INSULIN PRESCRIBING PRACTICES IN SAUDI ARABIA

Waleed M Al-shaqha*, Fuad A Al-Janabi2, Anis Ahmad Chaudhary1, Khalid M Alkharfy3

1College of Medicine, Al-Imam Mohammad Ibn Saud Islamic University (IMSIU)
Riyadh, Saudi Arabia
2Department of Pharmaceutical Services, Armed Forces Hospital
Jubail, Saudi Arabia
3Department of Clinical Pharmacy, College of Pharmacy, King Saud University.

ABSTRACT

To evaluate insulin prescribing practices in ambulatory care clinics at some hospitals in the Riyadh region, and investigate some potential errors related to insulin prescriptions. A retrospective descriptive study that conducted over a period of 3 months at three different hospitals (MOH, military, and teaching) in Riyadh city. The aim is to collect prescriptions that include insulin as a prescribed medicine from the outpatient pharmacy. A data-collecting sheet designed to tabulate the patient’s demographics and define prescriber/setting characteristics will be used to collect pertinent information. Several categories in the prescription will specifically be investigated: 1) completeness of the patient’s data that includes hospital name, patient name, MRN, date of birth, and diagnosis, and 2) insulin prescription content including writing illegibly, insulin name/type, non-standard nomenclature, dosage and direction, and an ambiguous medication order. A total of 1245 prescriptions were studied. The demographic of the patient observed in the prescription was 65.08% female and male 34.9%. For all prescription the prescriber was divided to three categories; and the frequency was general practitioners 46.6%, specialist 47.3%, and consultants 6.1%. The handwriting clarity was 613 (49.2%) unclear prescription and 632 (50.8%) clear one. The study found that 59% of prescriptions without “unit” and 16% of prescriptions include the use of “U” and “IU” instead of “Units”. The most used insulin regimen was premixed insulin 70/30 (56.1%) followed by combination of Regular with NPH insulin (32.1%). Also Metformin was the most oral hypoglycemic drug prescribed.
with insulin (34.9%). And almost 94% of patients have HbA1C values greater than 6.5%. The results showed that important information is missing from many insulin prescriptions. Almost 50% of all insulin prescriptions were deemed illegible. And there is some potential source of errors in insulin prescriptions include the use of “U” and “IU” instead of “Units”. The data also show that the majority of patients have HbA1C values exceeding the target set by international guidelines.

**KEY WORDS:** Insulin, Diabetes Mellitus, Hypoglycemic Drug, Metformin, MRN

**INTRODUCTION**

Diabetes Mellitus is a disease characterized by impaired insulin secretion, presence of insulin resistance or both.\(^1\) It has become one of the major causes of premature illness and death in the world, mainly through the increased risk of its macrovascular complications. It has been estimated that more than 135 million people worldwide have diabetes mellitus and their number expected to reach approximately 300 million people by 2025, 10% of them having type 1 Diabetes. Furthermore, 3.2 million deaths are attributable to diabetes every year.\(^2\) Because of its chronic nature, the severity of its complications and the means required to control them, diabetes is a costly disease.\(^3\) Approximately half of the U.S. expenditures for medical care of diabetes are for treatment of the metabolic condition and the other half for the treatment of its chronic complications.\(^3\)

Insulin remains the cornerstone in the management of type 1 diabetes and many patients with type 2 diabetes may require insulin therapy. Advances in biotechnologies have led to an array of insulin products with various formulations and analogs available for clinicians for use. This has increased the confusion and complexities when prescribing insulin by practitioners. Indeed, insulin is classified as "high-alert medication" that may be associated with significant morbidity when ordered and/or administered incorrectly. Insulin was involved in 9% of the error that resulted in patient harm, which include serious potentially life-threatening complications (e.g., severe hypoglycemia).\(^9\) Insulin prescribing tops the list of drugs involved in medication errors in the UK and in the USA.\(^7, 8\) Of interest are some recent reports of insulin-related medication errors involving confusion between Lantus and lent insulin.\(^10, 11\) Novo Nordisk Inc. has released an alert regarding two of its products (NovoLog\textsuperscript{®} Mix 70/30 -premixed insulin, and NovoLog\textsuperscript{®} -rapid acting insulin analog) in August 26, 2005 for clarifications and differentiation of both products. The manufacturer has recommended all pharmacists carefully distinguish insulin formulations by name and NDC...
number when dispensing insulin. The use of color branded labeling has also aided in facilitating dispensing of the correct product.[12]

The objectives of the current study were to evaluate insulin-prescribing practices at some hospitals in Saudi Arabia, and to investigate some potential sources for medication errors in the insulin prescription.

MATERIALS AND METHODS
All hand-written insulin prescriptions issued from the outpatient department at three governmental hospitals in Riyadh, Saudi Arabia, was conducted over a period of three months. A data collection sheet designed by the investigators was used to collect relevant information on the patient, the prescribed medicines, and the prescriber. The patient part included information such as name, medical number, diagnosis, gender, age, and weight. While the prescribed medicine section gave information about prescribed medications such as drug name, strength, dosage form, dosage, and treatment period. The third part contained some information about the prescriber including name, qualification, code, signature in addition to contact number e.g. extension or bleep number.

The data collection sheet was validated then the first ten prescriptions observed were considered another validity testing. The final design of the sheet was created by dividing it to four parts: 1) completeness of patient information, 2) prescription insulin content information; (e.g. handwriting, insulin type, dose, time and route of administration), 3) prescriber and setting information, 4) other drugs prescribed with insulin. Also the illegibility of prescribing was according the criteria for illegibility that include; unclear handwriting, incomplete drug name, ambiguous information, unclear or missed dose, unclear unit, and unclear or missed frequency.

The different type of insulin available in the studied hospitals was regular, NPH, Aspart, premixed (70/30 and 50/50), lente, and glargin. The study conducted retrospectively to observe prescriptions prescribed for three months period before the date of starting July to October 2006.

Statistical analysis
The statistical package for social sciences (SPSS/PC+), version 14.0 was used for data enter and analysis. A p value < 0.05 was considered to represent statistical significance.
RESULT

A total of 1245 prescriptions were collected and analyzed in this study. The proportion and frequency of patient receiving insulin are summarized in table 1.

Table-1: Proportion and frequency of patient receiving insulin in 1245 prescriptions

<table>
<thead>
<tr>
<th>Category</th>
<th>Proportion (%)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>65.06</td>
<td>810</td>
</tr>
<tr>
<td>Male</td>
<td>34.94</td>
<td>435</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child (0-12 year)</td>
<td>1.2</td>
<td>15</td>
</tr>
<tr>
<td>Adolescent (12-20 year)</td>
<td>6.2</td>
<td>77</td>
</tr>
<tr>
<td>Adult (20-65 year)</td>
<td>69.8</td>
<td>869</td>
</tr>
<tr>
<td>Elderly (&gt;65 year)</td>
<td>22.8</td>
<td>284</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>1245</td>
</tr>
</tbody>
</table>

Among the study prescription population 810 (65.06%) were belong to female, and 435 (34.94%) were male patient received prescription containing insulin. The age of all patient in the prescription was categorized and the result showing that 15 (1.2%) were child patient, 77 (6.2%) adolescent, 869 (69.8%) adult, and 284 (22.8%) prescription belong to elderly patients.

Table-2 illustrating the patient and administration information availability as follow; in all prescription patient information that were no available for diagnosis, age, sex, and weight were 447 (45.9%) 494 (39.7%), 382 (30.7%), and 1242 (99.8%) respectively.

Among the prescription studied regarding the dosage, direction and frequency the rout of administration, time of administration and direction for administration (e.g. before meal and before bed time) were missed as 93.1%, 15.7%, and 98% respectively.

Table-2: patient and administration information

<table>
<thead>
<tr>
<th>Description</th>
<th>Available</th>
<th>Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage (%)</td>
<td>frequency</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>64.1</td>
<td>798</td>
</tr>
<tr>
<td>Age</td>
<td>60.3</td>
<td>751</td>
</tr>
<tr>
<td>Sex</td>
<td>69.3</td>
<td>863</td>
</tr>
<tr>
<td>Weight</td>
<td>0.2</td>
<td>3</td>
</tr>
<tr>
<td>Rout of administration</td>
<td>6.9</td>
<td>86</td>
</tr>
<tr>
<td>Time of administration</td>
<td>84.3</td>
<td>1049</td>
</tr>
<tr>
<td>Direction for administration</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
In table-3 the prescribes were categorized to three categories; and the frequency and proportion were as follow: general practitioners 571 (45.9%), specialists 579 (46.5%), and consultants 95 (7.6%). According to the six points of suggested criteria for illegibility of the prescriptions was 613 (49.2%) found to be illegible as shown in table-3 and the figures 1 to 7 showing an example of illegibility prescriptions

Table-3: Prescriber and Illegibility of the prescriptions

<table>
<thead>
<tr>
<th>Description</th>
<th>Proportion (%)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prescriber</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General practitioners</td>
<td>45.9</td>
<td>571</td>
</tr>
<tr>
<td>Specialists</td>
<td>46.5</td>
<td>579</td>
</tr>
<tr>
<td>Consultants</td>
<td>7.6</td>
<td>95</td>
</tr>
<tr>
<td><strong>Illegibility of the prescriptions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legible</td>
<td>50.8</td>
<td>632</td>
</tr>
<tr>
<td>Illegible</td>
<td>49.2</td>
<td>613</td>
</tr>
</tbody>
</table>

Figure-1: Unclear Handwriting

Figure-2: Incomplete drug name

Figure-3: Ambiguous information
The study results show that among clear handwriting prescriptions the legible prescription for consultants were 117 (9.4%), specialists 715 (57.4%), and 733 (33.2%) prescriptions. And the illegible prescriptions were 74 (59%), 438 (35.2%), and 733 (58.9%) prescriptions for consultant, specialist, and general practitioners respectively. The type of insulin units written by the prescribers were either full unit "unit" were 25% (311) or partial "U" or "IU" were 13% (162), and 3% (37) respectively. While in 59% (735) of prescription the prescribers didn't write any type of units.
Prescriptions also reveal that 85.07% of prescriptions the device used were by syringes whereas pen and pump devices were 14.61% and 0.32% respectively. The study found the most type of insulin prescribed were premixed insulin (65.1%), Regular insulin mixed with the NPH insulin (32.1%), regular alone (3.1%), glargin alone (2.4%), NPH alone (1.5%), aspart alone and regular with premixed 70/30 were (1.1%) for both, regular with glargin (0.9%), aspart with glargin (0.6%), NPH with premixed 70/30 (0.5%), premixed 50/50 (0.4%), glargin with premixed 70/30 (0.2%), and lente alone (0.1%). As shown in figure-8.

Prescriptions of insulin were containing concomitant drugs of oral hypoglycemic agents including biguanide (metformin) 43.9%, acarbose (4.7%), sulfonylurea (3.2%), Biguanide with TZD (0.4%), and TZD (0.4%). And by observing the level of A1c of patients from laboratory records the average of each patient was as follow; less than 6.5 was 6.35%, 6.5-9.5 was 49.63%, and more than 9.5 was 44.01%.

![Figure-8: Types of Prescribed Insulin](image)

DISCUSSION

The study show that the most patient information missed from the prescriptions were the weight of the patient while the prescription designed to be filled for this information and others such as diagnosis, age, and sex which were 30 – 36% of prescriptions not containing such information. And missing of these information would be a source of prescription errors that put the patient in a risk, other important information regarding the prescribed medicine (insulin) such as the rout of administration and special directions for administration were also absent by more than 90% of the prescription which also will be a source of wrong administration that lead to harm of the patient beside to be the blood sugar will be not controlled. The study also show that approximately 46% of prescriptions were written by a general practitioner just like specialist and this is because the diabetic patients were followed up and have refill for his medication from the primary care where most physicians are general
practitioners. From this study observation the illegibility prescription according to the criteria designed for illegibility were around the half of prescriptions which considered as a part of medication errors.

All the sample shown in this study indicating that the hand clarity and illegibility by missing dose, unit, frequency and ambiguous information is a major source of mistakes and medication errors due to prescribing errors as most study regarding insulin and other medicines handwriting revealing.\textsuperscript{[18, 19, 20, 21]} In this study the qualification of prescriber was affecting the illegibility of prescription and by comparing the legible to illegible prescription (according to the criteria of eligibility) of prescribers the result was a statistical significance difference among prescribers which was the specialist associated with more legible prescriptions than the general practitioners whereas the illegible showing the opposite result. And the proportion of consultant with legible one is more than the illegibles (this is due to the small number of prescriptions by consultant the percentage was lesser than the specialist and general practitioners.

Most studies regarding the handwriting of insulin prescriptions pointing to the abbreviation of units is a leading sources for errors\textsuperscript{[22]}, this study also showed a risk of errors were 16%, but more than half of prescribers didn’t write units.

Not all hospitals providing devices other than syringes e.g. pen or pump, this lead to be the most used devices by diabetic patient was the syringes and the lowest was the pump devices, that need more education for the patient and the price is higher.

The availability of the type of insulin in studied hospitals were limited, where the premixed 70/30, NPH, and Regular insulins were the most available insulin type makes its prescribing is more among these types than the other such as glargin, aspart, lente, or premixed 50/50.

This study also found that Metformin was the most oral hypoglycemic agent prescribed with insulin which is congruent to the international guidelines; in addition the Canadian association of DM put the combination of insulin with TZD as a caution and to be not prescribed due the risk of weight gaining\textsuperscript{[23]}, while in this study the combination was observed in 0.8% of the prescriptions. Finally according to DCCT the A1C more than 6.5% is associated with risk of both micro- and macrovascular complications\textsuperscript{[23]}, this study result in
patients A1C level above 9.5% was 44.01% and the level between 6.5 – 9.5% was 49.63% which indicate a poor controlling of the patient glucose level.

Insulin prescribing errors may include eligibility handwriting such as confusing U or IU for 0 or 1 (e.g., 4 units can be misread as 40 or 41 units). Furthermore, several prescribers relate to regular insulin as “clear insulin” for the sake of convenience, and this could mean regular insulin, Lispro, Aspart or Glargine. Patients on Lispro (or Aspart) with Glargine combinations will be using two types of clear insulin. In addition, some clinicians prescribe “Insulin L” which could mean either Lente (intermediate acting insulin) or Lantus (Glargine, a long acting analogue). Patients who remember their insulin as 30/70 may be using either a premixed combination of human insulin (e.g. Huminsulin 30/70) or a premixed analog (e.g., Novomix 30/70). Also, common errors involve insulin ratios that may not be specified. For example, ‘Humulin’ or ‘Mixtard’ may be written in place of ‘Humulin M3™’ or ‘Mixtard 30™’, respectively and seems to have been given these uncompleted wrote names as a default of names, which is considered potentially dangerous.[6]

**CONCLUSION**

The results showed that important information is missing form many insulin prescriptions. And Almost 50% of all of insulin prescriptions was deemed illegible. Some potential sources of errors in insulin prescriptions include the use of “U” and “IU” instead of “Units”. Also Prescriber’s qualification appears to be an important factor in insulin prescription illegibility. The most commonly prescribed insulin types are pre-mixed 70/30 and regular with NPH. And the most oral hypoglycemic drug prescribed with insulin is Metformin. The data also show that the majority of patients have HbA1C values exceeding the target sated by international guidelines.

In Saudi Arabia medication errors problem was highlighted by many investigators. Al Nasser studied the pattern of drug prescribing in primary care centers in Al-Baha region. The study showed an inadequacy of documentation of prescribing information; 53.7% of medications were prescribed without a specific duration and almost 97% did not identify the strength.[13] Felimaban studied the prescribing habits of physicians in primary healthcare centers to assess the content of prescriptions. The study was carried out at three primary healthcare centers in Riyadh city. The investigator found that the prescription content score was generally unsatisfactory.[14] Bawazir has also examined the drug-prescribing pattern of ambulatory care physicians in the ministry of health hospitals. The study involves 22 general hospitals.
covering the various health regions within Saudi Arabia. Auditing prescription information revealed that documentation was not generally complete. Information relating the patient age and diagnosis was missing in 18.6% and 9.8% of the prescriptions, respectively.\textsuperscript{[15]} Khoja and coworkers studied the medication error problem in the primary care center in Riyadh; they found that out of all prescriptions collected in the study, 11.6% were identified to have at least one error.\textsuperscript{[16]} Finally, Mahfouz has investigated prescribing pattern at 23 primary health care centers in the Asir region, and found that the leading missing items in the studies prescriptions were the duration of therapy (32.9%), patient's name (15.8%), and patient’s health record number (6.5%). In addition, prescribing drugs by generic names among physicians was about 29%.\textsuperscript{[17]}

Recommendations
Guidelines must be established to assure the competence of insulin prescription. Computerized system implementation to Improve handwriting illegibility. Also the prescribers should be emphasized to write “Units” instead of using abbreviations. And finally educating practitioners about potential sources of error when prescribing insulin.

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