

REGIONAL LOCAL HEALTH NETWORKS

Protocol (clinical)

Title: Inpatient blood glucose and blood ketone monitoring in the hospital setting

Author: Rural Support Service – Diabetes Service

Sponsor: Executive Director, RSS

Approved by: RSS Policy & Procedure Committee on: 24 November 2023

BHF LHN Safety and Quality Committee on: 27 February 2024

EFN LHN Acute and Specialist Services Committee on: 24 April 2024

FUN LHN Operational Clinical Governance Committee on: 28 February 2024

LC LHN Safety and Quality Clinical Excellence Committee on: 23 June 2024

RMC LHN Clinical Oversight Governance Committee on: 21 March 2024

Y&N LHN Complex Care Committee on: 23 April 2024

Next review due: 09/06/2026

Summary	This protocol outlines responsibilities and actions required by medical practitioners, nurses and midwives to ensure the safety and quality of inpatient care.
Policy/procedure reference	This protocol supports the SA Health Recognising and Responding to Clinical Deterioration Policy Directive and Guideline, Diabetes Service Plan and Diabetes Inpatient Model of Care.
Keywords	Clinical, protocol, medical, nursing, midwifery, safety, quality, standards, diabetes, glucose, ketones, monitoring.
Document history	<p>Is this a new LHN protocol? Y</p> <p>Does this protocol <i>amend or update</i> an existing protocol? N</p> <p>Does this protocol <i>replace</i> an existing document? Y <i>Regional LHN Clinical Support Guide Inpatient blood glucose and ketone monitoring chart (MR59H) Objective No: 2020-06094</i></p>
Applies to	This protocol applies to all hospital medical practitioners, nursing and midwifery staff.
Objective file number	A2868537

Version control and change history

Version	Date	Amendment	Amended by:
1.0	01/05/2014	Original version	CHSA Diabetes Service
2.0	05/10/2016	Minor wording about blood ketones	CHSA Diabetes Service
2.0a	12/08/2019	This is an interim document until the 30 th December 2019. Amendments to aged care section, page 8.	Rural Support Service – Diabetes Service
3.0	22/01/2020	Updated Template	Rural Support Service – Diabetes Service
4.0	09/06/2023	Formerly a Guideline. Now a Protocol. Reference to SGLT2 inhibitors, CGM, consultation with Medstar and documentation on Sunrise EMR	Rural Support Service - Diabetes Service


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Blood glucose and blood ketone monitoring chart (MR59H)

OFFICIAL: Sensitive//Medical in confidence

 <p>BLOOD GLUCOSE & BLOOD KETONE MONITORING CHART (MR-59H)</p>		Affix patient identification label in this box UR No: _____ Surname: _____ Given Name: _____ Second Given Name: _____ D.O.B.: _____ Sex/Gender: _____ Visit No. (if applicable): _____																																																																																																																																																																																																																																																																																																																																																																											
Site/Facility: _____		Blood glucose (BG) targets General: 5.0 - 10.0mmol/L Obstetric: 4.1 - 7.9mmol/L Other: ____ - ____mmol/L																																																																																																																																																																																																																																																																																																																																																																											
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Instructions on routine blood glucose and blood ketone monitoring

Instructions on frequency of blood glucose and blood ketone monitoring

Blood glucose and blood ketones as a number

Document hypoglycaemia, notification of Dr and intervention initiated

Escalation instructions for blood glucose and blood ketones

Intervention detail recorded

1. Introduction

People can be admitted to a hospital with a new diagnosis of diabetes or after diagnosis, for management of acute or chronic diabetes related complications or for treatment of other conditions.

During admission, people with diabetes are at risk of glucose variability, acute medical emergencies (e.g. hypoglycaemia, hyperglycaemia, diabetic ketoacidosis (DKA), hyperosmolar hyperglycaemia state (HHS)) and other adverse outcomes, including death.

Accurate monitoring and careful management of inpatients with diabetes will minimise risk and improve glycaemic control.

This protocol outlines the requirements for blood glucose (BG) and blood ketone (BK) monitoring in people with diabetes admitted to regional local health network (LHN) hospitals.

The SA Health contracted BG and BK meter is the Abbott Freestyle Optium Neo H Meter. Refer to the [Integrated Cardiovascular Clinical Network SA](#) for training and information pertaining to the external and internal quality assurance programs.

1.1 Blood Glucose Monitoring

Blood glucose (BG) monitoring is performed through capillary glucose testing with a fingerstick, test strip and meter.

BG above target may increase risk of DKA in patients with type 1 diabetes or HHS in patients with type 2 diabetes. Refer to the regional LHN Protocols *Diabetic Ketoacidosis Management in Adults* and *Hyperglycaemic Hyperosmolar State Management in Adults with Type 2 Diabetes*.


BG below target may increase risk of hypoglycaemia (low blood glucose) in patients with diabetes who are prescribed sulfonylureas and/or insulin. Refer to the regional LHN Protocol *Treatment of hypoglycaemia in people with diabetes in the hospital and community setting*.

Target

The BG target range for an adult with diabetes in a general ward is 5.0 – 10.0mmol/L.

The medical practitioner is responsible for confirming if this target BG range is to be used. The medical practitioner can modify the BG target range if required (e.g. for women with pre-existing diabetes in pregnancy, the BG target range is generally 4.1 – 7.9mmol/L). Figure 1 identifies the general ward BG target range and area to document a modified BG target range on the *Blood Glucose & Blood Ketone Monitoring Chart (MR59H)*.

Figure 1: Modification of blood glucose targets

 <p>BLOOD GLUCOSE & BLOOD KETONE MONITORING CHART (MR-59H)</p> <p>Site/Facility: _____</p>	<p>Affix patient identification label in this box</p> <p>UR No: _____</p> <p>Surname: _____</p> <p>Given Name: _____</p> <p>Second Given Name: _____</p> <p>D.O.B.: _____ Sex/Gender: _____</p> <p>Visit No. (if applicable): _____</p>				
	<p>Blood glucose (BG) targets</p> <table border="1"> <tr> <td>General: 5.0 - 10.0mmol/L</td> <td>Obstetric: 4.1 - 7.9mmol/L</td> <td>Other: ____ - ____mmol/L</td> </tr> </table>			General: 5.0 - 10.0mmol/L	Obstetric: 4.1 - 7.9mmol/L
General: 5.0 - 10.0mmol/L	Obstetric: 4.1 - 7.9mmol/L	Other: ____ - ____mmol/L			

Blood glucose modification recorded

Frequency

The BG of a person with pre-existing diabetes should be tested within one hour of presentation.

All people with diabetes should have their BG tested before meals and at 2100hours (QID) from admission and until review by the medical practitioner.

Routine QID times may be increased if the BG results become unstable (e.g. 0200hour test is recommended if admission is for hypoglycaemia or nocturnal hypoglycaemia is suspected).

Routine QID times may be decreased if the person with diabetes is not at risk of hypoglycaemia (e.g. not prescribed sulfonylureas or insulin) or the person is medically stable and the BG tests have been within target (e.g. between 5.0 – 10.0mmol/L). In these instances, frequency in BG tests are recommended to be reduced to before breakfast and evening meal. Figure 2 identifies the area to document the reduction in BG test frequency and rationale on the *Blood Glucose & Blood Ketone Monitoring Chart (MR59H)*.

Figure 2: Modification of blood glucose monitoring frequency

Intervention <i>See overleaf</i>				
Interventions or Review				
Record intervention below and note corresponding letter in intervention row below graph.			Initial	Designation
A	Reduce BG testing as not at risk of 'hypo' Ca			RN
B				

1.2 Blood Ketone Monitoring

Blood ketone (BK) monitoring is performed through capillary ketone testing with a fingerstick, test strip and meter.

Beta-hydroxybutyrate is the predominant ketone body produced in DKA. It is detected in blood ketones test strips. It is not detected by urine ketone testing strips. If a BK testing strip is not available to check for ketones, urine ketone strips can be used; however, a strong clinical suspicion of DKA with a negative urine ketone result should prompt further assessment.

Elevated BK may be an indication of impending DKA in patients with type 1 diabetes or euglycaemic ketoacidosis in a patient with type 2 diabetes prescribed a sodium-glucose co-transporter 2 inhibitor (SGLT2i). Refer to the regional LHN Protocol *Diabetic Ketoacidosis Management in Adults* or the [Australian Diabetes Society](#) SGLT2i Position Statements.

Target

The BK target range for an adult with diabetes in a general ward is 0.0 – 0.6mmol/L. Modification of the BK target range is not recommended.

Frequency

If DKA or euglycaemic ketoacidosis is suspected, the blood ketone (BK) of a person with pre-existing diabetes should be tested within one hour of presentation.

All people with diabetes prescribed insulin should have their BK tested daily when fasting.

Routine daily BK testing may be increased if the BG test is greater than 15.0mmol/L or if the patient is unwell with persisting nausea and/or vomiting.

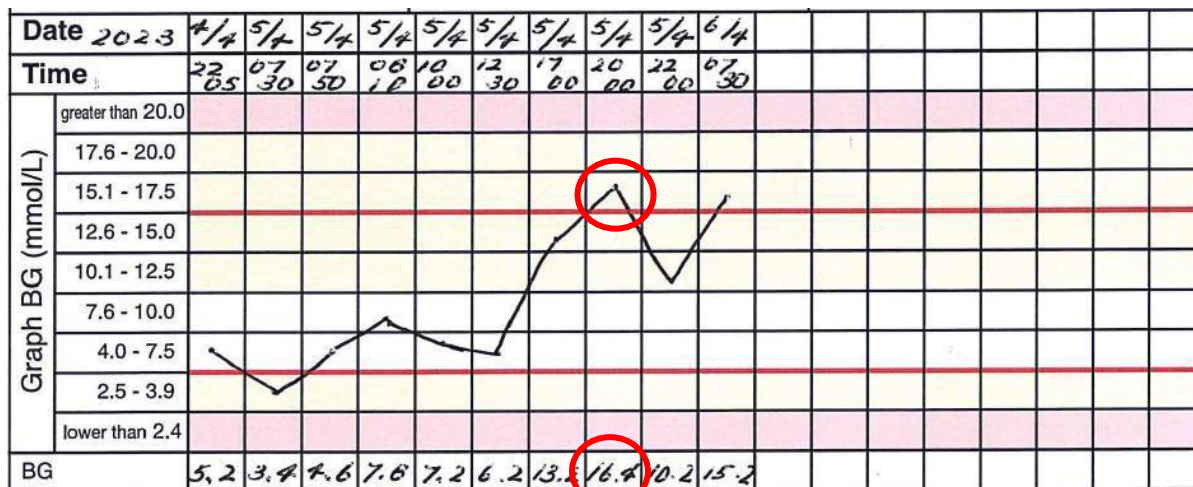
Routine daily BK testing may be decreased if the person with diabetes is medically stable and the BG and BK tests have been within target (e.g. BG between 5.0 – 10.0mmol/L and BK less than 0.6mmol/L).

1.3 Documentation

Nursing/midwifery staff are to document:

- > the date and time on the top row
- > the blood glucose (BG) should be graphed with a dot (.) in the centre of the square which coincides with the BG result, then connect to the previous dot with a straight line
- > the numerical value of the BG in row below the graphed value
- > the numerical value of the blood ketone (BK)
- > if the BG falls within a shaded area, the *Rapid Detection and Response Instruction* actions initiated as required for that colour zone
- > when the regional LHN Protocol *Treatment of hypoglycaemia in people with diabetes in the hospital and community setting* is initiated
- > when a medical practitioner is contacted, a tick is placed in the appropriate box on the chart.

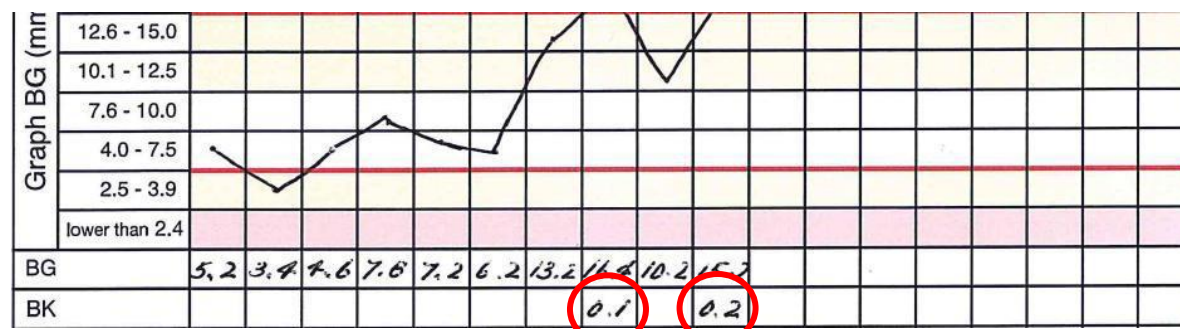
Figure 3: Example of how to chart the BG test result



Increased frequency of BG testing is required if BK are noted. Greater frequency (e.g. before meals and at bedtime) may be instructed by the medical practitioner.

Figure 4 identifies where blood ketone (BK) test results are to be documented as a number under the BG.

Figure 4: Example of how to chart the BK test result



The purpose of the **Intervention** row is to highlight the action/s that have been initiated with reference to the 'out of target' BG or BK result/s.

Nursing/midwifery staff are to document any event (e.g. hypoglycaemia treatment) and the corresponding letter (e.g. A) in the intervention row. Figure 5 highlights four (4) Intervention events (e.g. A, B, C and D).

Figure 5: Example of how to chart an Intervention

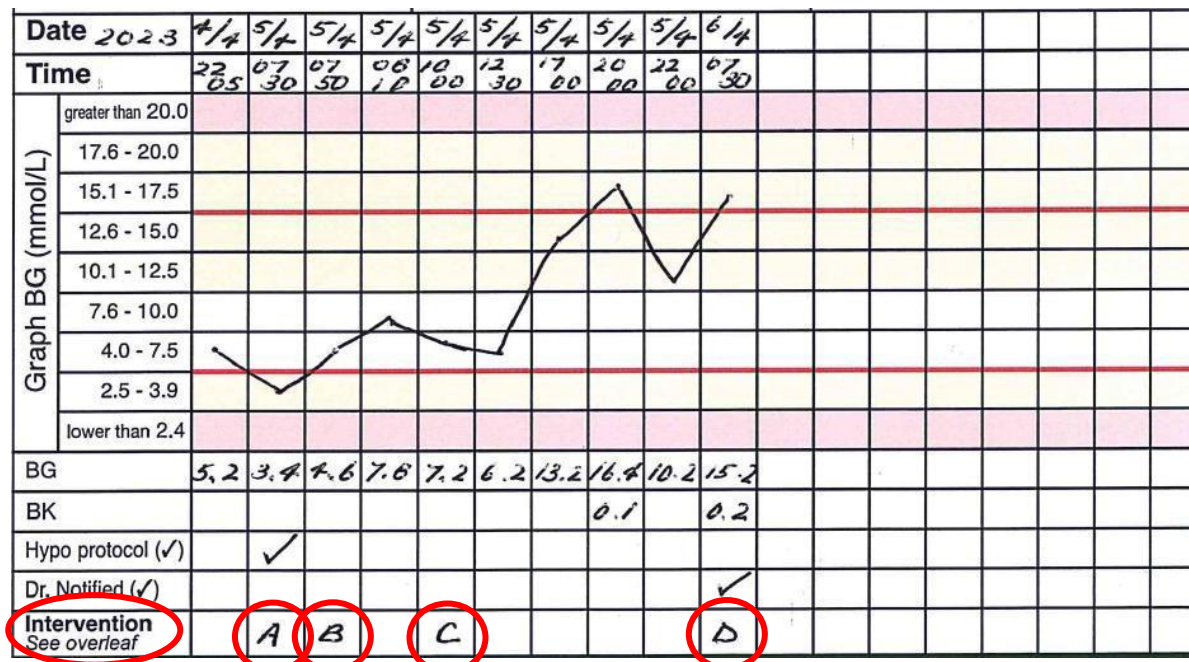


Figure 6 offers an example for documentation based on the four (4) events (e.g. A, B, C and D) that recorded in Figure 5.

Figure 6: Example of how the intervention box can be used

Interventions or Review				
Record intervention below and note corresponding letter in intervention row below graph.			Initial	Designation
A	60mL GTT 75 Glucose Drink		GA	RN
B	2 BISCUITS		GA	RN
C	REVIEWED by MD, medication change		GA	RN
D	BK check, RN notified		HP	EN
E	Notified MD of BG and BK result		GA	RN
F				

This notation in the Interventions and Review table should be brief with more detail documented in patient's medical record (e.g. in the hypoglycaemia example, further detail is recommended pertaining to assessment of safe to swallow, amount of glucose drink swallowed, amount of follow up complex carbohydrate eaten, review and subsequent action/s taken (e.g. medication titration etc).

It is not necessary to duplicate information in the Intervention table with what is captured elsewhere (e.g. in patient's medical record) or what is routine care (e.g. usual dose of insulin).

1.4 Escalation

In the event of out of target range blood glucose (BG) and/or blood ketone (BK) results, nursing/midwifery staff are to consult the *Rapid Detection and Response Instructions* and action recommendations.

Rapid Detection and Response Instruction	
<p>Senior Registered Nurse (RN) review when a blood glucose (BG) or blood ketone (BK) result is in the yellow zone:</p> <ul style="list-style-type: none"> • BG is less than 4.0mmol/L (refer to Hypoglycaemia Protocol) • BG between 10.1 - 20.0mmol/L • BK is between 0.1 - 0.9mmol/L <p>Review: Recheck BG and/or BK in 2 hours.</p>	<p>Multi-Disciplinary Team (MDT) review when a blood glucose (BG) or blood ketone (BK) result is in the red zone:</p> <ul style="list-style-type: none"> • BG is less than 2.5mmol/L or greater than 20.0mmol/L • Two consecutive BG results are greater than 15.0mmol/L • BK is greater than 1.0mmol/L <p>Review: Recheck BG and/or BK in 1 hour or when medically ordered.</p>
<p>A Medical Emergency Response (MER) review must occur when:</p> <ul style="list-style-type: none"> • Blood glucose (BG) is less than 4.0mmol/L and the patient is unconscious, unsafe to swallow or has not responded to the Hypoglycaemia Protocol oral treatment in 45 minutes. • The patient is drowsy, confused, breathing rapidly or having difficulty breathing or complaining of severe abdominal pain. <p>Review: Recheck BG and/or BK when medically ordered. Consult MedStar as may require transfer to HDU or ICU.</p>	

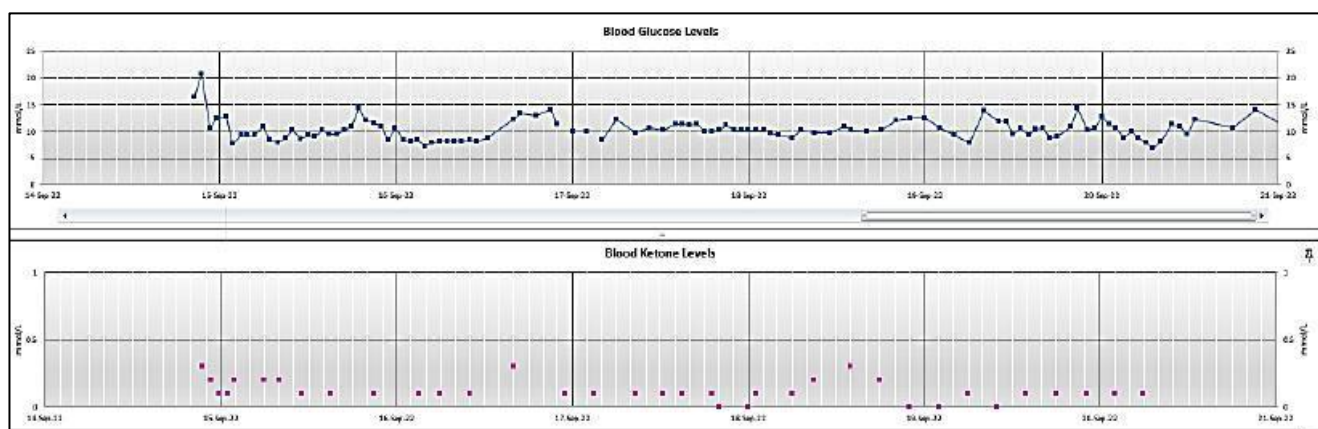
In the event the patient has responded well to a response (e.g. the regional LHN Protocol *Treatment of hypoglycaemia in people with diabetes in the hospital and community setting*), telephone reviews can be utilised. However, a diabetes treatment review by the medical practitioner on site should occur as soon as practicable.

Avoidable causes of hypoglycaemia or hyperglycaemia should be identified and corrected. If the cause is not identified or cannot be corrected, the patient’s medication regimens should be adjusted.

1.5 Alternative Documentation for Blood Glucose and Blood Ketone Monitoring

For regional LHN hospitals using electronic medical records (EMR) order sets, further information is available at the [BGL and Insulin Chart Window](#). Figure 7 offers an example of BG and BK documentation on EMR.

Figure 7: Example of EMR BG and BK documentation



Alternative regional LHN medication charts for monitoring blood glucose and blood ketones in the inpatient setting are:

- > *Hyperglycaemia Protocol and Basal Bolus Insulin Chart (MR62A)*
- > *Intravenous Insulin Infusion Type 1 Diabetes Chart – Adult (MR-INF-T1D)*
- > *Intravenous Insulin Infusion Type 2 Diabetes Chart – Adult (MR-INF-T2D).*

If either of these above mentioned charts are in use, cease using the MR59H as per the example offered in Figure 8.

However, in the event the patient is using a continuous subcutaneous insulin infusion (CSII or insulin pump), refer to regional LHN Protocol *Continuous Subcutaneous Insulin Infusion (CSII) in People with Diabetes in the Inpatient Setting*. The CSII (Insulin Pump) Inpatient Rate Record (MR-CIR) includes a consent and supports the person’s responsibilities related to the self-management of CSII while an inpatient. In this instance, whilst the patient documents their BG and BK results on the MR-CIR, nursing/midwifery staff are to document the BG and BK results on the *Blood Glucose and Blood Ketone Monitoring Chart (MR59H)*.

Figure 8: Discontinuation of blood glucose and blood ketone monitoring chart (MR59H) with reference to alternative chart (e.g. IV insulin infusion chart)

Date	20-23	4/4	4/4	4/4	4/4					
Time	13:00	14:00	15:00	16:00						
Graph BG (mmol/L)	greater than 20.0									
	17.6 - 20.0									
	15.1 - 17.5									
	12.6 - 15.0									
	10.1 - 12.5									
	7.6 - 10.0									
	4.0 - 7.5									
	2.5 - 3.9									
lower than 2.4										
BG	18.1	21.0	19.4	18.6						
BK	0.4	1.3	1.5	2.0						
Hypo protocol (✓)										
Dr. Notified (✓)		✓		✓						
Intervention See overleaf				A						
Interventions or Review										
Record intervention below and note corresponding letter in intervention row below graph.										
A	Transfer to IV insulin infusion chart							Ca	RN	

In the event the patient is using a continuous glucose monitor (CGM), refer to regional LHN Protocol *Continuous Glucose Monitoring (CGM) in the inpatient setting*. This protocol supports clinical decision making for supporting CGM use but stipulates that blood glucose results obtained from capillary BG meters must be used in assessment. This protocol identifies that nursing/midwifery staff responsibilities are to document the BG and BK results on the *Blood Glucose and Blood Ketone Monitoring Chart (MR59H)*.

2. Linked documents

- [Regional LHN Diabetic Ketoacidosis Management in Adults – Protocol](#)
- [Regional LHN | Hyperglycaemic Hyperosmolar State Management in Adults with Type 2 Diabetes – Protocol](#)
- [Regional LHN Protocol Hypoglycaemia in the Hospital and Community Setting](#)
- [Regional LHN Protocol Clinical Continuous Subcutaneous Insulin Infusion CSII Protocol](#)
- [Regional LHN CSII Inpatient Rate Record MR-CIR Example](#) (order via SA Distribution Centre)
- [Regional LHN Protocol Continuous Glucose Monitoring \(CGM\) in the inpatient setting](#)

References

Australian Diabetes Society (2012). *Guidelines for routine glucose control in hospital*. Sydney. ADS

Craig, M, S. Twigg, K. Donaghue, N. Cheung, F. Cameron, J. Conn, A. Jenkins and M. Silink (2011). *National evidence-based clinical care guidelines for type 1 diabetes in children, adolescents and adults*, Australasian Paediatric Endocrine Group and Australian Diabetes Society. Canberra, Australian Government Department of Health and Ageing.

Colagiuri, S, Dickinson, S, Girgis, S and Colagiuri, R (2009). *National evidence based guideline for blood glucose control in type 2 diabetes*. Canberra, Diabetes Australia and NHMRC.

3. Accreditation standards

National Safety and Quality Health Service Standards (2nd edition)

1	2	3	4	5	6	7	8
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Clinical Governance	Partnering with Consumers	Preventing & Controlling Healthcare Associated Infection	Medication Safety	Comprehensive Care	Communicating for Safety	Blood Management	Recognising & Responding to Acute Deterioration

Aged Care Quality Standards (includes home care clients)

1	2	3	4	5	6	7	8
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consumer Dignity & Choice	Ongoing Assessment & Planning with Consumers	Personal Care & Clinical Care	Services & Supports for Daily Living	Organisation's Service Environment	Feedback & Complaints	Human Resources	Organisational Governance

National Disability Insurance Scheme (NDIS) Practice Standards

CORE MODULE				SUPPLEMENTARY MODULES	
1	2	3	4	1	2
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rights and Responsibilities	Governance and Operational Management	Provision of Supports (to participants)	Provision of Supports (environment)	High Intensity Daily Personal Activities Module	Early Childhood Supports Module

4. Consultation

Version	Consultation
1.0	CHSA Directors of Nursing & Midwifery Services, CHSA Directors of Medical Services, CHSA Diabetes Educator Network.
2.0	Medication Portfolio Nurses, Medication Safety Workgroup, CHSA Diabetes Educator Network.
2.0B	This is an interim document until the 30th December 2019 while the current version is being reviewed and updated. Modifications have been made to the Aged Care Section.
3.0	Medication Portfolio Nurses, Medication Safety workgroup, Regional Diabetes Specialist Nurse Network.

Regional Local Health Networks do not accept any responsibility for the use of this material outside the scope for which it has been designed. This information is not intended to replace professional judgement or experience.