

Glycemic Control in Critically Ill Patients via Computer Algorithm Program An EBP Innovation Project

Melissa Deal RN-BC, MSN Tina Eckard RN, MSN, CCRN Crystal Shepherd RN, BA, PCCN
Catawba Valley Medical Center Hickory, North Carolina 28602



INTRODUCTION

Elevated blood glucose levels have been accepted as the norm in the critically ill patient. Recent studies have reported maintaining blood glucose levels between 80mg/dl-130mg/dl significantly reduces morbidity, e.g. infections, and mortality in critically ill patients.

Over the past several years, this community hospital's CCU nurses have observed uncontrolled hyperglycemia in their patient population. A standardized insulin infusion protocol was developed, yet the problem remained unsolved. In January 2007, an FDA approved glucose control computer algorithm program (CAP) was employed for insulin infusion dosing when ordered by the patient's physician. Assessment of this clinical issue led to development of the following PICO question.

PICO QUESTION

In critically ill patients, how does glycemic control (blood glucose 80mg/dl-130mg/dl) compare to uncontrolled glucose levels (blood glucose levels above 130mg/dl) in decreasing infection rates (VAP, BSI), prolonged CCU length of stay, ventilation days, and CCU mortality over a 1-year period?

LITERATURE SEARCH

A literature search was performed. Selected randomized control studies were reviewed yielding the following information:

- Optimal blood glucose level: 80-110mg/dl (2)
- Approx. 10% mortality reduction in patients with CCU stay \geq 5 days (2)
- 46% reduction in blood stream infections (2)
- 41% reduction in acute renal failure requiring dialysis or hemofiltration (2)
- 65% Improved glucose control by a fully automated (computerized) algorithm (1)

EBP INNOVATION IMPLEMENTATION STEPS

- Multidisciplinary glycemic control team formed:
 - CCU RNs, pharmacist, hospitalist, CCU educator, nutritionist
- CAP installed on computers critical care unit
- CCU staff education
 - Positive benefits of glycemic control for CCU patients
 - Specific CAP instructions

STUDY DESIGN

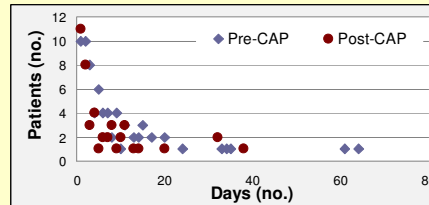
- Retrospective study of diverse critically ill patients in a 16-bed critical care unit
- Subjects
 - **Inclusion criteria:** Critically ill patients with two consecutive blood glucose levels above 130 mg/dl, receiving insulin infusion, and continuous caloric intake
 - **Exclusion criteria:** \leq 17 years of age, Department of Corrections, pregnant, or mentally handicapped patients
- Study conducted in 2 phases
 - **Phase 1 Pre-CAP:** convenience sample of 104 subjects; 73/104 would have qualified as CAP candidates
 - **Phase 2 Post-CAP:** post-CAP implementation for 1-year period yielded 46 subjects
- Statistics
 - Mean, standard deviation, t-Test of unequal variance, chi square analysis

CHARACTERISTIC COMPARISON OF PRE-CAP & POST-CAP SAMPLE POPULATIONS

	Pre-CAP	Post-CAP	Statistical Analysis	P value
N	73	46		
Gender (no.)			$\chi^2 = 0.21$	0.745
Female	38	22		
Male	35	24		
Age (years)			t = 3.31	*0.001
Range	20 - 93	20 - 83		
Mean	65.6	55.5		
STD	15.3	16.6		
LOS (days)			t = 1.22	0.22
Range	1 - 64	1 - 38		
Mean	9.19	6.91		
STD	11.83	8.46		
Ventilator (days)			t = 0.61	0.54
Range	0 - 63	0 - 22		
Mean	10.19	8.47		
STD	14.62	5.78		
VAP			$\chi^2 = 30.01$	*1.7x10 ⁻³
No. (%)	5 (13.9)	0		
BSI			$\chi^2 = 107.5$	*4.6x10 ⁻²⁴
No. (%)	3 (4.11)	0		
Mortality			$\chi^2 = 59.13$	*1.5 x10 ⁻¹³
No. (%)	14 (19.2)	4 (8.7)		

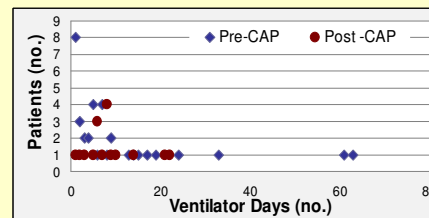
*Significant at CI=95%

PRE-CAP vs POST-CAP LOS IN CCU



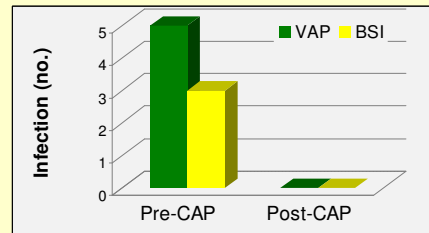
- Overall LOS range in CCU was less for Post-CAP subjects (64 vs 38 days), though mean LOS was not significantly different between the sample populations

PRE-CAP vs POST-CAP PATIENT VENTILATOR DAYS



- Greatest number of ventilator days in Post-CAP subjects of 22 days, while 2 Pre-CAP subjects were ventilated >60 days

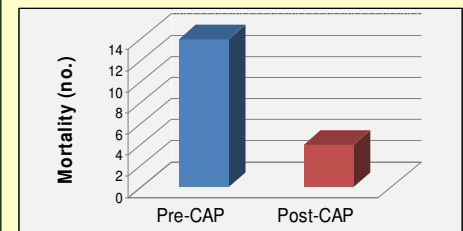
PRE-CAP vs POST-CAP VAP & BSI



- 100% success rate in reducing ventilator-associated pneumonia (VAP) and bloodstream infection (BSI), P<0.001

Hospital-associated infection; infection acquired 48 hr post-admission (CDC); VAP and BSI infections graded accordingly

PRE-CAP & POST-CAP MORTALITY



- Patient-specific insulin dosing via computer algorithm program yielded a decrease in CAP patient deaths from 19.18% to 8.7% over a 1-yr period, P<0.001

CONCLUSIONS & IMPLICATIONS

- Glycemic control EBP change utilizing CAP benefited critically ill patients in CCU at CVMC by significantly decreasing VAP, BSI, and mortality
- Data indicates EBP innovation project should be continued and extended to other areas of the hospital
- Expansion of the Glycemic Control EBP Innovation project:
 - Operating room: provide glycemic control to all surgical CAP candidates to reduce mortality and morbidity

REFERENCES

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CONTACT INFORMATION

Melissa Deal RN-BC, MSN
mqdeal@catawbavalleymc.org

Tina Eckard RN, MSN, CCRN
teckard@catawbavalleymc.org

Crystal Shepherd RN, BA, PCCN
cshepherd@catawbavalleymc.org

Rebecca Tart PhD
rtart@catawbavalleymc.org