMC. A machine learning (ML) model was developed to predict AKI in the intensive care unit 12 hours before the actual event. Main features of the model included medications and hemodynamic parameters. Our models perform with an accuracy of 81.8% on moderate to severe AKI and 79.8% on all AKI patients. Those results can compete with models reported in the literature and introduce an ML model for AKI based on European patient data.

Keywords. Acute Kidney Injury, AmsterdamUMCdb, ICU, Predictive Modeling

1. Introduction

Acute kidney injury (AKI) is a common complication in critically ill patients in the intensive care unit (ICU). AKI is diagnosed based on reductions of urinary output and elevations of serum creatinine, according to the KDIGO 2012 guidelines [1]. Since preventative measures effectively reduce the incidence of AKI the development of Machine Learning (ML) based models has been suggested for early identification [2]. Since the published models have mainly been developed on databases from the United States, this study, we developed such a model, based on European patient data to achieve an adequate generalizability [3].

[1] Corresponding Author, Michael Fujarski; E-mail: michael.fujarski@wwu.de.

2. Methods

The AmsterdamUMCdb contains data of 23,106 medical and surgical patients treated between 2003 and 2016 in the Amsterdam University Medical Centers. Available data includes routinely collected ICU data. A cohort of moderate or severe AKI were identified by an increase of their serum creatinine. A window of 48 hours was used to predict an AKI 12 hours into the future.

3. Results

The best performing model achieved an accuracy of 81.8% on severe AKI patients and 79.8% on all patients. See the supplements for detailed results and feature analyses [4].

4. Discussion

Using the AmsterdamUMCdb database, an ML based model for the prediction of AKI was developed and achieves a moderate accuracy. Frequently administered drugs that optimize hemodynamics as well as blood pressure lowering drugs correlated positively with the target variable. The limitations of the model include a missing validation on other databases and the identification of AKI solely based on serum creatinine.

5. Conclusion

The AmsterdamUMCdb offers the first open-access database of European ICU patient data. We present a novel ML model that accurately predicts severe AKI 12 hours prior to clinical occurrence. Future work includes a validation on other databases and implementation of other AKI criteria like reduced urine production.

References

[1] KDIGO Clinical Practice Guideline for Acute Kidney Injury. Official Journal of the International Society of Nephrology. 2012 Mar 1.

[2] Meersch M, Schmidt C, Hoffmeier A, Van Aken H, Wempe C, Gerss J, Zarbock A. Prevention of cardiac surgery-associated AKI by implementing the KDIGO guidelines in high risk patients identified by biomarkers: the PrevAKI randomized controlled trial. Intensive Care Med. 2017 Nov;43(11):1551-1561. doi: 10.1007/s00134-016-4670-3. Epub 2017 Jan 21. Erratum in: Intensive Care Med. 2017 Mar 7;: PMID: 28110412; PMCID: PMC5633630..

[3] Thoral PJ, Peppink JM, Driessen RH, Sijbrands EJG, Kompanje EJO, Kaplan L, Bailey H, Kesecioglu J, Cecconi M, Churpek M, Clermont G, van der Schaar M, Ercole A, Girbes ARJ, Elbers PWG; Amsterdam University Medical Centers Database (AmsterdamUMCdb) Collaborators and the SCCM/ESICM Joint Data Science Task Force. Sharing ICU Patient Data Responsibly Under the Society of Critical Care Medicine/European Society of Intensive Care Medicine Joint Data Science Collaboration: The Amsterdam University Medical Centers Database (AmsterdamUMCdb) Example. Crit Care Med. 2021 Jun 1;49(6):e563-e577. doi: 10.1097/CCM.0000000000004916. PMID: 33625129; PMCID: PMC8132908..

[4] Fujarski , Porschen. Sciebo University of Münster. [Online]. [cited 2022 03 31. Available from: https://uni-muenster.sciebo.de/s/ec3oTTfbfxwEWWT.