Insulin Prescribing, Administration, and Glucose Monitoring Trends in a Hospital Setting

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Abstract

Aims

Insulin is a high-alert critical medication which can cause significant patient harm when used inappropriately. The aim of this study was to conduct a prospective audit on insulin prescribing, administration, and glucose monitoring trends in Galway University Hospitals.

Methods

This audit was conducted over one day in March 2022. The audit was approved by the local Clinical Audit Committee, piloted on two 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

Four hundred and fifty-four inpatients were reviewed of which 17% (75) had diabetes and 9% (41) were prescribed insulin. The overall insulin error rate with one or more errors comprising prescribing and/or administration per inpatient drug record was 90% (37). In total, 95% (235) insulin brand names and 89% (220) dose units were clearly prescribed, 84% (208) administration times were clearly specified by a prescriber, 87% (214) orders were signed, 58% (25) prescribers clearly documented their registration number/bleep/name at least once for contact purposes, 35% (30) meal time supplements were documented clearly by a nurse, 70% (202) administrations were double checked by a second person, 53% (142) administration times were documented by a nurse, and 26% (10) of inpatients were administered insulin by a nurse when not prescribed.

Conclusion

Results will assist in developing quality improvement initiatives to optimise patient care.

Introduction

Diabetes mellitus (DM) is a heterogeneous complex metabolic condition characterised by hyperglycaemia with a degenerative potential resulting from changes in the production, secretion and/or inability of insulin to adequately exercise its effects[1]. The most common classifications include Type 1 DM and Type 2 DM, the latter accounting for more than 90% of all cases[2]. Type 2 DM is characterised by insulin resistance and a relative deficiency of insulin secretion which progressively worsens over time[3,4]. Type 1 DM results in an absolute deficiency in beta-cell function with autoimmune destruction of beta-cells a common origin[5]. Current estimates suggest more than half a billion adults live with DM worldwide, a rise of 16% since previous estimates in 2019[6]. This is predicted to escalate to almost 800 million by 2045[6]. In Ireland, in the absence of a national DM registry, the current approximate projection is 5.6%[7].

DM is a leading cause of death globally[8] and described as the most challenging health problem in the 21st century[9,10] driven primarily by rising levels of obesity and an ageing population[9,11]. A systematic review and meta-analysis on the epidemiology of DM and its complications amongst adults in Ireland found variables from 7–25% for retinopathy; 3–32% for neuropathy; and 3-5% for nephropathy[12]. The economic burden also plays heavily with Ireland ranked 7th in the world for DM related health expenditure per person[7], and as high as €1.4 billion annually with costs mostly associated with hospitalisations and treatment of complications[6].

Insulin is a high-alert medicine used in the treatment of DM which bears a heightened risk of causing significant patient harm. With limited Irish data availability and few local incidents reported, anecdotal evidence suggests insulin accounts for a substantial number of medication errors[13,14]. A review by the States Claims Agency of over 20,000 medication incidents reported by Irish acute hospitals in 2017 and 2018 found insulin was the fourth most commonly implicated therapeutic subgroup[15], many comprising omissions leading to hyperglycaemia and inaccurate dosing leading to hyperglycaemia and hypoglycaemia[16].

Insulin has been identified as a significant medication safety concern in Galway University Hospitals (GUH). The aim of this study was to conduct a prospective audit on insulin prescribing, administration, and glucose monitoring trends in GUH in order to identify and develop agreed quality improvement initiatives to enhance patient care.

Methods

A prospective audit on insulin prescribing, administration, and glucose monitoring was conducted over one day in March 2022 on 24 wards in GUH. GUH comprises University Hospital Galway (UHG), a Model 4 public hospital, and Merlin Park University Hospital (MPUH), a Model 2 public hospital, and provides a comprehensive range of services to emergency and elective patients within the Saolta University Healthcare Group in the West of Ireland.

Inclusion criteria comprised inpatients prescribed/administered insulin in UHG and MPUH for the previous 72 hours until 9am on the morning of audit. Exclusion criteria comprised non-admitted patients, Day Wards, Emergency Department, Acute Medical Unit, Short Stay Unit, Emergency Surgical Unit, Critical Care including Post Anaesthetic Care Unit, Maternity Department, and Psychiatry Department. 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 two random inpatients prescribed and administered insulin. Minor amendments were made to its content and the pilot was excluded from data analysis.

The audit was led by two lead researchers and conducted by 29 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 prior to the audit via video conferencing and face-to-face meetings and emails. This audit was conducted in accordance with the HSE Code of Governance (2021) and HSE Healthcare Audit Quality Assurance and Verification Standards (2019) and was approved by the GUH Clinical Audit Committee 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 the two primary researchers and a specialist registrar in endocrinology to confirm reliability of results. This process involved independently inputting content of paper audit forms into excel, analysing data, and comparing results. No significant discrepancies were identified.

Results

General participation and prevalence

In total, 454 inpatients were reviewed of which 41 (9%) were prescribed insulin and included in the audit. The number of inpatients using an Insulin and Glucose Monitoring Record was 117 (26%) of which 75 inpatients (17%) had a documented history of DM (Figure 1). This equates to 55% of all inpatients with DM were treated with insulin. Patient specialty comprised medical (27, 66%), surgical (12, 29%), and paediatric (2, 5%).
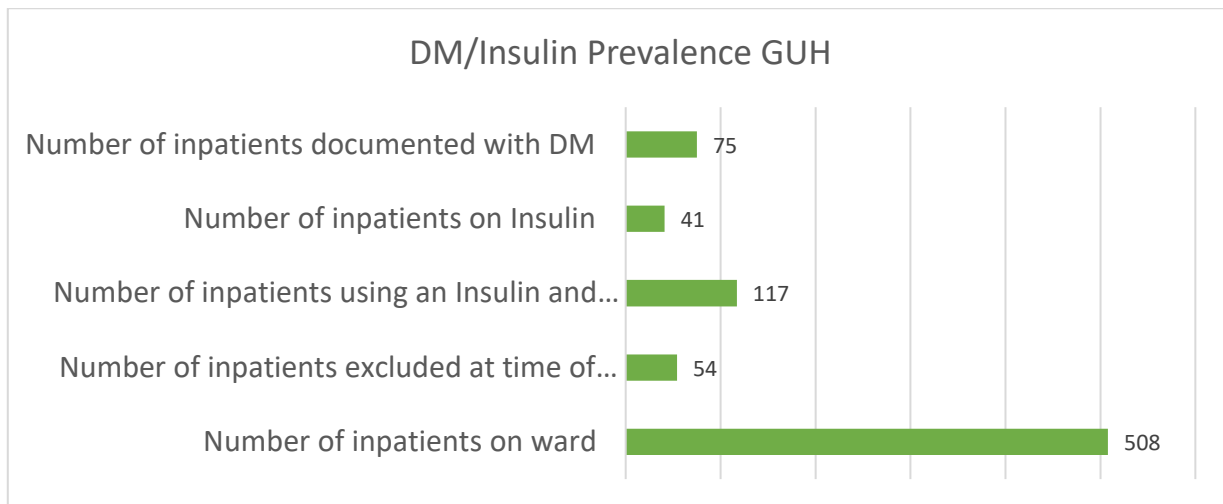
Figure 1*: DM/Insulin prevalence GUH.*

Overall insulin error rate per inpatient drug record

The overall insulin error rate with one or more errors comprising prescribing and/or administration per inpatient drug record was 90% (n=41) as presented in Table 1.

Table 1: *Overall insulin error rate per inpatient drug record.*

Error description		Error type	
Insulin brand incorrect	0%	Prescribing error 80%	Insulin error 90%
Insulin name not clearly prescribed	5%		
Insulin dose units not clearly prescribed	11%		
Insulin administration times not clearly specified by the prescriber	16%		
Insulin orders not signed by the prescriber	13%		
Prescriber MCRN/bleep/name unclear for contact purposes	42%		
Meal time supplement documented incorrectly	65%		
Insulin administration not double checked by a second person	30%	Administration error 89%	
Insulin administration times not documented	47%		
Insulin administered when not prescribed	26%		

Insulin prescribing patterns

Nineteen inpatients (n=37; 51%) were prescribed the same insulin as pre-admission, four inpatients (n=37; 11%) were not prescribed the same insulin as pre-admission, and 14 inpatients (n=37; 38%) were not on insulin pre-admission and were either prescribed a meal time supplement (10 inpatients; n=37; 27%) or were newly prescribed insulin on admission (4 inpatients; n=37; 11%).

A total of 247 insulin doses were prescribed of which 235 orders (95%) had the insulin name clearly documented. Two hundred and twenty (89%) insulin dose units were clearly prescribed, 208 (84%) administration times were clearly specified by a prescriber, and 214 (87%) orders were signed by a prescriber (Figure 2).
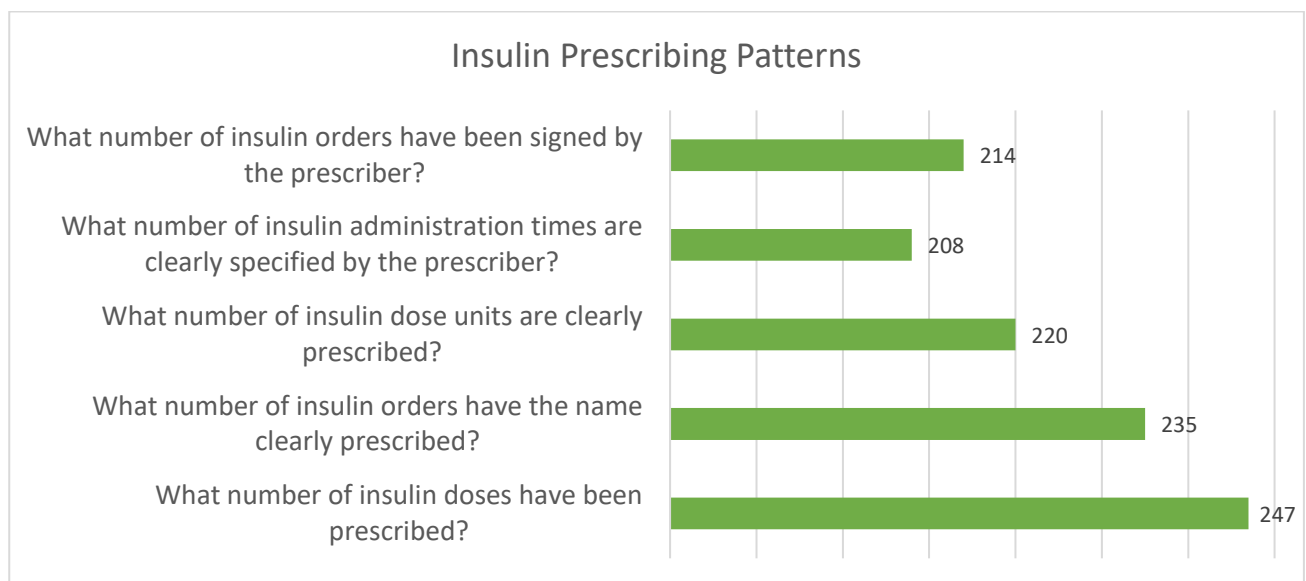

Figure 2: Insulin prescribing patterns.

Twenty-five prescribers (n=43; 58%) clearly documented their medical council registration number (MCRN)/bleep/name on the insulin drug record at least once for contact purposes and 25 inpatients (61%) had the meal time supplement signed by a prescriber. The meal time supplement was documented clearly 30 times out of a total of 86 entries (35%).

Insulin administration patterns

Two hundred and eighty-seven doses were administered of which 202 (70%) were double checked by an independent second person. Administration times were documented for 142 doses (n=270; 53%) as illustrated in Figure 3. Ten inpatients (n=39; 26%) were administered insulin by a nurse when not prescribed.
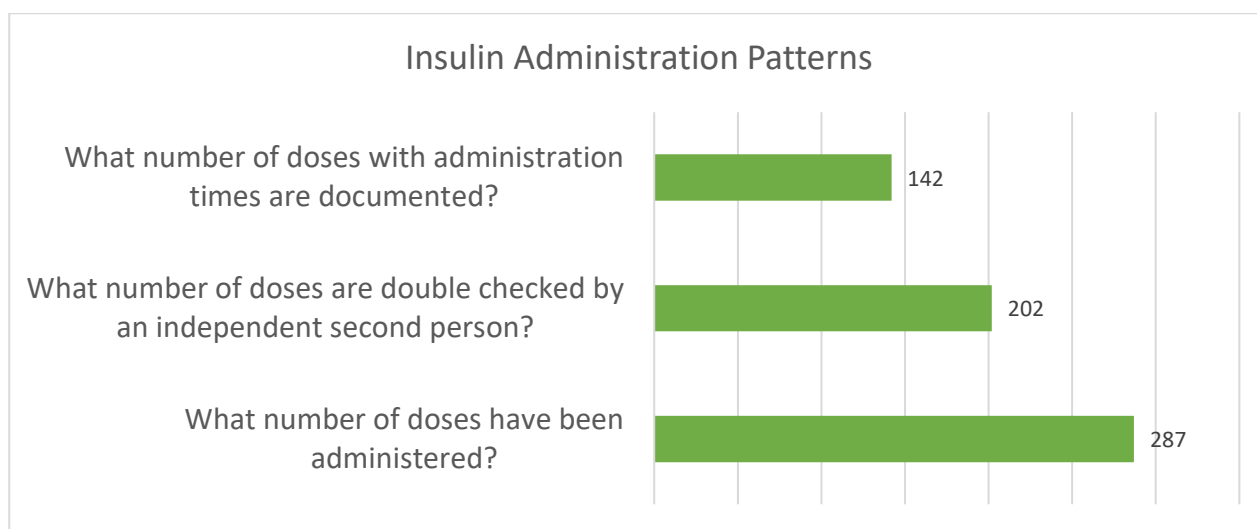
Figure 3: *Insulin administration patterns.*

Glucose management

The GUH DM team reviewed/was contacted to review 21 inpatients insulin drug record (55%, n=38). Twenty-five inpatients (61%; n=41) had changes to their insulin regimen made during their inpatient stay. This included changes to a brand name of insulin (4; n=37; 11%), the initiation of insulin and/or a meal time supplement (14; n=37; 38%), and/or a dose change (9; n=32; 28%; median 3; range 1-6). Three inpatients had their insulin omitted after an episode of hypoglycaemia (blood glucose <4 mmol/L).

Discussion

This audit identified 17% of inpatients had DM on audit day in GUH of which 9% were insulin dependent and 55% of all inpatients with DM were treated with insulin. This is similar to the most recently published National Health Service (NHS) National Diabetes Inpatient Audit (NaDIA) England 2019 report which found 18% of all inpatients in 188 NHS hospitals had documented DM[17]. The NaDIA England and Wales 2015 report identified a lower prevalence of 6% of all inpatients in 206 NHS hospitals were insulin dependent and 36% of inpatients with DM were treated with insulin[18].

The majority of inpatients in this audit were medical and prescribed the same insulin as pre-admission. All inpatients that were not prescribed the same insulin as pre-admission, were altered by the DM 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 overall insulin error rate comprising both prescribing (80%) and administration (89%) per inpatient drug record was 90%. This is significantly higher than the NaDIA 2019 report which found

18% of inpatient drug records had one or more insulin errors[17]. This figure is also higher than findings from an analysis of the National Reporting and Learning System database of patient safety incidents concerning insulin reported from NHS providers in England and Wales over a six year period which found 61% of incidents occurred at the administration stage and 17% at the prescribing stage[19]. The most common medication error types were wrong dose, strength, or frequency followed by omitted or delayed insulin[19]. Most prescriptions in this audit had the insulin name, dose, and administration times clearly documented and signed by the prescriber which are positive findings. However, less than three out of five prescribers clearly documented their MCRN/bleep/name on the insulin drug record at least once for contact purposes leading to possible time delays and patient care issues if communication is required.

Whilst the majority of inpatients were prescribed a meal time supplement, it was only documented clearly by nurses for approximately one in every three inpatients potentiating administration errors and significant patient harm. Almost one in three insulin doses were also not double checked by an independent second person and almost half administration times were not documented. Insulin is a high-alert medication which requires a two-person check of both dose preparation and administration at the bedside as well as precise administration timing to minimise hypoglycaemia, hyperglycaemia, wide glycaemic excursions, and diabetic ketoacidosis.

More than one in four inpatients were administered insulin by a nurse when not prescribed. A nurse may only administer a non-prescribed medication in a situation that requires immediate intervention in life-threatening situations and there is no immediate access to an appropriate prescriber. All insulin doses should be prescribed prior to nurse administration.

The GUH DM team reviewed or was contacted to review more than half of the inpatients prescribed insulin. More than three out of five inpatients had changes to their insulin regimen made during their inpatient stay including brand of insulin, the initiation of insulin, and dose changes. Three inpatients had their insulin omitted after an episode of hypoglycaemia. This is lower than a study evaluating insulin information on discharge summaries in a United Kingdom (UK) hospital which found 33 out of 42 patients (79%) had changes made including the initiation and/or discontinuation of insulin therapy, insulin dose changes, and insulin preparation/brand[20].

Based on audit results as well as evidence from local insulin error reporting, local practices, and best practice, some of the current interventions implemented specific to insulin in GUH with support from hospital management and medication safety committees which are transferrable to other hospitals include an updated inpatient Insulin and Glucose Monitoring Drug Record; recruitment of a clinical pharmacist with a special interest in diabetes; implementation of mandatory e-learning for nurses and doctors on insulin prescribing and administration; updated/newly approved policies, —

procedures, protocols, and guidelines; piloting of a self-administration policy; continuous education

and training to patients as well as medical, nursing, and pharmacy undergraduate students and employees in GUH; expansion of a medication safety portal inclusive of educational videos; use of hospital screens and social media to disseminate prudent information; and further promotion of error reporting. No challenges were encountered as all key stakeholders were involved from the onset.

Future quality improvement interventions for consideration to optimise patient care include implementing a dedicated insulin safety team that comprises a broad membership to facilitate sustainability and spread of interventions to improve insulin prescribing and administration practice; electronic prescribing as a part of the ongoing implementation of a new pharmacy system; an insulin inpatient and discharge checklist; and promotion of an annual national audit on insulin prescribing, administration, and glucose monitoring trends similar to the UK. Once interventions are in situ it is anticipated that results of a re-audit in GUH will be favourable.

Declaration of Conflicts of Interest:
The authors report no conflict of interest.

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