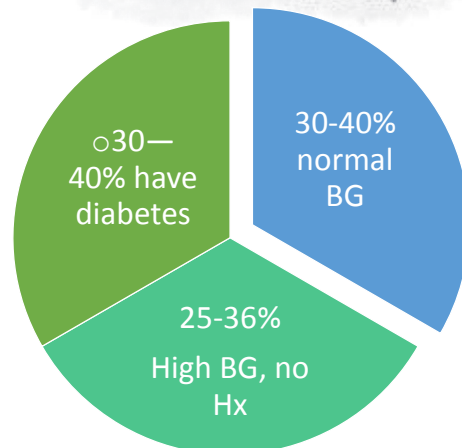


Setting Glycemic Protocol in CCU

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- Co-founder at NAPHS Consultancy

Holistic Approach

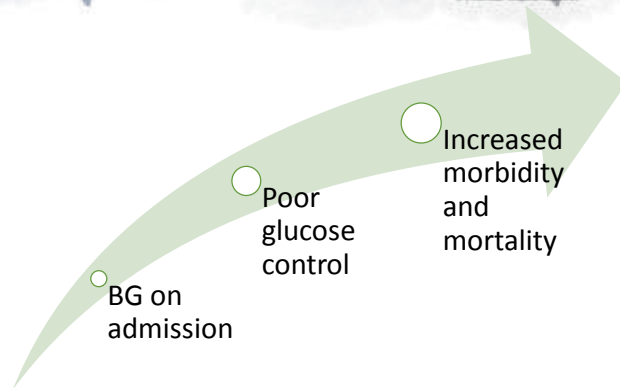
Distribution among patients hospitalized for ACS



Archives of Cardiovascular Disease(2012)105,239—25
 Joint British Diabetes Societies (JBDS) for Inpatient Care (2019)

Holistic Approach

- Poor blood glucose control in patients with an ACS is a strong independent risk factor for increased morbidity and mortality. The relationship between the level of admission blood glucose and the adjusted relative risk of death is almost linear and is more strongly associated with mortality.



Archives of Cardiovascular Disease(2012)105,239—25
 Joint British Diabetes Societies (JBDS) for Inpatient Care (2019)



<http://clinical.diabetesjournals.org>



<http://guidelines.diabetes.ca/>



NICE National Institute for Health and Care Excellence

<http://www.nice.org.uk/>



JBDS-IP Joint British Diabetes Societies for inpatient care

A good inpatient diabetes service

July 2019

<http://www.diabetologists-abcd.org.uk/JBDS/JBDS.htm>

For ACS follow local policy

Rates →	Standard Rate	Reduced Rate	Increased Rate	Customised Scale
	Start on standard rate unless indicated	For use in insulin sensitive patients i.e. needing less than 24 units/day	For use in insulin resistant patients, i.e. needing more than 100 units/day	For use to bespoke rate
CBG Levels <small>(mmol/L) ↓</small>	Infusion Rate (units/hr = ml/hr)			
<4	Stop VRIII. Administer 100 ml IV 20% Glucose. Restart when CBG >4 mmol/L but at reduced rate			
	0	0	0	
4.1-8	1	0.5	2	
8.1-12	2	1	4	
12.1-16	4	2	6	
16.1-20.0	5	3	7	
20.1- 24.0	6	4	8	
>24.1	8	6	10	
Signed/Dated				
Print Name				

ENTRY CRITERIA:	RATE GUIDE	
<p>Start VRIII and fluids for:</p> <ol style="list-style-type: none"> NBM >1 missed meal Type 1 diabetes with recurrent vomiting (exclude DKA) Type 1 or 2 diabetes and severe illness with need to achieve good glycaemic control e.g. sepsis <p>Special circumstances: For ACS, stroke, TPN/enteral feeding/steroids and pregnancy, follow local guidelines and seek advice from the diabetes team</p>	<p>Standard Rate</p>	<p>Most patient will start here</p>
	<p>Reduced Rate</p>	<p>Use this rate for insulin sensitive patients (i.e. needing <24 units/day) or when CBGs are persistently 4-6 mmol/L or dropping too fast</p>
	<p>Increase Rate</p>	<p>Use this rate for patient who are likely to require more insulin (on steroids; on >100 units of insulin prior to admission; or those not achieving target on Standard Rate)</p>
	<p>Customised Rate</p>	<p>Use this to bespoke rate depending on co-morbidities</p>
	<p>If the patient is not achieving targets with these algorithms, contact the diabetes team (out of hours: Medical SpR on call)</p>	
<p>Target CBG level = 4 – 12 mmol/L</p>		
<p>Check CBG every hour whilst on VRIII</p>		
<p>Move to the increased rate if the CBG is > target and is not dropping over three consecutive hours by 3 mmol/L/hr or more</p>		
<p>Move to the reduced rate if CBG falls below 3 mmol/L or is dropping too fast i.e. >3 mmol/L/hr</p>		



- 12 Glycemic Management in Adults with Type 1 Diabetes
- 13 Pharmacologic Glycemic Management of Type 2 Diabetes in Adults
- 14 Hypoglycemia
- 15 Hyperglycemic Emergencies in Adults
- 16 **In-hospital Management of Diabetes**
- 17 Weight Management in Diabetes
- 18 Diabetes and Mental Health
- 19 Influenza, Pneumococcal, Hepatitis B and Herpes Zoster Vaccinations
- 20 Diabetes and Transplantation
- 21 Diabetes and Driving
- 22 Complementary and Alternative Medicine for Diabetes
- 23 Cardiovascular Protection in People with Diabetes
- 24 Screening for Presence of Cardiovascular Disease
- 25 Dyslipidemia
- 26 Treatment for Hypertension
- 27 Management of Acute Coronary Syndromes
- 28 Treatment of Diabetes in People with Heart Failure
- 29 Chronic Kidney Disease in Diabetes

French Society of Diabetes in collaboration with the French Society of Cardiology

Archives of Cardiovascular Disease (2012) 105, 239–253



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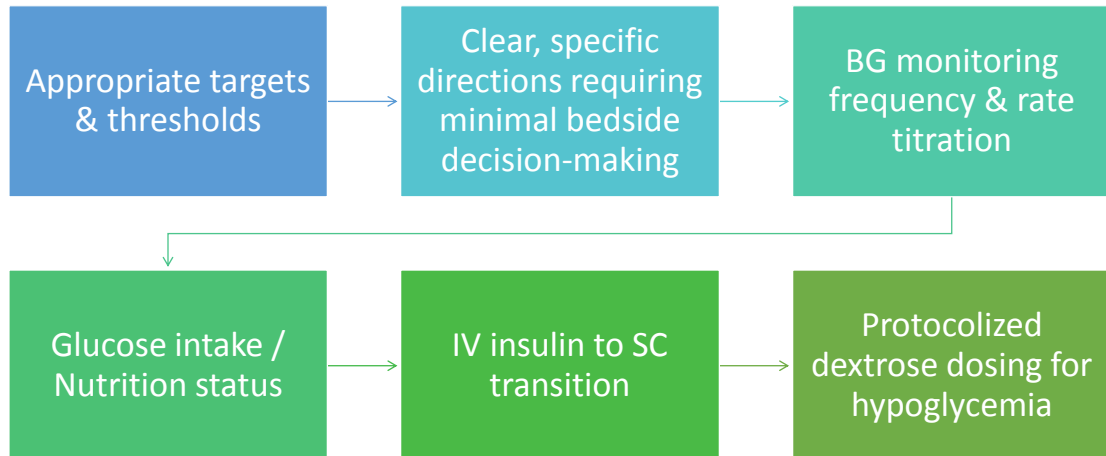
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GUIDELINES

**Consensus statement on the care of the
 hyperglycaemic/diabetic patient during and in the
 immediate follow-up of acute coronary syndrome** ☆

Characteristics of an optimal insulin dosing protocol



Continuous Insulin Infusion: When, Where, and How?. *Diabetes Spectr.* 2014;27(3):218–223

DC is a 62-year-old man with no known history of diabetes who is admitted with ACS. His current glucose is 205 mg/dL, and on recheck after 2 hrs, his glucose is 220 mg/dL. Which of the following shall be added:

- 1- OHG
- 2- SC regular insulin
- 3- Insulin infusion
- 4- Nothing, just monitor



Sliding-scale Or Correction Algorithms

- Sliding-scale or correction algorithms alone are outdated treatment modalities that should be discouraged.
- Playing catch up; it is a reactive approach, not a proactive strategy to prevent hyperglycemic states
- These practices are associated with wide fluctuations in blood glucose, which have been linked to higher hospital mortality rates.

Kelly JL. Continuous Insulin Infusion: When, Where, and How?. *Diabetes Spectr.* 2014;27(3):218–223.

Patient should be started on insulin infusion when 2 consecutive BG readings (within 2hrs) are:

> 140
mg/dl

>180
mg/dl

> 250
mg/dl

> 300
mg/dl

After insulin is initiated, the target blood glucose range should be 140-180 mg/dl.

Table 1

Summary of selected randomized trials evaluating insulin infusion effect on major cardiovascular events in patients admitted for acute coronary syndrome.

Study	DIGAMI [16]	ECLA [46]	GIPS [47]	POL-GIK [17]	HI-5 [48]
No. of patients	620	407	940	954	240
Dose (U/h)	5	1.4/5.2	5	1.3 → 0.8	2
Insulin perfusion duration (h)	24–72	24	24	24	24
Glucose level target (g/dL)	1.26–1.80	1.26–1.98	1.26–1.98	<3	0.72–1.80
Results	↓Mortality	↓Mortality	↓Mortality	↑Mortality	↑Mortality

Potential Barriers & Fears of IV infusion



1. Fear of hypoglycemia
2. Confusion regarding appropriate glycemic targets
3. Insufficient nurse-to-patient ratios
4. Insufficient availability or convenience of glucose-monitoring devices
5. Lack of administrative support
6. Resistance to change

Insulin infusion is rapidly effective, is easily titrated, and has no absolute contraindications

Kelly JL. Continuous Insulin Infusion: When, Where, and How?. *Diabetes Spectr.* 2014;27(3):218–223.

Examples of Published IV Insulin Protocols

Yale	Markovitz	Leuven	Portland	Texas Diabetes Council
DIGAMI	University of Washington	Krinsley	Rush University Protocol	Northwestern University

Preparation

50 Units of regular insulin diluted in 50 units of diluent

→ 1 Unit/ml



1- Yale-New Haven

1- Target BG: 120-160 mg/dl

2- Bolus & Initial Infusion Rate: Divide initial BG level by 100, then round to nearest 0.5 units for bolus AND initial infusion rate

300mg/dl → 3ml/hr

3- Titration

Yale-New Haven

After 1 hr,
300 →
220mg/dl

IF BG ≥ 100 mg/dL:

STEP 1: Determine the **CURRENT BG LEVEL** - identifies a **COLUMN** in the table.

BG 100-119 mg/dL	BG 120-159 mg/dL	BG 160-199 mg/dL	BG ≥ 200 mg/dL
------------------	------------------	------------------	----------------

STEP 2: Determine the **RATE OF CHANGE** from the prior BG level - identifies a **CELL** in the table - Then move right for **INSTRUCTIONS**.

[Note: If the last BG was measured 2 or more hrs before the current BG, calculate the hourly rate of change. Example: If the BG at 2PM was 110 mg/dL and the BG at 4PM is 120 mg/dL, the total change over 2 hours is +10 mg/dL, however, the hourly change is +10 mg/dL ÷ 2 hours = +5 mg/dL/hr.]

BG 100-119 mg/dL	BG 120-159 mg/dL	BG 160-199 mg/dL	BG ≥ 200 mg/dL	INSTRUCTIONS*
		BG ↑ by > 60 mg/dL/hr	BG ↑	↑ INFUSION by "2Δ"
	BG ↑ by > 40 mg/dL/hr	BG ↑ by 1-60 mg/dL/hr OR BG UNCHANGED	BG UNCHANGED OR BG ↓ by 1-20 mg/dL/hr	↑ INFUSION by "Δ"
BG ↓	BG ↑ by 1-40 mg/dL/hr, BG UNCHANGED, OR BG ↓ by 1-20 mg/dL/hr	BG ↓ by 1-40 mg/dL/hr	BG ↓ by 21-60 mg/dL/hr	NO INFUSION CHANGE
BG UNCHANGED OR BG ↓ by 1-20 mg/dL/hr	BG ↓ by 21-40 mg/dL/hr	BG ↓ by 41-60 mg/dL/hr	BG ↓ by 61-80 mg/dL/hr	↓ INFUSION by "Δ"
BG ↓ by > 20 mg/dL/hr see below	BG ↓ by > 40 mg/dL/hr	BG ↓ by > 60 mg/dL/hr	BG ↓ by > 80 mg/dL/hr	HOLD x 30 min, then ↓ INFUSION by "2Δ"

STEP 3: CHANGES IN INFUSION RATE* ("Δ") are determined by the current rate:

Current Rate (Units/hr)	Δ = Rate Change (Units/hr)	2Δ = 2X Rate Change (Units/hr)
< 3.0	0.5	1
3.0 - 6.0	1	2
6.5 - 9.5	1.5	3
10.0 - 14.5	2	4
15 - 19.5	3*	6*
≥ 20*	4*	8*

IF INSULIN INFUSION: If BG is 15 units or more above goal, then check BG q 1 hr; when at goal, restart infusion at 75% of new target rate.

* Depending on the clinical circumstances, infusion rates typically range between 0-10 units/hr. Doses in excess of 20 units/hr are unusual, and, if required, the responsible MD should be notified to explore other potential causes such as pump malfunctions, medication, and/or other causes.

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July 2009, revised 05/15/15 by JG (1/15)



Patient BG level was 300mg/dl.
 What's the initial infusion rate?
 Patient was put on 3ml/hr

After 1 hr BG level is 220mg/dl

What is your NEW recommendation?

2ml/hr



Insulin IP Calc

EncodenetApps Medical



This app is compatible with all of

You can share this with your family. [Family Library](#)

Insulin IP Calc ABOUT

Target Blood Sugar 120 - 160 mg/dL

Current Blood Sugar 220 mg/dL

Previous Blood Sugar 300 mg/dL

Time between readings 1 hr

Current infusion rate 3 Units/hr

Calculate Rate

Set Insulin infusion rate at:
 2 Units/hr

Yale Insulin Infusion Protocol Logic:
 Blood Sugar change is -80 mg/dL/hr, Delta is
 1, Insulin infusion rate change required is by
 -1 Units/hr

pharmacyjoe.com
PODCAST HELPI MY PAT

Pharmacyjoe
.com/insulin

Insulin

Yale New Haven Based Insulin Protocol Calculator

Source

Enter the following information:

3	Current insulin infusion rate in units per hour
220	Most recent blood glucose
300	Previous blood glucose
1	Hours between above blood glucose levels (round to nearest hour)

Calculate change in insulin infusion

Decrease insulin infusion by 1 unit/hour

2-The Francophone Diabetes Society

Initial dose: the initial dose of insulin depends on the admission blood glucose (BG).	
Admission BG	Insulin dose
180–300 mg/dL (10–16.6 mmol/L)	2 U/h
300–400 mg/dL (16.6–22.2 mmol/L)	3 U/h
> 400 mg/dL (22.2 mmol/L)	4 U/h
Then, insulin dosage will be adapted to BG level (monitored 1 hr after initiation, then every 2 hours).	
BG level	insulin dose
< 80 mg/dL (4.4 mmol/L)	Stop insulin
80–140 mg/dL (4.4–7.8 mmol/L)	↘ by 0.5 U/h
140–180 mg/dL (7.8–10 mmol/L)	→ unchanged
180–300 mg/dL (10–16.6 mmol/L)	↗ by 1 U/h
> 300 mg/dL (16.6 mmol/L)	↗ by 1.5 U/h
In patients older than 75 years old, insulin dosage could be adapted to BG as follows.	
BG level	insulin dose
< 80 mg/dL (4.4 mmol/L)	Stop insulin
80–140 mg/dL (4.4–7.8 mmol/L)	Stop insulin
140–180 mg/dL (7.8–10 mmol/L)	→ unchanged
180–300 mg/dL (10–16.6 mmol/L)	↗ by 0.5 U/h
> 300 mg/dL (16.6 mmol/L)	↗ by 1 U/h

Target BG: 140-180 mg/dL

4 ml/hr

3-Canadian guidelines

- Target= 125-180mg/dl
- If BG > 200mg/dl → start with 5 units/hr
- Then after 1st hr, change rate according to table 1
- Note :
220mg/dl= 12.2mmol/l

SAMPLE INSULIN INFUSION CLINICAL ORDER SET

Acute Coronary Syndrome: Initial Management

Blood Glucose (mmol/L)	Infusion Rate Change
Greater than 11 mmol/L >200mg/dl	No Change
7 to 11 mmol/L	Decrease infusion to 4 units/h
4 to 6.9 mmol/L	Decrease infusion to 3 units/h
Less than 4 mmol/L	<ul style="list-style-type: none"> • Decrease infusion to 2 units/h • Call physician managing diabetes • Follow hospital hypoglycemia protocol

5 ml/hr

TABLE 2:

Instructions for all Bedside Blood Glucose Monitor (BBGM) checks after the first hour.

Blood Glucose (mmol/L)	Infusion Rate Change	Bolus Dose	Repeat Blood Glucose
Greater than 15 mmol/L	Increase infusion by 1 unit/h	8 units regular human insulin IV	1h
11 to 15 mmol/L	Increase infusion by 0.5 units/h	-	1h
7 to 10.9 mmol/L	No change	-	2h
4 to 6.9 mmol/L	Decrease infusion by 1 unit/h	-	1h
Less than 4 mmol/L	<ul style="list-style-type: none"> • Stop infusion • Call physician managing diabetes • Follow hospital hypoglycemia protocol 	50 mL D10W IV Repeat bolus q30minutes until blood glucose results greater than 7 mmol/L	q30 minutes until glucose greater than 7 mmol/L, then restart infusion at 1 unit/h less than the rate before infusion stopped

4-“Multiplier” Protocol Concept

Initial rate

(Blood glucose – 60) X multiplication factor (0.02)

$$(300-60) \times 0.02 = 4.8 \text{ ml/hr}$$

Titration: Increase/decrease by 0.05 or 0.1

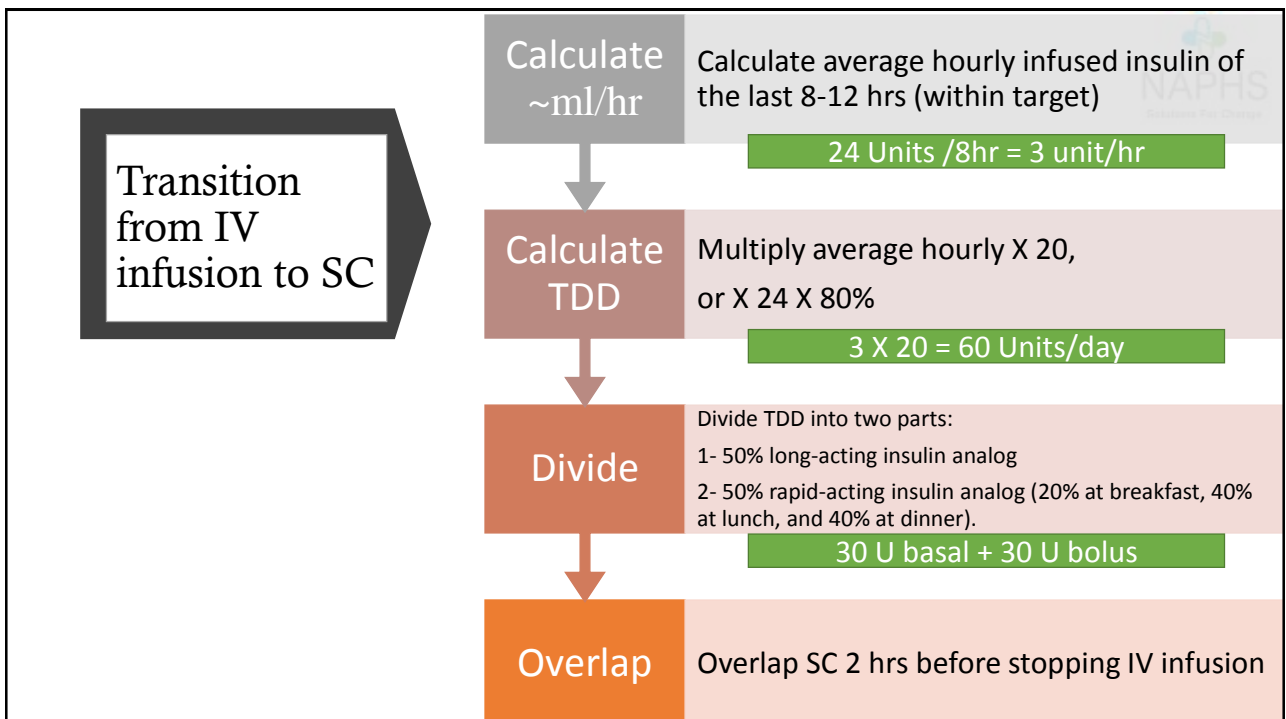
$$(220-60) \times 0.02 = 3.2 \text{ ml/hr}$$

Start infusion using the drip rate (ml/hr) in COLUMN E for the current Blood Glucose Row	Blood Glucose Rows (mg/dl)	column A (ml/hr) 0.005	column B (ml/hr) 0.0075	column C (ml/hr) 0.01	column D (ml/hr) 0.015	column E (ml/hr) 0.02	column F (ml/hr) 0.025	column G (ml/hr) 0.03	column H (ml/hr) 0.035	column I (ml/hr) 0.04	column J (ml/hr) 0.045	column K (ml/hr) 0.05
- If current BG Row is lower than the previous BG Row, STAY IN THE SAME COLUMN - If current BG Row has not dropped, MOVE 1 COLUMN TO your RIGHT	Over 450	2.2	3.3	4.4	6.6	8.8	11	13.2	15.4	17.6	19.8	22
	385-450	1.8	2.8	3.6	5.4	7.2	9	10.8	12.6	14.4	16.2	18
	334-384	1.6	2.3	3	4.5	6	8	9	10.5	12	13.5	15
	290-333	1.4	1.9	2.5	3.8	5	6.3	7.5	8.8	10	11.2	12.5
	251-289	1.3	1.6	2.1	3.2	4.2	5.3	6.3	7.4	8.4	9.5	10.5
	217-250	1.1	1.3	1.7	2.6	3.4	4.3	5.1	6	6.8	7.7	8.5
	191-216	0.9	1.1	1.4	2.1	2.8	3.5	4.2	5	5.6	6.3	7
	181-190	0.7	1	1.3	1.9	2.5	3.2	3.8	4.4	5.1	5.8	6.5
When hourly BG is 140-180, stay in the same column. Do Not Change Columns	172-180	0.6	0.9	1.2	1.8	2.4	3	3.6	4.2	4.8	5.4	6
	164-171	0.5	0.8	1.1	1.7	2.2	2.8	3.3	3.9	4.4	5.0	5.5
	156-163	0.5	0.7	1	1.5	2	2.5	3	3.5	4	4.5	5
	148-155	0.4	0.6	0.9	1.3	1.8	2.2	2.7	3.2	3.6	4	4.5
	140-147	0.4	0.5	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4
When new BG is less than 140 Move 1 Column To your Left	130-139	0.3	0.4	0.7	1.1	1.4	1.8	2.1	2.5	2.8	3.2	3.5
	120-129	0.3	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3
	110-119	0.2	0.2	0.5	0.8	1	1.3	1.5	1.8	2	2.3	2.5
Refer to Figure # 2 for D25 treatment.	100-109	0.2	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
	90-99	0.1	0.2	0.3	0.4	0.6	0.8	0.9	1.1	1.2	1.4	1.5
	80-89	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
	Under 80	0	0	0	0	0	0	0	0	0	0	0

BG Monitoring Rate

- Recommend hourly blood glucose monitoring for patients receiving IV insulin therapy except for patients with stable blood glucose within the target range, for whom monitoring can be performed every 2 hours.
- Some protocols have used a monitoring schedule of every 4 hours. However, the incidence of hypoglycemia exceeds 10% with many of these protocols.

Kelly JL. Continuous Insulin Infusion: When, Where, and How?. *Diabetes Spectr.* 2014;27(3):218–223



Thank you

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