

# Efficacy and Safety of SPRINT and STAR Protocol on Malaysian Critically-Ill Patients

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**Abstract**—Intensive care unit patients may have a better glycaemic management with the right control protocol. Results of virtual trial performance on Malaysian critically-ill patients adopting a model-derived and model-based control protocol known as SPRINT and STAR are presented in this paper. These ICU patients have been treated by intensive sliding-scale insulin infusion. The effectiveness and safety of glycaemic control are then analysed. Results showed that patient safety improved by 83% with SPRINT and STAR protocol as the number of hypoglycaemic patients significantly reduced ( $BG < 2.2$  mmol/L). Percentage of time within desired bands and median BG improves in both SPRINT and STAR. However, the improvements are associated with higher number of BG measurements (workload).

**Keywords**—model-based protocol; hyperglycaemia; ICU patients.

## I. INTRODUCTION

Stress-induced hyperglycemia is prevalent in the intensive care unit (ICU), occurring in patients even without prior diabetes [1]–[3]. Hyperglycaemia worsens outcomes, namely increasing the risk of severe infection, myocardial infarction, multiple organ failure and at worst, mortality [1]. Many studies [4], [5] demonstrated that tight glucose control (TGC) may lessen ICU patients' mortality and other negative outcomes. A lot of TGC studies, either successful or unsuccessful had adopted nurse-implemented protocol that comes with some disadvantages: to name a few, as protocols are not individualized it is more of a one-size fits all method, some protocols may be ad-hoc or based on experience. Furthermore, providing round the clock care for ICU patients while adopting TGC has proven to be taxing.

One approach to develop a glycaemic control protocol that can be implemented within ICU is through model-based method. Model-based protocols deliver patient specific control where the control protocol can be devised individually. Through model-based methods, virtual trials may be simulated to design or develop protocols in-silico. Herewith attention to control glycaemia either through feed and/or insulin (subcutaneous, IV, bolus) may be evaluated and devised. Glycaemic control protocol may be optimized virtually to save time, money and most importantly to yield a better patient outcome.

SPRINT [4], a model-derived protocol was first implemented in Christchurch Hospital Department of Intensive Care in August 2005 and has treated over 1500 patients. SPRINT protocol has been effective at decreasing organ failure and mortality [6], [7] giving the most secure control over all patients of several extensive studies [8], [9]. It modulates both nutrition and insulin to provide tight glycaemic control. Insulin and dietary inputs are taken into account on hourly or 2-hourly blood glucose (BG) measurements for TGC. The protocol specifies carbohydrate intake, formula and/or goal feed rates [10], [11]. SPRINT is a paper-based protocol, developed through extensive computer simulations and does not require a bed-side computer.

Stochastic Targeted protocol (STAR) [12], downloadable on a tablet is a model-based protocol that uses a clinically validated glucose-insulin model which provides patient specific recommendations of insulin and nutrition while ensuring a 5% maximum risk of hypoglycaemia. STAR can be adopted over a scope of clinical scenarios and used for real-time bedside care. The adaptability of STAR includes to local nutrition practices, desired BG target levels,