And Top Reserves

**Original Research Paper** 

**General Medicine** 

# GLYCEMIC CONTROL IN HOSPITALIZED PATIENTS IN A TERTIARY CARE HOSPITAL.

Ms Vaishnavi reddy M	Apollo institute of hospital and health care management, Hyderabad.	
Dr Srinivas Jakkinaboina	Department of Critical Care Medicine – Citizens Specialty Hospitals, Hyderabad.	
Dr Bhasker Tammali	${\sf Department}\ of\ Critical\ Care\ Medicine-Citizens\ Specialty\ Hospitals,\ Hyderabad.$	
Dr Geetadevi Yammala	Department of Critical Care Medicine – Citizens Specialty Hospitals, Hyderabad.	
ABSTRACT Introduction - The purpose of this study was to understand the practices of alycemic control, management and		

outcomes in hospitalized patients at Citizens Specialty Hospitals for a period of 10 days.

**Methods** - The cross-sectional survey was conducted to know the glycemic control and management of all adult patients admitted to Citizens specialty hospital for a period of 10 days.

Study population - All the patients admitted to Citizens Specialty Hospital were enrolled. The exclusion criteria were a) Age <18 years b) post transplantation c) Palliative care during hospitalization d) malignancy. The study protocol was approved by hospital Ethical Review Board.

**Data collection** - The following were the parameters collected from the patients. Age, sex, diagnosis, Hospital ID Number, number of Days in the hospital, diabetic, ventilator support, ICU or non ICU admission, comorbidities, organ failure, serum creatinine, steroids, mean glucose levels, use of oral hypoglycemic agents / insulins, frequency of monitoring of blood sugars and outcomes. Depending on the glucose levels divided into 5 groups a) blood sugar < 40mg/dl b) blood sugar 40-70mg/dl c) blood sugar 70-110 mg/dl d) blood sugar 110 – 180 mg/dl e) blood sugar > 180 mg/dl. All the wards and the (ICU) Intensive care units (surgical ICU, Medical ICU, cardiac ICU) were included in this study.

Statistical analysis- Each patient's mean BG level for the entire hospitalization as a single data point. Statistical analyses were performed with Stata version 12.

**Results-** The total number of patients enrolled were 246 in 10 days duration. All the enrolled patients were followed till In-hospital discharge or death of the patients. Of 246 total patients 66.7% patients were male and 33.3% were female. Significant number of patients 86 (35%) were admitted to ICU. The mean age was 47.78 years. The mean blood glucose was 140mg/dl. The hospital ALOS was 4.9 days. Every patient admitted to the hospital were monitored blood sugar. 58.5% of admitted patients blood sugars were monitored only at admission.

The glycemic control is within acceptable range (blood sugar 80 mg/dl - 180 mg/dl) were 57.8%. The blood sugars above 180 mg/dl were 38.21%. 10 (4%) patients had blood glucose between 40- 70 mg/dl and None of the patients had blood sugar <40 mg/dl. The most common co-morbidities of the patient were Diabetics 33.3%. Hypertension, coronary artery disease, chronic kidney disease and cerebrovascular disease were 13.8%, 4%, 1.6%, 1.6% respectively. 49.6% of the patients had no comorbidities.

The most common organ failure were cardiac failure 20.3% followed by respiratory failure 13%. The most common causes for the hospital admission were cardiac failure and sepsis with 22.8% and 22.3% respectively. The overall In-hospital mortality were (4%) 10 patients.

The Non ICU and ICU In-hospital mortality were 4 and 6 patients with 2.5% and 7% respectively. The mortality in the ICU patients were high due to higher organ failure.

**Conclusion**- Overall glycemic control in the hospital is acceptable. ICU patients had better control of blood sugars than Non ICU patients. Diabetics had increased hospital LOS. Non diabetics also need to have better control of blood sugars. Frequent monitoring, training and protocols implementation can improve the blood sugar control in the hospital.

## KEYWORDS : Average length of stay in days(ALOS), Intensive care unit (ICU), Oral hypoglycemic agents (OHA),

Introduction - Hyperglycemia and hypoglycemia are the most common problems in the hospital. Incidence of Hyperglycemia is most common than hypoglycemia. During hospitalization, hyperglycemia can adversely affect fluid balance (through glycosuria and dehydration), immune function and outcome. In vitro studies report that hyperglycemia is associated with abnormalities in white cell function, including granulocyte adhesion, chemotaxsis, phagocytosis, respiratory burst, superoxide formation, and intracellular killing. Hyperglycemia is a strong predictor of adverse clinical outcome in a range of diseases such as acute stroke [1,2], congestive heart failure [3,4], community acquired pneumonia [5], acute myocardial infarction [6,7] and postoperative nosocomial infection [8]. Evidence suggests that poorly controlled blood glucose levels among inpatients are associated with increased morbidity and mortality, as well as with higher health care costs. The strict glycemic control between 80-

110 mg/dl improved outcomes in the cardiothoracic ICU (10) . Intensive insulin therapy significantly reduced morbidity but not mortality among all patients in the medical intensive care unit (ICU). Although the risk of subsequent death and disease was reduced in patients treated for three or more days (9).

A blood glucose target of 180 mg/dl or less resulted in lower mortality than did a target of 81 to 108 mg per deciliter (11). Strict glycemic control lead to increased episodes of hypoglycemia.

The use of continuous insulin infusion or subcutaneous insulins given through a standardized ICU protocol as the approach to control hyperglycemia in ICU patients. For non ICU patients, the use of specific insulin regimens with combined basal and short-acting insulin or oral hypoglycemic agents (OHA) as per the Endocrino logist or Consultant advice. In ICU the blood sugars are monitored

### VOLUME-6, ISSUE-11, NOVEMBER-2017 • ISSN No 2277 - 8160

by bedside capillary blood sugar. The Non ICU blood sugars are monitored by capillary sugar bedside or Venous blood in the lab. Knowing the current recommendations for the in-patient glycemic control both in the non ICU and ICU patients which requires a protocolised approach. The purpose of this study was to understand the practices of glycemic control, management and outcomes in hospitalized patients at Citizens Specialty Hospitals for a period of 10days.

**Methods** - The cross-sectional survey was conducted to know the glycemic control and management of all adult patients admitted to Citizens specialty hospital for a period of 10days.

**Study population** - All the patients admitted to Citizens Specialty Hospital were enrolled. The exclusion criteria were a) Age <18 years b) post transplantation c) Palliative care during hospitalization d) malignancy. The study protocol was approved by hospital Ethical Review Board.

**Data collection** - The following were the parameters collected from the patients. Age, sex, diagnosis, Hospital ID Number, number of Days in the hospital, diabetic, ventilator support, ICU or non ICU admission, comorbidities, organ failure, serum creatinine, steroids, mean glucose levels, use of oral hypoglycemic agents / insulins, frequency of monitoring of blood sugars and outcomes.

Depending on the glucose levels divided into 5 groups a) blood sugar < 40mg/dl b) blood sugar 40-70mg/dl c) blood sugar 80-110 mg/dl d) blood sugar 110 – 180 mg/dl e) blood sugar > 180 mg/dl . The frequency of blood glucose monitoring and administration of insulin or Oral hypoglycemic agents depends on the existing ICU and Ward protocols ordered by the concerned physicians.

All the wards and the (ICU) Intensive care units (surgical ICU, Medical ICU, cardiac ICU) are included in this study. The patients admitted directly to the surgical ICU from the Emergency room were included in the ICU patient group, ward patient observed postoperatively for few hours in the SICU were grouped in Non ICU patients. Most of the patient blood sugars were monitored by bedside capillary blood sugar. All the patients are followed till In-hospital death or discharge from the hospital.

**Statistical analysis-** Each patient's mean BG level for the entire hospitalization as a single data point. For each of these approaches, some of the following performance measures were calculated: mean BG level, the percentage of BG levels that fell within a predefined "optimal" range a) blood sugar < 40mg/dl b) blood sugar 40-70mg/dl c) blood sugar 80-110 mg/dl d) blood sugar 110 – 180 mg/dl e) blood sugar > 180 mg/dl. Statistical analyses were performed with Stata version 12.

**Results-** The total number of patients enrolled were 246 in 10 days duration. All the enrolled patients were followed till In-hospital discharge or death of the patients.

The initial admission data were presented in the table 1.

### Table 1 The Initial admission data for the study group.

Variable	No (%)
Male	164 (66.7)
Female	82 (33.3)
ICU patients	86 (35)
Non ICU patients	160 (65)
Ventilated patients	28 (11.4)
Non ventilated patients	218 (88.6)
Diabetic	72 (29.3)
Steroids	8 (3.2)
Oral hypoglycemic agents	30 (41.7)
Insulins	42 (58.3)

Of 246 total patients 66.7% patients were male and 33.3% were female. Significant number of patients 86 (35%) were admitted to ICU of which 28 patients were mechanically ventilated. 29.3 % patients were diabetic of which 41.7 % were on oral hypoglycemic agents and 58.3% were receiving insulins. 3.2% of patients were on steroids for the various reasons.

The mean of the study group were presented in Table 2.

### Table 2 The mean of the study group

Variable	Mean
Age in years	47.78
Average length of stay in days (ALOS)	4.9
Serum creatinine mg/dl	1.2
Glucose mg/dl	140

The mean age was 47.78 years. The mean blood glucose was 140mg/dl. The hospital ALOS was 4.9 days which was higher, possibly due to the significant number (35%) of patients were admitted to the ICU.

The frequency of monitoring of blood sugars to the Patients were presented in table 3.

### Table 3 Frequency of Monitoring of blood sugars.

Frequency	No (%)
Only at Admission	144 (58.5)
Every 24 hourly	10 (4)
Every 12 <sup>th</sup> hourly	22 (9)
Every 8 <sup>th</sup> hourly	34 (6.5)
Every 6 <sup>th</sup> hourly	18 (7.3)
Every 4 <sup>th</sup> hourly	16 (14)
Every 2 <sup>nd</sup> hourly	2 (0.4)

Every patient admitted to the hospital were monitored blood sugar. 58.5% of admitted patients blood sugars were monitored only at admission. All the diabetic patients were monitored more than once after the admission. Only 12.2% of the non diabetic patients blood sugars were monitored more than once after the admission. The increased frequency of monitoring 4th hourly was seen in 14%.

The glycemic control of the study group were represented in the table 4.

### Table 4. Glucose Category

Glucose level	No (%)
< 40 mg/dl.	0 (0)
40- 70 mg/dl	10 (4)
70-110 mg/dl.	40 (16.3)
110-180 mg/dl.	102 (41.5)
>180 mg/dl.	94 (38.21)

The glycemic control is within acceptable range (blood sugar 80 mg/dl – 180 mg/dl) were 57.8%. The blood sugars above 180 mg/dl were in 38.21%. 10 (4%) patients had blood glucose between 40-70 mg/dl and None of the patients had blood sugar <40 mg/dl.

#### **Table 5. Comorbidities**

Co-morbidities	No (%)
Hypertension	34 (13.8)
Coronary artery disease	10 (4)
Chronic kidney disease	4 (1.6)
Cerebrovascular disease	4 (1.6)
No comorbidities	122(49.6)

The most common co-morbidities of the patient were Diabetics 33.3%. Hypertension, coronary artery disease, chronic kidney disease and cerebrovascular disease were 13.8%, 4%, 1.6%, 1.6% respectively. 49.6% of the patients had no comorbidities.

### Table 6. Organ failures

Organ Failure	No (%)
Respiratory failure	32 (13)
Acute kidney disease	22 (9)
Acute liver failure	2 (0.8)
Cardiac failure	50 (20.3)
Central nervous system (CNS)	22 (9)
Gastrointestinal system (GI)	26 (10.6)
No organ failure	92 (37.4)

The most common organ failure were cardiac failure 20.3% followed by respiratory failure 13%. The other organs kidney, central nervous system and gastrointestinal system failure were 9%, 9% and 10.6% respectively. 37.4% of the patients did not have any organ failure.

### Table 7. Admission diagnosis

Diagnosis	No %
Fever for evaluation	24(9.7)
Malignancy	33(13.4)
Cardiac failure	56(22.8)
Acute on CKD	6(2.4)
Sepsis	55(22.3)
RTA (Road traffic accidents)	30(12.2)
Stroke	10(4)
Abdominal	28(11.4)
Miscellaneous	4(1.6)

The most common causes for the hospital admission were cardiac failure and sepsis with 22.8% and 22.3% respectively. Malignancy, RTA and abdominal cause were 13.4%, 12.2% and 11.4% respectively.

The overall In-hospital mortality is (4%) 10 patients.

### Non ICU and ICU patients

The total number of Non ICU and ICU (Intensive care unit) patients enrolled were 160 and 86 patients respectively in 10 days duration. The initial admission data were presented in the table 8.

### Table 8 The data for Non ICU and ICU patients.

Variable	ICU No (%)	Non ICU No (%)
Male	58 (67.4)	106 (66.3)
Female	28 (32.6)	54 (33.7)
Diabetic	50 (58)	22 (13.75)
Steroids	2 (2.3)	6 (3.7)
Oral hypoglycemic agents (OHA)	0 (0)	12 (54.5)
Insulins	58 (100)	10 (45.5)

The number of Male patients in Non ICU and ICU patients were 66.3% and 67.4% respectively. Diabetic patients in the ICU were 58% and the Non ICU were 13.75%. After the admission the OHA in Non ICU and ICU were 54% and 0% respectively. The insulin in Non ICU and ICU were 45.5% and 100% respectively.

The mean of the study group patients were presented in Table 9.

### Table 9 The mean of the Non ICU and ICU patients.

Variable	ICU Mean	Non ICU Mean
Age in years	46.3	48.57
Average length of stay in days (ALOS)	6.5	3.5
Serum creatinine mg/dl	1.12	1.24
Glucose mg/dl	151	134

The mean age in years of ICU and Non ICU patients were 46.3 and

VOLUME-6, ISSUE-11, NOVEMBER-2017 • ISSN No 2277 - 8160

48.57 respectively. The ALOS of the ICU and Non ICU were 6.5 days and 3.5 days respectively. The blood glucose of Non ICU and ICU were 134mg/dl and 151mg/dl respectively.

The frequency of monitoring of the Patients were presented in table 10.

Table 10	Frequency	y of Monitoring	j in ICU and Non IC	Upatients.

Frequency	Non ICU	ICU
	No (%)	No (%)
Only at Admission	102 (63.7)	42 (48.8)
Every 24 hourly	8 (5)	2 (2.3)
Every 12 <sup>th</sup> hourly	16 (10)	6 (7)
Every 8 <sup>th</sup> hourly	24 (11.25)	16 (18.6)
Every 6 <sup>th</sup> hourly	10 (6.25)	8 (9.3)
Every 4 <sup>th</sup> hourly	0 (0)	10 (11.6)
Every 2 <sup>nd</sup> hourly	0 (0)	2 (2.3)

48.8% of patients in the ICU and 63.7% of the Non ICU patients blood sugar were monitored only at admission. In Non ICU patients blood sugars were not monitored 4th and 2nd hourly. In ICU blood sugars 4th hourly and 2nd hourly monitored were 11.6% and 2.3% respectively. The frequency of monitoring is more in the ICU patients than Non ICU patients.

The glycemic control of the Non ICU and ICU patients were represented in the table 11.

### Table 11 Glucose Category

Glucose level	Non ICU	ICU
	No (%)	No (%)
< 40 mg/dl.	0 (0)	0 (0)
40-70 mg/dl	2 (1.25)	8 (9.3)
70-110 mg/dl.	40 (25)	4 (4.6)
110-180 mg/dl.	26 (16.25)	62 (72)
>180 mg/dl.	92 (57.5)	12 (13.9)

The glycemic control is within acceptable range (blood sugar 80 mg/dl – 180 mg/dl) in Non ICU and ICU category were 41.25% and 76.6% respectively. The ICU patients had better control of blood sugars than the Non ICU patients. The blood sugars above 180mg/dl in Non ICU and ICU category were in 57.5% and 13.9% respectively. 1.25% and 9.3% of the Non ICU and ICU category have blood glucose < 70mg/dl, more incidence of lower blood sugars in the ICU patients but none of the patients had blood sugar <40 mg/dl.

### Table 12. Comorbidities

Co-morbidities	Non ICU No (%)	ICU No (%)
Diabetic	22 (13.75)	50(58)
Hypertension	20 (12.5)	14 (16.3)
Coronary artery disease	8 (5)	2 (2.3)
Chronic kidney disease	4 (2.5)	0 (0)
Cerebrovascular disease	0 (0)	4 (4.6)
No comorbidities	128 (80)	66 (76.7)

The most common co-morbidity in both the category were diabetic with very high percentage of patients were in ICU 58% and Non ICU 13.75%. The second common co-morbidity were Systemic hypertension. All the co-morbidities were represented in table 12.

#### Table 13. Organ failures

### **Organ failures**

Organ Failure	Non ICU No (%)	ICU No (%)
Respiratory failure	2 (1.25)	20 (23.25)
Acute kidney disease	12 (7.5)	20(23.25)

### VOLUME-6, ISSUE-11, NOVEMBER-2017 • ISSN No 2277 - 8160

Acute liver failure	2 (1.25)	0 (0)
Cardiac failure	12 (7.5)	14(16.25)
Central nervous system (CNS)	10 (6.25)	12 (13.95)
Gastrointestinal system (GIT)	10 (6.25)	16(18.6)
No organ failure	112 (70)	4 (4.65)

**Non ICU-** The most common organ failure were cardiac failure and acute kidney injury with 7.5% in each, 70% of patients had no organ failure.

**ICU** – The most common organ failure were acute respiratory failure and acute kidney injury with 23.25% in each, followed by GIT, cardiac failure and CNS with 18.6%, 16.25% and 13.95% respectively. 95.35% of the patients had organ failure. 4.65% of patients had no organ failure.

**Mortality**- The Non ICU and ICU In-hospital mortality were 4 and 6 patients with 2.5% and 7% respectively. The mortality in the ICU patients were high due to higher organ failure.

### **Diabetic and Non Diabetic patients**

The total number of Non diabetic and Diabetic patients enrolled were 174 (70.7) and 72 (29.3) patients respectively in 10 days duration.

### Table 15 The Initial admission data

Variable	Diabetic	Non Diabetic
	No (%)	No (%)
Male	56 (77.8)	108 (66.3)
Female	16(22.2)	54(33.7)
Number of patients	72 (29.3)	174(70.7)
Steroids	4 (5.6)	4(2.3)
Oral hypoglycemic agents (OHA)	12 (16.7)	0 (0)
Insulins	60 (83.3)	0(0)

The number of Male patients in Non diabetic and diabetic patients were 66.3% and 77.8% respectively. 29.3% of the patients were diabetic. The OHA and Insulins in diabetic were 16.7% and 83.3% respectively. once the blood sugars are high in the Non diabetic patients, all the patients were started on insulins.

The mean of the study group patients were presented in Table 9.

### Table 16 The mean of the study group

Variable	Diabetic Mean	Non Diabetic Mean
Age in years	54.3	45
Average length of stay in days	6.8	4.2
Serum creatinine mg/dl	1.38	1.12
Glucose mg/dl	172.2	126.5

The mean age in years of Non diabetic and diabetic patients were 45 and 54.3 respectively. The ALOS of the Non diabetic and diabetic were 4.2 days and 6.8 days respectively. The Mean blood glucose of Non diabetic and diabetic were 126.5 mg/dl and 172.2 mg/dl respectively.

The diabetic patients stayed significantly higher days in the hospital compared with Non Diabetic patients.

### **Table 17 Frequency of Monitoring**

Frequency	Diabetic No %	Non Diabetic No %
Only at Admission	0(0)	144(82.7)
Every 24 hourly	8 (11.11)	2 (1.14)
Every 12 <sup>th</sup> hourly	14 (19.5)	8 (4.6)
Every 8 <sup>th</sup> hourly	26 (36.1)	8 (4.6)
Every 6 <sup>th</sup> hourly	12 (16.7)	6 (3.44)
Every 4 <sup>th</sup> hourly	10 (13.9)	6 (3.44)
Every 2 <sup>nd</sup> hrly	2 (2.8)	0 (0)

82.7 % of patients in the Non Diabetic patients blood sugar were monitored only at admission, all diabetic patients blood sugars were monitored more than once after the admission. The frequency of monitoring is more in the diabetic than Non diabetic patients.

#### Table 18 Glucose Category

Glucose level	Diabetic No (%)	Non Diabetic No (%)
< 40 mg/dl.	0 (0)	0 (0)
40-70 mg/dl	8 (11.1 )	2(1.1)
70-110 mg/dl.	14(19.44)	22 (12.7)
110-180 mg/dl.	36 (50)	104 (59.8)
>180 mg/dl.	22 (30.5)	42 (24.1)

The glycemic control is within acceptable range (blood sugar 80 mg/dl – 180 mg/dl) in Non diabetic and diabetic patients were 72.5% and 69.4% respectively. The blood sugars above 180mg/dl in Non diabetic and diabetic patients were 24.1% and 30.5% respectively. 1.1% and 11.1% of the Non diabetic and diabetic patients have blood glucose between 40-70mg/dl, more incidence of lower blood sugars in the diabetic patients than Non diabetic patients but none of the patients had blood sugar <40 mg/dl.

#### Discussion

We observed only 57.8% of patients with mean BG levels between 80-180 mg/dL, though Goldberg et al. [37] have proposed 85% of patient had mean BG levels within this range as a "gold standard" for inpatient glycemic control.

The target of maintaining all glucose values  $\leq$ 180 mg/dL recommended in the ADA/AACE guidelines for hospital diabetes management was not generally achieved [7,24]. The mean rate of hyperglycemia (BG>180 mg/dL) was higher than previously reported in a survey at a large teaching hospital in the US (38.21 % vs.31%) [13].

The glycemic control is within acceptable range (blood sugar 80 mg/dl – 180 mg/dl) in Non ICU and ICU category were 41.25% and 76.6% respectively. The ICU patients had better control of blood sugars than Non ICU patients. 1.25% and 9.3% of the Non ICU and ICU category have blood glucose < 70mg/dl, more incidence of lower blood sugars in the ICU patients but none of the patients had blood sugar <40 mg/dl. Better control of blood sugars and treating with insulins.

Although hyperglycemia was common, blood sugar between 40-70 mg/dl were 4%, hypoglycemia with blood sugar <40mg/dl was nil. This should be interpreted with caution, and may be a consequence of insufficient insulin regimens and loose glycemic control rather than an indication of good glycemic management, as suggested by the high rates of hyperglycemia.

Most patients with diabetes in our study received sliding-scale insulin regimen alone, even though it has been shown that sliding-scale insulin by itself is associated with poor inpatient glycemic control and even deleterious effects [14].

A study conducted on 1,718 patients with a history of diabetes in thirty-seven US academic medical centers found that 77% had a laboratory blood glucose result recorded within 8 hours of hospital admission, and 81.3% had blood glucose monitored at least 4 times on the second day of hospitalization [15]. In our study 100% of the in patients blood sugar were monitored at admission, 58.5% of admitted patients blood sugars were monitored only at admission. All the diabetic patients were monitored more than once after the admission. Only 12.2% of the non diabetic patients blood sugars were monitored more than once after the admission. The frequency of monitoring is very less compared with US academic medical centers (15).

The hospital ALOS was 4.9 days which was higher, possibly due to the significant number (35%) of patients were admitted to the ICU.

The Non ICU and ICU In-hospital mortality were 2.5% and 7% respectively and were comparable to the other hospitals.

The ALOS of the Non diabetic and diabetic were 4.2 days and 6.8 days respectively. 50 patients (70%) of the diabetic patients were admitted to ICU were the possible reason for increased hospital LOS in diabetics. The Mean admission blood glucose of Non diabetic and diabetic were 126.5 mg/dl and 172.2 mg/dl respectively. Eventhough the admission glucose were higher in diabetics compared with non diabetics, Diabetics and non diabetics both have better control of sugars in the hospital. The glycemic control is within acceptable range (blood sugar 80 mg/dl – 180 mg/dl) in Non diabetic and diabetic patients were 72.5% and 69.4% respectively.

The blood sugars above 180mg/dl in Non diabetic and diabetic patients were 24.1% and 30.5% respectively. Non diabetics also need to have frequent monitoring and better control of blood sugars as the poor blood sugar control in non diabetics leads to higher mortality than diabetics.

The mortality risk was significantly greater with uncontrolled blood glucose for patients without a history of diabetes in a large University-affiliated Veterans Affairs Medical Center (VAMC) database(16).

Hospital mortality was significantly increased at all mean blood glucose ranges (111-145, 146-199, 200-300 and > 300 mg/dL) in non-diabetic patients when compared to diabetic patients (17).

### Conclusion

Overall glycemic control in the hospital is acceptable. ICU patients had better control of blood sugars than Non ICU patients. Diabetics had increased hospital LOS. Non diabetics also need to have better control of blood sugars. Frequent monitoring, training and protocols implementation can improve the blood sugar control in the hospital.

#### REFERENCES

- 1. Capes SE, Hunt D Stress hyperglycemia and prognosis of stroke in nondiabetic and diabetic patients: a systematic overview. Stroke 2001, 32: 2426–2432.
- Jorgensen H Stroke in patients with diabetes. The Copenhagen stroke study. Stroke 1994, 25:1977–1984.
- Guazzi M Diabetes worsens pulmonary diffusion in heart failure, and insulin counteracts this effect. Am J Respir Crit Care Med 2002, 166:978–982.
- Masoudi FA Metformin and thiazolidinedione use in medicare patients with heart failure. JAMA 2003, 290:81–85. 17.
- McAlister FA The relation between hyperglycemia and outcomes in 2,471 patients admitted to the hospital with community-acquired pneumonia. Diabet Care 2005, 28:810–815.
- Capes SE Stress hyperglycaemia and increased risk of death after myocardial infarction in patients with and without diabetes: a systematic overview. LANCET 2000, 355:773–778.
- Malmberg K Intense metabolic control by means of insulin in patients with diabetes mellitus and acute myocardial infarction (DIGAMI 2): effects on mortality and morbidity. Eur Heart J 2005, 26:650–661.
- Grey NJ Reduction of nosocomial infections in the surgical intensive-care unit by strict glycemic control. Endocr Pract 2004, 10(Suppl 2):46–52.
- 9. Greet Van den Berghe, M.D. Intensive Insulin Therapy in the Medical ICU. N Engl J Med 2006;354:449-61.
- Greet Van den Berghe, M.D. Intensive Insulin Therapy in critically ill patients. N Engl J Med, 2001, Vol. 345, No. 19.
- 11. The NICE-SUGAR Study Investigators- Intensive versus Conventional Glucose Control in Critically III Patients. N Engl J Med 2009;360:1283-97.
- Goldberg PA- "Glucometrics"-assessing the quality of inpatient glucose management. Diabetes Technol Ther 2006, 8:560–569.
- Schnipper J Inpatient management of diabetes and hyperglycemia among general medicine patients at a large teaching hospital. J Hosp Med 2006, 1:145–150.
  Queale WS Glycemic control and sliding scale insulin use in medical inpatients with
- Queale WS Glycemic control and sliding scale insulin use in medical inpatients with diabetes mellitus. Arch Intern Med 1997, 157:545–552.
- Boord JB Evaluation of hospital glycemic control at US academic medical centers. J Hosp Med 2009,4:35–44.
- Glycemic control in non-diabetic critically ill patients. Clin Endocrinol Metab. 2011 October; 25(5):813–824.
- Falciglia M Hyperglycemia-related mortality in critically ill patients varies with admission diagnosis. Crit Care Med. 2009;37:3001–3009