Glycaemic Control

Part I

Clinical Practice Guidelines				
Revision	**Description of Change**	**Author**	**Effective Date**	**Page No.**
1	Initial Release	Dr. H Y SO, NDH Dr. Alexander CHIU, QMH Dr. Claudia CHENG, PWH Dr. W L WAN, YCH	June 2006	P.2-P.4

Part II

Sample Clinical Practice Protocol				
Revision	**Description of Change**	**Author**	**Effective Date**	**Page No.**
1	Initial Release	Intensive Care Working Group on Clinical Practice Guidelines	June 2006	P.5-P.13

Clinical Practice Guidelines on Glycaemic Control

Current Trend

1. **Hyperglycaemia should be controlled in critically ill patients. Blood glucose level should preferably be controlled below 8 mmol/L. (Grade D Recommendation)**

   Rationale:
   Current evidence suggests that maintenance of normoglycemia reduce mortality and morbidity in critically ill adult patients [1, 2, 6].
   Existing evidence showed that the benefit might be more significant with glucose controlled below 6mmol/L, although levels below 8 mmol/L can also result in survival benefit and probably reduce the risk of hypoglycaemia [3, 4].
   This guideline however does not apply to patients suffering from diabetic ketoacidosis or hyperosmolar nonketotic syndrome.

Strategies for Glycaemic Control

1. **Hyperglycaemia should be controlled by rapid acting insulin through intravenous administration**

   Rationale:
   Tissue perfusion in critically ill patients are often impaired, making absorption of insulin administered through subcutaneous route less reliable.
   In critically ill patients with changing clinical conditions, intravenous infusion is preferable for rapid adjustment.
   All published protocols have used intravenous administration of short acting insulin [1, 2, 5, 6]

2. **Rate of insulin administration should be titrated according to blood glucose level using a regime based on understanding of the pharmacokinetics and pharmacodynamics of rapid acting insulin.**

   Rationale:
   There are different regimes of insulin administration published but there is no evidence that one is superior to the other.
   The half-life of soluble insulin is 2-4 hours but may be longer in critically ill patients. Change in infusion rate may take longer time to establish a new stable state and bolus administration might be necessary.
   Caution must be exercised when dealing with patients with severe liver or renal failure.

3. Regular measurement of blood glucose level at adequate frequency should be carried out to assess the efficacy of glycaemic control and detect presence of hypoglycaemia.

Rationale:
Hypoglycaemia is a recognized problem with glycaemic control [1, 2], although risk of harm (or adverse effects) would be minimized if hypoglycaemia were recognized early by close monitoring. Hypoglycemia in critically ill should be defined at a higher level to avoid neuroglycopenic complications because physiological defenses against low blood glucose are hampered in these patients and there are few warning signs in unconscious or sedated patients. In order to reduce the risk of inadvertent hypoglycaemia, a constant caloric source is desirable, be it enteral, or parenteral.

Blood glucose should be monitored more frequently (e.g. hourly) when rapid changes are anticipated, e.g.

a. during initiation, adjustment or cessation of insulin therapy
b. during initiation, adjustment or cessation of inotrope/pressor therapy
c. during initiation or cessation of steroid therapy
d. during initiation, adjustment or cessation of nutritional support
e. when significant changes in clinical condition occur

The frequency of monitoring can be lowered when the following conditions are satisfied:

a. blood glucose level is stabilized
b. no significant change in nutritional intake
c. no significant change in clinical condition

Whole blood instead of capillary blood should be used for measurement of blood glucose level because of the possible inaccuracy associated with the latter [7, 8, 9].

4. If blood glucose is measured by sending specimen to the laboratory, the turn around time should be short enough to allow rapid adjustment of insulin infusion.

Rationale:
Blood glucose measured by the laboratory should be more accurate. However, as the administration rate of insulin may need to be adjusted frequently the turnaround time cannot be too long.

5. If blood glucose is measured using point-of-care testing system, operators should be properly trained and the device properly calibrated and maintained.

Rationale:
This is in line with the recommendations of the Hospital Authority to ensure that measured results are reliable. [10,11]

References

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4. Dellinger RP, Carlet JM, Masur H, Gerlach H, Calandra T, et.al.: Surviving Sepsis Campaign guidelines for management of severe sepsis and septic shock. Intensive Care Med 2004; 30:536-55
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9. Sylvain HF, Pokorny ME, English SM, Benson NH, Whitley TW, et al: Accuracy of fingerstick glucose values in shock patients. Am J Crit Care. 1995 Jan;4(1):44-8.
10. HAHO Risk management committee: Risk management Release. Issue No. 4. May 2001
11. HAHO joint COC working group: Point of care testing guideline First Revision. Oct 2001

Sample Clinical Practice Protocol on Glycaemic Control

1. Objective

To achieve a tight glycaemic control (maintaining blood glucose level of 5-8 mmol/L) despite stress related to critical illness.

2. Scope

It is **NOT intended** for management of **Diabetic Emergencies**, such as diabetic ketoacidosis or hyperosmolar nonketotic coma.

It is applicable for all patients managed in the ICU for whom details of blood glucose control is not mentioned in the clinical guideline for that particular disease/condition.

3. Definitions

Senior	Medical practitioner registered as critical / intensive care specialist or an experienced medical practitioner as assigned by the director of the unit
MO	Registered medical practitioner after ICU orientation
RN	Registered nurse after ICU orientation

4. Responsibilities

4.1 **Senior** shall:
Supervise & assist MO and RN on carrying out the protocol

4.2 **MO** shall:
- Decide on whom should be included / excluded for the protocol
- Prescribe and determine insulin dosage when blood glucose level is >20 mmol/L

4.3 **RN** shall:
- Monitoring of blood glucose level
- Adjust insulin infusion when blood glucose level is within 0-20 mmo/L
- Report to doctor when indicated

5. Procedures

5.1 Initiation (Appendix A)

Action	*Responsible*
5.1.1 Decide to exclude patient with diabetic emergency from the protocol	MO / Senior

	Action	*Responsible*
5.1.2	• Monitor Blood Glucose Assay (BGA) every 4 hourly • Start insulin protocol	RN
5.1.3	Start enteral feeding or dextrose-containing IV fluid	MO / RN
5.1.4	Look up the Insulin Slide scale for the bolus dose, infusion rate ("Start") and time for next BGA	RN
5.1.5	• Prescribe PRN insulin bolus on the pre-printed Insulin Administration / Test strip glucose Monitoring Form (Appendix B) • Prescribe insulin infusion according to the Insulin Slide Scale Rule (Append C) on the Drug Infusion Order Chart	MO
5.1.6	• Prepare insulin by diluting 50 units (0.5 ml) of Actrapid into 49.5 ml 0.9% NS to 50 ml if necessary • Administer the insulin in the IV fluid line if present	RN
5.1.7	• Administer the bolus dose and the infusion of insulin • Record the BGA, bolus & insulin infusion rate on the ICU Flow Chart and Insulin Therapy Monitoring Chart (Appendix D)	RN

5.2 Monitoring of blood glucose

	Action	*Responsible*
5.2.1	• Monitor blood glucose level using BGA every 30 minutes to 4 hourly as indicated on the Insulin Slide Scale Rule • Document BGA and insulin infusion rates on the ICU Flow Chart and Insulin Therapy Monitoring Chart	RN

5.3 Titration (Appendix A)

	Action	*Responsible*
5.3.1	Nurses should decide the titration when BGA is within 0-20 mmol/L	RN

5.3.2	• Make a decision for a bolus dose, change of infusion rate and time for next BGA on every BGA, using the Insulin Slide Scale Rule
	• The decision depends on
	  ▪ The current blood glucose level; and
	  ▪ The trend using the previous blood glucose level
		RN

	Action	*Responsible*
5.3.3	• **No insulin** for at least 4 hours if BGA is <3 mmol/L • Consider starting a D20 infusion if frequent D50 boluses are required	RN / MO
5.3.4	**Do not** ▪ Increase infusion rate if the last change is an increase within 8 hours ▪ Decrease infusion rate if the last change is a decrease within 2 hours	RN
5.3.5	Round off infusion rate to highest 0.5 mL/hr no greater than the calculated value	RN
5.3.6	Keep a minimum infusion of 0.5 mL/hr in patient with insulin dependent diabetes	RN / MO
5.3.7	Bolus dose should be administered as indicated in the Insulin Slide Scale Rule, though infusion rate is not changed	RN
5.3.8	Check the pump & IV line for insulin infusion regularly	RN / MO

5.4 Management of Excessive Hyperglycaemia (>20 mmol/L)

	Action	*Responsible*
5.4.1	Inform MO if blood glucose level is >20 mmol/L	RN / MO
5.4.2	Look for correctable cause of the excessive hyperglycaemia Examples includes: ▪ Insulin pump failure ▪ Disconnection of insulin ▪ Extravasation ▪ Bolus administartion of dextrose	MO / RN
5.4.3	• Determine a bolus dose of insulin and the new insulin infusion rate • It is NOT usually appropriate to increase infusion rate more frequent than once every 4 hours	MO / Senior

5.5 Fasting (Appendix E)

	Action	*Responsible*
5.5.1	Insulin infusion should be stopped temporarily when ▪ Fasted for an operation/procedure ▪ Total parental nutrient infusion is stopped ▪ Feeding being interrupted & resumption was not expected	RN / MO

	Action	*Responsible*
	with 2 hours (e.g. NG tube slipped out & pending confirmation by X-ray)	
5.5.2	• Decide on the need for insulin during fasting. Dextrose-Potassium-Insulin (DKI) infusion may be preferred for insulin dependent diabetic patients • One may also choose to keep a 0.5mL/hr infusion in these patients	MO / Senior
5.5.3	Monitor blood glucose using BGA according to the Insulin Slide Rule	RN
5.5.4	If feeding is restarted within 6 hours ▪ Resume insulin infusion at the previous rate of infusion ▪ Give a bolus & check next BGA according to the Insulin Slide Rule ▪ Continue with titration as usual (See 5.3)	RN
5.5.5	If fasting is >6 hours ▪ Start dextrose-containing IV fluid infusion if not on one ▪ Follow the protocol as if starting again. (See 5.1)	RN / MO

5.6 Termination

	Action	*Responsible*
5.6.1	Patient should be taken off from the protocol if ▪ Patient is discharged from ICU ▪ Patient is on continuous feeding (e.g. patient on normal diet) ▪ Otherwise decided by the MO	RN / MO
5.6.2	MO should decide on an appropriate method to control BGA after termination of the protocol	MO

6. Quality Records

Patient's Clinical Record

7. Bibliography

Chan, K.C. (2004). Departmental protocol: Insulin infusion protocol. H.K. ICU. Princess Margaret Hospital.
Goldberg, P.A. et al (2004). Implementation of a safe and effective insulin infusion protocol in a medical intensive care unit. Diabetic Care, 27 (2), 461-467.
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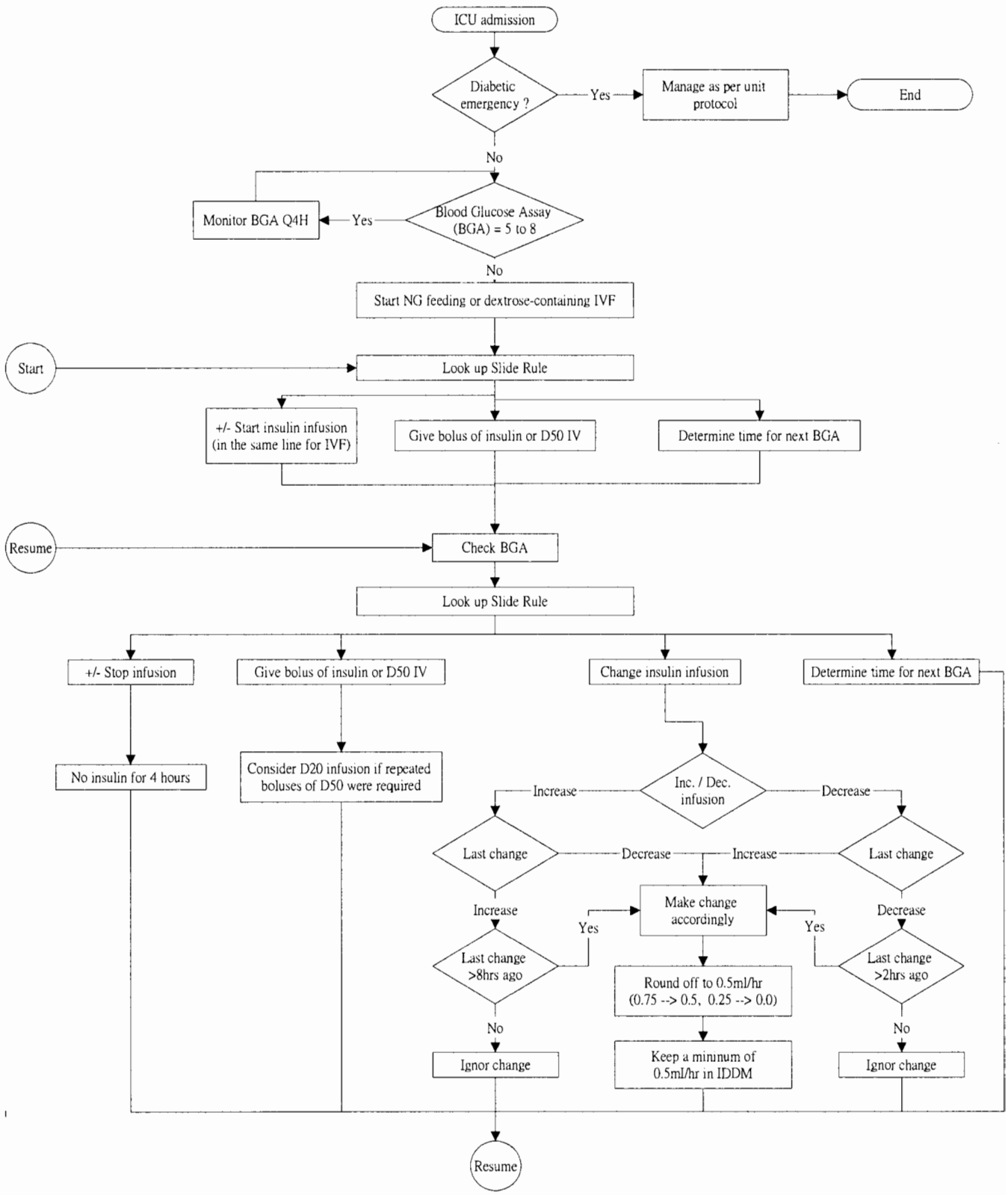
8. Appendix

Appendix A: Flow Chart for Starting & Titrating



Appendix B: Insulin Administration

HOSPITAL AUTHORITY
Princess Margaret Hospital
Insulin Administration /
Test strip glucose Monitoring Form
(For Doctors / Nurses Use)

Hosp # _____ ID # _____
Name _____
Sex _____ Age ____ Chinese Name _____
Ward ____ Bed ____ Dept _____

Page ( )

Known drug allergy:

H'stix glucose monitoring — Date / Freq.

Prescription (regular / as required)

Drug | Dose (unit) | Freq.

Actrapid 50 units in 49.5ml NS (1 unit/ml)

IV Q1H PRN according to ICU insulin protocol

Route: **IV** | Date on | Dr's sig. | Code | Date off | Dr's sig. | Code

Drug | Dose (unit) | Freq.

D50% 10ml or 40ml

IV Q30mins PRN according to ICU insulin protocol

Route: **IV** | Date on | Dr's sig. | Code | Date off | Dr's sig. | Code

Drug | Dose (unit) | Freq.

Route | Date on | Dr's sig. | Code | Date off | Dr's sig. | Code

Date	Time	Urine ketone	H'stix	Treatment Given	Checked by	Given by	Remarks

Stat Dose Prescription

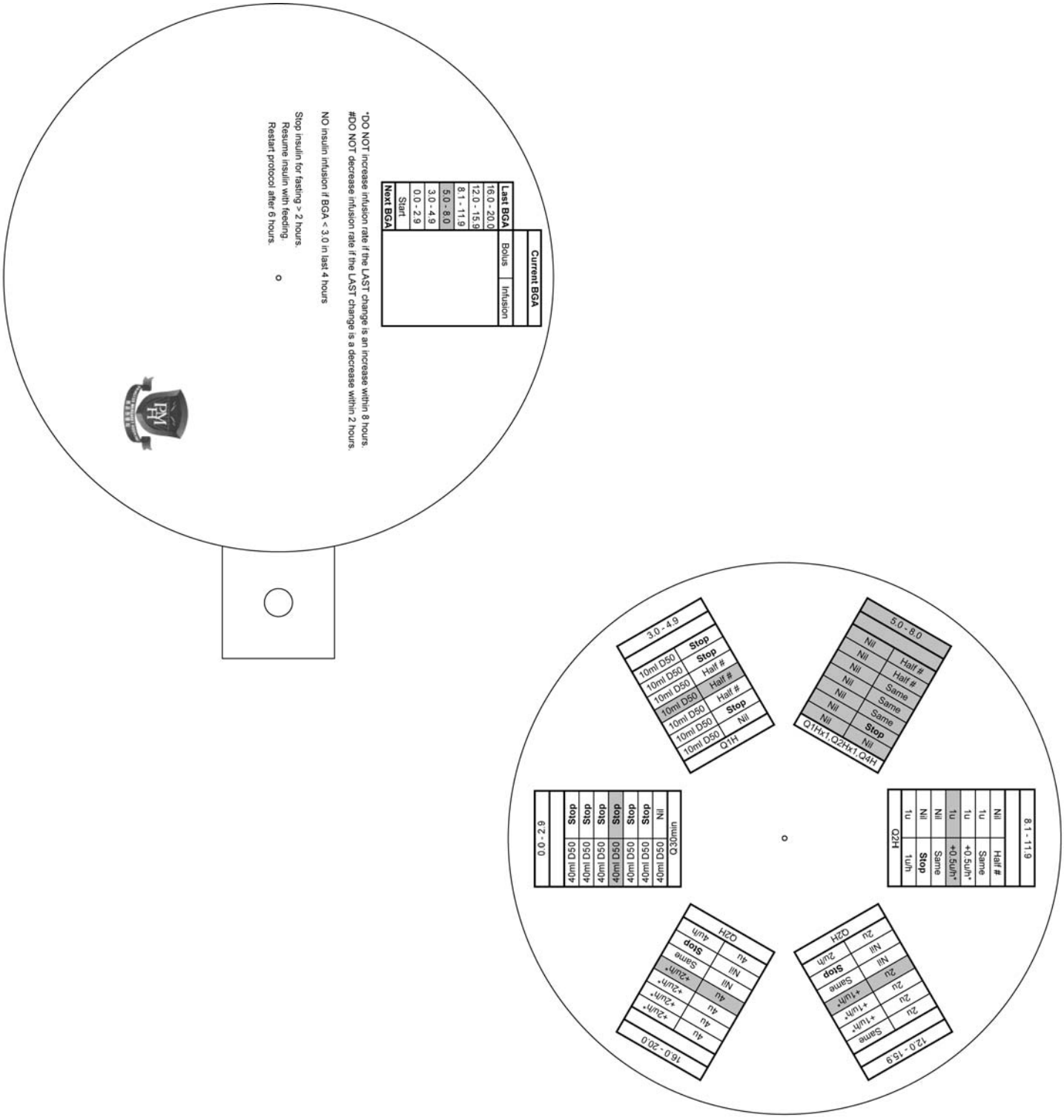
Date to be given	Time to be given	Drug	Dose	Route	Dr's sig.	Code

GIVEN

Date	Time	Given by (sig.)	Checked by (sig.)

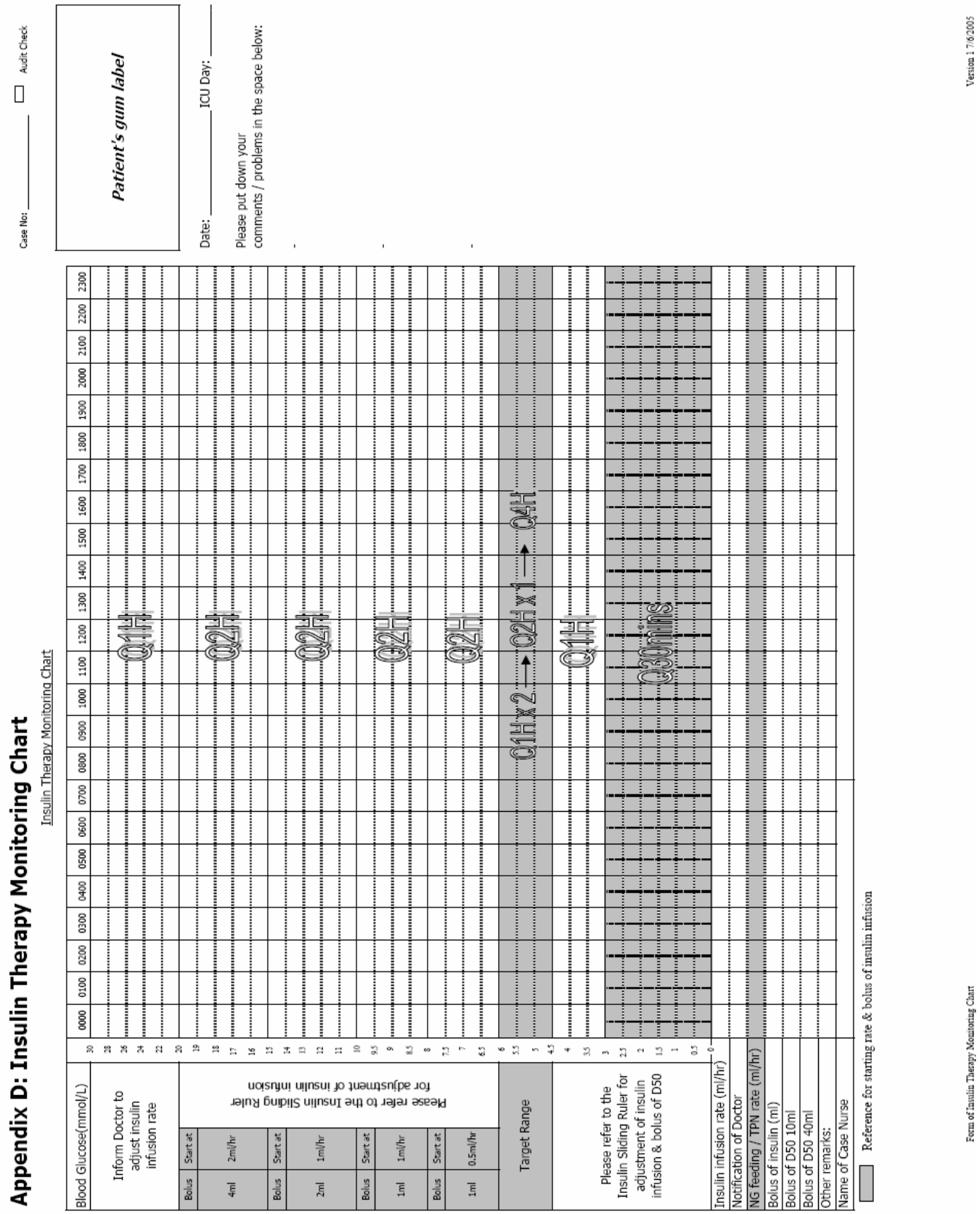
- PRN insulin should be given before meal • Avoid frequent use of sliding scale which can lead to fluctuating blood glucose control
- Capillary blood glucose should be done before or 2-hour post meal or when patient is symptomatic

Appendix C: Insulin Slide Scale Rule



Hospital Authority Central Committee on Intensive Care

Appendix D: Insulin Therapy Monitoring Chart



Appendix E: Flow Chart for Fasting