Revisiting insulin practices in Galway University Hospitals

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Abstract

Background: Injectable insulin formulations exhibit a notable propensity for errors and can cause significant patient harm when used inappropriately.

Aims: The aim was to conduct a second audit on insulin prescribing, administration and glucose monitoring practices in Galway University Hospitals since the initial audit in 2022.

Methods: This audit was conducted over one day in June 2023, approved by the local Clinical Audit Committee, piloted on four inpatients, and communicated to all data collectors prior to commencement. Generated data were anonymous and securely stored. Independent analysis was conducted by three researchers to confirm reliability of results.

Results: Five hundred and fifty-seven inpatients were reviewed, of whom 21% (116) had diabetes and 10% (56) were prescribed insulin. In total, 94% (265) insulin brand names and 94% (266) dose units were clearly prescribed, 90% (254) administration times were clearly specified by a prescriber, 80% (227) orders were signed, 70% (39) prescribers clearly documented their registration number/bleep/name at least once for contact purposes, 80% (210) administrations were double-checked by a second person, 58% (152) administration times were documented by a nurse, and 24% (9) inpatients were administered insulin by a nurse when not prescribed.

Conclusion: Results have identified an overall practice improvement. High-leverage strategies such as electronic prescribing are a current consideration to standardise practices. All aspects of this review are transferable to other hospitals. Disseminating results and promoting transferable benefits should encourage participation of all Irish hospitals to conduct a standardised national annual insulin audit to improve patient care.

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Introduction

Diabetes mellitus imposes a heavy burden on public health and socio-economic development and is currently one of the largest global public health concerns, mainly due to rising levels of obesity and an ageing population.[1] Prevalence is on the increase, with one in 16 individuals in Ireland diagnosed with diabetes.[2] Globally, the incidence is expected to rise from 537 million in 2021 to 783 million in 2045, which equates to one in eight adults.[3] Injectable insulins are high-alert critical medicines used in the treatment of diabetes mellitus which can cause significant patient harm when used inappropriately and are one of the most frequently reported medication incidents in Ireland.[4-6] Omission errors leading to hyperglycaemia and incorrect doses leading to hyper- or hypoglycaemia are the most frequently reported errors related to insulin in UK and US hospitals.[7,8] The most recently published National Inpatient Diabetes Audit (NaDIA) – Harms conducted in 2020 in acute hospitals in England found the majority of inpatient harms relate to hypoglycaemic rescue.[9] The risk of hyperosmolar hyperglycaemic state is higher in stroke patients and the rate of hospital-acquired diabetes ketoacidosis (DKA) is higher in surgical patients.[9] Overall, those experiencing inpatient harms are more likely to be admitted as an emergency, be of white ethnicity, have type 1 diabetes (T1DM), and have not met the combined treatment target for HbA_{1c}, cholesterol and blood pressure.[9] In addition to adverse health outcomes, the financial burden of managing diabetes in the Irish healthcare system is estimated at €2 billion annually.[10] Yearly incremental costs are estimated at €89 million, with hospital admissions accounting for 67% of these costs.[10-12]

Insulin preparations have been identified as a significant medication safety concern in Galway University Hospitals (GUH), which comprises University Hospital Galway (UHG) and Merlin Park University Hospital (MPUH) in the West of Ireland. Local medication incident reports pertaining to insulin predominantly relate to delayed or omitted doses of either long-acting or rapid-acting insulin in patients living with T1DM, leading to hyperglycaemia and temporary patient harm requiring intervention. The first hospital-wide insulin audit in GUH was conducted in March 2022.[13] The overall insulin error rate with

one or more errors comprising prescribing and/or administration per inpatient drug record was 90%.[13] Based on these audit results, as well as evidence from local insulin error reporting, local practices and best practice,[14,15] multiple interventions have been implemented in GUH which are transferrable to other hospitals. These include: the appointment of a senior clinical pharmacist with a special interest in diabetes (June 2022); an updated Insulin and Glucose Monitoring Record (Appendix 1 online, November 2022, previous edition June 2019); a bespoke eLearning module for the safe use of high-alert medications specific to GUH for all doctors, nurses and pharmacy staff which includes a section on insulin (March 2023);[16] continuous education on appropriate insulin use for medical, nursing and pharmacy undergraduate students and employees in GUH as well as for patients and carers; updated/newly approved local guidelines; use of hospital screens and social media to disseminate pertinent information; and promotion of medication incident reporting.

The aim of the current study was to conduct a similar audit on insulin prescribing, administration and glucose monitoring practices in order to assess performance since the previous audit, to identify and develop further quality improvement initiatives as needed, and to encourage participation of all Irish hospitals in conducting a standardised annual insulin audit by disseminating results and promoting benefits.

Methods

A prospective audit was conducted over one day in June 2023 on 24 wards in GUH; similar to the 2022 audit. Inclusion criteria comprised inpatients prescribed/administered an insulin pen during the previous 72 hours to 9am on the morning of the audit. Exclusion criteria comprised non-admitted patients, Day Wards/Emergency Department/Acute Medical Unit/Short Stay Unit/Emergency Surgical Unit (most patients not admitted/not prescribed insulin for previous 72 hours), Critical Care (most patients on variable rate insulin infusion), Maternity (different insulin chart), and Psychiatry (separate governance structure to acute setting). No data were collected in relation to patients' food intake and subsequent adjustments. Content of the audit protocol and tool was informed by the research objective, local practices and existing evidence-based international and national literature. The audit tool was piloted on a medical ward in UHG with four random inpatients prescribed/administered insulin and was thereafter excluded from data analysis. The audit was led by two lead researchers and conducted by 26 interprofessional data collectors comprising endocrine consultant and non-consultant hospital doctors, diabetes nurse specialists and pharmacists. The audit tool was guided by the protocol, which was communicated to all data collectors via video conferencing and face-to-face meetings and emails. This audit was approved by the GUH Clinical Audit Committee and conducted in accordance with the HSE Code of Governance (2021) and HSE Healthcare Audit Quality Assurance and Verification Standards (2019), which was shared and agreed in person with the wider team prior to commencement.

All audit forms were anonymous and securely stored in a locked cabinet, and all generated data were securely stored on an encrypted password-protected work computer. Any audit records will be destroyed after full dissemination of audit findings. Independent analysis was conducted by three researchers to confirm reliability of results. This process involved independently inputting content from paper audit forms into Excel, analysing data and comparing results. No significant discrepancies were identified.

Results

General participation and prevalence

In total, 557 inpatients met the inclusion criteria and were reviewed on the day of the audit. Fifty-six (10%) inpatients were prescribed insulin. The number of inpatients using an Insulin and Glucose Monitoring Record was 149 (27%), of whom 116 inpatients (21%) had a documented history of diabetes. This equates to 48% of all inpatients with diabetes who were treated with insulin. The remaining Insulin and Glucose Monitoring Record use was for inpatients on steroids or parenteral nutrition. Patient specialties were medical (46; 82%) and surgical (10; 18%). There were no paediatric inpatients prescribed insulin at the time of audit. The updated version of the Insulin and Glucose Monitoring Record was used for 52% of inpatients. Insulin was referred to in the main drug record in 41% of charts (e.g. 'on insulin, see chart') as a reminder to assist with unintended dose delays or omissions during hospital admission and at discharge.

Insulin prescribing patterns

Thirty-five inpatients (n=56; 63%) were prescribed regular insulin prior to admission, of whom 27 inpatients (n=35; 77%) were prescribed the same insulin as pre-admission. Twenty-one inpatients (n=56; 37%) were not prescribed regular insulin prior to admission and were either prescribed a meal-time supplement (18 inpatients; n=21; 86%) or newly prescribed regular insulin on admission (three inpatients; n=21; 14%). A total of 283 insulin doses were prescribed, of which 265 orders (94%) had the insulin name clearly documented. As illustrated in Figure 1, most insulin names, dose units and administration times were clearly specified and signed by the prescriber. Thirty-nine prescribers (n=56; 70%) clearly documented their medical council registration number (MCRN)/bleep/name on the Insulin and Glucose Monitoring Record at least once for contact purposes.

Insulin administration patterns

Two hundred and sixty-four doses were administered, of which 210 (80%) were double-checked by an independent second person and 152 (58%) had the administration times documented (Figure 2). Nine inpatients (n-38; 24%) were administered insulin by a nurse when not prescribed. No insulin doses were self-administered as no hospital-wide self-administration policy is in situ in GUH.

Overall insulin error rate per inpatient drug record

The overall insulin error rate with one or more errors comprising prescribing and/or administration per Insulin and Glucose

Figure 1. Insulin prescribing patterns

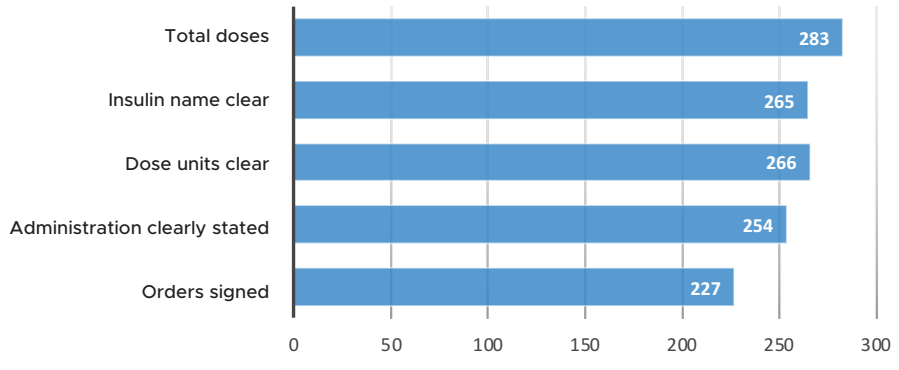


Figure 2. Insulin administration patterns

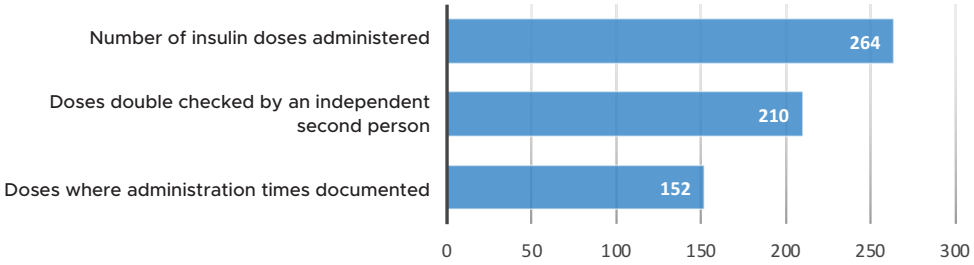


Table 1. Colour-coded comparison between overall insulin error rates per inpatient drug record 2023 and 2022

Error description	Error % 2023	Error % 2022	Error type	
Insulin name **not** clearly prescribed	6%	5%	Prescribing error	
Insulin dose units **not** clearly prescribed	6%	11%		
Insulin administration times **not** clearly specified by the prescriber	10%	16%	63% 2023	80% 2022
Insulin orders **not** signed by the prescriber	20%	13%		
Prescriber MCRN, bleep OR name **not** clear for contact purposes	30%	42%		
Insulin doses **not** double checked by an independent second person	20%	30%	Administration error	
Insulin doses with administration times **not** documented	42%	47%		
Patients where a nurse administered insulin when **not** prescribed	24%	26%	84% 2023	89% 2022

Overall Error 95% 2023 90 % 2022

Monitoring Record was 95% (n=38). Table 1 illustrates overall insulin error rates per inpatient drug record and compares audit results between 2023 and 2022.

Meal-time supplement

Forty-one inpatients (73%) had the meal-time supplement documented. Results are illustrated in Figure 3 (n=169).

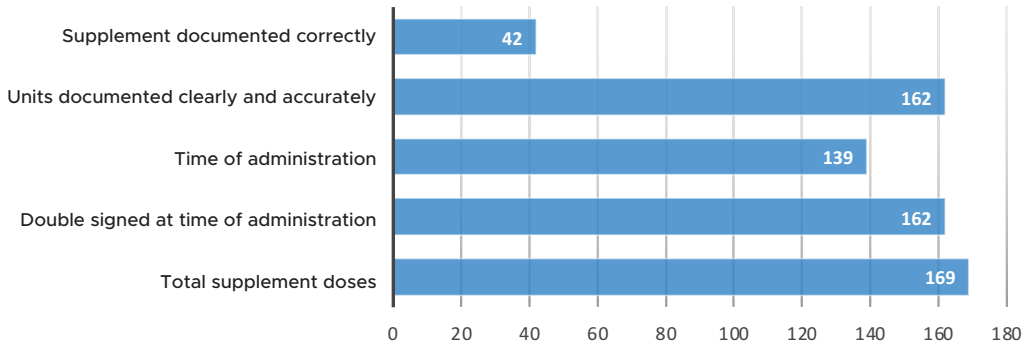
Glucose management

The GUH diabetes team reviewed or was contacted to review 30 inpatients' insulin requirements (n=56; 54%). Fifteen inpatients had changes to their regular insulin doses (n=38; 39%). Four inpatients had an episode of hypoglycaemia due to poor dietary intake, of whom two inpatients had an omission of insulin post hypoglycaemia.

Discussion

Of the 557 inpatients reviewed, 10% were prescribed insulin and 21% had diabetes. A similar audit conducted in GUH in 2022 found that 9% of inpatients were insulin-dependent and 17% had

Figure 3. Meal time supplement insulin patterns



diabetes.[13] Comparable clinical audits of inpatient diabetes care such as the NaDIA 2019 and the Queensland Inpatient Diabetes Survey (QuIDS) 2019 report the proportion of inpatients with diabetes at 18% and 24%, respectively.[17,18]

Most inpatients in this audit were medical rather than surgical and were prescribed the same insulin as pre-admission. All inpatients who were not prescribed the same insulin as pre-admission had their insulin altered by the diabetes team during admission and were therefore appropriately changed. The remaining inpatients were not on insulin pre-admission and were either prescribed a meal-time supplement or were newly prescribed insulin on admission.

The updated Insulin and Glucose Monitoring Record was rolled out as a phased implementation in November 2022 and was used in 52% of charts reviewed (Appendix 1 - online). Whilst there may not have been enough time between the two audits for its full effects to be realised, as per best practice, this yellow colour-coded record is both user-friendly and informative. It includes information on blood glucose monitoring, insulin prescribing, brand names, continuation of long-acting insulin, hypoglycaemia treatment, meal-time supplement and peri-operative guidance to minimise insulin errors and improve patient safety.[15] Since conducting this audit in June 2023, an updated version of the chart has been approved due to the recent discontinuation of the recommended referenced perioperative fluid and the introduction of non-referenced blood ketone monitors. All older versions have been removed from each ward and replaced with the most recent version.

The overall insulin error rate per inpatient drug record remains high in GUH, at a rate of 95% compared with 90% in the 2022 audit,[13] and 39% and 18% insulin error rates documented in NaDIA and QuIDS, respectively.[17,18] Prescribing errors inclusive of unclear documentation which can cause patient harm comprised 63% of records, an improvement from 80% in 2022. Twenty percent of all insulin orders were not signed by a prescriber, compared to 13% the previous year. Administration errors inclusive of failure to double-check at the bedside and administering insulin when not prescribed, which can equally cause patient harm, comprised 84% of records, similar to the 89% error rate observed in 2022. This may be partly due to non-compliance with the local insulin policy, which requires insulin to be prescribed every 24 hours inclusive of the morning dose and omission to prescribe same thereafter. While the overall insulin error rate does not suggest an improvement since the initial audit, there is evidence of positive change in insulin prescribing practices. More than nine out of 10 prescribers clearly documented the correct insulin name, dose and administration times, and 70% of prescribers are now documenting a MCRN, bleep or name for contact purposes compared to 58% the previous year. The impact of a new diabetes pharmacist, an updated Insulin and Glucose Monitoring Record and engaging healthcare professionals in education sessions on insulin prescribing have likely assisted in better insulin prescribing practices.

With regards to insulin administration, failure to document administration times was noted in 42% of instances compared with 47% the previous year. Insulin was not double-checked by a second independent individual in 20% of cases, compared with 30% in 2022. As a high-alert medication, it is important that administration times are documented and a two-person check is in place to ensure that the correct medication, at the prescribed dose, is administered at the right time and to the right patient. Both audits identified that one in four inpatients are administered insulin when not prescribed. All insulin doses should be prescribed prior to nurse administration to avoid adverse outcomes. No hospital-wide self-administration policy is in situ in GUH. Locally agreed practice is that insulin pens are supplied by the hospital pharmacy, stored on the ward away from the patient, two nurses double-check the insulin pen, and the patients themselves administer insulin when able, this being witnessed and signed by the nurses. Currently there is an insulin self-administration policy pilot in place on three wards in UHG for inpatients with T1DM. Widespread roll-out will be supported for suitable inpatients when more bedside locked press infrastructure is available.

Meal-time supplement insulin is routinely prescribed in GUH. Twenty-two percent of incidences were not signed by prescribers, compared to 39% in 2022. This is similar to regular

Key messages

- Insulin use is rising in the inpatient setting
- Insulin error rates remain high per inpatient drug record
- Strategies such as the implementation of hospital-wide electronic prescribing systems which have the potential to reduce insulin errors as well as conducting standardised national annual insulin audits in hospitals should be considered to enhance patient care

insulin prescribing, and an improvement in prescribing practices, but still requires better compliance. Targeted education on documenting meal-time supplement insulin correctly is required to minimise risk of errors and patient harm.

The GUH diabetes team reviewed or was contacted to review more than half of inpatients on insulin and was involved with all inpatients who had their regular insulin changed during admission. The NaDIA 2019 reported that 75% of inpatients were reviewed by the diabetes team, with the proportion increasing to 78% when seven-day diabetes inpatient specialist nurse cover was provided.[17] Four inpatients had an episode of hypoglycaemia, of whom two inpatients had an omission of insulin post hypoglycaemia. A separate local audit was conducted in 2024 to review episodes of hypoglycaemia and the reasons for same, including a review of meals consumed.

Future interventions for consideration include high-leverage strategies such as electronic prescribing as a part of the newly implemented Hospital Medicines Management System. The NaDIA 2019 report found that insulin errors reduced if electronic prescribing was in use.[17] Participation by Irish hospitals in an annual audit on insulin prescribing, administration and glucose monitoring practices similar to the UK should be considered to enhance insulin management and patient care. It is anticipated that results of a re-audit in GUH will be favourable.

Conflict of interest The authors declare they have no conflict of interest.
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Appendix

GUH Subcutaneous Insulin and Glucose Monitoring Record **Patient Name:** **BN:** **DOB:** **p1**

GUH Adult Subcutaneous INSULIN & Glucose Monitoring Record

Refer to this chart in the patient's main drug chart by writing *'See insulin chart'* in regular medicines section
(Prescribe all NON-INSULIN diabetes medication in main drug chart)

Always use an INSULIN syringe when drawing up insulin from vials.
Never use a syringe to draw insulin from a pen or cartridge.

AFFIX ADDRESSOGRAPH HERE

AFFIX ADDRESSOGRAPH HERE

Consultant	**Ward**

PRESCRIBER TO COMPLETE:

Baseline HbA1c: ..... mmol/mol

Diabetes type (tick as appropriate)

Type 1 ☐ On insulin ☐ On insulin pump ☐

Type 2 ☐ On non-insulin hypoglycaemic agents ☐

OTHER ☐ (e.g. TPN, steroids, etc.) Specify:.....

Cautions	**Prescribe subcutaneous insulin for next 24 hours - <u>including</u> next day 0800h dose If patient is stable on Friday, prescribe doses for weekend <u>including</u> Monday morning dose**
In Type 1 diabetes	**NEVER hold the LONG-ACTING or INTERMEDIATE-ACTING insulin** (the dose may need to be reduced in certain circumstances)
	Consider **checking for urinary ketones** if the patient is unwell or **blood glucose is GREATER THAN 16mmol/L**
Prescribing insulin	The only acceptable form of expressing insulin doses is in "**units**" (failure to comply can be extremely hazardous). **Insulin may be prescribed as a dose range ONLY for patients deemed appropriate by the diabetes team**
Diabetic Ketoacidosis	This document is **NOT** to be used for the treatment of Diabetic Ketoacidosis (DKA) - **Use separate DKA chart**
Hyperosmolar Hyperglycaemic state	This document is **NOT** to be used for the treatment of Hyperosmolar Hyperglycaemic state (HHS) - **Use separate HHS chart**
Complex hyperglycaemia	This document is **NOT** to be used for the delivery of variable rate INTRAVENOUS insulin infusion (VRIII) – Separate chart
Discharging patients	Ensure that any changes to the regimen made during hospitalisation are reviewed and appropriate for the patient on discharge. All changes to insulin regimen (and other medicines) must be documented on discharge
Insulin **PUMP**	**Use separate *Guideline for in-hospital use of insulin pumps*** **NEVER DISCONNECT insulin pump from patient** unless going for MRI, X-ray or CT or in severe hypoglycaemia. Ensure **PUMP IS RECONNECTED** afterward. PUMP should NEVER be disconnected for more than ONE hour
SUPPLEMENTS	**Supplementary insulin** should be charted as "SUPPLEMENT".

Hypoglycaemia Treatment

(See 'HypoKit' containing drug treatment in clinical room)

CONSCIOUS patient with glucose less than 4mmol/L	- 15g of short-acting carbohydrate e.g. 5 glucose (dextrose) sweets or sweetened drink such as 60mL Glucojuice (located in ward HypoKit) - Repeat glucose measurement 15 minutes later
Unconscious patient with glucose less than 4mmol/L	Inform Doctor immediately and administer 100mL of **<u>20%</u>** glucose IV infused over 10 minutes **OR** 1mg of glucagon intramuscular injection (IM)**. Prescribe on main drug chart**
Patients on insulin **PUMP**	The patient should be treated according to the usual protocol and the Diabetes team should be informed

Circle Insulin/s Prescribed PRE-ADMISSION

Rapid acting analogue insulin	Short acting human insulin	Intermediate acting human insulin	Pre-mixed analogue insulin	Pre-mixed human insulin	Long acting analogue insulin
Novo**RAPID**		Insulatard	Novo**MIX** (30)	Insuman Comb (15)	Lantus
Humalog*	Actrapid	Humulin **I**	Humalog **Mix** (25)	Insuman Comb (25)	Levemir
Apidra	Humulin **S**	Insuman Basal	Humalog **Mix** (50)	Insuman Comb (50)	Tresiba*
Fiasp**				Humulin **M3**	Toujeo (300) units/ml

*** Caution: Humalog and Tresiba available in multiple strengths** – always CHECK the strength prescribed

**** Fiasp must ONLY be administered during or soon after a meal (not before)**

GUH Subcutaneous Insulin and Glucose Monitoring Record **Patient Name:** **BN:** **DOB:** **p2**

Clinical judgement must be applied at all times in the use of this document

Blood glucose: Pre-meal **Dose**: During or Pre-meal	**Time**	**MONITORING**		**INSULIN PRESCRIPTION**										**ADMINISTRATION**		
		Blood Glucose (mmol/L)	**Ketones** (mmol/L)	**Insulin** ***Write Brand name*** ***(write "SUPPLEMENT" for supplement doses)***										**Dose (or Dose range) prescribed**	**Prescriber** (signature, bleep & MCRN)	**Dose Given**	**Nurse / Checker Initials**	**Time**
e.g 0800	h	*7.3* mmol/L		*N*	*o*	*v*	*o*	*M*	*I*	*X*	*30*			*12* units	*Dr A Sugar #777, MCN 2424255*	*12* units	*ML* / *JC*	*0810* h
e.g 1200	h	*12.5* mmol/L		*S*	*U*	*P*	*P*	*L*	*E*	*M*	*EN*	*T*		*3* units	*Dr A Sugar #777, MCN 2424255*	*3* units	*ML* / *JC*	*1205* h
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		h
Pre-breakfast	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L																
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		H
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		H
Pre-breakfast	h	mmol/L												units		units		H
	h	mmol/L												units		units		H
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		h
Pre-breakfast	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h

Appendix

GUH Subcutaneous Insulin and Glucose Monitoring Record **Patient Name:** **BN:** **DOB:** **p3**

Blood glucose: Pre-meal Dose: During or Pre-meal	Time	MONITORING		INSULIN PRESCRIPTION										ADMINISTRATION		
		Blood Glucose (mmol/L)	Ketones (mmol/L)	Insulin *Write Brand name (write "SUPPLEMENT" for supplement doses)*										Dose (or Dose range) prescribed	Prescriber (signature, bleep & MCRN)	Dose Given	Nurse / Checker Initials	Time
e.g 0800	h	*7.3* mmol/L		*N*	*o*	*v*	*o*	*M*	*I*	*X*	*30*			*12* units	*Dr A Sugar #777, MCN 2424255*	*12* units	*ML* / *JC*	*0810* h
e.g 1200	h	*12.5* mmol/L		*S*	*U*	*P*	*P*	*L*	*E*	*M*	*EN*	*T*		*3* units	*Dr A Sugar #777, MCN 2424255*	*3* units	*ML* / *JC*	*1205* h
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		h
Pre-breakfast	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L																
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		H
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		H
Pre-breakfast	h	mmol/L												units		units		H
	h	mmol/L												units		units		H
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h

The following tables may be used for patients with pre-meal blood glucose persistently GREATER THAN 10mmol/L. **Doses should be adjusted after 24 to 48 hours according to requirements**. When **administering** supplemental insulin doses, please write "**SUPPLEMENT**" in insulin prescription column and dose given. Timing of supplemental insulin may vary for patients on **enteral or parenteral feeding.**

Blood glucose (mmol/L)	MEAL TIME SUPPLEMENT for NON-Periop patients			
	NovoRAPID Dose *(cross out if using alternative scale/insulin)*	Alternative scale/insulin:	Alternative scale/insulin:	Alternative scale/insulin: .....
10 to 11.9	2 units	units	units	units
12 to 13.9	3 units	units	units	units
14 to 17.9	4 units	units	units	units
Greater than 18	5 units, and check urinary ketones & inform doctor	units	units	units
Prescriber signature ..... **MCRN** ..... **Date** ..... **Time**		**Prescriber signature & MCRN:** ..... **Date & Time:**	**Prescriber signature & MCRN:** ..... **Date & Time:**	**Prescriber signature & MCRN:** ..... **Date & Time:** .....

Notify doctor immediately if Blood Glucose Level > 20mmol/L	**Notify doctor if 3 consecutive Blood Glucose levels >12mmol/L**
Notify doctor if **2 consecutive** Blood Glucose levels **>16mmol/L**	**Treat HYPOGLYCAEMIA and notify doctor IMMEDIATELY if Blood Glucose Level < 4mmol/L**

GUH Subcutaneous Insulin and Glucose Monitoring Record **Patient Name:** **BN:** **DOB:** **p4**

Blood glucose: Pre-meal **Dose**: During or Pre-meal	**Time**	**MONITORING**		**INSULIN PRESCRIPTION**											**ADMINISTRATION**		
		Blood Glucose (mmol/L)	**Ketones** (mmol/L)	**Insulin** ***Write Brand name*** *(write "SUPPLEMENT" for supplement doses)*										**Dose (or Dose range) prescribed**	**Prescriber** (signature, bleep & MCRN)	**Dose Given**	**Nurse / Checker Initials**	**Time**
e.g 0800	h	*7.3* mmol/L		*N*	*o*	*v*	*o*	*M*	*I*	*X*	*30*			*12* units	*Dr A Sugar #777, MCN 2424255*	*12* units	*ML* / *JC*	*0810* h
e.g 1200	h	*12.5* mmol/L		*S*	*U*	*P*	*P*	*L*	*E*	*M*	*EN*	*T*		*3* units	*Dr A Sugar #777, MCN 2424255*	*3* units	*ML* / *JC*	*1205* h
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		h
Pre-breakfast	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L																
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		H
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		H
Pre-breakfast	h	mmol/L												units		units		H
	h	mmol/L												units		units		H
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		h
Pre-breakfast	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	hh	mmol/L												units		units		h
	h	mmol/L												units		units		h

Appendix

GUH Subcutaneous Insulin and Glucose Monitoring Record **Patient Name:** **BN:** **DOB:** **p5**

Blood glucose: Pre-meal Dose: During or Pre-meal	Time	MONITORING		INSULIN PRESCRIPTION										ADMINISTRATION		
		Blood Glucose (mmol/L)	Ketones (mmol/L)	Insulin *Write Brand name (write "SUPPLEMENT" for supplement doses)*									Dose (or Dose range) prescribed	Prescriber (signature, bleep & MCRN)	Dose Given	Nurse / Checker Initials	Time
e.g 0800	h	*7.3* mmol/L		*N*	*o*	*v*	*o*	*M*	*I*	*X*	*30*		*12* units	*Dr A Sugar #777, MCN 2424255*	*12* units	*ML* / *JC*	*0810* h
e.g 1200	h	*12.5* mmol/L		*S*	*U*	*P*	*P*	*L*	*E*	*M*	*EN*	*T*	*3* units	*Dr A Sugar #777, MCN 2424255*	*3* units	*ML* / *JC*	*1205* h
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																
	h	mmol/L											units		units		h
Pre-breakfast	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
Pre-lunch	h	mmol/L											units		units		h
	h	mmol/L															
	h	mmol/L											units		units		h
Pre-dinner	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		H
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																
	h	mmol/L											units		units		H
Pre-breakfast	h	mmol/L											units		units		H
	h	mmol/L											units		units		H
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
Pre-lunch	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
Pre-dinner	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h

The following tables may be used for patients with pre-meal blood glucose persistently GREATER THAN 10mmol/L. **Doses should be adjusted after 24 to 48 hours according to requirements**. When **administering** supplemental insulin doses, please write "**SUPPLEMENT**" in insulin prescription column and dose given. Timing of supplemental insulin may vary for patients on **enteral or parenteral feeding.**

Blood glucose (mmol/L)	MEAL TIME SUPPLEMENT			
	NovoRAPID Dose *(cross out if using alternative scale/insulin)*	Alternative scale/insulin:	Alternative scale/insulin:	Alternative scale/insulin: .....
10 to 11.9	2 units	units	units	units
12 to 13.9	3 units	units	units	units
14 to 17.9	4 units	units	units	units
Greater than 18	5 units, and check urinary ketones & inform doctor	units	units	units
Prescriber signature ..... **MCRN**		**Prescriber signature & MCRN:**	**Prescriber signature & MCRN:**	**Prescriber signature & MCRN:** .....
Date ..... **Time**		**Date & Time:**	**Date & Time:**	**Date & Time:** .....

Notify doctor immediately if Blood Glucose Level > 20mmol/L	**Notify doctor if 3 consecutive Blood Glucose levels >12mmol/L**
Notify doctor if **2 consecutive** Blood Glucose levels **>16mmol/L**	**Treat HYPOGLYCAEMIA and notify doctor IMMEDIATELY if Blood Glucose Level < 4mmol/L**

GUH Subcutaneous Insulin and Glucose Monitoring Record **Patient Name:** **BN:** **DOB:** **p6**

Blood glucose: Pre-meal Dose: During or Pre-meal	Time	MONITORING		INSULIN PRESCRIPTION										ADMINISTRATION		
		Blood Glucose (mmol/L)	Ketones (mmol/L)	Insulin *Write Brand name (write "SUPPLEMENT" for supplement doses)*									Dose (or Dose range) prescribed	Prescriber (signature, bleep & MCRN)	Dose Given	Nurse / Checker Initials	Time
e.g 0800	h	7.3 mmol/L		N	o	v	o	M	I	X	30		12 units	Dr A Sugar #777, MCN 2424255	12 units	ML / JC	0810 h
e.g 1200	h	12.5 mmol/L		S	U	P	P	L	E	M	EN	T	3 units	Dr A Sugar #777, MCN 2424255	3 units	ML / JC	1205 h
Date		**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**															
	h	mmol/L											units		units		h
Pre-breakfast	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
Pre-lunch	h	mmol/L											units		units		h
	h	mmol/L															
	h	mmol/L											units		units		h
Pre-dinner	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		H
Date		**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**															
	h	mmol/L											units		units		H
Pre-breakfast	h	mmol/L											units		units		H
	h	mmol/L											units		units		H
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
Pre-lunch	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
Pre-dinner	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
Date		**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**															
	h	mmol/L											units		units		h
Pre-breakfast	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
Pre-lunch	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
Pre-dinner	h	mmol/L											units		units		h
	h	mmol/L											units		units		h
	hh	mmol/L											units		units		h
	h	mmol/L											units		units		h

Appendix

GUH Subcutaneous Insulin and Glucose Monitoring Record **Patient Name:** **BN:** **DOB:** **p7**

Blood glucose: Pre-meal Dose: During or Pre-meal	Time	MONITORING		INSULIN PRESCRIPTION										ADMINISTRATION		
		Blood Glucose (mmol/L)	Ketones (mmol/L)	Insulin *Write Brand name (write "SUPPLEMENT" for supplement doses)*										Dose (or Dose range) prescribed	Prescriber (signature, bleep & MCRN)	Dose Given	Nurse / Checker Initials	Time
e.g 0800	h	*7.3* mmol/L		*N*	*o*	*v*	*o*	*M*	*I*	*X*	*30*			*12* units	*Dr A Sugar #777, MCN 2424255*	*12* units	*ML* / *JC*	*0810* h
e.g 1200	h	*12.5* mmol/L		*S*	*U*	*P*	*P*	*L*	*E*	*M*	*EN*	*T*		*3* units	*Dr A Sugar #777, MCN 2424255*	*3* units	*ML* / *JC*	*1205* h
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		h
Pre-breakfast	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L																
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		H
Date	**TPN/ Enteral feed ☐ Steroids ☐ Fasting ☐ Dialysis day ☐ (see Page 1) Comments:**																	
	h	mmol/L												units		units		H
Pre-breakfast	h	mmol/L												units		units		H
	h	mmol/L												units		units		H
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-lunch	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
Pre-dinner	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h
	h	mmol/L												units		units		h

The following tables may be used for patients with pre-meal blood glucose persistently GREATER THAN 10mmol/L. **Doses should be adjusted after 24 to 48 hours according to requirements**. When **administering** supplemental insulin doses, please write "**SUPPLEMENT**" in insulin prescription column and dose given. Timing of supplemental insulin may vary for patients on **enteral or parenteral feeding.**

Blood glucose (mmol/L)	MEAL TIME SUPPLEMENT			
	NovoRAPID Dose *(cross out if using alternative scale/insulin)*	Alternative scale/insulin:	Alternative scale/insulin:	Alternative scale/insulin: .....
10 to 11.9	2 units	units	units	units
12 to 13.9	3 units	units	units	units
14 to 17.9	4 units	units	units	units
Greater than 18	5 units, and check urinary ketones & inform doctor	units	units	units
Prescriber signature ..... **MCRN** ..... **Date** ..... **Time**		**Prescriber signature & MCRN:** ..... **Date & Time:**	**Prescriber signature & MCRN:** ..... **Date & Time:**	**Prescriber signature & MCRN:** ..... **Date & Time:** .....

Notify doctor immediately if Blood Glucose Level > 20mmol/L	**Notify doctor if 3 consecutive Blood Glucose levels >12mmol/L**
Notify doctor if **2 consecutive** Blood Glucose levels **>16mmol/L**	**Treat HYPOGLYCAEMIA and notify doctor IMMEDIATELY if Blood Glucose Level < 4mmol/L**

GUH Subcutaneous Insulin and Glucose Monitoring Record **Patient Name:** **BN:** **DOB:** **p8**

Patient Name: .....
Board No.: .....
Date of Birth: .....

Perioperative/Fasting Section ONLY

For use until first meal post-op/post-fast

Select the patient's diabetes type below (*Tick appropriate box*)

Diet controlled Type 2 diabetes *Tick if applicable* ☐

- Monitor glucose 2 hourly
- **If 2 consecutive readings are GREATER than 12mmol/L**, administer subcutaneous insulin according to perioperative supplemental scale below and IV Fluids as outlined below

On non-insulin hypoglycaemic agents *Tick if applicable* ☐

- **Hold** all non-insulin anti-diabetic medications on the morning of procedure.
- ***SGLT2 inhibitors*** (e.g. canagliflozin, dapagliflozin, empagliflozin, ertugliflozin) should be held for the duration of any fasting, any bowel prep, in severe illness and for 48 hours afterwards
- Monitor glucose every 2 hours
- **If 2 consecutive glucose readings are GREATER than 12mmol/L**, administer subcutaneous insulin according to perioperative supplemental scale below and IV Fluids as outlined below

On insulin

Patient's insulin regimen	Day BEFORE procedure	Day OF procedure	*Tick one*
On TDS rapid or short-acting insulin with long-acting/intermediate-acting insulin	No change in normal insulin doses	Long-acting/intermediate-acting insulin plus **perioperative** supplemental insulin scale (*see below*)	
On TWICE daily regimen (e.g. NovoMIX)	No change in normal insulin doses	1/3 of morning (AND evening dose if still fasting) plus **perioperative** supplemental insulin scale (*see below*)	
Long-acting insulin ONLY	No change in normal insulin doses	Long-acting insulin plus **perioperative** supplemental insulin scale (*see below*)	
On Insulin PUMP	No change	Reduce the basal rate by 10% from 0700h plus **perioperative** supplemental insulin scale (*see below*)	

and **IV Fluids** as outlined below

IV Fluids - for ALL[1] patients on insulin, and for patients on non-insulin hypoglycaemic agents with poor control[2]

NOTES: **1. This regimen does not apply to patients on dialysis** - please consult nephology/endocrinology services
2. Poor control = HbA1c GREATER than 64mmol/mol or ward glucose levels persistently GREATER than 12mmol/L

*(Tick one below **AND** prescribe on IV Fluids page in main drug chart)*

Patient NOT susceptible to hyperkalaemia:	Commercially manufactured bag of **500ml of 0.45% sodium chloride/5% glucose/20mmol potassium** at 100ml per hour from 0700h on the morning of surgery	*Tick one*
Patient SUSCEPTIBLE to hyperkalaemia (e.g. renal failure, high potassium):	Commercially manufactured bag of **500ml of 0.45% sodium chloride/5% glucose** at 100ml per hour from 0700h on the morning of surgery	*Tick one*

Choose your PERIOPERATIVE subcutaneous insulin regimen

Check glucose every 2 hours. If standard scale is not adequate, or patient is taking an alternative rapid/short insulin to NovoRAPID (e.g. Apidra, Humalog or Actrapid), prescribe this in the "alternative insulin" box below.

Blood glucose (mmol/L)	PERIOPERATIVE Subcutaneous Supplemental Scale			
	NovoRAPID Dose *(cross out if using alternative scale/insulin)*	Alternative scale/insulin:	Alternative scale/insulin:	Alternative scale/insulin: .....
0 to 7.9	0 units	units	units	units
8 to 11.9	2 units	units	units	units
12 to 13.9	4 units	units	units	units
14 to 17.9	6 units	units	units	units
Greater than 18	6 units, and check urinary ketones & inform doctor	units	units	units
Prescriber signature ..... **MCRN** ..... **Date** ..... **Time**		**Prescriber signature & MCRN:** ..... **Date & Time:**	**Prescriber signature & MCRN:** ..... **Date & Time:**	**Prescriber signature & MCRN:** ..... **Date & Time:** .....

Please record and monitor perioperative Blood Glucose Levels on pages 2 – 7

Version 7 November 2022 Review November 2024 (Approved by GUH Insulin Working Group)