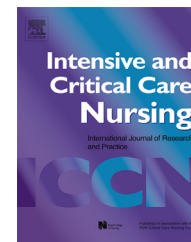




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## REVIEW

# Computerised insulin dosing calculators for the management of continuous insulin infusions after cardiac surgery: A systematic review and meta-analysis

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### KEYWORDS

Cardiac surgery;  
Critical care;  
Hyperglycaemia;  
Insulin;  
Insulin infusion;  
Intensive care units;  
Meta-analysis;  
Systematic review

### Summary

**Objectives:** To investigate the effectiveness of computerised insulin dosing calculators for the management of continuous insulin infusions in adult patients who underwent cardiac surgery.

**Method:** A systematic review was conducted. The CINAHL, MEDLINE and Cochrane databases were searched for primary studies that compared a computerised insulin dosing calculator to a paper protocol. The main outcome measures were mean Blood Glucose Level (BGL), time to achieve BGL target range, time spent within BGL target range, the incidence of hyperglycaemia and the incidence of hypoglycaemia.

**Results:** Five studies were included in the final review. Pooled data demonstrated significant improvements in mean BGL (MD  $-14.24$ , 95% CI  $-26.93$  to  $-1.55$ ),  $p=0.03$  and significantly lower rates of hypoglycaemia (OR  $0.038$ , 95% CI:  $0.16-0.90$ ),  $p=0.03$  amongst the computer calculator groups in comparison to the paper protocol groups. No significant difference in the incidence of severe hypoglycaemia was demonstrated (OR  $0.21$ , 95% CI  $0.02-1.79$ ),  $p=0.15$ . No difference was found in time (hours) to reach target blood glucose range (MD  $-1.47$ , 95% CI  $-3.75$  to  $0.81$ ),  $p=0.21$ .

**Conclusion:** There is some evidence to support the use of computerised insulin dosing calculators for insulin infusion management within critical care environments.

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### Implications for clinical practice

- Hyperglycaemia is a common peri-operative complication experienced by patients undergoing cardiac surgery.
- Uncontrolled hyperglycaemia in cardiac surgery patients increases patient risk for secondary complications and increases burden on the health care system.
- A continuous intravenous insulin infusion is the preferred method for controlling hyperglycaemia associated with cardiac surgery within the critical care environment.
- Evidence from this secondary analysis supports the use of either a paper protocol or a Computerised Insulin Dosing Calculator (CIDC) for the management of a continuous intravenous insulin infusion within the critical care environment, however it should be noted that a limited amount of evidence regarding the use of a CIDC exists.
- This secondary review highlights the need for standardised and endorsed protocol parameters that will see target blood glucose ranges, blood glucose monitoring intervals and definitions of hypoglycaemia and hyperglycaemia aligned.

## Introduction

In the context of cardiac surgery hyperglycaemia is a peri-operative complication that occurs in the vast majority of patients despite pre-operative diabetic status (Bellomo, 2011; Langouche and Van den Berghe, 2006). Hyperglycaemia, in hospitalised patients, is defined by the American Diabetes Association and the American Association of Clinical Endocrinologists, as blood glucose levels (BGL) that exceed 7.8 mmol/L (140 mg/dL) (Moghissi et al., 2009). If left untreated or if treated inadequately, hyperglycaemia can be detrimental to the cardiac surgery patient's recovery during the post-operative period.

Evidence from the literature has demonstrated that patients who have cardiac surgery and experience hyperglycaemia are at a significantly increased risk for the development of surgical wound infections and have an increased risk for mortality (Girish et al., 2014; Lazar et al., 2009). It is postulated that hyperglycaemia increases the risk for infection by causing changes to leucocyte function, specifically impairing the function of neutrophils (Girish et al., 2014; Lorenz et al., 2005; Stegenga et al., 2008; Turina et al., 2005), white blood cells that fight bacterial infection. Patients with unmanaged or poorly managed

hyperglycaemia also experience an increase hospital length of stay and consequently an increase in associated hospital costs (Schmeltz, 2011). It is therefore recommended by The Society of Thoracic Surgeons that insulin therapy for the management of hyperglycaemia is commenced in both patients with and without diabetes mellitus who have undergone cardiac surgery and are in an the intensive care environment, if hyperglycaemia is persistent (Lazar et al., 2009); however no definition of persistent hyperglycaemia is identified. The preferred treatment for hyperglycaemic control in hospitalised patients is the administration of insulin and the preferred method of insulin therapy in the cardiac surgery population is a continuous intravenous insulin infusion (Lorenz et al., 2005; Schmeltz, 2011), initiated prior to elevation of BGL greater than 10 mmol/L (180 mg/dL) and continued to maintain BGLs between 7.8–10 mmol/L (140–180 mg/dL) (Moghissi et al., 2009).

A number of methods to manage continuous insulin infusions (CIIs) for patients following cardiac surgery have been reported in the literature, including personnel directed methods, paper protocol directed methods and Computerised Insulin Dosing Calculator (CIDC) directed methods. In the personnel directed method, the nurse or medical officer is responsible for titrating the infusion dose in response to BGL readings as well as determining the

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