International Journal of Medical Toxicology & Forensic Medicine

January 2026, Volume 16, E50965

Research Paper

Sliding Scale Regimen Versus Basal Bolus Insulin Regime for Hyperglycemia Management in Hospitalized Patients with Type 2 Diabetes

Sarah Jaafar Saadoon[1], Hayder Hamid Al-Anbari[2], Thair L. Jabbar[3], Fatma M. Mostafa[4*]

1. *College of Pharmacy, University of Thi-Qar, Thi-Qar, 64001, Iraq.*
2. *PhD Pharmacology and Therapeutics, College of Pharmacy, Al-Ayen Iraqi University, AUIQ, An Nasiriyah 64001, Iraq.*
3. *Clinical Pharmacy Department, College of Pharmacy, Al-Ayen Iraqi University, AUIQ, An Nasiriyah 64001, Iraq.*
4. *Microbiology & immunology, College of Pharmacy, Al-Ayen Iraqi University, AUIQ, An Nasiriyah 64001, Iraq.*

Citation Saadoon SJ, Al-Anbari HH, Jabbar TL, Mostafa FM. Sliding Scale Regimen Versus Basal Bolus Insulin Regime for Hyperglycemia Management in Hospitalized Patients with Type 2 Diabetes. International Journal of Medical Toxicology and Forensic Medicine. 2026; 16:E50965.

https://doi.org/10.22037/ijmtfm.v16.50965

Article info:

Received: 25 Nov, 2025

First Revision: 29 Nov, 2025

Accepted: 06 Dec, 2025

Published: 01 Jan, 2026

Keywords:

Type 2 diabetes mellitus, Basal–bolus insulin, Sliding scale insulin, Hyperglycemia

ABSTRACT

Background: Since type-2 diabetes mellitus (T2DM) is becoming more common, it is crucial to implement an appropriate care plan for these patients' hyperglycemia to lower the risk of complications. While Sliding Scale Insulin (SSI) has been the traditional approach, Basal-bolus insulin (BBI) therapy is a promising strategy and is increasingly recommended. We aimed to compare the efficacy of SSI versus BBI regimens in hospitalized patients with T2DM.

Methods: The demographics, complications, and type of insulin therapy for type 2 diabetic hospitalized patients were recorded from patients' archived documents.

Results: We observed that 59.7% of the patients were treated for SSI accompanied by macrovascular complications. While 37.8% of patients treated with BBI had macrovascular complications, the difference between the BBI & SSI groups was statistically significant. For microvascular complications, also, a statistically significant difference was detected between the BBI & SSI groups (P-value = 0.001). Only 18.6% & 17.2% of the patients developed hypoglycemia in the BBI group & SSI group, respectively. We evaluated the efficacy of both treatments on daily random blood glucose (RBG) in our patients for 1 week; a slight decrease in RBG was observed between the first & the seventh days of treatment in the SSI group. An obvious improvement was observed in the BBI, indicating that BBI was more effective at controlling RBG than SSI.

Conclusion: Our study demonstrated that BBI therapy was superior to SSI therapy in achieving ideal blood glucose levels, with fewer hypoglycemic episodes and cardiovascular events.

*** Corresponding Author:**

Fatma M. Mostafa, Ph.D

Microbiology & immunology, College of Pharmacy, Al-Ayen Iraqi University, AUIQ, An Nasiriyah 64001, Iraq.

E-mail: *fatmamostafa888999@gmail.com*

Introduction

In a hospital setting, type 2 diabetes mellitus (T2DM) presents a substantial problem since acute illness, drugs, and metabolic stress can worsen hyperglycemia. Infection risks, longer hospital stays, and greater rates of morbidity and mortality are all linked to poor glycemic management during hospital stays. Therefore, improving clinical outcomes requires effective control of inpatient hyperglycemia [1].

In the past, hospitals have frequently employed sliding-scale insulin (SSI) for glycemic control. Without addressing basal insulin requirements, this reactive technique relies on pre-meal blood glucose readings to deliver rapid-acting insulin. However, SSI does not replicate physiological insulin secretion and often results in uneven glycemic control, with the risks of both hyperglycemia and hypoglycemia [2].

Type 2 diabetic hospitalized patients are advised to be treated for hyperglycemia with a basal-bolus regimen, supplemented with rapid-acting insulin at meals and additional rapid-acting insulin for correction of hyperglycemia [3, 4]. However, hospitalized type 2 diabetic patients might not require similar regimens to those required for type 1 diabetes because they may have fluctuating insulin secretion. The basal-bolus regimen is neglected, even though guidelines recommend it with supplementary sliding-scale insulin. When supplemental insulin is added to a basal-bolus insulin regimen for type 2 diabetes (T2D), this may improve glycemic control; however, the additional insulin dose calculations and injections may increase treatment burden [5].

Physicians switched to administering SSI, relying on capillary blood glucose (BG) levels as bedside glucose meters became more accessible and SSI was frequently used to treat inpatient hyperglycemia [6]. Basal-bolus insulin was suggested as an optimal strategy for glycemic control in inpatients with T2D, and against the use of SSI alone [7]. In addition to opposing SSI monotherapy, it was reiterated that the majority of non-critically sick diabetic patients should follow a basal-bolus insulin regimen. Those rules are still in effect today [8].

With an emphasis on glycemic control, complication rates, and hypoglycemic episodes, this study examined the practical effectiveness and safety of SSI versus BBI regimens in hospitalized T2DM patients. We aimed to provide further information to inform clinical practice and improve inpatient diabetes treatment procedures by analyzing archived patient data.

Materials and Methods

We reviewed the medical records of all patients aged 18 or older admitted to the Alnaseryia Hospital from August 2023 to July 2025.

Chart reviews & case records were used to gather all of the information. Hospitalized males and females with T2DM, aged ≥18 years, were included.

Exclusion criteria: Intensive care unit patients, patients receiving corticosteroids, patients with endocrine disorders, pregnant or nursing, and patients with HIV.

Gender, age, weight, Body Mass Index (BMI), Random Blood Glucose (RBS), Fasting Blood Sugar (FBS), Hemoglobin A1c (HbA1c), and insulin regimen type were all included in the data collection form.

We separated the research participants into two groups: the BBI and SSI groups.

Statistical analysis

Statistical analysis was performed with an alpha error of 0.05 and a 95% confidence interval. Data are presented by mean ± SD. Frequency and percentage were used to describe demographic and baseline factors; the chi-square test was used to compare categorical variables. Fisher's exact test was used for categorical variables; SPSS software version 26.0 was used.

Results

Our study was conducted in 217 hospitalized patients with T2DM. Our patients were divided into two groups: group 1, treated with BBI (n=118), and group 2, treated with SSI (n=99). As shown in Tables 1 and 2 and Figures 1-5, in the BBI group, 52.5% (n= 62) were females, and 47.5% (n=56) were males. In the SSI group, 40.4% (n=40) were males, and 59.6% (n=59) were females. The mean age of our patients was 57.56±14.62 years in the BBI group and 61.39±17.02 in the SSI group. The BMI mean was 30.23±6.40 in the BBI group and 30.91±6.18 in the SSI group. In our study, patients treated with BBI had a diabetes history of 10.36±7.01 years, while patients of the SSI group had a diabetes history of 8.54±5.76 years.

Regarding risk factors in the BBI group, the highest was genetic at 32.2% (n=38), followed by obesity at

Table 1. Demographic characteristics of patients.

		Group 1 BBI (n=118)			Group 2 SSI (n=99)		
		Number (N)	Percentage (%)	Mean± SD	Number (N)	Percentage (%)	Mean± SD
Gender	Female	62	52.5	--	59	59.6%	--
	Male	56	47.5	--	40	40.4%	--
Age	(Years)	--	--	57.56±14.62	--	--	61.39±17.02
BMI	(Kg/ m^2)	--	--	30.23±6.40	--	--	30.91± 6.18
Diabetes history (years)		--	--	10.36±7.01	--	--	8.54±5.76
Risk factors of diabetes	Cardiac	3	2.5	--	0	0.0	--
	Diet	8	6.8	--	9	9.1	--
	Genetic	38	32.2	--	17	17.2	--
	Infect	7	5.9	--	26	26.3	--
	Insulin	0	0.0	--	6	6.1	--
	Kidney	3	2.5	--	0	0.0	--
	obesity	34	28.8	--	17	17.2	--
	Stress	25	21.2	--	24	24.2	--
Anti-diabetic drug history	insulin	30	25.4	--	46	46.5	--
	Oral	88	74.6	--	53	53.5	--
Diet control	No	94	79.7	--	77	77.8	--
	yes	24	20.3	--	22	22.2	--
Smoking	No	96	81.4	--	79	79.8	--
	yes	22	18.6	--	20	20.2	--
Education level	High	25	21.2	--	10	10.1	--
	Low	93	78.8	--	89	89.9	--
RBG (mg/dl)		--	--	360.25 ±102.83	--	--	257.22±110.23
HbA1c (%)		--	--	9.31 ±1.75	--	--	9.42±2.11
FBG (mg/dl)		--	--	203.70 ±45.17	--	--	201.81±51.83

BBI: Basel bolus insulin; SSI: Sliding scale insulin; BMI: Body mass index; RBG: Random blood glucose; HbA1c:Hemoglobin A1c; FBG: Fasting blood glucose

Table 2. Complications of diabetes associated with BBI & SSI groups.

		BBI (n=11 8)	SSI (n=9 9)	P-value
Macrovascular complications	**CVD**	24 (20.3%)	35 (35.4%)	0.005*
	PAD	10 (8.5%)	9 (9.1%)	
	Stroke	9 (7.6%)	15 (15.2%)	
Microvascular complications	**Nephropathy**	20 (16.9%)	30 (30.3%)	0.001*
	Neuropathy	27 (22.9%)	8 (8.1%)	
	Retinopathy	19 (16.1%)	6 (6.1%)	
Hypoglycemic incidence	**No**	94 (79.7%)	82 (82.8%)	0.397
	Yes	22 (18.6%)	17 (17.2%)	

CVD; cardiovascular diseases, PAD: peripheral artery disease *: Statistically significance difference

28.8% (n=34), then stress at 21.2% (n=25). In the SSI group, infection was most common, detected in 26.2% (n=26) of patients, followed by stress at 24.2% (n=24), and genetics and obesity had the same percentage at 17.2% (n=17).

In the BBI group, insulin was used in 25.4% (n=30) of our patients, while 74.6% (n=88) were treated with oral hypoglycemic agents. In the SSI group, oral hypoglycemic agents were used in only 53.5% (n=53) of patients; insulin was used in 46.5% (n=46). The majority of our patients in both groups didn't control their diet, with only 20.3% (n=24) and 22.2% (n=22) in the BBI and SSI groups, respectively, controlling their diet.

Among our patients, only 21.2% (n=25) & 10.1% (n=10) had a high level of education in the BBI & SSI groups, respectively. Regarding laboratory parameters, RBG was 360.25±102.83 in the BBI group &

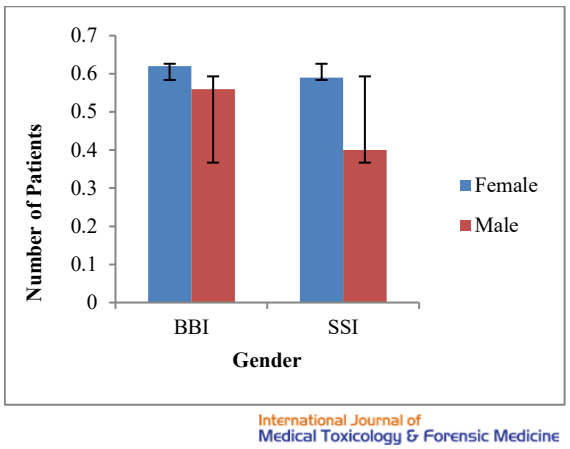

Figure 1. A Gender distribution between BBI & SSI groups.

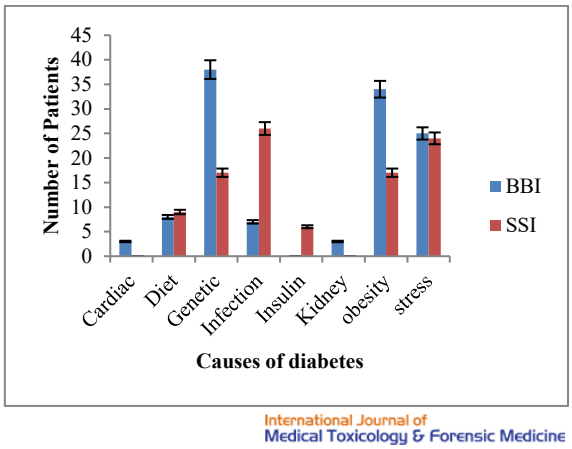

Figure 2. Diabetes risk factors in BBI & SSI groups.

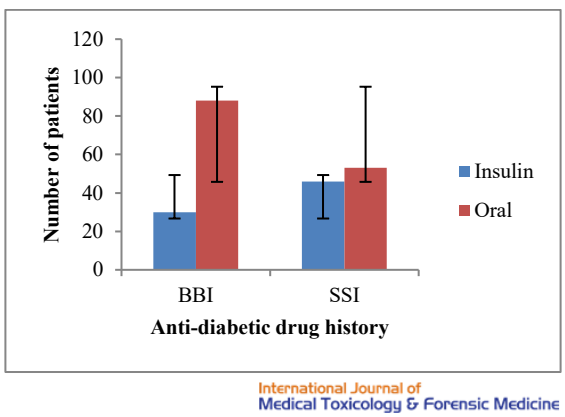

Figure 3. Antidiabetics history in BBI & SSI groups.

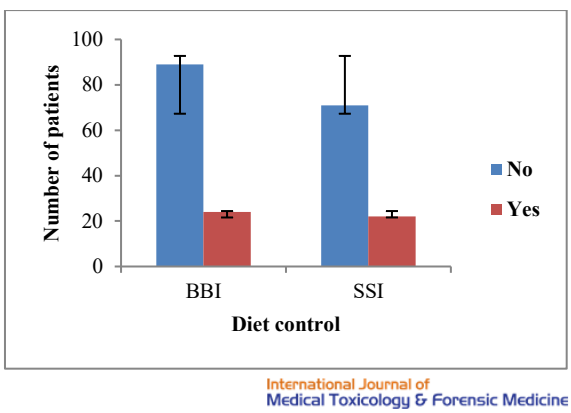

Figure 4. Diet control in BBI & SSI groups.

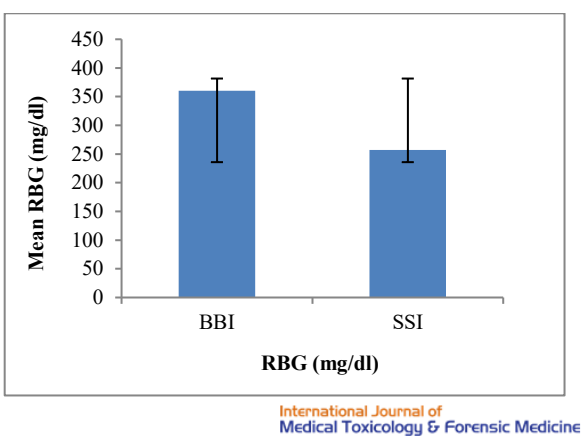

Figure 5. Mean RBG measures in BBI & SSI groups.

257.22±110.23 in the SSI group.

For HbA1c results, it was 9.31±1.75 in the BBI group & 9.42±2.11 in the SSI group. Finally, for FBG, the results were 203.70±45.17 and 201.81±51.83 in the BBI group & SSI group, respectively.

The efficacy of BBI and SSI on the complications of diabetes is illustrated in Table 2. As shown in the table, regarding macrovascular complications, we found that 35.4%, 9.1%, and 15.2% of the patients treated with SSI had Cardiovascular Disease (CVD), Peripheral Artery Disease (PAD), and stroke, respectively. While a lower percentage of patients treated with BBI had macrovascular complications, only 20.3%, 8.5%, and 7.6% of patients had CVD, PAD, and stroke, respectively.

Statistical significance was detected between the BBI & SSI groups (P value = 0.005), indicating that the BBI-treated group had a lower tendency to develop macrovascular complications than the SSI group. For microvascular complications, statistical significance was also observed between the BBI & SSI groups (P-value = 0.001), with the SSI group showing a higher tendency to develop microvascular complications than the BBI group. Nephropathy, neuropathy, and retinopathy were found in 16.9%, 22.9%, and 16.1% of patients treated with BBI and were found in 30.3%, 8.1%, and 6.1% of patients treated with SSI, respectively.

Regarding hypoglycemic incidence, only 18.6% and 17.2% developed hypoglycemia in the BBI and SSI groups, respectively, with a slightly higher rate in the SSI group. No statistical significance was detected between the two groups.

Table 3. Random Blood Glucose distribution between BBI group & SSI group from day 1 to day 7.

	BBI	SSI	Mean Difference	P-value
On admission	360.25 ±102.83	257.22 ±110.23	103.03	0.93
Day 1	279.66±110.16	227.59±88.59	52.07	<0.001*
Day 2	249.99±95.09	215.41±84.97	34.58	0.005*
Day 3	228.89±93.69	211.58±85.07	17.31	0.166
Day 4	220.08±78.83	202.37±81.46	17.71	0.18
Day 5	199.43±78.99	202.79±83.12	-3.35	0.82
Day 6	200.00±82.87	199.43±76.22	0.57	0.975
Day 7	179.29±67.90	180.31±67.30	-1.01	0.949
Reduction in RBG	210.1±116.76	99.36±109.67	110.74	<0.001*

Data is present as mean ± standard deviation *: significant statistical association.

As shown in Table 3, we studied the efficacy of both treatments on RBG in our patients daily for 1 week. A slight decrease in RBG was detected between the first & the seventh days of treatment in the SSI group, with readings of 227.59±88.59 and 180.31±67.30, respectively. On the other hand, an obvious improvement was observed in the BBI-treated group, with RBG of 279.66±110.16 on the first day and 179.29±67.90 on the seventh day, indicating that BBI was more effective at controlling RBG than SSI. The difference between SSI and BBI in the first two days was statistically significant.

Discussion

In our study, we compared the SSI and BBI regimens for decreasing blood glucose (BG) levels in hospitalized patients. The mean age of our study cohort was 57.56±14.62. In line with our results, Aly et al. reported that the mean age of the patients was 65.4 ± 10.5 years, with most patients in the study cohort aged 65 years or older (52.3%) [9].

Regarding risk factors, in the BBI group, the highest risk factor was genetic (32.2%), followed by obesity (28.8%) and stress (21.1%). For the SSI group, infection was the most frequently detected risk factor in 26.2% of patients, followed by stress at 24.2%, and genetics & obesity at 17.2%. In line with our results, several studies reported comparable results [5, 9, 10].

Cardiovascular illnesses affected 36.4% of the BBI group's patients and 59.7% of the SSI group's patients in our study. In this regard, our research aligns with studies that have shown that cardiovascular disorders affect more than a third of patients [5, 9].

Our research showed that BBI treatment was more efficient than SSI therapy at lowering the levels of blood glucose in hospitalized patients with type 2 diabetes. According to numerous studies, BBI therapy was associated with lower mean blood glucose levels and better glycemic control than SSI [11]. Also, compared to patients receiving SSI therapy, more patients in the BBI therapy group were released with ideal blood glucose levels [11, 12].

We investigated how well both treatments affected our patients' RBG during the first 7 days of treatment. In the SSI group, we observed a small drop in RBG from the first to the seventh day of treatment, from 227.59±88.59 to 180.31±67.30. However, the BBI-treated group showed a clear improvement, with RBG measurements of 279.66±110.16 on the first day and 179.29±67.90 on the seventh day, indicating that BBI was more effective than SSI at controlling RBG.

In the first two days, a significant difference was detected between SSI and BBI. As reported by Aly et al. (2022), patients receiving BBI had considerably lower RBG levels immediately before discharge than those receiving SSI therapy, consistent with our findings (10.7 vs. 12.4; p = 0.001). Additionally, according to Umpierrez et al. and Huri et al., the RABBIT2 trial also found a significant difference in blood glucose levels between the therapy groups on the

final day of hospitalization (7.8 vs. 10.4; p = 0.001) [10, 11].

Regarding hypoglycemia, we found that the BBI group had a rate of just 18.6%, whereas the SSI group had a rate of 17.2%. Between the two tested groups, no statistically significant difference was found. Accordingly, Huri et al. found that 9.5% and 5.7% of patients in the SSI and BBI therapy groups experienced hypoglycemia episodes (p = 0.186), respectively, which is consistent with our findings [10]. In contrast to our results, Aly et al. documented hypoglycemia and demonstrated that BBI therapy was linked to higher hypoglycemic rates than SSI (24% vs. 6%; p<0.001) [9]. Additionally, Umpierrez et al.'s findings demonstrated that two patients experienced hypoglycemic episodes in each insulin therapy group, but none were associated with any problems. Compared to 4.7% of the SSI group, 23.1% of the study participants in the BBI therapy group experienced hypoglycemia (p <0.001) [12].

Conclusion

A considerable drop in random blood sugar after seven days of treatment indicated that BBI therapy was more effective than SSI at controlling blood sugar. BBI therapy was used more often than SSI and was linked to similar levels of peripheral artery disease, hypoglycemia, cardiovascular symptoms, stroke, and nephropathy.

Acknowledgment

None.

Funding

None.

Conflicts of Interest

The authors report there are no competing interests to declare.

References

[1] Dhatariya K, Umpierrez GE. Management of diabetes and hyperglycemia in hospitalized patients. Endotext [Internet]. 2024. [DOI: 10.4158/EP-2024-00623]

[2] Alex M, Sreedharan DP, Bhandari R, Kolar R. Retrospective analysis of Sliding Scale versus Basal Bolus Insulin in the treatment of uncontrolled hyperglycemia in patients with Type 2 diabetes mellitus and infections .Int J Diabetes Dev Ctries. 2025;45(3):661–9. [DOI: 10.1007/s13410-024-01500-5]

[3] Umpierrez GE, Smiley D, Hermayer K, Khan A, Olson DE, Newton C, et al. Randomized study comparing a Basal-bolus with a basal plus correction insulin regimen for the hospital management of medical and surgical patients with type 2 diabetes: basal plus trial .Diabetes Care. 2013;36(8):2169–74. [DOI: 10.2337/dc12-2470]

[4] Saadoon SJ, Helmy H, Mostafa FM. Hyperglycemia Management in Critical Units and End-Stage Hospitalized Patients .Int J Med Toxicol Forensic Med .2025;15)03:(1–6. [DOI: 10.32598/ijmtfm.15.3.1]

[5] Umpierrez GE, Gianchandani R, Smiley D, Jacobs S, Wesorick DH, Newton C, et al. Safety and efficacy of sitagliptin therapy for the inpatient management of general medicine and surgery patients with type 2 diabetes: a pilot, randomized, controlled study .Diabetes Care. 2013;36(11):3430–5. [DOI: 10.2337/dc13-0685]

[6] Migdal AL, Fortin-Leung C, Pasquel F, Wang H, Peng L, Umpierrez GE. Inpatient glycemic control with sliding scale insulin in noncritical patients with type 2 diabetes: who can slide ?J Hosp Med. 2021;16(8):462–8. [DOI: 10.12788/jhm.3638]

[7] Garber AJ, Moghissi ES, Bransome ED Jr, Clark NG, Clement S, Cobin RH, et al. American College of Endocrinology position statement on inpatient diabetes and metabolic control .Endocr Pract. 2004;10 Suppl 2:4–9. [DOI: 10.4158/EP.10.S2.4]

[8] Vellanki P, Cardona S, Galindo RJ, Urrutia MA, Pasquel FJ, Davis GM, et al. Efficacy and safety of intensive versus nonintensive supplemental insulin with a basal-bolus insulin regimen in hospitalized patients with type 2 diabetes: a randomized clinical study .Diabetes Care. 2022;45(10):2217–23. [DOI: 10.2337/dc22-0459]

[9] Aly A, Al Suleimani Y. Management of Hyperglycemia in Hospitalized Patients with Type-2 Diabetes Using Insulin Therapy .Eur J Clin Pharm. 2022;24(2):84–91. [DOI: 10.29045/14784710.2022.24.2.84]

[10] Zaman Huri H, Permalu V, Vethakkan SR. Sliding-scale versus basal-bolus insulin in the management of severe or acute hyperglycemia in type 2 diabetes patients: A retrospective study .PLoS One .2014;9(9):e106505. [DOI: 10.1371/journal.pone.0106505]

[11] Umpierrez GE, Pasquel FJ. Management of inpatient hyperglycemia and diabetes in older adults .Diabetes Care. 2017;40(4):509–17. [DOI: 10.2337/dc16-1722]

[12] Umpierrez GE, Smiley D, Jacobs S, Peng L, Temponi A, Mulligan P, et al. Randomized study of basal-bolus insulin therapy in the inpatient management of patients with type 2 diabetes undergoing general surgery (RABBIT 2 surgery) .Diabetes Care. 2011;34(2):256–61. [DOI: 10.2337/dc10-1417]