Analysis of pharmacist interventions associated with insulin prescribing for hospital inpatients with diabetes

Nathan Zipf
Gold Coast Hospital and Health Service
Lauren Grant
Gold Coast Hospital and Health Service
Brent Robinson
Gold Coast Hospital and Health Service
Trudy Teasdale
Gold Coast Hospital and Health Service
Gary Grant
Griffith University - GC Campus: Griffith University - Gold Coast Campus
Hendrika Laetitia Hattingh (l.hattingh@griffith.edu.au)
Griffith University https://orcid.org/0000-0002-4553-743X

Research Article

Keywords: Insulin prescribing, pharmacist intervention, electronic prescribing, high-risk medicine, hospital pharmacist

Posted Date: March 19th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-323832/v1

Version of Record: A version of this preprint was published at International Journal of Clinical Pharmacy on July 11th, 2021. See the published version at https://doi.org/10.1007/s11096-021-01307-1.

Abstract

Background: Insulin is a high-risk medicine, associated with hospital medication errors. Pharmacists play an important role in the monitoring of patients on insulin.

Objective: To analyse interventions made by hospital pharmacists that were associated with insulin prescribing for inpatients with diabetes.

Method: Retrospective audit of pharmacist interventions for adult inpatients for an 8-month period, 1 June 2019 to 31 January 2020. Pharmacist interventions recorded in the electronic medication management system by inpatient unit and dedicated high-risk medicine pharmacists were extracted, screened, and analysed.

Results: Of 3,975 pharmacist interventions 3,356 (84.43%) were recorded by high-risk medicine pharmacists and 619 (15.57%) by inpatient unit pharmacists. July and August 2019 had the highest numbers of interventions with 628 and 643 (15.80% and 16.18%) respectively. Most of the interventions, namely 3,410 (85.79%) were classified as *medicine optimisation interventions* and 565 (14.21%) as *prescribing errors*. In the *medicine optimisation intervention* category, 2,985 (75.09%) were due to insulin not charted for ongoing administration.

Conclusion: This study provides insights into pharmacist interventions for inpatients on insulin, showing that high-risk medicine pharmacists recorded most interventions. The classification of the insulin interventions into medicine optimisation and prescribing errors provides useful information for the training of prescribers in insulin management.

Impact Of Findings On Practice

- Categorising of hospital pharmacists' interventions into medicine optimisation interventions and prescribing errors provides useful information for targeted prescriber training.
- The role of a dedicated pharmacist, the high-risk medicine pharmacist, that focusses on the monitoring of patients on high-risk medicines is a valuable medication safety resource.
- Although electronic medication management systems facilitate prescribing, the training of staff to use systems is paramount.

Background

An estimated 1.2 million Australian hospitalisations during 2017–2018 were associated with diabetes as the principal or additional diagnosis(1). Insulin plays a major role in the management of patients with diabetes however it is a high-risk medicine with the potential to cause significant patient harm or even death if administered incorrectly(2). It is one of the frequently cited medicines prescribed and administered in hospitals associated with medication errors(3–5). Various interventions have been implemented to address insulin errors including process redesign and implementation(6) as well as real-time alert processes(4), with some successes in reducing insulin error rates. Use of electronic medication management (EMM) software systems reduce medicine error rates but training of staff to use systems is paramount, especially as EMM systems impact on workflow(7). While electronic prescribing provides significant benefits over handwritten medication charts it has been shown to contribute to new types of errors compared with paper charts(6, 8).

Referred to as the integrated electronic Medication Record (ieMR), the Gold Coast Hospital and Health Service (GCHHS) implemented an EMM system April to May 2019. The prescribing of insulin in ieMR is facilitated by decision support plans to guide insulin prescribing and prompt the ordering of dose checks and hypoglycaemia treatment orders. Short-term insulin prescribing has a 24-hour default, therefore requiring daily ordering by prescribers. Longer term prescribing is only recommended for patients with stable blood glucose levels (BGLs). A GCHHS initiative following the implementation of ieMR was the establishment of a dedicated high-risk medicine (HRM) pharmacist position in June 2019 to improve medication safety through monitoring insulin, warfarin and heparin infusions. This position is shared between several senior pharmacists with one pharmacist allocated to the role daily, seven days per week during business hours. The role involves daily clinical review of all inpatients prescribed insulin, warfarin and heparin with patients identified through a locally developed dashboard. The dashboard extracts data from ieMR in real-time and flag potential problems with dosing regimens to facilitate prioritisation of reviews.

Interventions made by inpatient unit (IPU) and HRM pharmacists while completing their clinical tasks are recorded in ieMR. Guidance is provided to pharmacists regarding risk classification for recording of interventions according to 1) the consequences or impact and 2) likelihood of occurrence. All interventions and recommendations by IPU and HRM pharmacists are communicated to relevant prescribers, with the severity of the intervention dictating the urgency and method of communication used.

Aim Of The Study

The aim of this study was to analyse interventions made by hospital pharmacists that were associated with insulin prescribing for inpatients with diabetes to inform insulin prescribing practices and prescriber training strategies.

Ethics Approval

This project was approved by the Human Research Ethics Committees of GCHHS (LNR/2019/QMS/56429) and Griffith University (2019/995).

Methods

A retrospective audit of pharmacist interventions was undertaken for adult patients admitted to hospital (including emergency department encounters), for an 8-month period 1 June 2019 to 31 January 2020, following the implementation of ieMR. The audit covered GCHHS inpatients from Gold Coast University and Robina Hospitals (750 bed tertiary and 350 bed hospitals).

Pharmacist Interventions

Intervention data extracted were for inpatients prescribed insulin with the following inclusion and exclusion criteria:

Inclusion criteria:

- Patients ≥ 18 years old.

Exclusion criteria:

- Patients admitted to the Intensive Care Unit, paediatric patients, maternity patients;
- Patients on intravenous insulin;
- Patients who were not physically present at hospital (e.g. on leave, hospital-in-the-home); and
- Patients on self-administered insulin pumps.

Data Extraction

Data extracted included:

- Encounter identification;
- Unique intervention identification code;
- Intervention date and time;
- Type of insulin(s) involved;
- Intervention type: 20 pre-defined options for selection as well as an option for free-type text into an ‘other’ category;
- Importance of intervention: insignificant, minor, moderate, major;
- Status of intervention: resolved, not resolved;
- Intervention details: free text; and
- Insulin orders.

Extracted data was screened to check for accuracy of the data against patients’ ieMR records. Samples for checking were selected randomly, aiming to validate a range of different intervention types to clarify classification of the interventions, also targeting a range of variables. In total, 10% of the interventions were validated. Differences in classifications were discussed and consensus reached between all authors. Insulin orders were also screened following the same process.

Data analysis

Upon consensus, the following intervention data were excluded from the analysis:

- *Importance of intervention: insignificant, minor, moderate, major* - regarded to be subjective and open to interpretation of the intervention pharmacist, and
- *Status of intervention: resolved, not resolved* - not an accurate reflection of the outcome as pharmacists are trained to mark all outstanding interventions as *resolved* at patients' discharge from hospital as part of the discharge medication reconciliation process.

Five *intervention type* options did not have any interventions recorded and were hence removed, reducing intervention types to 15.

Analysis of interventions involved descriptive statistics using Microsoft Excel for Office 365©; data were summarised using frequencies and percentages.

Results

A total number of 4,003 pharmacist interventions were identified over the 8-month study period. Following data cleaning, 3,975 interventions were identified and included in the analysis.

Interventions And Insulin Brands

Sixteen insulin brands were involved in 3,907 (98.29%) interventions (no insulin brand recorded against 68, 1.71%, of the interventions). A comparison of intervention and ordering data (Table 1) showed that the highest percentage of interventions (46.44%) were for Lantus® whereas this brand made up 21.90% of the insulin orders over the study period. NovoRapid® was the insulin mostly ordered at 58.43% and contributed 23.85% towards the interventions.

Table 1
Interventions and orders per insulin brand

Insulin by brand	No. interventions	% interventions	No. orders	% orders
Lantus®	1,846	46.44%	21,706	21.90%
NovoRapid®	948	23.85%	57,926	58.43%
NovoMix 30/70®	517	13.01%	6,877	6.94%
Protaphane®	129	3.25%	2,280	2.30%
Ryzodeg 70/30®	115	2.89%	1,358	1.37%
Levemir®	89	2.24%	1,812	1.83%
Toujeo®	70	1.76%	873	0.88%
#Not recorded	68	1.71%	0	-
Humalog®	51	1.28%	1,659	1.67%
Mixtard 30/70®	48	1.21%	660	0.67%
Actrapid®	31	0.78%	2,228	2.25%
Apidra®	27	0.68%	1,235	1.25%
Humulin 30/70®	25	0.63%	284	0.29%
Humalog Mix 25/75®	6	0.15%	83	0.08%
Humulin NPH®	4	0.10%	44	0.04%
Humulin R®	1	0.03%	52	0.05%
U200 Humalog®	0	-	20	0.02%
Fiasp®	0	-	18	0.02%
Humalog Mix 50/50®	0	-	12	0.01%
Mixtard 50/50®	0	-	2	0.00%
TOTAL	**3,975**	**100.00%**	**99,129**	**100.00%**
#Insulin brand not recorded however intervention was related to insulin				

Pharmacists Recording Of Interventions

The majority of interventions (3,356, 84.43%), were recorded by HRM pharmacists (Fig. 1). July and August 2019 had the highest numbers of interventions with 628 and 643 (15.80% and 16.18%) interventions respectively. The rolling average shows a modest increase in HRM pharmacist interventions in January 2020 compared to the previous four months. The recording of HRM pharmacist interventions was relatively low in June 2019, which was when the position was created.

Intervention Type

Interventions were categorised as either medicine optimisation or prescribing error interventions and the type of insulin: ultra short-acting, short-acting, long-acting and mixed (Table 2).

Table 2
Types of insulin matched to frequency of intervention categories

Intervention Category/ Type of insulin	Ultra short-acting (%)		Short-acting (%)		Long-acting (%)		Mixed (%)		Not recorded (%)		Total Interventions (%)	
Medicine optimisation												
#Future doses not charted	666	(16.75%)	17	(0.43%)	1,701	(42.79%)	549	(13.81%)	52	(1.31%)	2,985	(75.09%)
Optimisation of dosing regimen	184	(4.63%)	7	(0.18%)	134	(3.37%)	76	(1.91%)	12	(0.30%)	413	(10.39%)
*LAM conversion	0	(0.00%)	0	(0.00%)	5	(0.13%)	4	(0.10%)	0	(0.00%)	9	(0.23%)
TOTAL											**3,407**	**(85.71%)**
Prescribing errors												
Duplicate order	59	(1.48%)	0	(0.00%)	82	(2.06%)	15	(0.38%)	1	(0.03%)	157	(3.95%)
Weekly order recurring	9	(0.23%)	0	(0.00%)	46	(1.16%)	11	(0.28%)	0	(0.00%)	66	(1.66%)
Incorrect dose	18	(0.45%)	0	(0.00%)	36	(0.91%)	9	(0.23%)	0	(0.00%)	63	(1.58%)
Day of the week outside of date range	8	(0.20%)	0	(0.00%)	38	(0.96%)	11	(0.28%)	0	(0.00%)	57	(1.43%)
Missed dose	13	(0.33%)	0	(0.00%)	32	(0.81%)	11	(0.28%)	0	(0.00%)	56	(1.41%)
Instructions unclear	31	(0.78%)	2	(0.05%)	20	(0.50%)	4	(0.10%)	2	(0.05%)	56	(1.41%)
$Dose charted in advance	8	(0.20%)	2	(0.05%)	20	(0.50%)	9	(0.23%)	0	(0.00%)	39	(0.98%)
Unsafe order	7	(0.18%)	0	(0.00%)	12	(0.30%)	3	(0.08%)	0	(0.00%)	22	(0.55%)
Incorrect frequency	6	(0.15%)	0	(0.00%)	6	(0.15%)	8	(0.20%)	0	(0.00%)	20	(0.50%)
No valid medicine indication	13	(0.33%)	4	(0.10%)	1	(0.03%)	0	(0.00%)	0	(0.00%)	18	(0.45%)
Not receiving a medicine for condition	4	(0.10%)	0	(0.00%)	5	(0.13%)	1	(0.03%)	1	(0.03%)	11	(0.28%)
TOTAL											**568**	**(14.29%)**

Future doses not charted: The absence of an order(s) for upcoming doses of insulin e.g. for the next meal time or coming days

* LAM: List of approved medicines

$ Dose charted in advance: A pre-order(s) for an upcoming dose of insulin e.g. at next meal time or coming days without considering patient’s clinical presentation

Medicine optimisation interventions involved pre-emptive recommendations to prevent medicine errors from occurring, as well as improving patient outcomes by using medicines more effectively (e.g. ensuring insulin was ordered in advance where appropriate, suggesting dose adjustments based on recorded BGLs, recommending alternative insulin regimes when patient's own was unavailable). Prescribing error interventions involved corrective actions undertaken by pharmacists in response to an error in prescribing, in order to prevent patient harm (e.g. duplicate orders prescribed for the same medicine, incorrect doses prescribed, missed doses of insulin, doses charted for the incorrect date range, doses charted a week in advance).

Most interventions (3,407, 85.71%) were classified as medicine optimisation and 568 (14.29%) as prescribing errors. In the medicine optimisation intervention category, 75.09% (2,985) were due to 'Regular medication not charted', where the pharmacist alerted the prescriber pre-emptively to chart an upcoming insulin dose to prevent the dose from being missed. 'Regular medication not charted' mainly involved long-acting insulins (42.79%). Of the interventions classified as prescribing errors, 157 (3.95%) were due to a duplicate order.

Discussion

A total of 3,975 pharmacist interventions for adult inpatients who were prescribed insulin over an 8-month period were recorded. Interventions peaked during July and August 2019 with another slight increase January 2020.

Our study was unique as it involved the monitoring of insulin by the IPU clinical pharmacists as well as dedicated HRM pharmacists, showing that more than 84% of interventions were recorded by HRM pharmacists. This finding provides evidence that the setting up of the dedicated HRM pharmacist position is effective in providing support to prescribers and IPU pharmacists in the monitoring of inpatients on insulin, potentially avoiding medication and prescribing errors, and contribute to patient safety.

Most of the interventions were medicine optimisation recommendations with *future doses not charted* the majority. However, 14% involved prescribing errors and these interventions specifically prevented potential patient harm. The differentiation between medicine optimisation and prescribing errors provides potential to develop targeted interventions and prioritisation of monitoring, hence reducing errors and the need for the pharmacist to intervene.

The data showed a slight increase in interventions in January 2020, which overlapped with the start of new medical interns. As prescribing by interns represents a large proportion of medication charting, this increase may be related to new interns having less expertise with the EMM system. Research with junior doctors highlighted that some medications were perceived as being disproportionately complex to prescribe through electronic prescribing systems with varying levels of confidence and competence(8). Studies highlighted the benefit of interactive educational training programmes for junior doctors as a means of improving confidence and ability in managing diabetes(9) and practice exposure to improve safe prescribing(10).

This study has some limitations. It is likely that intervention recording was underreported due to pharmacist workload constraints. Because of this, small variances in reporting month-to-month rates are potentially a reflection of pharmacist workload rather than changes in HRM prescribing. While this audit was only conducted at GCHHS, results should be transferable to other Queensland Health Hospitals. Results, however, may not apply nationally as other states and jurisdictions use different EMM systems. This study did not assess the outcome and impact of interventions.

Conclusion

This study provides insights into pharmacist interventions for inpatients on insulin and supports the role of dedicated HRM pharmacists to focus on the monitoring of insulin and other HRMs. Information obtained from this study will be used to advocate for improvements in the electronic prescribing of insulin and prescriber training strategies.

Declarations

Funding

This study was funded by a Griffith and University of Queensland Quality Use of Medicines research grant.

Conflicts of interest

The authors have no conflict of interest.

Availability of data and material (data transparency)

Not applicable

Code availability (software application or custom code)

Not applicable

References

1. Australian Institute of Health and Welfare. Diabetes: Australian Government; 2020 [Available from: https://www.aihw.gov.au/reports/diabetes/diabetes/data.
2. Australian Commission on Safety and Quality in Health Care. APINCHS Classification of High Risk Medicines Sydney, NSW: ACSQHC; 2019 [Available from: https://www.safetyandquality.gov.au/our-work/medication-safety/high-risk-medicines/apinchs-classification-of-high-risk-medicines/.
3. Cefalu WT, Berg EG, Saraco M, Petersen MP, Uelmen S, Robinson S, et al. Diabetes Care in the Hospital: Standards of Medical Care in Diabetes-2019. Diabetes Care. 2019;42(1):173-S81.
4. Cruz P, Blackburn MC, Tobin GS. A Systematic Approach for the Prevention and Reduction of Hypoglycemia in Hospitalized Patients. Curr DiabRep. 2017;17(11):117.
5. Taylor JE, Campbell LV, Zhang L, Greenfield JR. High diabetes prevalence and insulin medication errors in hospital patients. Internal Medicine Journal. 2018;48(12):1529–32.
6. Citty SW, Zumberg L, Chappell J. Improving Insulin Administration Through Redesigning Processes of Care: A Multidisciplinary Team Approach. J Patient Saf. 2017;13(3):122–8.
7. Jheeta S, Franklin BD. The impact of a hospital electronic prescribing and medication administration system on medication administration safety: An observational study. BMC Health Services Research. 2017;17(1):547–10.
8. Puaar SJ, Franklin BD. Impact of an inpatient electronic prescribing system on prescribing error causation: a qualitative evaluation in an English hospital. BMJ Quality Safety. 2018;27:529–38.
9. Brennan N, Mattick K. A systematic review of educational interventions to change behaviour of prescribers in hospital settings, with a particular emphasis on new prescribers. Br J Clin Pharmacol. 2013;75(2):359–72.
10. Hansen R, Bradley C, Sahm CP. LJ. Factors influencing successful prescribing by intern doctors: a qualitative systematic review. Pharmacy. 2016;4(3):24.

Figures

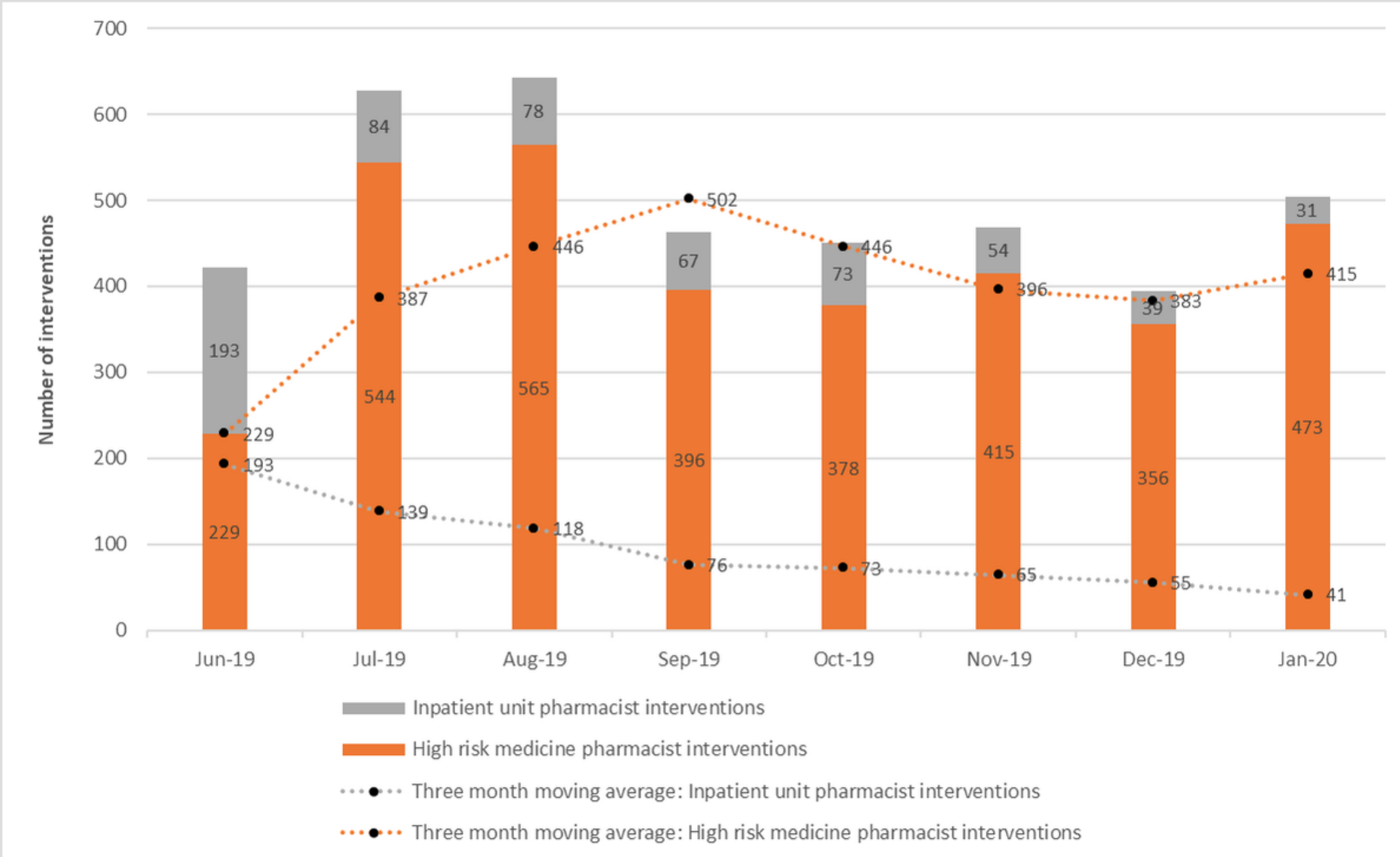

Figure 1

Insulin interventions per month