

# The prescribing trend of oral antidiabetic agents for type 2 diabetes in Taiwan

## An 8-year population-based study

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### Abstract

The purpose of this study was to evaluate the prescription trend and pattern of oral antidiabetic (OAD) medications, which are extensively used worldwide for treating type 2 diabetes, in 2 age groups.

In this population-based study, data obtained from the National Health Insurance Research Database, Taiwan, were analyzed to investigate the prescription trend of all types of OAD medications during 2005 to 2012. We used descriptive statistics to demonstrate the trend of prescription patterns stratified by age (aged 65 years and above or younger than 65).

Sulfonylurea (SU) was once the most commonly used drug, but the proportion of its prescription had declined gradually (76.83% in 2005 to 63.70% in 2012). Consequently, biguanide (BG) became the most commonly used drug since 2010 (64.31% in 2005 to 74.41% in 2012). In addition, the prescriptions of thiazolidinedione decreased significantly (9.20% in 2005 to 2.86% in 2012), whereas the usage of DPP-4 inhibitor increased with time (3.73% in 2009 to 19.64% in 2012). The treatment choice of SU and  $\alpha$ -glucosidase inhibitor (AGI) was higher in elderly patients compared with the younger population (SU: 62.70% in 2012, AGI: 12.78% in 2012). Two-drug combination therapies were the prevalent treatment choices for patients with type 2 diabetes (44.77% in 2012), particularly in the elderly group; however,  $\geq 3$  drug combination therapies increased gradually during the study period, particularly in the younger group.

This descriptive study presents the change in the prescription of OAD medication for different age groups during 2005 to 2012.

**Abbreviations:** ADA = American Diabetes Association, AGI =  $\alpha$ -glucosidase inhibitor, AMI = acute myocardial infarction, BG = biguanide, BNHI = Bureau of National Health Insurance, DPP4-I = dipeptidyl peptidase-4 inhibitors, FDA = Food and Drug Administration, GLDs = glucagon-like peptide-1, GLP-1 = glucagon-like peptide-1 agonist, LHID = Longitudinal Health Insurance Database, MG = meglinides, NEJM = New England Journal of Medicine, NHI = National Health Insurance, NHIRD = National Health Insurance Research Database, OAD = oral antidiabetic medication, PPARs = peroxisome proliferator-activated receptors, SU = sulfonylurea, TZD = thiazolidinediones.

**Keywords:** antidiabetic medication, glycemic control, prescription trends, type 2 diabetes

### 1. Introduction

Diabetes is one of the most critical epidemic diseases in the world. According to the International Diabetes Federation, the global prevalence of diabetes was 8.3% in 2013, which will increase to 10.1% by 2035, and this is equivalent to approximately 3 new cases every 10 seconds.<sup>[1]</sup> In Taiwan, diabetes is the fifth leading

cause of death for 25 years. Moreover, the Nutrition and Health Surveys in Taiwan conducted during 1993 to 1996 and 2005 to 2008 revealed a significant increase in the crude prevalence of diabetes from 5.33% to 9.05%.<sup>[2]</sup>

In contrast to type 1 diabetes, which is treated only by insulin, different mechanisms of drugs were developed for type 2 diabetes including sulfonylureas (SU), meglinides (MG), biguanides (BG),

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$\alpha$ -glucosidase inhibitors (AGI), thiazolidinediones (TZD), dipeptidyl peptidase-4 inhibitors (DPP4-I), glucagon-like peptide-1 (GLP-1) agonists, and sodium/glucose cotransporter-2 inhibitors.

Because only 6% of patients with type 2 diabetes in Taiwan use insulin alone for treatment,<sup>[3]</sup> analyzing oral antidiabetic (OAD) medication usage is imperative for understanding its current prescription trend and economic burden. Several drug utilization studies on glucose-lowering drugs (GLDs) have been previously conducted in the United States,<sup>[4]</sup> United Kingdom,<sup>[5–7]</sup> and other European countries.<sup>[8–10]</sup> Most of such studies have reported a substantial increase in the prescription of antidiabetic medications as well as a decreased SU usage and an increased BG and DPP4I usage. In Taiwan, 2 studies separately conducted during 1997 to 2003 and 2000 to 2009 have revealed similar results and a prescription trend toward combination therapy.<sup>[3,11]</sup>

Because of the increasing number of OAD medication choices, we can be able to evaluate considerably more specific circumstances that may influence clinical OAD use, such as changing treatment guidelines, aging population, new adverse effects of drugs, and changing health insurance payment system.

The *New England Journal of Medicine* (NEJM) published a meta-analysis in 2007 that reported an increased risk of acute myocardial infarction (AMI) and cardiovascular-related deaths associated with rosiglitazone usage,<sup>[12]</sup> which caused a 50% decline in its prescription after warning.<sup>[13]</sup> In addition, a study examining pioglitazone usage and the associated risk of bladder cancer was published in the *British Medical Journal* and received extensive attention.<sup>[14–16]</sup>

Treatment goal setting for type 2 diabetes have undergone a major shift since 2006,<sup>[17]</sup> the target HbA1c was 7.0 since then, however many issues of intensive care came out later, including intensive glycemic control may increase mortality and fails to reduce cardiovascular events.<sup>[18]</sup> In 2010, the American Diabetes Association published standard medical care in diabetes, emphasizing on individualized goal setting based on life expectancy, comorbidities, hypoglycemia awareness, and duration of diabetes.<sup>[19]</sup>

Only one study investigated the prescription trend of antidiabetic medication as well as examining new GLDs, such as DPP4-I in Taiwan. Ou et al<sup>[20]</sup> found that healthcare costs spent on DPP4-I increased significantly during 2008 to 2013 and DPP4-I was the most commonly used as 2nd and 3rd line antidiabetic treatment. The result showed that every category of antidiabetic medication was used more among elderly. However, this study did not analyze the prescription trend according to different age category. Moreover, the difference in antidiabetic prescription between elderly and younger Asian populations has not been researched yet.

Age is another crucial factor for consideration. Because aging has become an inevitable trend in developed countries, prescribing medication for elderly patients with type 2 diabetes is highly common. However, many factors influence drug prescription for elderly patients including age, renal function, drug compliance, comorbidities, and adverse effects. Two past studies on the trend of antidiabetic prescriptions reported inconsistent patterns for the elderly.<sup>[21,22]</sup>

The aim of the current study was to analyzing the prescription data by the type of therapy and by the age group of patients from Taiwan's National Health Insurance Research Database (NHIRD) and try to have more understanding of the prescribing trends of OAD medication for type 2 diabetes. We included current drugs, such as DPP4-I, in our analysis as long as fixed-

dose combination treatment and compared the difference in prescription between older and younger patients.

## 2. Subjects, materials, and methods

### 2.1. Data sources

In this population-based study, data from the NHIRD were analyzed to understand the trend of OAD prescription for type 2 diabetes. The National Health Insurance (NHI) program in Taiwan was launched by the Bureau of National Health Insurance (BNHI) in 1995, and this program covers all healthcare services for >95% of the population of Taiwan. The National Health Research Institutes (NHRI) maintains the Longitudinal Health Insurance Database (LHID) in coordination with the BNHI; the LHID is a representative database of 1,000,000 subjects who were randomly sampled from the 2000 registry of all NHI enrollees through a systematic sampling method for research purposes. No statistically significant differences exist in age, sex, or healthcare costs between the sample group and the enrollees, as reported by the NHRI. These databases have been used for epidemiological research, and the information provided regarding prescription, diagnoses, and hospitalizations is of high quality.<sup>[23,24]</sup> All patients' records/information were anonymized and de-identified before the analysis. The Institutional Review Board of the Taichung Armed Forces General Hospital, Taiwan, approved this study.

### 2.2. Identification of the study group

In this study, we analyzed the registration files and original claims data of patients during 2005 to 2012. All patients with type 2 diabetes were identified according to International Classification of Diseases, Ninth Revision codes 250.XX, either thrice during a study year or once with the prescription of antidiabetic medication. All patients claimed at least 1 prescription of an OAD. All antidiabetic prescriptions were identified after confirmation of the diagnosis of type 2 diabetes. Our unit of observation was the antidiabetic prescription which may include >1 OAD. Several classes of OAD medications were identified using specific drug codes for each drug in the NHIRD, namely 1, SU; 2, MG; 3, BG; 4, AGI; 5, TZD; and 6, DPP-4I. In 2013, the Food and Drug Administration (FDA) approved a new class of OAD medication, sodium/glucose cotransporter-2 inhibitor, which increases renal glucose excretion and inhibits renal glucose reabsorption. However, we excluded it from our analysis because it was approved by the Taiwan FDA only in 2014.

We recorded the prescription rates and patterns for each antidiabetic medication from every antidiabetic prescription each year during the study. The prescription rates were defined as the number of each antidiabetic prescription divided by the total number of antidiabetic prescriptions. The prescription patterns were classified into 4 categories: monotherapy, 2-drug combination therapy, 3-drug combination therapy, and  $\geq 4$  drug therapy. The prescription pattern was defined as how many antidiabetic medication among 1 single prescription. We tried to observe the prescription trend and the prescribing behavior behind each single prescription. For example, if a patient initiates a sulfonylurea but switches to DPP-4 inhibitors, he or she used 1 antidiabetic medication at each time, thus his/her treatment would be categorized into monotherapy in both situation. For fixed-dose combination medication, the prescription rates for each component of the drug were added to its original category.

**Table 1**  
The type 2 diabetes patient and prescription numbers in each year.

Year	All patients			<65 y			≥65 y		
	Patients no.	Prescription no.	Mean no. of prescriptions per patient	Patients no.	Prescription no.	Mean no. of prescriptions per patient	Patients no.	Prescription no.	Mean no. of prescriptions per patient
2005	39,878	337,004	8.45	22,278	179,471	8.06	17,600	157,533	8.95
2006	42,053	353,985	8.42	23,337	187,496	8.03	18,716	166,489	8.90
2007	45,054	372,811	8.27	24,937	198,387	7.96	20,117	174,424	8.67
2008	47,978	387,203	8.07	26,539	205,365	7.74	21,439	181,838	8.48
2009	51,113	399,081	7.81	28,439	212,586	7.48	22,674	186,495	8.23
2010	54,210	414,878	7.65	30,321	223,336	7.37	23,889	191,542	8.02
2011	57,012	428,956	7.52	31,810	231,735	7.28	25,202	197,221	7.83
2012	60,219	439,720	7.30	33,506	237,521	7.09	26,713	202,199	7.57

The definition of fixed-dose combination is that ≥2 drugs contained in a single dosage form, such as a capsule or tablet.

**2.3. Statistical analysis**

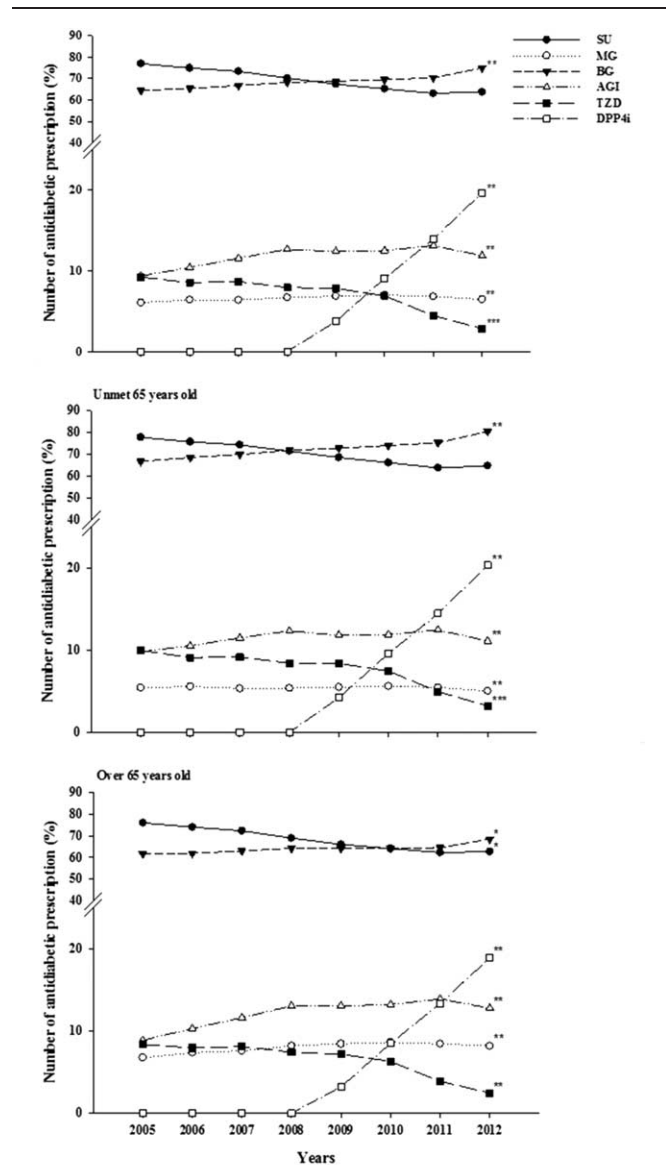
To understand the prescription trend of OAD medication, we used descriptive statistics to demonstrate the trend of OAD prescription, stratified by age (aged 65 years and above or younger than 65). All statistical analyses were conducted using SAS software (version 9.2; SAS Institute Inc., Cary, NC).

**3. Results**

Our study population comprised 39,878 diabetic patients having claimed at least 1 OAD in 2005, which increased to 60,219 in 2012. Table 1 shows the number of patients enrolled each year and the number of their OAD prescriptions. The number of antidiabetic prescriptions in 2005 was 33,7004, which increased to 439,720 in 2012. Figure 1 shows the prescription rates of OAD medication in each study year. SU was once the most commonly used drug, but its prescription proportion declined gradually (76.83% in 2005 to 63.7% in 2012). However, there was no statistical difference for the changing trend of SU. BG became the most commonly used drug since 2010 (64.31% in 2005 to 74.41% in 2012). The prescriptions of TZD dropped significantly (9.2% in 2005 to 2.86% in 2012), whereas the usage of DPP-4I (3.73% in 2009 to 19.64% in 2012) increased with time. The prescription trends of MG and AGI were similar, demonstrating a slight increase initially and then decreasing thereafter.

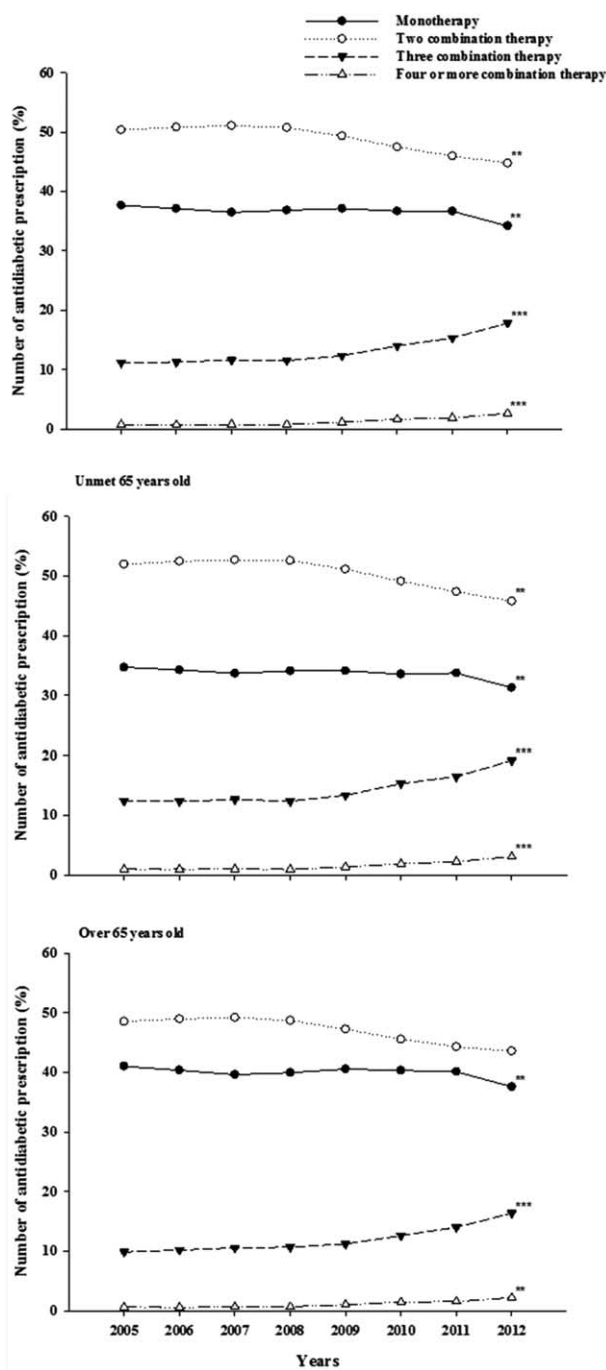
Compared with patients aged younger than 65 years, elderly patients received more MG (8.17% and 5.03% for elderly and younger patients in 2012, respectively) and AGI (12.78% and 11.07% for elderly and younger patients in 2012, respectively) prescriptions and lower TZD (2.45% and 3.31% for elderly and younger patients in 2012, respectively) and BG (68.16% and 79.73% for elderly and younger patients in 2012, respectively) prescriptions. In the elderly group, the usage rate of DPP-4I was 18.9% in 2012, which was slightly lower than that of the younger group (20.26% in 2012).

Figure 2 illustrates a comparison of prescription patterns, including monotherapy and combination therapy, between the groups. The proportion of combination therapy accounted for 60% of all prescriptions, and the most frequently used regimen in both groups was the 2-drug combination therapy. Regarding the prescription trend, the 3-drug combination therapy and ≥4 drug



\*P<0.05, \*\*P<0.01, \*\*\*P<0.001

**Figure 1.** Prescribing rates of oral antidiabetic medication in Taiwan, 2005 to 2012.



\*P<0.05, \*\*P<0.01, \*\*\*P<0.001

Figure 2. Prescribing patterns of oral antidiabetic medication in Taiwan, 2005 to 2012.

combination therapies were used increasingly in both groups during the study period. Regarding the monotherapy category, BG became the most commonly used drug since 2010 instead of SU. In the 2-drug combination therapy, SU combined with BG remained the most commonly used regimen. P value for trend was also shown in the figure.

Table 2 shows the difference in the prescription trend and pattern of monotherapy and 2-drug combination therapy between both groups in 2012. For the monotherapy category,

elderly patients used SU, AGI, and DPP-4I most frequently (SU, 34.14%; AGI, 4.98%; and DPP-4I, 5.13% in 2012). Two-drug combination therapy was still the prevalent treatment for elderly patients. Elderly patients more frequently used SU-based and DPP-4I-based combination therapies, whereas the younger group used more of BG-based combination therapy. Moreover, the prescription of fixed-dose combination therapies increased with time for elderly patients; however, not as much as for younger patients in 2012.

#### 4. Discussion

We examined time trends in the prescription patterns of OAD medication for type 2 diabetes during 2005 to 2012 by using data from the LHID, a representative database of 1,000,000 subjects randomly sampled from the 2000 registry of all NHI enrollees by using a systematic sampling method for research purposes. The results revealed a constantly changing OAD prescription trend and a significant difference in this trend between both age groups during 2005 to 2012.

Treatment goal setting for type 2 diabetes has undergone a major shift since 2006,<sup>[17]</sup> the target HbA1c was set 7.0 since then. In 2008, the American Diabetes Association (ADA) published standard medical care in diabetes and change the preprandial glucose target to 70 to 130 mg/dL.<sup>[25]</sup> In 2010, the ADA reset the preprandial glucose target back to 80 to 130 mg/dL, while emphasizing on individualized goal setting based on life expectancy, comorbidities, hypoglycemia awareness, and duration of diabetes.<sup>[19]</sup> These changes had influences on prescribing behavior of physician and thus the prescription trend was changing.

Among the OAD medications, BG became the most widely used medication since 2010. By contrast, the usage rate of SU dropped gradually. Because SU was introduced for managing type 2 diabetes mellitus in Taiwan in the 1970s, drugs of this class are considered the core oral treatment for patients with this disease. However, clinical physicians raised concerns about the side effects of such drugs such as hypoglycemia and weight gain; this may explain the decline in the prescription of such drugs.<sup>[11]</sup> Moreover, additional advantages of BG were discovered such as facilitating weight loss, improving insulin resistance, reducing cardiovascular mortality among obese patients with diabetes, and reducing cancer risk.<sup>[26,27]</sup> The American Diabetic Association regarded metformin as the first line antidiabetic drug as did other guidelines.<sup>[28,29]</sup>

TZD, introduced in Taiwan in 2001, activates peroxisome proliferator-activated receptors (PPARs) and increases insulin sensitivity by acting on adipose tissues, muscles, and the liver to increase glucose utilization and reduce glucose production. This drug is widely used because of its antihypoglycemic effect. In 2007, the NEJM reported that an increased risk of AMI and cardiovascular-related death was associated with rosiglitazone.<sup>[12]</sup> Moreover, the Journal of American Medical Association reported that rosiglitazone was associated with an increased risk of congestive heart failure, acute myocardial infarction, and mortality compared with other combination oral hypoglycemic agent treatments.<sup>[30]</sup> This medication was suspended in European countries in 2010, and the FDA placed a warning on the medication package. The Taiwan FDA has strictly restricted the use of rosiglitazone since 2011; therefore, pioglitazone became the predominantly used TZD drug. This may explain the significant decrease in the use of TZD during past decade. Nevertheless, few reports and studies have mentioned the



**Table 2**  
**Oral anti-diabetic medication used alone or in 2 combination in Taiwan, 2012.**

	Prescription number (%)		
	All	<65 y	≥65 y
Monotherapy	141,924 (100)	70,198 (100)	71,725 (100)
Sulfonylureas	43,678 (30.78)	19,191 (27.34)	24,487 (34.14)
Meglitinides	9960 (7.02)	3399 (4.84)	6561 (9.15)
Biguanides	75,723 (53.35)	42,522 (60.57)	33,201 (46.29)
α-glucosidase inhibitors	5704 (4.02)	2128 (3.03)	3576 (4.98)
Thiazolidinediones	490 (0.34)	266 (0.38)	224 (0.31)
Dpp-4 inhibitors	6369 (4.49)	2692 (3.84)	3677 (5.13)
Two-combination therapy	185,483 (100)	102,450 (100)	83,033 (100)
Sulfonylurea + Meglitinide	391 (0.21)	165 (0.16)	226 (0.27)
Sulfonylurea + Biguanide	112,866 (60.85)	64,109 (62.58)	48,757 (58.72)
Sulfonylurea + α-glucosidase inhibitor	7301 (3.94)	2819 (2.75)	4482 (5.40)
Sulfonylurea + Thiazolidinedione	844 (0.45)	436 (0.43)	408 (0.49)
Sulfonylurea + Dpp-4 inhibitor	7244 (3.90)	2991 (2.92)	4253 (5.12)
Meglitinide + Biguanide	7160 (3.86)	3725 (3.64)	3435 (4.14)
Meglitinide + α-glucosidase inhibitor	1893 (1.02)	618 (0.60)	1275 (1.54)
Meglitinide + Thiazolidinedione	112 (0.06)	49 (0.05)	63 (0.08)
Meglitinide + Dpp-4 inhibitor	2462 (1.33)	883 (0.86)	1579 (1.90)
Biguanide + α-glucosidase inhibitor	4562 (2.46)	2807 (2.74)	1755 (2.11)
Biguanide + Thiazolidinedione	665 (0.36)	428 (0.42)	237 (0.29)
Biguanide + Dpp-4 inhibitor	7809 (4.21)	4745 (4.63)	3064 (3.69)
α-glucosidase inhibitor + Thiazolidinedione	34 (0.02)	24 (0.02)	10 (0.01)
α-glucosidase inhibitor + Dpp-4 inhibitor	966 (0.52)	434 (0.42)	532 (0.64)
Thiazolidinedione + Dpp-4 inhibitor	29 (0.02)	11 (0.01)	18 (0.02)
Fixed-dose combination			
Sulfonylurea/Biguanide	27,176 (14.65)	15,824 (15.44)	11,352 (13.67)
Thiazolidinedione/Biguanide	536 (0.29)	337 (0.33)	199 (0.24)
Dpp-4 inhibitor/Biguanide	3433 (1.85)	2045 (2.00)	1388 (1.67)

possible association of pioglitazone with bladder cancer, and this topic warrants further examination.<sup>[14-16]</sup>

Our results revealed that old and new drugs for diabetes are currently combined for optimal treatment. Acarbose, a type of AGI, which lowers postprandial blood glucose, is still used in combination therapies for type 2 diabetes in Taiwan. This is probably because of its relatively cheap price and minimal effect on the fasting blood glucose, leading to a lesser possibility of hypoglycemia, particularly in elderly patients. However, the gastrointestinal disorders and symptoms caused by AGI should not be ignored.<sup>[31,32]</sup>

Regarding the new generation of antidiabetic medication, DPP-4I is one of the most widely used drugs. Results from previous studies have revealed that the prescription trend for this drug is increasing rapidly, and this trend is consistent with that observed in our study. Rafaniello et al<sup>[33]</sup> determined an overall increase in the proportion of monotherapy treatment, particularly for DPP-4I, in recent years. Oishi et al<sup>[22]</sup> discovered that combination therapy is the prevalent treatment of choice in addition to the increased use of BG and DPP-4I. DPP-4I has several advantages such as an appropriate effect on blood glucose lowering, a neutral effect on the body weight, and relatively lesser hypoglycemia rate; however, its higher cost might impose an economic burden on the healthcare system. Moreover, long-term safety data,<sup>[34]</sup> such as the association of DPP-4I with the risk of arthritis,<sup>[35]</sup> or DPP-4I with the risk of heart failure, are still incomplete.<sup>[36,37]</sup>

In the analysis of the prescription patterns, the proportion of combined therapy constituted 60% of all prescriptions. Although metformin is the major prescription for monotherapy, metformin combined with SU was the preferred choice of 2-drug combination treatment, which is consistent with the current treatment

guidelines. In recent years, early combination therapy has become increasingly crucial in diabetes treatment. Current guidelines also encourage the early use of combination therapy involving submaximal doses of each drug to lower blood glucose more effectively with less adverse outcomes.<sup>[38]</sup> According to Yu et al<sup>[39]</sup> the overall control of diabetes in Taiwan improved considerably after the introduction of new healthcare models and initiatives during 2006 to 2011, which could be the evidence of early combination treatment.

A previous meta-analysis revealed that fixed-dose combination therapy could lower the in adherence rate to 26%.<sup>[40]</sup> Another systematic review indicated that fixed-dose combination therapy increased patient adherence and satisfaction in addition to lowering treatment costs.<sup>[41]</sup> In our study, the trend of prescribing a fixed-dose combination therapy increased over the past years.

Our results showed an increasing trend of prescribing ≥4 drug combination therapies. Although clinical guidelines recommend using insulin after >3 OAD medications are prescribed, patients in Taiwan are still reluctant to use insulin injection. Therefore, physicians tend to prescribe more types of oral medications.

The antidiabetic prescription for elderly patients with type 2 diabetes slightly varied from that for younger patients. Elderly patients tend to receive more MG and AGI, but less TZD and BG. TZD would cause heart failure problem in elderly,<sup>[30]</sup> while BG could cause lactic acidosis especially when elderly have renal impairment.<sup>[42]</sup> Though there is no specific difference regarding drug choice in current treatment guideline, elderly with multiple morbidity, and decreased heart and renal function still have limits of drug choice. This result is consistent with that in a study conducted in Japan.<sup>[22]</sup>

Among the elderly patients, 51.9% were undergoing SU monotherapy. SU is a widely used medication that causes severe hypoglycemia in elderly patients, leading to fatal consequences. The use of SU increases the risk of hypoglycemia,<sup>[43]</sup> emergency department admissions,<sup>[44]</sup> and hip fracture in elderly patients.<sup>[45]</sup> Therefore, the current prescription behavior of SU and its adverse effects toward elderly patients should be evaluated more carefully.

The percentage of DPP-4I use in elderly patients in our study was extremely low compared with that in Japan, which was 34.6%. This is probably because of the high costs of DPP-4I, which may affect the choice of physicians who are under Taiwan's NHI system. Therefore, because of its advantages, we consider that the use of DPP-4I will constantly increase in the near future; however, physicians should be aware of its adverse effects on elderly patients.

In our study, more monotherapy was prescribed to elderly patients compared with younger patients; this may be because of the multiple factors that must be considered for treating elderly patients including adjusted treatment goal, daily life activities, comorbidities, life expectancy, adverse drug effects (such as hypoglycemia), potential benefits, and individualized preference.<sup>[46,47]</sup>

Some limitations exist in our study. First, DPP-4I was introduced for the first time in Taiwan since 2011; hence, only 2 years of data were available for analysis. Therefore, it was difficult to evaluate the prescription trend from a limited study. Second, no HbA1c data of NHIRD were available; therefore, we could not calculate the individual severity of type 2 diabetes with the treatment outcome, whereas the change of disease severity overtime is another factor that might be associated with the use of medication. Third, patients may not take all the medication from prescription claimed due to altered drug adherence. However, Under the National Health Insurance in Taiwan, most patients can have their medication within the same hospital or clinic which physician belong to. Fourth, since we used prescription claimed to observe the prescription trend of antidiabetic medication, some of the diabetic patients could be missed because they may not use any medication. Also, we cannot tell which prescription was for incident patients or prevalent users, owing to the NHIRD was started since 2005. However, this study aimed to evaluate the overall prescription trend, so the result still reflected clinical usage of each type of antidiabetic medication.

## 5. Conclusion

This descriptive study describes the change in the prescription of OAD medication in Taiwan. The prescription trend has changed gradually over the past decade. Monotherapy, as the conventional treatment, was used less during the study period, while 2-combination therapy and 3-combination therapy was used more during study period. More new antidiabetic medication was made each year, and physicians now have more choices for treating type 2 diabetes. Further research is required for exploring the effect of each factor associated with the prescription trend as well as the effect of the prescription trend on medical cost. Also, future study aims to see how the characteristics of either patients or physicians affect the prescribing trend of antidiabetic medication.

The results of this study can serve as a reference for clinical physicians and central health authorities in prescribing medication and implementing health policies for enhancing the care quality for patients with diabetes.

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