



22nd National Day of Biomedical Engineering 2025

Title: Safe and effective digital glycaemic control: Results from a 1,000-patient clinical trial

Seret Marie^{1*}, Vincent Uyttendaele¹, J. Geoffrey Chase², Goeffrey M. Shaw³, and Thomas Desaive¹

¹ Model-based therapeutics, GIGA Institute, University of Liege, Allée du 6 Août, 19 (Bât B5a) B4000 Liège, Belgique.

² Department of Mechanical Engineering, Centre for Bio-Engineering, University of Canterbury, Private Bag 4800, Christchurch, New-Zealand.

² Department of Intensive Care, Christchurch Hospital, Christchurch, New-Zealand.

* Corresponding author; email: marie.seret@uliege.be

Abstract

Objective: Stress-induced hyperglycaemia and glycaemic variability are associated with increased mortality and morbidity in intensive care unit (ICU) patients [1]. Glycaemic control (GC) protocols aimed at maintaining blood glucose (BG) within safe ranges have been shown to improve outcomes [2], but they are often difficult to implement safely, limiting their adoption in clinical practice [3]. **Methods:** This study presents clinical trial results of the STAR-3D protocol, a unique, AI-powered, digital twin-based system that provides real time recommendations for insulin and nutrition therapy [4]. Between April 2019 and December 2024, 1085 patients were enrolled, representing 1430 GC episodes and 86,010 hours of control after data filtering. **Results:** STAR-3D delivered effective and safe control, with 71% of BG measurements falling within the normoglycaemic target range (4.4-8.0 mmol/L) and only 3 severe hypoglycaemia events (BG < 2.2 mmol/L). High and personalised nutrition delivery was also achieved, with a median [IQR] of 89.0 [17.2 – 100.0] %goal feed delivered. **Conclusions:** These outcomes were consistent at both cohort and per-patient levels, demonstrating STAR-3D's ability to provide safe and effective GC through personalised management of glycaemia and nutrition. Its adaptability to individual patients' needs supports broader adoption in ICUs and offers a robust platform for evaluating the clinical impact of GC.

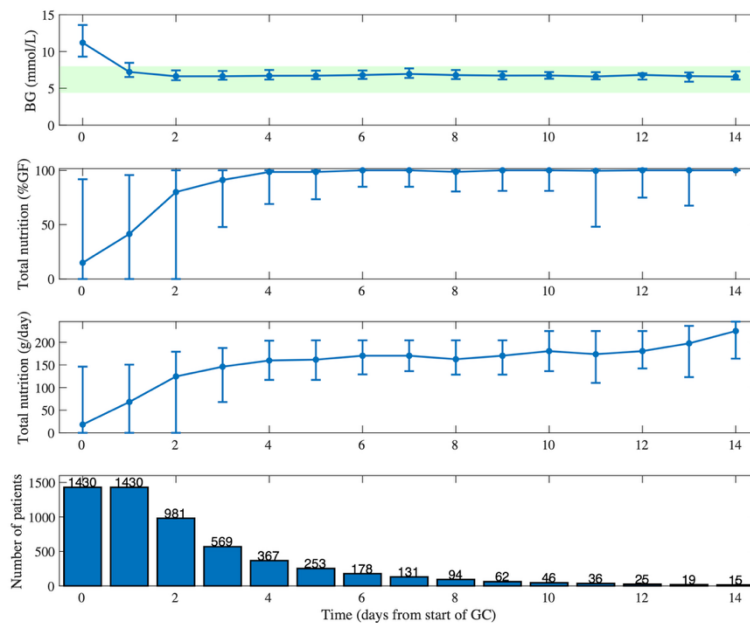


Fig.1 BG level, nutrition and patients under GC over time during GC. BG level (top), total amount of nutrition administered in %GF (second to top) and in kcal/day (third to top), and number of patients under GC (bottom) are shown as a function of the number of days under GC. The first three panels are expressed as median (IQR). The shaded band in the top panel represents the target range (80-145 mg/dL)

Key words: Digital twin, Glycaemic control, Intensive Care, Stress-induced hyperglycaemia.

References

- [1] C.W. Hsu. World Journal of Critical Care Medicine, 2012.
- [2] J. Gunst, Y. Debaveye, F. Guiza, et al. New England Journal of Medicine. 2023.
- [3] V. Uyttendaele, J. L. Dickson, G.M. Shaw, et al. Critical Care. 2017.
- [4] K.W. Stewart, C.G. Pretty, H. Tomlinson, et al. Annals of Intensive Care. 2016.