

# Roles of Nurses on Rational Drug Use with Diabetic Patients: Case Study

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## Abstract

Patients with diabetes are people who have to use medicines continuously for many years. Therefore, rational drug use is important to prevent drug side-effects, drug resistance, duplicated medication, drug overdose and over dosage, and drug abuse. Using drugs rationally with diabetic patients should emphasize on specification of drug use in order to obtain drug effectiveness and quality. In addition, there are reliable evidences about effects of irrational drug use on diabetic patients i.e. difficulty from drug overuse, and waste of money with effects on economic statuses of the patient families, service places, and societies. Nurses should be aware of rational drug use, give advice against irrational drug prescription, read drug labels, and give correct advice to patients. Importantly, manuals or guidelines of drug use for diabetic patients should be arranged for everyone in an organization to follow.

**Keywords:** Roles of Nurses, Rational Drug Use, Diabetic Patients

## I. Introduction

At present, diabetes medication evolves continuously and increasingly. Variety of oral hypoglycemic drugs has been developed for diabetic patients who have to take these drugs continuously for a long time to control blood glucose. Right and appropriate medication is important to prevent drug side-effects, drug resistance, duplicated medication, drug overdose and over dosage, and drug abuse. Using drugs rationally with diabetic patients should emphasize on specification of drug use in order to obtain drug effectiveness and quality. In addition, there are reliable evidences about effects of irrational drug use on diabetic patients i.e. difficulty from drug overuse, and waste of money with effects on economic statuses of the patient families, service places, and societies. Rational drug use is an important heart to take care of people's health. Moreover, when medical providers become ill, they also expect to receive appropriate medication as well. Health promotion for diabetic patients can be done by controlling their food on starch and sugar, enhancing their exercise, reducing their stress, and stopping them from consumption of alcohols and cigarettes. However, we may be unaware that overuse of drug in diabetic patients is also an important problem which needs to be

solved for their rational drug use.

## II. Common drugs used in primary medical care for diabetic patients

Diabetic patients have to take drugs continuously according to the medical plan for keeping the drug level instant and effective for controlling blood glucose. However, diabetic patients usually have comorbidity so they have to take drugs so various that they are bored of drug-taking (Busapavanich & Dandacha, 2006). Some patients have drug side-effects so they have to stop taking drugs due to the effects on their daily life while some patients do not take drug continuously on time because of their daily burdens (Ovataganont and Sunthara, 2012). As a result, patients have to be informed about advantages of each drug, and initial solutions for drug side-effects in order to raise their awareness of the importance of the planned medication. The main drugs used with diabetic patients for controlling blood glucose and treating comorbidity include antihypertensive drugs, hypolipidaemic agents, and thrombolytic agents. These types of drugs are managed as follows (Jongtrakul and Chanprasert, 2014; Jongtrakul, 2018).

### **1. Biguanide i.e. Metformin**

This type is the first medical drug used for diabetic patients with declining renal function. However, it is not suggested to be used when the serum creatinine level is higher than 1.5 milligram per deciliter in males or higher than 1.4 milligram per deciliter in females. The benefits of this drug type is its little risk of hypoglycemia, less effects on blood pressure, and reduction of triglycerides.

### **2. Sulfonylurea**

This drug type works well with diabetic patients at the age of over 40 without side-effects. The effectiveness of this drug type depends on patient pancreas' capacity to function. This drug cannot be used in patients with nonfunctional pancreas. Sulfonylurea can be divided into 3 sub-types as follows.

**2.1 Chlorpropamide** is active for 30 – 36 hours with once taking a day. This drug is suggested not to be used with patients with chronic kidney disease, severe sepsis, acidosis, liver disease, and thyroid. It should not be used with patients who are mothers during lactation period, pregnant women, and young children. It should be used with caution with elderly patients and patients with Addison's disease and liver disease because of undesirable nervous symptoms such as dizziness, spasm, fatigue, nausea, loss of appetite, constipation, and severe hypoglycemia due to its long half-life etc.

**2.2 Glibenclamide** is moderately active about 5-8 hours with twice taking a day to control glucose level all day. It is suggested not to be used if the patients' glomerular filtration rate is less than 30 milliliters per minute.

**2.3 Glipizide and Gliclazide** are active for reducing blood glucose in second generation sulfonylurea to activate beta cells of pancreas for stimulating Insulin secretion. These drugs can be used with chronic kidney disease patients. However, they should be used cautiously in patients with glomerular filtration rate at less than 30 milliliters per minute, ketoacidosis, liver disease, severe fatigue, or adrenal or pituitary sufficiency. These drugs cannot be used with pregnant women, children, and mothers during lactation period.

### **3. Alpha-glucosidase inhibitors**

This drug type includes acarbose and miglitol. It is suggested not to be used in patients with glomerular filtration rate at less than 30 milliliters per minute.

### **4. Metiglinide or Repaglinide**

Repaglinide is used in patients with chronic kidney disease without dose adjustment whereas metiglinide needs dose adjustment and is suggested not to be used in patients with glomerular filtration rate at less than 30 milliliters per minute.

### **5. Thiazotidinedione**

Thiazotidinedione can be used in patients with chronic kidney disease without dose adjustment but with caution of edema and heart failure from congestion of water and salt.

### **6. Dipeptidyl peptidase-4 (DDP-4 inhibitor)**

This drug type is the most expensive but it has no information about long-term safety.

### **7. Insulin Sensitizer**

This drug is initially used in patients with Type 1 diabetes

or may be used in patients with Type 2 diabetes, especially when the level of blood glucose is very high i.e. hemoglobin A1C more than 10 percent, plasma glucose before breakfast more than 250 milligrams per deciliter, and plasma glucose at random tests more than 300 milligrams per deciliter. Insulin can be used with oral drugs if plasma glucose cannot be controlled.

### **III. Drug description and regular uses**

#### **1. Drug for glycemic control: Biguanide**

This drug type is active differently from sulfonylurea by reducing glucose formation in livers and increasing tissue intake and uses (active in reducing tissues' Insulin resistance). The first drug in this type is metformin which should be used in patients with overweight or fat patients with failure in blood glucose control. It can be an alternative use in patients without overweight, but it is not suitable for elderly patients with kidney problems because kidneys of elderly usually decline in function. If necessary, the eGFR should be less than 30 milliliters per minute (CKD stage 4 and 5) to prevent lactic acidosis. Therefore, this drug type is not suitable for patients with kidney problems, patients with risks of liver disease and heart attack, or mothers during lactation period. The advantages of this drug type include absence of hypoglycemia and inactiveness to reduce blood glucose of people without diabetes except using large dosages of drug (Jongtrakul, 2018).

#### **1.1 Drug use**

- 1) Taking drugs with meals.
- 2) Do not forget to take drug. If not, take it immediately as soon as you remember. If it is nearly the time for the next meal, skip it and take drug in the next meal without increasing to double dose.

#### **1.2 Side-effects**

- 1) Palpitation, nausea, vomit, diarrhea, weight loss, itching rash, and vitamin B12 deficiency
- 2) Headache, flatulence, indigestion, hypoglycemia, or lactic acidosis from taking drug with alcohol

#### **1.3 Management of side-effects**

- 1) Symptoms to immediate inform doctors or pharmacists are difficult or rapid breathing, chest pain, slow heart rate or unusual heart beats, muscle pain, unconsciousness, faint, dizzy, upset stomach or stomachache, unusual fatigue, severe vomit, and diarrhea. Symptoms indicating hypoglycemia are restless, confusion, lack of concentration, easy upset, immediate changes of emotions or behaviors, hunger, nausea, fatigue, sweat, headache, palpitation, mouth numb, tingles at the ends of fingers, tremble, muscle fatigue, blur vision, cold feeling, often yawn, rapid heart rate, dizzy, faint, or convulsion. This drug type can cause hypoglycemia when using with other diabetic drugs, and the solution is to take food or drinks with sugar such as juices.
- 2) If other symptoms during drug use occur continuously or disturbingly daily life, inform doctors or pharmacists. These symptoms may be loss of appetite, flatulence, upper chest pain, weight loss, nausea, constipation, headache, cough, sneeze, and runny nose.

#### **2. Drugs for stimulating Insulin secretion from pancreas: Sulfonylurea**

This drug type is active for stimulating Insulin secretion from pancreas. The drug is effective only when beta cells of pancreas are still functional, (not used with Type 1

diabetes). This drug type cannot be single use for treatment since it may increase risks of death and coronary heart disease. Therefore, such drug is not the first type to be used; but it should be used in patients with prohibition or insufferableness of metformin, or used as secondary drug in combination with metformin. Patients who use this drug gain weight so it is not commonly used as single drug in overweight patients (Jongtrakul, 2013). This drug type includes Glibenclamide, Gliclazide, and Glipizide.

**2.1 Glibenclamide** is used to lower blood glucose by stimulating Insulin secretion from pancreas. It is helpful for body to use Insulin effectively. However, this drug cannot be used with elderly patients at the age of more than 60 years and patients with eGFR less than 60 milliliters per minute since it may cause hypoglycemia easily. Due to its long half-life, this drug accumulates long in blood flow with slow drainage.

#### 2.1.1 Drug use

- 1) Take drug once a day with meals or the first main meal of the day, or take it immediately after breakfast.
- 2) Use 1.25 mg dose for patients with risks of hypoglycemia.
- 3) Adjust the dose by increasing not more than 2.5 mg in each week.
- 4) Drug dose should not more than 20 mg a day, especially with patients who take drugs more than 10 mg. In such case, drug intake should be divided into twice a day.
- 5) Patients should meet the doctors as appointed, especially in the first 2-3 weeks in order to adjust the drug dose appropriately.
- 6) Postponing meals, skipping meals, or over exercising may reduce blood glucose so low that faint occurs.
- 7) Taking this drug with alcoholic drinks can lower blood glucose and lead to facial flush, sweat, gasp and rapid breathing, headache, or nausea.

#### 2.1.2 Side-effects

Hypoglycemia, nausea, abdominal discomfort, mild fever, loss of appetite, dark urine, jaundice, pale yellow eyes, fatigue, confusion, ecchymosis, easy bleeding, urticarial, difficult breathing, and swollen face tongue or lips. If these symptoms occur, stop using drug immediately and consult with doctors.

#### 2.1.3 Management of side-effects

- 1) Side-effects of hypoglycemia include sweat, headache, sweat, tremble, anxious, rapid heart rate, fatigue, mouth or tongue numb, and blurry vision. If these symptoms occur; drink water, juices, or sweet drinks, or consult with doctors.
- 2) In case of faint, patients should be delivered to hospital immediately. Consult with doctors immediately if these symptoms occurs i.e. itching or red rash, sunburn, yellow eyes or skin, pale stool, dark urine, fever, and sore throat.

**2.2 Gliclazide** is used to lower blood glucose by stimulating Insulin secretion from pancreas. It is helpful for body to use Insulin effectively.

#### 2.2.1 Drug use

- 1) Take drug once a day with breakfast or the first main meal of the day, or take it immediately after breakfast. Drug intake may be divided into twice a day, depending on individual patients and the used doses.

- 2) If you forget to take drug, take it immediately as soon as you remember. If it is nearly the time for the next meal, skip it and take drug in the next meal without increasing to double dose.

#### 2.2.2 Side-effects

Hypoglycemia, nausea, vomit, constipation, pancreatitis, itching rash or urticaria, allergic to light, anemia in blood system, low platelet count, *leukopenia*, and hyponatremia.

#### 2.2.3 Management of side-effects

- 1) Side-effects from hypoglycemia are headache, stretch marks, tremble, anxious, rapid heart rate, fatigue, mouth or tongue numb, and blurry vision. If these symptoms occur; drink water, juices, or sweet drinks, or consult with doctors. In case of faint, patients should be delivered to hospital immediately.
- 2) Stop using drug or consult with doctors if these symptoms occurs i.e. itching or red rash, unusual sunburn, yellow eyes or skin, pale stool, dark urine, fever, and sore throat.

**2.3 Glipizide** is used to lower blood glucose by stimulating Insulin secretion from pancreas. It is helpful for body to use Insulin effectively. This drug is suitable for replacing Glibenclamide in elderly patients who necessarily use this drug type because it has half-life at 2 – 4 hours (Half of Glibenclamide causes less risks of hypoglycemia).

#### 2.3.1 Drug use

- 1) Take drug 30 minutes before meals and take it on time.
- 2) If you forget to take drug before meals, take it immediately as soon as you remember while having it with meals or snacks between main meals. If it is nearly the time for the next meal or no snack between meals; skip it to take drug in the next meal without increasing to double dose.

#### 2.3.2 Management of side-effects

- 1) This drug can cause hypoglycemia, leading to restless, confusion, no concentration, easy upset, rapid immediate changes of emotions or behaviors, hunger, pallor, nausea, fatigue, sweat, headache, palpitation, mouth numb, tingles at the ends of fingers, tremble, weak muscles, cold feeling, often yawn, rapid heart rate, dizzy, unconsciousness, or convulsion. The solution is to take food or drink with sugar such as sweet drinks or juices.
- 2) If skin is allergic or sensitive to sunlight, wear coveralls and sunglasses, apply sunscreen lotion before leaving home, and avoiding to be near bright light.
- 3) Stop using this drug and consult doctors if there are symptoms of ecchymosis, easy bleeding such as scurvy or nosebleed, easy sweat, palpitation, nausea, abdominal discomfort, itching, loss of appetite, dark stool, jaundice, fever, and drowsiness.

### 3. Selection of intravenous drugs for diabetes treatment

A short-acting intravenous Insulin drug is the drug to promote glucose change back to glycogen, to inhibit fat disintegration into fatty acid, to be helpful for triglyceride synthesis, to stimulate protein formation, and to enhance mutual exchange of potassium and magnesium in diabetic patients' cells. Insulin temporarily accumulates for burning glucose and fat. Intravenous Insulin is quick absorbed by injecting into skin and muscles. Intravenous insulin is Regular Insulin (RI) for patients with

hyperglycemia or diabetic ketoacidosis. Insulin is injected through patients' vein to make it active quickly. A moderate-acting Insulin is Protamine Stabilized Insulin (NPH). This drug is used in patients with mild diabetic symptoms. Regular Insulin (RI) is selected if the level of blood glucose is high during patients' fasting, or the medical treatment is to lower glucose level quickly.

### **3.1 Cautions of drug use**

1. Do not use in patients with allergy to Insulin from animal protein.
2. Insulin injection should not be used in combination with other drugs in order for contaminate prevention.
3. When using intravenous Insulin in treatment, reduce or stop using drugs for stimulating Insulin secretion from pancreas such as Sulfonylurea and Glinide. The use of combined drugs cannot supplement the drug action at all, but it may increase hypoglycemia.
4. Inject Insulin on time as the doctor's prescription. In general, Insulin is injected before meals about 15 – 30 minutes to make it active at the time of high blood glucose after meals.
5. Regarding use of other drug which is active to increase level of blood glucose such as birth-control pills or corticosteroid, the intravenous dose may be necessarily increased. Or if other drug is taken to lower blood glucose such as some antibiotics or antidepressants, this case depends on the doctors' judgment.
6. Consult doctors for drug adjustment in case of going to other country in different time zone. Drug is necessarily to be adjusted before travelling.
7. Regarding patients who do exercise regularly, the dose of Insulin may be reduced during and after the exercises.

### **3.2 Guidelines for rational drug use**

1. Pills to reduce blood glucose is in the types of intake either before or after meals. Drug intake before meals should be eaten half an hour before meals. If such drug is taken too long before meals or without meals, hypoglycemia may occur and lead to faintness, palpitation, and sweat to faint or unconsciousness. If these symptoms occur, do not eat candies but drink a can of sweet drink (20 g glucose) followed by having a meal because a candy has not enough sugar for the body demand. (One candy contain 2 g glucose. If the demand is for 20 g, the demand is for 20-candy intake.) (Jongtrakul and Chanprasert, 2014). If the symptom is not better, go to see the doctor. Diabetic patients should be well-prepared when taking a long travel which is inconvenient to have meals. For example, diabetic patients with kidney functional deficiency e.g. eGFR lower than 30 milliliters per minute should change from oral to intravenous drugs.
2. Always read drug labels before taking pills because the drug dosage may be adjusted each time of doctor visit.
3. Patients who cannot read the labels or cannot see the labels clearly, may take drugs wrongly. These patients should inform pharmacists at a dispensary area to get labels with figures, or ask relatives to help them arrange drugs for each meal, or find suitable solution for particular cases.
4. If there are remaining drugs at home, bring them to the hospital and request pharmacists to examine expiry date and drug deterioration. These drug may be similar to the new drugs.
5. Keep drugs away from sunlight and wetness. The drugs should not be removed from the pack because they may be deteriorated. They should be removed only when they

are taken. The drug packets should not be switched to prevent confusion and eating wrong drugs.

6. Drugs must be taken regularly for high effectiveness of treatments for diabetes with hyperlipidemia and hypertension.

7. If there are problems about drug use such as frequent hypoglycemia, swollen symptom, cough, rash, or anxiety about unusual symptoms etc.; consult the doctors or pharmacists by bringing all kinds of the existing drugs to examine whether the unusual symptoms are from them and how to solve the problems.

8. If you want to use other drugs such as herbal drugs together, you should consult doctors or pharmacists in advance because there may be interaction among these drugs which leads to negative effects on treatment.

9. Do not use anticoagulant drugs such as aspirin in diabetic patients unless they have cardiovascular disease or risks of cerebrovascular such as hypertension, hyperlipidemia, smoking, drinking alcohols etc. Anticoagulant drug is not usually used for primary prevention drug. (Jongtrakul, 2018).

Patients should behave correctly, take drugs regularly without changing drugs by themselves, and get continuous treatments as appointed. In case of going out, take drugs with you to prevent incomplete drug intakes as medical plan.

## **IV. Nurses' roles on rational drug use**

The main objective to treat diabetic patients is to maintain their level of blood glucose closely to the normal criteria as much as possible i.e. the accumulated blood glucose of Hemoglobin A1c is less than 6 percent. If this cannot be controlled, patients need to have drugs. Diabetic drugs are in oral and intravenous forms with different activeness, prohibition, or cautions. Although the role of prescription belongs to the doctor, nurses work most closely to patients. Therefore, nurses have an important role to help patients about drug intake. The roles of professional nurses on rational drug use for diabetic patients can be summarized as follows (Suwanjedi and Somroop, 2007; Jongtrakul, 2018)

1. Roles on determining directions and policies for rational drug use with diabetic patients: Nurses should involve with policy determination, be able to explain guidelines, and follow up the progress and performance of rational drug use. To seriously perform and manage according to the policies, meetings among multidisciplinary teams should be arranged for reviewing use of diabetic drugs, for making understanding, and for cooperating to develop the system of rational drug use continuously.
2. Roles on managing a rational dispensary system: The example is to develop manuals or guidelines of drug use with diabetic patients in order for everyone in the organization to follow. For example, the dispensary criterion is used with elderly patients at the age of more than 65 years, or with eGFR less than 60 millimeters per minute etc.
3. Roles on developing an information technology system about rational drug use with diabetic patients: For example, a program is developed to prevent overlapping of drug prescription or prescription not conforming to academic principles in order to remind medical officers to be careful in drug dispensary.
4. Roles on using information about diabetic drugs: Nurses should recommend diabetic patients to always read drug labels before eating or injecting drugs, to read labels with understanding, and strictly follow the

instruction. They should use drugs correctly according to diseases, individuals and time.

5. Roles on following up to assess the results of drug use with diabetic patients, to find out whether there are problems of diabetic drug use, to examine patients' understanding about drug use, and to prevent intake of excessive drugs.

#### V. Case study of irrational drug use

An analysis of problems and effects covers about people, service system of public health, laws, economy, and nurses' roles on prevention and solutions.

##### Case study

A 67-year old diabetes patient was examined as appointed and it was found that the blood test result of eGFR was in 34 milliliters per minute (CKD stage 3B), Hemoglobin A1c = 8.3 percent. The patient took Metformin 1 tab oral bid ac through the whole treatment, but the level of blood glucose still could not be controlled. The doctor adjusted drug by give prescription of Glibenclamide 1 tab oral bid ac and intravenous Regular Insulin (RI).

The old patient used Metaformin. If eGFR was less than 45 milliliters per minute, the drug should be reduced or stopped because Metaformin was drain through kidney and this could result in increasingly kidney functional decline. According to the patient's blood test results, eGFR was 34 millimeters per minute (CKD stage 3B) so the drug intake should be stopped. However, the patient's blood glucose level could not controlled, he had to take diabetic drugs continuously.

This patient was elderly at the age of 67 years which was at the age of kidney functional decline. Therefore, drugs suitable for this patient should be in the type of Sulfonylurea i.e. Glibenclamide, Glipizide etc. However, Glibenclamide had long half-life at 10 – 12 hours so its slow drainage from the body was not suitable for elderly patients because of risks of hypoglycemia. As a result, Glipizide should be used because its shorter half-life at 3 – 5 hours had less effects on hypoglycemia.

According to the result of eGFR at 34 milliliters per minute (CKD stage 3B), this patient had kidney functional decline. Therefore, oral drugs were not suitable for him so intravenous drugs were used instead. The patient was injected with Regular Insulin (RI) which replaced functions of Insulin secreted from pancreas in order to control blood glucose. Oral drugs i.e. Sulfonylurea and Glinide should not be used to prevent stimulation of Insulin secretion from pancreas since using these two drug together was non-synergistic for better treatment.

##### Conclusion

This patient should receive only intravenous Regular Insulin (RI). He should be appointed for examination of eGFR and HbA1c every 3-6 month to assess the drug effectiveness.

#### VI. Effects of irrational drug use

As mentioned earlier, diabetic patients have to use drug continuously for many years. Therefore, drug expenditure has effects on patients' economic status. According to the above case study, the patient took excessive drugs. It was unnecessary for him to take drugs for stimulating insulin secretion from pancreas. He only needed intravenous insulin. This case made the patient to waste money for unnecessary drugs as well as the hospital to waste expenditure for unnecessary drugs. In

this case, the patient had a health card so he did not pay for drugs but the hospital did.

According to the case study of the patient with chronic kidney disease stage 3, if oral diabetic drugs were further taken, it would have effects on the patient's kidney because such drug was drained through kidney and slow kidney function with more burden. In this case, it was not necessary for the patient to take oral drug. However, oral and intravenous drugs were prescribed together without considering on rational of drug use. This is like indirect harm to the patient because of wrong judgment. Therefore, this is wrong in terms of moral, ethics, and professional ethics. In addition, this case also has effect on legal punishment.

Therefore, to avoid possible mistake, nurses should be aware of rational drug use by inhibiting if diabetic drugs are prescribed irrationally. They should read drug labels and give correct suggestion to patients. Importantly, they should arrange manuals or guidelines about drug use with diabetic patients in order for everyone in the organization to perform in the same direction.

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