

Inpatient diabetes care: evaluation and intervention.

Thesis

In fulfilment of requirements for the degree Philosophiae Doctor

By

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Declaration

I, **Daniel Gerhardus van Zyl** hereby declare that the work on which this thesis is based is original and my own work (except where acknowledgements indicate otherwise), and that neither the whole work or any part of it has been, is being or shall be submitted for another degree at this or any other university or institution.

Abstract

This thesis consists of 3 components. The first consisted of an audit of inpatient glycaemic control; this was followed by an intervention which attempted to improve the inpatient glucose control, followed by a second audit to assess how well the intervention succeeded in improving glycaemic control. The second component assessed the knowledge and attitudes of hospital staff regarding inpatient management of diabetes. The third component consisted of a randomized controlled trial evaluating whether Ringer's lactate or 0.9% Sodium chloride solution is superior in the resuscitation of patients with diabetic ketoacidosis.

The intervention to improve the quality of inpatient diabetes management consisted of a physician and nurse training programme as well as the introduction of a structured inpatient management protocol for diabetic inpatients. The mean blood glucose on day one of the second audit was significantly higher than that of the first audit (1.72 mmol/L higher, $p < 0.001$). A significant improvement from day 1 to day 7 was seen in audit 2 (-1.88 mmol/L, $p < 0.001$), which was not significant in audit 1 (-0.88 mmol/L, $p = 0.33$). The proportion of patients achieving glycaemic control did not significantly differ between the two audits (43.0% versus 43.7%, $p = 0.97$). Even after adjustment for baseline differences between the two audits no difference in glycaemic control could be demonstrated.

The second component evaluated the perceptions, knowledge and attitudes of health care providers at Kalafong hospital regarding care of diabetic inpatients. A survey of 54 doctors and 61 nurses taking care of inpatients (response rate of 82%), using the DAS3 scale and the diabetes knowledge questionnaire of O'Brien, indicated that 80.9% felt that special training for management of diabetic patients is needed, 90.5% realised that diabetes is a serious condition and 92.2% valued the importance of tight glycaemic control. Despite this perception of importance, the knowledge of doctors and nurses caring for diabetic inpatients were suboptimal.

The third component reports on a double blind randomised controlled trial to assess if Ringer's lactate solution is superior to 0.9% Sodium chloride solution in the normalisation of pH in patients with diabetic ketoacidosis. The study analysed 27 patients allocated to each arm of the study. The time to normalisation of venous pH (pH > 7.32) was not significantly different between the two arms of the study (HR: 1.863, CI: 0.937 to 3.705). The time to reach a blood glucose of 14 mmol/L was significantly longer in the Ringer's lactate group (410 minutes) compared to the 0.9% Sodium chloride group (300 minutes) (p = 0.044). Patients treated with Ringers lactate needed significantly more insulin during the first six hours of treatment (44 units versus 36 units, p = 0.02). No difference between the two groups could be demonstrated in time to resolution of DKA (p = 0.758). The overall conclusion of this study is that there is no significant benefit in using Ringer's lactate solution as initial resuscitation fluid compared to the currently advised 0.9% Sodium chloride solution.

Keywords: Diabetes, Inpatient, Glycaemic control, Knowledge, Attitudes, Inpatient diabetes management protocol, Audit, Diabetic Ketoacidosis, Ringer's lactate solution, 0.9% sodium chloride solution.

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List of Abbreviations

0.9% NaCl - 0.9% Sodium Chloride solution
AACE - American Association of Clinical Endocrinologists
ACE - American College of Endocrinology
ADA - American Diabetes Association
Anti-GAD antibodies - Anti-Glutaminic AcideDecarboxylase antibodies
CI - Confidence interval
CO₂ - Carbondioxide
DAS - Diabetes Attitude Scale
DIGAMI - Diabetes mellitus Insulin-glucose infusion in Acute Myocardial Infarction
DKA - Diabetic Ketoacidosis
EURODIAB study - European Diabetes Study
HbA1C - Glycated Haemoglobin
HIV - Human Immunodeficiency Virus
hly - hourly
HR - Hazard Ratio
ICU - Intensive Care Unit
IQR - Inter Quartile Range
IV - Intravenous
JEMDSA - Journal of Endocrinology Diabetes and Metabolism of South Africa
K⁺ - Potassium ion
Na⁺ - Sodium ion
NaCl - Sodium Chloride
NaHCO₃ - Sodium bicarbonate
NPH - Neutral Protein Hagedörn
PCO₂ - Partial carbondioxide pressure
PO₄ - Phosphate
RR - Relative Risk
SA Fam Pract - South African Journal of Family Practice
SD - Standard Deviation
SPSS - Statistical Package For Social Sciences
β-OHB - Beta-hydroxybuterate
TEN - Total Enteral Nutrition
TPN - Total Parenteral Nutrition

Contributors and acknowledgements

Chapter	Contributor	Contribution
Chapter 1:	DG van Zyl	Planning of chapter Literature search Writing of chapter
	Prof Paul Rheeder	Supervisor
Chapter 2:	DG van Zyl	Research idea Writing of protocol Data analysis Writing of chapter and paper Submission of paper for publication
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Chapter 3	DG van Zyl	Research idea Writing of protocol Data collection Data analysis Writing of chapter and paper Submission of paper for publication
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	Prof Paul Rheeder	Supervisor Analysis of serial data
	Ane Lombaard (Paid research assistant)	Training of nursing staff in inpatient diabetes management in the wards at Kalafong hospital Data collection for the second audit

Chapter 5	DG van Zyl	Writing of chapter and paper Submission of paper for publication
Chapter 6	DG van Zyl	Research idea Writing of protocol Coordinating execution of study at Kalafong hospital Preparation of trial materials Data analysis Writing of chapter and paper Submission of paper for publication
	Prof Paul Rheeder	Supervisor Research idea
	E Delpont	Coordinating execution of study at Steve Biko Academic hospital
	Debbie Schmidt (Paid data capturer)	Data capturing
	Registrars and medical officers of Department of Internal Medicine	Management of patients with DKA and following the prescribed patient management protocol

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