

BUKTI KORESPONDENSI

Jurnal Nasional Terakreditasi Peringkat 3 dan 4

Judul Artikel : *Evaluation of Anti-diabetic Drugs using ATC/DDD and DU90% Methods in Diabetes Mellitus Patients*

Jurnal : Galenika Journal of Pharmacy Vol. 10, No. 1, Maret 2024.

Penulis :

No.	Perihal	Tanggal
1.	Bukti konfirmasi submit artikel	20 Oktober 2023
2.	Pemberitahuan revisi pertama	20 November 2023
3.	Submit revisi	27 Desember 2023
4.	Pemberitahuan revisi kedua	5 Januari 2024
5.	Submit revisi	31 Januari 2024
6.	Pemberitahuan revisi ketiga	9 Februari 2024
7.	Submit revisi	15 Februari 2024
8.	<i>Accept Submission</i>	23 Februari 2024
9.	<i>Copyediting</i>	2 Maret 2024
10.	Publish artikel	4 Maret 2024

Bukti Konfirmasi Submit Artikel (20 Oktober 2023)

Jurnal Farmasi Galenika (Galenika Journal of Pharma... Tasks 0 English View Site godeliva13

Submission Library View Metadata

Evaluation of Anti-diabetic Drugs using ATC/DDD and DU90% Methods in Diabetes Mellitus Patients

Godeliva Adriani Hendra, Dhanang Prawira Nugraha, Tuswatul Anggi Krisdia

Submission Review Copyediting **Production**

Submission Files

Search

56770-1	godeliva13, Godeliva Adriani Hendra_Semnas Kefarmasian Untad 2023.docx	October 20, 2023	Article Text
56777-1	zubair, Evaluation_of_Anti_diabetic_Drugs_using_ATC_DDD_an, 13% plagiarism.pdf	October 20, 2023	Article Text
56778-1	zubair, Format review 16624-Article Text-56770-1-2-20231020.docx	October 20, 2023	Article Text

Download All Files

Pre-Review Discussions

Add discussion

Name	From	Last Reply	Replies	Closed
No Items				

Pemberitahuan Revisi Pertama (20 November 2023)

Jurnal Farmasi Galenika (Galenika Journal of Pharma... Tasks 0 English View Site godeliva13

Reviewer's Attachments

Search

57083-1	16624-Article Text-56939-1-4-20231020 review 1.docx	November 20, 2023
57216-1	16624-Article Text-56939-1-4-20231020.docx	November 27, 2023

Revisions

Search Upload File

57681-1	Article Text, Revisi ATC:DDD Diabetes Melitus.docx	December 27, 2023	Article Text
---------	--	-------------------	--------------

Review Discussions

Add discussion

Name	From	Last Reply	Replies	Closed
No Items				

https://bestjournal.untad.ac.id/index.php/Galenika/\$\$\$call\$\$\$/tab/author-dashboard/author-dashboard-review-round-tab/fetch-review-round-info?submissionid=16624&stageid=3&reviewRoundid=11843

Submit Revisi (27 Desember 2023)

Jurnal Farmasi Galenika (Galenika Journal of Pharma... Tasks 0 English View Site godeliva13

Reviewer's Attachments [Search](#)

57083-1	, 16624-Article Text-56939-1-4-20231020 review 1.docx	November 20, 2023
57216-1	, 16624-Article Text-56939-1-4-20231020.docx	November 27, 2023

Revisions [Search](#) [Upload File](#)

57681-1	Article Text, Revisi ATC:DDD Diabetes Melitus.docx	December 27, 2023	Article Text
---------	--	-------------------	--------------

Review Discussions [Add discussion](#)

Name	From	Last Reply	Replies	Closed
No Items				

[https://bestjournal.untad.ac.id/index.php/Galenika/\\$\\$\\$call\\$\\$\\$/tab/author-dashboard/author-dashboard-review-round-tab/fetch-review-round-info?submissionId=16624&stageId=3&reviewRoundId=11843](https://bestjournal.untad.ac.id/index.php/Galenika/$$$call$$$/tab/author-dashboard/author-dashboard-review-round-tab/fetch-review-round-info?submissionId=16624&stageId=3&reviewRoundId=11843)

Pemberitahuan Revisi Kedua (5 Januari 2024)

Jurnal Farmasi Galenika (Galenika Journal of Pharma... Tasks 0 English View Site godeliva13

Reviewer's Attachments [Search](#)

57954-1	, 16624-Article Text-57791-1-4-20231227 review 2.docx	January 5, 2024
---------	---	-----------------

Revisions [Search](#) [Upload File](#)

58212-1	Article Text, Revisi ATC:DDD.docx	January 31, 2024	Article Text
---------	-----------------------------------	------------------	--------------

Review Discussions [Add discussion](#)

Name	From	Last Reply	Replies	Closed
No Items				

[https://bestjournal.untad.ac.id/index.php/Galenika/\\$\\$\\$call\\$\\$\\$/tab/author-dashboard/author-dashboard-review-round-tab/fetch-review-round-info?submissionId=16624&stageId=3&reviewRoundId=11867](https://bestjournal.untad.ac.id/index.php/Galenika/$$$call$$$/tab/author-dashboard/author-dashboard-review-round-tab/fetch-review-round-info?submissionId=16624&stageId=3&reviewRoundId=11867)

Submit Revisi (31 Januari 2024)

Jurnal Farmasi Galenika (Galenika Journal of Pharma... Tasks 0 English View Site godeliva13

Reviewer's Attachments

57954-1 , 16624-Article Text-57791-1-4-20231227 review 2.docx January 5, 2024

Revisions

58212-1 Article Text, Revisi ATC:DDD.docx January 31, 2024 Article Text

Review Discussions

Name	From	Last Reply	Replies	Closed
No Items				

https://bestjournal.untad.ac.id/index.php/Galenika/\$\$call\$\$/tab/author-dashboard/author-dashboard-review-round-tab/fetch-review-round-info?submissionId=16624&stageId=3&reviewRoundId=11887

Pemberitahuan Revisi Ketiga (9 Februari 2024)

Jurnal Farmasi Galenika (Galenika Journal of Pharma... Tasks 0 English View Site godeliva13

Reviewer's Attachments

58259-1 , 16624-Article Text-58244-1-4-20240131.docx February 9, 2024

Revisions

58277-1 Article Text, Revisi anti-diabetic drug.docx February 15, 2024 Article Text

Review Discussions

Name	From	Last Reply	Replies	Closed
No Items				

https://bestjournal.untad.ac.id/index.php/Galenika/\$\$call\$\$/tab/author-dashboard/author-dashboard-review-round-tab/fetch-review-round-info?submissionId=16624&stageId=3&reviewRoundId=11918

Submit Revisi (15 Februari 2024)

Jurnal Farmasi Galenika (Galenika Journal of Pharma... Tasks 0 English View Site godeliva13

Reviewer's Attachments

[Search](#)

58259-1	,16624-Article Text-58244-1-4-20240131.docx	February 9, 2024
---------	---	------------------

Revisions

[Search](#) [Upload File](#)

58277-1	Article Text, Revisi anti-diabetic drug.docx	February 15, 2024	Article Text
---------	--	-------------------	--------------

Review Discussions

[Add discussion](#)

Name	From	Last Reply	Replies	Closed
No Items				

[https://bestjournal.untad.ac.id/index.php/Galenika/\\$\\$\\$call\\$\\$\\$/tab/author-dashboard/author-dashboard-review-round-tab/fetch-review-round-info?submissionId=16624&stageId=3&reviewRoundId=11918](https://bestjournal.untad.ac.id/index.php/Galenika/$$$call$$$/tab/author-dashboard/author-dashboard-review-round-tab/fetch-review-round-info?submissionId=16624&stageId=3&reviewRoundId=11918)

Accept Submission (23 Februari 2024)

Jurnal Farmasi Galenika (Galenika Journal of Pharma... English View Site godeliva13

Notifications

[JFG] Editor Decision

2024-02-23 06:24 AM

Godeliva Adriani Hendra:

We have reached a decision regarding your submission to Jurnal Farmasi Galenika (Galenika Journal of Pharmacy) (e-Journal), "Evaluation of Anti-diabetic Drugs using ATC/DDD and DU90% Methods in Diabetes Mellitus Patients".

Our decision is to: Accept Submission

Amelia Rumi
Universitas Tadulako
amelia.rumi@gmail.com

Prof. Apt. M. Sulaiman Zubair, PhD
Editor in Chief
Jurnal Farmasi Galenika (Galenika Journal of Pharmacy) (e-Journal)

[Search](#) [Upload File](#)

58305-1 Article Text, Revisi Artikel ATC/DDD Anti-diabetic Drugs.docx February 21 Article Text

Copyediting (2 Maret 2024)

Jurnal Farmasi Galenika (Galenika Journal of Pharma... Tasks 0 English View Site godeliva13

Submission Library View Metadata

Evaluation of Anti-diabetic Drugs using ATC/DDD and DU90% Methods in Diabetes Mellitus Patients
Godeliva Adriani Hendra, Dhanang Prawira Nugraha, Tuswatul Anggi Krisdia

Submission Review Copyediting Production

Copyediting Discussions [Add discussion](#)

Name	From	Last Reply	Replies	Closed
Author Addition in the Article	godeliva13	-	0	<input type="checkbox"/>
Publikasi Artikel	saifulm11	godeliva13	1	<input type="checkbox"/>

2024-02-25 01:21 PM


2024-03-01 05:41 PM 2024-03-02 01:25 PM

Copyedited [Search](#)

58360-1	saifulm11, Copyedit_Godeliva.docx	March 1, 2024	Article Text
---------	-----------------------------------	---------------	--------------

[https://bestjournal.untad.ac.id/index.php/Galenika/\\$\\$\\$\\$call\\$\\$\\$/tab/author-dashboard/author-dashboard-tab/fetch-tab?submissionid=16624&stageid=4](https://bestjournal.untad.ac.id/index.php/Galenika/$$$$call$$$/tab/author-dashboard/author-dashboard-tab/fetch-tab?submissionid=16624&stageid=4)

Publish artikel (4 Maret 2024)



Submitted
Oct 20, 2023

Accepted
Feb 23, 2024

Published
Mar 4, 2024

[Download](#)

Abstract

Background: Diabetes Mellitus (DM), which results from insulin resistance, is closely linked to long-term damage to pancreatic beta cells, organ dysfunction, and organ failure, particularly in the eyes, kidneys, nerves, heart, and blood vessels. The development of the ATC/DDD system is necessary to increase global drug knowledge, ensure equitable drug availability, and promote responsible drug use. **Objectives:** This study aimed to identify data on patient characteristics and oral anti-diabetic drugs and insulin using the ATC/DDD and DU90% methods. **Material and Methods:** This study was a cross-sectional evaluation of oral anti-diabetic medications and insulin using the ATC/DDD method and DU90% at the Bala Keselamatan Bokor Turen Hospital from January to December 2022. The inclusion criteria were patients diagnosed with type 1 or type 2 diabetes mellitus, with or without comorbidities, who were treated with oral anti-diabetic medications and a combination of insulin and oral medications. In the present study, the incomplete medical record data served as the exclusion criteria. The sample for this investigation consisted of 238 patients selected using the complete sampling technique. **Results:** Most patients who used oral anti-diabetic medications and insulin were between the ages of 46 and 65 (71.34%), were female (73.2%), had standard body mass index (BMIs between 18.5 and 25), and had diagnoses of DM + HT (20.73%) and Type II DM (18.29%). Glulisin was the most used anti-diabetic drug, accounting for 589 DDD/100 days of hospitalization, and DU90% was 21.39%. **Conclusion:** Glulisin is the most frequently prescribed anti-diabetic medication at Bokor Turen Hospital.

Keywords

Antidiabetic Oral and Insulin Diabetes Mellitus ATC/DDD DU 90%

scite_ 0 0 0 0 → hide



Jurusan Farmasi Fakultas Matematika dan Ilmu Pengetahuan Alam
Universitas Tadulako

Jurnal Farmasi Galenika (*Galenika Journal of Pharmacy*) (e-Journal)

ISSN 2442-7284 (print) || ISSN 2442-8744 (online)

Jl. Soekarno Hatta km. 9, Palu, Sulawesi Tengah, Indonesia. Telp/Fax : (0451) 422611

Homepage Journal: <https://bestjournal.untad.ac.id/index.php/Galenika/>

SURAT KETERANGAN

Nomor: 6/JFG/III/2024

Kepada Yth.

Godeliva Adriani Hendra, Dhanang Prawira Nugraha, Tuswatul Anggi Krisdia

Program Studi Farmasi, Fakultas Ilmu Kesehatan, Universitas Ma Chung, Malang, Indonesia.

Berdasarkan proses penelaahan artikel yang telah dilakukan oleh tim Reviewer, maka artikel saudara yang berjudul:

Evaluation of Anti-diabetic Drugs using ATC/DDD and DU90% Methods in Diabetes Mellitus Patients

dinyatakan **diterima** (*accepted*) untuk diterbitkan dalam Jurnal Farmasi Galenika (*Galenika Journal of Pharmacy*) (e-Journal) Volume 10, Nomor 1, Maret 2024

Demikian pengumuman ini dibuat, atas perhatiannya diucapkan terima kasih.

Palu, 1 Maret 2024
Pimpinan Redaksi,

Prof. apt. Muhammad Sulaiman Zubair, M.Si., Ph.D.



Jurusan Farmasi Fakultas Matematika dan Ilmu Pengetahuan Alam
Universitas Tadulako

Jurnal Farmasi Galenika (*Galenika Journal of Pharmacy*) (e-Journal)

ISSN 2442-7284 (print) || ISSN 2442-8744 (online)

Jl. Soekarno Hatta km. 9, Palu, Sulawesi Tengah, Indonesia. Telp/Fax : (0451) 422611

Homepage Journal: <https://bestjournal.untad.ac.id/index.php/Galenika/>

Lampiran:

Untuk proses berikutnya, kami memohon kerjasamanya untuk melengkapi beberapa hal di bawah ini:

- Kesiediaan untuk merevisi artikel, jika ada catatan dari Reviewer artikel (keterlambatan mengirimkan revisi berakibat keterlambatan pada publikasi). Penulis dimungkinkan juga, apabila ingin memperbaiki atau menambahkan kekurangan bagian artikel yang mungkin luput dari penelaahan editor maupun reviewer, dapat mengirimkan naskah perbaikannya ke email: jurnalgalenika.farmasiuntad@gmail.com.
- Kesiediaan untuk memberi biaya kontribusi sebesar Rp. 500.000,- (lima ratus ribu rupiah). Semua biaya dikirim ke rekening **BNI 0155360681 a.n M. Sulaiman Zubair**. Bukti transfer dikirim melalui email: jurnalgalenika.farmasiuntad@gmail.com dengan cara membalas (*reply*) dari email LoA yang dikirimkan.

Evaluation of Anti-diabetic Drugs using ATC/DDD and DU90% Methods in Diabetes Mellitus Patients

ABSTRACT

Background: Diabetes Mellitus (DM), which results from insulin resistance, is closely linked to long-term damage to pancreatic beta cells, organ dysfunction, and organ failure, particularly in the eyes, kidneys, nerves, heart, and blood vessels. The development of the ATC/DDD system is necessary to increase global drug knowledge, ensure equitable drug availability, and promote responsible drug use. **Objectives:** This study aimed to identify data on patient characteristics and oral anti-diabetic drugs and insulin using the ATC/DDD and DU90% methods. **Material and Methods:** This study is a cross-sectional evaluation of oral anti-diabetic medications and insulin using the ATC/DDD method and DU90% at the Bala Keselamatan Bokor Turen Hospital from January to December 2022. The inclusion criteria were individuals diagnosed with type 1 or type 2 diabetes mellitus, with or without comorbidities, who were treated with oral anti-diabetic medications and a combination of insulin and oral medications. In the present study, the incomplete medical record data served as the exclusion criteria. The sample for this investigation consisted of 238 patients selected using the complete sampling technique. **Results:** The majority of patients who used oral anti-diabetic medications and insulin were between the ages of 46 and 65 (71.34%), were female (73.2%), had standard body mass indices (BMIs between 18.5 and 25), and had diagnoses of DM + HT (20.73%) and Type II DM (18.29%). Glulisin was the most commonly used anti-diabetic drug, accounting for 589 DDD/100 days of hospitalization, and DU90% was 21.39%. **Conclusion:** Glulisin is the most frequently prescribed anti-diabetic medication at Bokor Turen Hospital.

Keywords: Antidiabetic Oral and Insulin; Diabetes Mellitus; ATC/DDD; DU 90%

ABSTRAK

Latar Belakang: Resistensi insulin yang berkembang menjadi Diabetes Melitus (DM) erat hubungannya dengan terjadinya kerusakan sel beta pankreas dalam jangka panjang, disfungsi organ, dan kegagalan organ terutama pada mata, ginjal, saraf, jantung, dan pembuluh darah. Pengembangan sistem ATC/DDD diperlukan untuk meningkatkan pengetahuan tentang penggunaan obat di seluruh dunia, memastikan ketersediaan obat secara merata, dan mendorong penggunaan obat yang bijak. Tujuan penelitian ini adalah mengidentifikasi data karakteristik pasien serta obat anti-diabetes oral dan insulin menggunakan metode ATC/DDD dan DU90%. Bahan dan Metode: Rancangan penelitian ini menggunakan *cross-sectional study* yang mengevaluasi obat anti-diabetes oral dan insulin dengan metode ATC/DDD dan DU90% di RS Bala Keselamatan Bokor Turen bulan Januari hingga Desember 2022. Kriteria inklusi terdiri dari pasien DM tipe 1 dan tipe 2 dengan dan atau tanpa komorbid, menggunakan obat anti-diabetes oral dan insulin/kombinasi keduanya. Sedangkan, kriteria eksklusinya berupa data rekam medis tidak lengkap. Populasi penelitian ini sebanyak 238 pasien menggunakan teknik total sampling. Hasil: Data karakteristik pasien pengguna obat anti-diabetes oral dan insulin terbanyak berusia 46 hingga 65 tahun (71,34%); jenis kelamin perempuan (73,2%); Indeks Masa Tubuh normal sebesar 53,66% (IMT= 18,5-25); diagnose DM+HT (20,73%) dan DM Tipe II (18,29%). Penggunaan obat anti-diabetes tertinggi adalah obat glulisin sebesar 589 DDD/100 hari rawat inap dan DU90% sebesar 21,39%. Kesimpulan: Obat anti-diiabetes yang paling banyak digunakan di RS Bokor Turen adalah glulisin.

Kata kunci: Obat Anti-diabetes Oral dan Insulin; Diabetes Melitus; DDD; DU 90%

INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic disorder. The presence of risk factors, damage to insulin secretion and sensitivity leads to an increase in blood glucose and changes in fat and protein metabolism (DiPiro, 2020). The lack of insulin function contributes to the development of

Comment [MOU1]: Past tenses

Comment [MOU2]: Index?

52 microvascular, macrovascular, and neuropathy as a chronic consequence of DM (Almasdy *et al.*,
53 2015).

54

55 The *World Health Organization* (WHO) in 2023 states that in 2014, 8.5% of adults aged 18 years and
56 over have diabetes. In 2019, diabetes was the direct cause of 1.5 million deaths, and 48% of all deaths
57 from diabetes occurred before the age of 70. Furthermore, 460,000 deaths from kidney disease are
58 caused by diabetes, and elevated blood glucose causes about 20% of deaths from cardiovascular
59 disease (WHO, 2023). DM is more common in low- and moderate-income countries and countries
60 undergoing major economic and demographic transformations. DM is a significant global health
61 problem and requires proper prevention and management measures. DM in Indonesia is currently a
62 serious problem. Most DM sufferers are type 2 DM groups. Therefore, it is essential to evaluate the
63 use of the drug as a basis for selection to ensure that the drug is used appropriately, safely, and
64 efficiently (Pitasari, Andayani and Wijayanti, 2022).

65

66 There is a need to develop ATC/DDD systems to acquire knowledge about drug use worldwide to
67 achieve equitable drug availability and prudent drug use, especially in developing countries. The
68 primary purpose of the ATC/DDD system is to facilitate research on drug use and improve the overall
69 quality of drug use (Tahar *et al.*, 2020). A retrospective study using a *cross-sectional study*, which
70 evaluated drug use patterns and costs associated with Type 2 DM in Saudi Arabia, showed that
71 biguanide (metformin) was most widely prescribed as a monotherapy drug followed by a *fixed-dose*
72 *combination*. The effectiveness of monotherapy drugs decreases with the duration of treatment; in
73 these cases, combination drugs are prescribed. The most commonly prescribed combination drug is a
74 biguanide with sulfonylurea/biguanide with thiazolidinedione, according to guidelines by the
75 *American Diabetes Association* (ADA). The combination of sitagliptin and metformin is most widely
76 preferred and widely prescribed in *fixed-dose combination therapy*, followed by vildagliptin and
77 metformin (Ali *et al.*, 2022). Combination drugs are used when a single pill cannot achieve the desired
78 blood glucose level in diabetic patients (Okoro, Nmeke and Erah, 2018).

79

80 Evaluation of the use of anti-diabetic drugs with ATC/DDD and DU90% methods can provide insight
81 into the dominant drug use patterns and the extent to which these drugs follow existing treatment
82 recommendations and guidelines. Therefore, this study evaluated oral anti-diabetic drugs and insulin
83 using ATC/DDD and DU90% in DM patients with and without comorbidities at the Bokor Turen
84 Safety Army Hospital.

85 MATERIAL AND METHODS

Comment [MOU3]: Please explain about the hospital, namely its level of accreditation, etc

86 Research Methods

87 The study design used a *cross-sectional study* with retrospective data collection through patient
88 medical records. Quantitative evaluation of the use of anti-diabetic drugs using ATC / DDD and DU
89 90% techniques. This research has gone through the health research ethics committee with no
90 E.5.a/145/KEPKUMM/V/2023.

92 Population and Sample

93 This population is in the form of patients hospitalized with a diagnosis of DM and or without
94 comorbidities at the Bokor Turen Salvation Army Hospital. The study sample included patients
95 hospitalized with a diagnosis of DM and without comorbidities from January to December 2022 and
96 who met the inclusion and exclusion criteria. Inclusion criteria include patients aged ≥ 17 years with a
97 diagnosis of DM and without comorbidities. Exclusion criteria are patients whose medical record data
98 is incomplete.

Comment [MOU4]: Past tenses

Comment [MOU5]:

100 Sampling Techniques

101 The sampling technique is total sampling, where the number of samples is equal to a population of 164
102 patients and meets the criteria for inclusion and exclusion of the study.

Comment [MOU6]:

104 Data Analysis

105 The calculation in evaluating the use of ATC / DDD method anti-diabetic drugs in the hospitalization
106 of the Bokor Turen Salvation Army Hospital uses the formula:

$$\frac{DDD}{100} \text{ hari rawat inap} = \frac{\text{Jumlah antidiabetik (gram)}}{\text{Standar DDD WHO (gram)}} \times \frac{100}{LOS}$$

107
108 DU 90% is used to identify the amount of drug used as much as 90% of the total use of prescribed
109 medicines and compare it with the amount of residual drug use (RI, 2017). The efficiency of drug use
110 must be observed if the amount of drug use in 10% is more. The DU value of 90% is known after
111 calculating DDD / 100 days of hospitalization per year. DU 90% is obtained by arranging the use of
112 antibiotics from highest to lowest, then determining the cumulative percentage up to 90%.

Comment [MOU7]: Do not use a picture

Comment [MOU8]: ???

114 RESULTS

115 a. Demographic Characteristics of Diabetes Mellitus Patients

116 The demographic characteristics of Diabetes Mellitus patients at the Bokor Turen Salvation Army
117 Hospital from January to December 2022 were 164 patients in age, gender, BMI, diagnosis,

Comment [MOU9]: Is this the number population in 1 year that meet the criteria? What is the total population in 1 year?is it only 164?

118 comorbidities, drug names, administration intervals, and duration of administration. Judging from the
 119 most significant number, in the age characteristics of 117 patients aged 46-65, as many as 120 were
 120 female, and as many as 88 patients had a regular Body Mass Index (BMI) of 18.5-25 (Table 1).

121 **Table 1.** Data on the characteristics of diabetes mellitus patients

Karakteristik	Bulan (Tahun 2022)												Jumlah pasien (n=164)	%
	Jan 2022	Feb 2022	Mar 2022	Apr 2022	Mei 2022	Jun 2022	Jul 2022	Agust 2022	Sept 2022	Okt 2022	Nov 2022	Des 2022		
Usia														
17- 45 thn	1	0	1	1	0	2	3	3	0	0	1	0	12	7,32
46 – 65 thn	11	6	13	12	7	12	13	8	8	14	8	5	117	71,34
66 – 95 thn	5	5	1	8	1	5	0	2	1	4	1	2	35	21,34
Mean ± SD	59,71 ± 9,18	63,54 ±	57,46 ±	62,28 ±	57,62 ±	57,57 ±	52,68 ±	58,46 ±	58,11 ±	61,38 ±	56,3 ±	60,29 ±	58,78 ± 2,52	
Total	17	11	15	21	8	19	16	13	9	18	10	7	164	100
Jenis kelamin														
Perempuan	12	9	11	14	5	16	13	8	7	10	10	5	120	73,2
Laki-laki	5	2	4	7	3	3	3	5	2	8	0	2	44	26,8
Total	17	11	15	21	8	19	16	13	9	18	10	7	164	100
IMT														
Kurus < 18,4	1	1	1	2	0	0	0	0	1	0	0	0	6	3,66
Normal 18,5 – 25	11	4	5	11	4	12	10	11	4	6	7	3	88	53,66
Gemuk > 25	5	6	9	8	4	7	6	2	4	12	3	4	70	42,68
Mean ± SD	23,07 ± 3,07	24,89 ±	25,94 ±	24,44 ±	24,85 ±	24 ± 4,16	24,15 ±	23,26 ± 2,33	25,48 ±	26,37 ±	23,71 ±	25,40 ±	24,63 ± 1,08	
Total	17	11	15	21	8	19	16	13	9	18	10	7	164	100

122
 123 The description of DM and or without comorbidities at the Bokor Turen Salvation Army Hospital
 124 showed that the most patients with a diagnosis of DM and Hypertension (HT) were 34 patients
 125 (20.73%), followed by patients with a diagnosis of Type 2 DM as many as 28 patients (18.29%). At
 126 the same time, DM patients with other comorbidities have fewer than ten patients (Table 2).

127
 128 **Table 2.** Description of Patients with Diabetes Mellitus and or Without Comorbidities

Comment [MOU10]: Use the table format, not a images
 Please present in English and the numbers of patient in 1 years, not every month

Diagnosis dengan Komorbid	Jumlah (n = 164)	%
DM (HT)	34	20,73
DM T2	28	18,29
DM (HT, CAD)	6	3,66
DM (Anemia)	5	3,05
DM (CAD)	5	3,05
DM (CKD)	5	3,05
DM (CVA)	5	3,05
DM (COPD)	5	3,05
DM (CVA, HT)	4	2,44
DM (Anemia, Thalasemia)	3	1,83
DM (Dispepsia)	3	1,83
DM (GERD, HT)	3	1,83
DM (HT, Anemia)	3	1,83
DM (Asma)	2	1,22
DM (DKD)	2	1,22
DM (DKD, HT)	2	1,22
DM (HT, CKD)	2	1,22
DM (HT, HF)	2	1,22
DM (HT, Vertigo)	2	1,22
DM (STEMI)	2	1,22
DM (Vertigo)	2	1,22
DM (GERD)	1	0,61
DM (Anemia, PAD)	1	0,61
DM (AKI)	1	0,61
DM (Anemia, CKD)	1	0,61
DM (Anemia, Dispepsia)	1	0,61
DM (Angina, Thalasemia)	1	0,61
DM (CAD, COPD)	1	0,61
DM (CAD, CVA, HT)	1	0,61
DM (CAD, HT)	1	0,61
DM (CAD, STEMI)	1	0,61
DM (CAD, TB)	1	0,61

Table 2. Description of Patients with Diabetes Mellitus and Without Comorbidities

(Continued)

Comment [MOU11]: Use the table format, not a images

Please present in English

Comment [MOU12]: Use the table format, not a images

Please present in English

129
130
131

Diagnosis dengan Komorbid	Jumlah (n = 164)	%
DM (CKD, HT, TB)	1	0,61
DM (CKD, STEMI)	1	0,61
DM (CKD, Thalasemia)	1	0,61
DM (COPD, Dispepsia)	1	0,61
DM (COPD, HT)	1	0,61
DM (CVA, susp covid)	1	0,61
DM (Gastritis)	1	0,61
DM (GERD, HF)	1	0,61
DM (Hepatitis)	1	0,61
DM (HF)	1	0,61
DM (HF, CAD, COPD)	1	0,61
DM (HF, Hepatitis)	1	0,61
DM (HT, HF, dispepsia)	1	0,61
DM (HT, CA infark)	1	0,61
DM (HT, CAD, Gerd)	1	0,61
DM (HT, CAD, Parkinson)	1	0,61
DM (HT, COPD, CVA)	1	0,61
DM (HT, COPD, Dispepsia)	1	0,61
DM (HT, Dispepsia)	1	0,61
DM (HT, HF, CAD)	1	0,61
DM (HT, STEMI)	1	0,61
DM (Myalgia)	1	0,61
DM (PAD)	1	0,61
DM (PAD, Vertigo)	1	0,61
DM T1 (HT)	1	0,61
Total	164	100

132

133 Based on the DM treatment profile seen in the 12 months of 2022, it shows that the use of anti-diabetic
 134 drugs is the most in the use of glargine drugs with a dose strength of 100U/ml in as many as 71
 135 patients. Followed by glulisine drugs with a dose strength of 100U / ml for as many as 57 patients. The
 136 third highest use was aspart 100U / ml, as many as 54 patients. Concerning the administration interval
 137 of most anti-diabetic drugs given every 24 hours a day with the duration of most drug administration
 138 for 4-6 days (Table 3).

139

140

141

142

143

144

145

Table 3. Profile of Anti-diabetic Drug Use

Karakteristik	Bulan (Tahun 2022)												Total (n=293)	%
	Jan 2022	Feb 2022	Mar 2022	Apr 2022	Mei 2022	Jun 2022	Jul 2022	Agust 2022	Sept 2022	Okt 2022	Nov 2022	Des 2022		
Nama obat														
Acarbos 50 mg	1	0	0	0	0	1	2	0	0	0	0	1	5	1,7
Glulisin 100U/ml	4	7	8	10	5	7	2	3	1	5	3	2	57	19,5
Glargine 100U/ml	8	9	8	8	4	9	4	4	5	7	3	2	71	24,2
Glibenklamid 5 mg	1	0	0	0	0	0	1	1	0	0	0	0	3	1,0
Glikuidon 30 mg	2	0	4	1	0	1	1	1	1	4	2	1	18	6,1
Glimepirid 2 mg	2	0	0	3	2	3	3	3	2	0	0	0		
Glimepirid 4 mg	0	0	0	1	0	1	1	0	2	0	0	0	18	6,1
Glimepirid 3 mg	0	0	0	0	1	0	0	0	0	0	0	0		
Lispro 100U/ml	1	0	0	0	0	1	2	0	1	0	0	2	7	2,4
Detemir 100U/ml	2	0	3	6	3	5	4	2	2	7	2	2	38	13,0
Metformin 500 mg	2	1	0	4	1	2	3	3	1	1	1	1	20	6,8
Aspart 100U/ml	6	3	3	4	2	8	7	4	5	8	4	0	54	18,4
Pioglitazon 30 mg	0	0	0	0	0	0	0	1	0	0	0	0	1	0,3
Degludec-Aspart 100U/ml	0	1	0	0	0	0	0	0	0	0	0	0	1	0,3
Total	29	21	26	36	17	37	29	22	18	32	15	11	293	100
Interval pemberian														
24 jam	15	10	16	20	9	18	14	11	9	20	9	6	157	53,6
12 jam	2	1	0	3	1	3	3	2	3	2	1	0	21	7,2
8 jam	12	10	10	13	7	16	12	9	6	10	4	5	114	38,9
6 jam	0	0	0	0	0	0	0	0	0	0	1	0	1	0,3
Total	29	21	26	36	17	37	29	22	18	32	15	11	293	100

Comment [MOU13]: Use the table format, not a images

Please present in English

Karakteristik	Bulan (Tahun 2022)												Total (n=293)	%
	Jan 2022	Feb 2022	Mar 2022	Apr 2022	Mei 2022	Jun 2022	Jul 2022	Agust 2022	Sept 2022	Okt 2022	Nov 2022	Des 2022		
Durasi														
1-3 Hari	7	15	12	10	5	20	14	13	9	15	4	3	127	43,3
4 - 6 Hari	22	6	14	26	12	17	15	9	9	17	11	8	166	56,7
Total	29	21	26	36	17	37	29	22	18	32	15	11	293	100

b. Evaluation of the Use of Anti-diabetic Drugs with ATC/DDD and DU 90% Methods

The results of the evaluation of the use of anti-diabetic drugs using the ATC / DDD method showed that the use of antidiabetics that are often used is glulisine drugs with a dose strength of 100U / ml of 589.02 DDD / 100 days of hospitalization, which means that during 100 days of treatment in the hospital around 589 diabetic patients received glulisine amounting to 40 IU every day. The total number of patients hospitalized and using anti-diabetic drugs from January to December 2022 was 568 days. The second most significant use of anti-diabetic medications is aspart with a dose strength of 100U / ml of 519.72 DDD / 100 days of hospitalization, which means that during 100 days of hospitalization in the hospital around 520 DM patients received aspart drugs of 40 IU (Table 4).

Table 4. Analysis of the Use of Anti-diabetic Drugs using the ATC / DDD Method

No.	Kode ATC	Nama Obat	DDD (WHO)	LOS (Hari)	DDD/100 Hari rawat inap
1	A10AB06	Glulisin 100 U/ml	40 UI		589,02
2	A10AB05	Aspart 100 U/ml	40 UI		519,72
3	A10BB12	Glimepirid 2 mg, 3 mg, 4 mg	2 mg		474,28
4	A10AE04	Glargine 100 U/ml	40 UI		426,85
5	A10AE05	Detemir 100 U/ml	40 UI		221,38
6	A10BA02	Metformin 500 mg	2 g	568 Hari	198,80
7	A10BB08	Glikuidon 30 mg	60 mg		129,22
8	A10AB04	Lispro 100 U/ml	40 UI		85,20
9	A10BF01	Acarbos 50 mg	0,3 g		43,55
10	A10BB01	Glibenklamid 5 mg	10 mg		31,24
11	A10BG03	Pioglitazon 30 mg	30 mg		22,72
12	A10AD06	Degludec-Aspart 100 U/ml	40 UI		11,36

Comment [MOU14]: Use the table format, not a images

Please present in English

165

166 The 90% DU in this study was used to evaluate the use of anti-diabetic drugs in the top 90% of
 167 services in the population. There were 12 anti-diabetic assessed drugs in 90% DU and showed that
 168 glulycin, aspart, glimepiride 2 mg, glimepiride 3 mg, glimepiride 4 mg, glargine 100U/ml, detemir
 169 100U/ml, and metformin 500 mg were anti-diabetic drugs that accounted for 90% of the highest anti-
 170 diabetic drug use in the DM patient population at the Bokor Turen Salvation Army Hospital (Table 5).

171

172

Table 5. Profile of Anti-diabetic Drug Use with DU Method 90%

Kode ATC	Nama Obat	DDD/100 Hari rawat inap	Persentase	Persentase Kumulatif	Segmen
A10AB06	Glulisin 100 U/ml	589,02	21,39%	21,39%	Du 90%
A10AB05	Aspart 100 U/ml	519,72	18,88%	40,27%	

173

174

175

176

Table 5. Profile of Anti-diabetic Drug Use with DU Method 90% (Continued)

	Glimepirid 2 mg				
A10BB12	Glimepirid 3 mg	474,28	17,23%	57,49%	
	Glimepirid 4 mg				
A10AE04	Glargine 100 U/ml	426,85	15,50%	73,00%	
A10AE05	Detemir 100 U/ml	221,38	8,04%	81,04%	
A10BA02	Metformin 500 mg	198,80	7,22%	88,26%	
A10BB08	Glikuidon 30 mg	129,22	4,69%	92,95%	
A10AB04	Lispro 100 U/ ml	85,20	3,09%	96,05%	
A10BF01	Acarbos 50 mg	43,55	1,58%	97,63%	
A10BB01	Glibenklamid 5 mg	31,24	1,13%	98,76%	Du 10%
A10BG03	Pioglitazon 30 mg	22,72	0,83%	99,59%	
A10AD06	Degludec- Aspart 100 U/ ml	11,36	0,41%	100,00%	
		2753,33	99,99		

177

178

179 DISCUSSION

180 Insulin glulisine (Apidra) in this study occurred in patients with Type 2 diabetes with comorbidities,
 181 such as hypertension, coronary artery disease (CAD), and chronic kidney disease (CKD). On average,
 182 DM patients who get apidra drugs are given every 8 hours, and this drug is widely presented to 76% of
 183 female patients with an age range of 58-61 years. This insulin is widely recommended at the Bokor
 184 Turen Salvation Army Hospital because it can lower blood sugar levels quickly and has a more
 185 negligible risk of hypoglycemia. Following the 2021 PERKENI guidelines, Apidra is insulin rapid-
 186 acting, generally used with food. Apidra is designed to decrease glucose levels in the blood after a
 187 meal rapidly or when blood glucose levels are high. Apidra is commonly combined with basal insulins
 188 such as Lantus (insulin glargine) and Levemir (insulin detemir) (Soelistijo et al., 2021). A study
 189 examining the clinical effects of Type 2 DM patients with cardiovascular comorbidities where patients
 190 used insulin rapid-acting showed that it could have beneficial effects from insulin glulisine
 191 administration associated with death and stroke. Still, there was no difference in coronary heart disease
 192 (CHD) or cardiovascular disease (CVD) (Svensson et al., 2017).

193

194 Insulin aspart (novorapid) is given to patients with type 2 diabetes with comorbid HT accompanied by
 195 CAD, ST-Elevation Myocardial Infarction (STEMI), and Heart Failure (HF). The interval of insulin

196 administration averaged every 8 hours per day and was used by 66% of female patients with an
197 average of 58-61 years. Like glulisine insulin, this insulin can also quickly lower blood sugar levels
198 and has a low risk of hypoglycemia. This insulin is also rapid-acting, which provides therapeutic
199 effectiveness after 15 minutes, with the peak of therapeutic efficacy occurring within 1-2 hours and
200 can last up to 4-6 hours. In the case of the population in Japan, administering insulin aspart to type 2
201 DM patients can significantly reduce cardiovascular complications within 5 to 10 years, resulting in
202 improved quality of life and lower costs compared to *human insulin* (Pollock et al., 2011).

203

204 The third most significant use of anti-diabetic drugs is glimepiride doses of 2mg, 3 mg, and 4 mg. This
205 drug is given to patients with type 2 diabetes with cardiovascular comorbidities and an interval of 24
206 hours per day and primarily female patients (83%) with an average age of 58 years. Regular
207 glimepiride is combined with insulin or another oral medication such as metformin. In the case study
208 of type 2 DM patients with CVD, the average patient suffering from DM was around 5.7 ± 4.8 years.
209 CVD suffered by type 2 DM patients in the form of hypertension (68.5% of patients); dyslipidemia
210 (47.9% of patients); CAD (25.4% of patients); Transient Ischemic Attack (TIA) in 3.6% of patients;
211 peripheral artery disease (PAD) accounted for 4.8% of patients and heart failure in 2.9% of patients.
212 Type 2 DM patients with various comorbidities receive the drug glimepiride/metformin Fixed Dose
213 Combination (FDC) as a first-line therapy. As many as 68.2% of FDC patients achieved blood
214 pressure within optimal limits. Most of the other patients experienced an increase in glycemic
215 parameters and a change in body weight of about 18.4%. 59.2% of patients experienced weight loss
216 (Ray et al., 2022). Glimepiride is a sulfonylurea class drug that has pharmacological effects to increase
217 insulin production by pancreatic beta cells. The most common side effects are hypoglycemia and
218 weight gain.

219

220 The limitation of this study is that data were taken only retrospectively from patient medical record
221 data and did not make direct observations on DM patients.

222

223 CONCLUSION

224 Based on the analysis of demographic data and treatment profiles of DM patients, DM patients are
225 dominated by the age group of 46-65 years, with women who use anti-diabetic drugs more. Patients
226 with comorbidities use more anti-diabetic medications than patients with non-comorbid DM.
227 Evaluation of anti-diabetic drugs ATC / DDD method shows that insulin glulisine (Apidra) is most
228 used in DM patients with and without comorbidities. Through the DU method, 90% of glulisine,
229 aspart, glargine, glimepiride, detemir, and metformin drugs were most widely used in DM patients.

Comment [MOU15]: Why is insulin glulisine more often choice than aspart?

Comment [MOU16]: Why is metformin not among the top three most widely used antidiabetic drug? Wasn't it the first choice?

Comment [MOU17]: Please compare the result of this research with the previous research

Comment [MOU18]: Please explain benefit and follow up from the result of research for the hospital or science?

230

231 **CONFLICT OF INTEREST**

232 All authors declare no conflict of interest.

233 **REFERENCES**

234

235 Ali, M.D. et al. (2022) 'Evaluation of drug utilization pattern and cost associated with diabetes
236 mellitus Type two management in Saudi Arabia', *Brazilian Journal of Pharmaceutical
237 Sciences*, 58, p. E20681. Available at: <https://doi.org/10.1590/s2175-97902022e20681>.

238 Almasdy, D. et al. (2015) 'Evaluation of the Use of Anti-diabetic Drugs in Type-2 Diabetes Mellitus
239 Patients in a Government Hospital of Padang City – West Sumatra', *Journal of
240 Pharmaceutical & Clinical Science*, 2(1), p. 104. Available at:
241 <https://doi.org/10.29208/jsfk.2015.2.1.58>.

242 DiPiro, J.T. (ed.) (2020) *Pharmacotherapy: a pathophysiologic approach*. Eleventh edition. New
243 York: McGraw Hill Medical.

244 Okoro, R.N., Nmeka, C. and Erah, P.O. (2018) 'Utilization study of antidiabetes medicines at a tertiary
245 care hospital in Nigeria', *Future Journal of Pharmaceutical Sciences*, 4(2), pp. 109–115.
246 Available at: <https://doi.org/10.1016/j.fjps.2017.11.004>.

247 Pitasari, N.W.N., Andayani, T.M. and Wijayanti, T. (2022) 'Evaluation of the Use of Antidiabetic
248 Drugs in Patients of Back-Referral Program at the Demak District Pharmacy', *Journal of
249 Management and Pharmacy Practice*, 12(2), p. 125. Available at:
250 <https://doi.org/10.22146/jmpf.73841>.

251 Pollock, R.F. et al. (2011) 'The cost effectiveness of rapid-acting insulin aspart compared with human
252 insulin in type 2 diabetes patients: an analysis from the Japanese third-party payer perspective',
253 *Journal of Medical Economics*, 14(1), pp. 36–46. Available at:
254 <https://doi.org/10.3111/13696998.2010.541045>.

255 Ray, S. et al. (2022) 'Usage Pattern of Glimepiride/Metformin Fixed-dose Combination in Type 2
256 Diabetes Patients with CVD or at Risk of CVD: An Experience in Indian Setting', *Asian
257 Journal of Diabetology*, 23(2), pp. 13–19.

258 RI, K. (2017) 'Technical Guidelines for Evaluation of Drug Use in Health Facilities'.

259 Soelistijo, S.A. dkk. (2021) 'Guidelines for the management and prevention of adult type 2 diabetes
260 mellitus in INDONESIA - 2021', *PB. PERKENI*, p. 119.

261 Svensson, A.-M. et al. (2017) 'Clinical effects, cardiovascular and renal outcomes associated with
262 rapid-acting insulin analogs among individuals with type 2 diabetes: a nation-wide
263 observational cohort study', *Clinical Diabetes and Endocrinology*, 3(1), p. 5. Available at:
264 <https://doi.org/10.1186/s40842-017-0043-2>.

Comment [MOU19]: The number of references not enough

- 265 Tahar, N.dkk. (2020) 'EVALUATION OF THE USE OF ORAL ANTI-DIABETIC DRUGS IN TYPE
266 2 DIABETES MELLITUS PATIENTS USING ATC/DDD AND DU 90% METHODS', *The*
267 *2nd Alauddin Pharmaceutical Conference and Expo (ALPHA-C) 2020* [Preprint]. Available
268 at: <https://doi.org/10.24252/kesehatan.v1i1.18380>.
- 269 WHO (2023) *Diabetes*. Available at: <https://www.who.int/news-room/fact-sheets/detail/diabetes>
270 (Accessed: September 21, 2023).

Evaluation of Anti-diabetic Drugs using ATC/DDD and DU90% Methods in Diabetes Mellitus Patients

ABSTRACT

Background: Diabetes Mellitus (DM), which results from insulin resistance, is closely linked to long-term damage to pancreatic beta cells, organ dysfunction, and organ failure, particularly in the eyes, kidneys, nerves, heart, and blood vessels. The development of the ATC/DDD system is necessary to increase global drug knowledge, ensure equitable drug availability, and promote responsible drug use. **Objectives:** This study aimed to identify data on patient characteristics and oral anti-diabetic drugs and insulin using the ATC/DDD and DU90% methods. **Material and Methods:** This study is a cross-sectional evaluation of oral anti-diabetic medications and insulin using the ATC/DDD method and DU90% at the Bala Keselamatan Bokor Turen Hospital from January to December 2022. The inclusion criteria were individuals diagnosed with type 1 or type 2 diabetes mellitus, with or without comorbidities, who were treated with oral anti-diabetic medications and a combination of insulin and oral medications. In the present study, the incomplete medical record data served as the exclusion criteria. The sample for this investigation consisted of 238 patients selected using the complete sampling technique. **Results:** The majority of patients who used oral anti-diabetic medications and insulin were between the ages of 46 and 65 (71.34%), were female (73.2%), had standard body mass indices (BMIs between 18.5 and 25), and had diagnoses of DM + HT (20.73%) and Type II DM (18.29%). Glulisin was the most commonly used anti-diabetic drug, accounting for 589 DDD/100 days of hospitalization, and DU90% was 21.39%. **Conclusion:** Glulisin is the most frequently prescribed anti-diabetic medication at Bokor Turen Hospital.

Keywords: Antidiabetic Oral and Insulin; Diabetes Mellitus; ATC/DDD; DU 90%

ABSTRAK

Latar Belakang: Resistensi insulin yang berkembang menjadi Diabetes Melitus (DM) erat hubungannya dengan terjadinya kerusakan sel beta pankreas dalam jangka panjang, disfungsi organ, dan kegagalan organ terutama pada mata, ginjal, saraf, jantung, dan pembuluh darah. Pengembangan sistem ATC/DDD diperlukan untuk meningkatkan pengetahuan tentang penggunaan obat di seluruh dunia, memastikan ketersediaan obat secara merata, dan mendorong penggunaan obat yang bijak. Tujuan penelitian ini adalah mengidentifikasi data karakteristik pasien serta obat anti-diabetes oral dan insulin menggunakan metode ATC/DDD dan DU90%. Bahan dan Metode: Rancangan penelitian ini menggunakan *cross-sectional study* yang mengevaluasi obat anti-diabetes oral dan insulin dengan metode ATC/DDD dan DU90% di RS Bala Keselamatan Bokor Turen bulan Januari hingga Desember 2022. Kriteria inklusi terdiri dari pasien DM tipe 1 dan tipe 2 dengan dan atau tanpa komorbid, menggunakan obat anti-diabetes oral dan insulin/kombinasi keduanya. Sedangkan, kriteria eksklusinya berupa data rekam medis tidak lengkap. Populasi penelitian ini sebanyak 238 pasien menggunakan teknik total sampling. Hasil: Data karakteristik pasien pengguna obat anti-diabetes oral dan insulin terbanyak berusia 46 hingga 65 tahun (71,34%); jenis kelamin perempuan (73,2%); Indeks Masa Tubuh normal sebesar 53,66% (IMT= 18,5-25); diagnose DM+HT (20,73%) dan DM Tipe II (18,29%). Penggunaan obat anti-diabetes tertinggi adalah obat glulisin sebesar 589 DDD/100 hari rawat inap dan DU90% sebesar 21,39%. **Kesimpulan:** Obat anti-diiabetes yang paling banyak digunakan di RS Bokor Turen adalah glulisin.

Kata kunci: Obat Anti-diabetes Oral dan Insulin; Diabetes Melitus; DDD; DU 90%

INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic disorder. The presence of risk factors, damage to insulin secretion and sensitivity leads to an increase in blood glucose and changes in fat and protein metabolism (DiPiro, 2020). The lack of insulin function contributes to the development of

Comment [AR1]: English to poor, please check proofreading and grammar

Comment [AR2]: not fit for purpose

52 microvascular, macrovascular, and neuropathy as a chronic consequence of DM (Almasdy *et al.*,
53 2015).

54

55 The *World Health Organization* (WHO) in 2023 states that in 2014, 8.5% of adults aged 18 years and
56 over have diabetes. In 2019, diabetes was the direct cause of 1.5 million deaths, and 48% of all deaths
57 from diabetes occurred before the age of 70. Furthermore, 460,000 deaths from kidney disease are
58 caused by diabetes, and elevated blood glucose causes about 20% of deaths from cardiovascular
59 disease (WHO, 2023). DM is more common in low- and moderate-income countries and countries
60 undergoing major economic and demographic transformations. DM is a significant global health
61 problem and requires proper prevention and management measures. DM in Indonesia is currently a
62 serious problem. Most DM sufferers are type 2 DM groups. Therefore, it is essential to evaluate the
63 use of the drug as a basis for selection to ensure that the drug is used appropriately, safely, and
64 efficiently (Pitasari, Andayani and Wijayanti, 2022).

65

66 There is a need to develop ATC/DDD systems to acquire knowledge about drug use worldwide to
67 achieve equitable drug availability and prudent drug use, especially in developing countries. The
68 primary purpose of the ATC/DDD system is to facilitate research on drug use and improve the overall
69 quality of drug use (Tahar *et al.*, 2020). A retrospective study using a *cross-sectional study*, which
70 evaluated drug use patterns and costs associated with Type 2 DM in Saudi Arabia, showed that
71 biguanide (metformin) was most widely prescribed as a monotherapy drug followed by a *fixed-dose*
72 *combination*. The effectiveness of monotherapy drugs decreases with the duration of treatment; in
73 these cases, combination drugs are prescribed. The most commonly prescribed combination drug is a
74 biguanide with sulfonylurea/biguanide with thiazolidinedione, according to guidelines by the
75 *American Diabetes Association* (ADA). The combination of sitagliptin and metformin is most widely
76 preferred and widely prescribed in *fixed-dose combination therapy*, followed by vildagliptin and
77 metformin (Ali *et al.*, 2022). Combination drugs are used when a single pill cannot achieve the desired
78 blood glucose level in diabetic patients (Okoro, Nmeka and Erah, 2018).

79

80 Evaluation of the use of anti-diabetic drugs with ATC/DDD and DU90% methods can provide insight
81 into the dominant drug use patterns and the extent to which these drugs follow existing treatment
82 recommendations and guidelines. Therefore, this study evaluated oral anti-diabetic drugs and insulin
83 using ATC/DDD and DU90% in DM patients with and without comorbidities at the Bokor Turen
84 Safety Army Hospital.

85 MATERIAL AND METHODS

86 **Research Methods**

87 The study design used a *cross-sectional study* with retrospective data collection through patient
88 medical records. Quantitative evaluation of the use of anti-diabetic drugs using ATC / DDD and DU
89 90% techniques. This research has gone through the health research ethics committee with no
90 E.5.a/145/KEPKUMM/V/2023.

91

92 **Population and Sample**

93 This population is in the form of patients hospitalized with a diagnosis of DM and or without
94 comorbidities at the Bokor Turen Salvation Army Hospital. The study sample included patients
95 hospitalized with a diagnosis of DM and without comorbidities from January to December 2022 and
96 who met the inclusion and exclusion criteria. Inclusion criteria include patients aged ≥ 17 years with a
97 diagnosis of DM and without comorbidities. Exclusion criteria are patients whose medical record data
98 is incomplete.

99

100 **Sampling Techniques**

101 The sampling technique is total sampling, where the number of samples is equal to a population of 164
102 patients and meets the criteria for inclusion and exclusion of the study.

103

104 **Data Analysis**

105 The calculation in evaluating the use of ATC / DDD method anti-diabetic drugs in the hospitalization
106 of the Bokor Turen Salvation Army Hospital uses the formula:

107
$$\frac{DDD}{100} \text{ hari rawat inap} = \frac{\text{Jumlah antidiabetik (gram)}}{\text{Standar DDD WHO (gram)}} \times \frac{100}{LOS}$$

108 DU 90% is used to identify the amount of drug used as much as 90% of the total use of prescribed
109 medicines and compare it with the amount of residual drug use (RI, 2017). The efficiency of drug use
110 must be observed if the amount of drug use in 10% is more. The DU value of 90% is known after
111 calculating DDD / 100 days of hospitalization per year. DU 90% is obtained by arranging the use of
112 antibiotics from highest to lowest, then determining the cumulative percentage up to 90%.

113

114 **RESULTS**

115 **a. Demographic Characteristics of Diabetes Mellitus Patients**

116 The demographic characteristics of Diabetes Mellitus patients at the Bokor Turen Salvation Army
117 Hospital from January to December 2022 were 164 patients in age, gender, BMI, diagnosis,

Comment [AR3]: With english

Comment [AR4]: All table and picture with full english

118 comorbidities, drug names, administration intervals, and duration of administration. Judging from the
 119 most significant number, in the age characteristics of 117 patients aged 46-65, as many as 120 were
 120 female, and as many as 88 patients had a regular Body Mass Index (BMI) of 18.5-25 (Table 1).

121

Table 1. Data on the characteristics of diabetes mellitus patients

Karakteristik	Bulan (Tahun 2022)												Jumlah pasien (n=164)	%
	Jan 2022	Feb 2022	Mar 2022	Apr 2022	Mei 2022	Jun 2022	Jul 2022	Agust 2022	Sept 2022	Okt 2022	Nov 2022	Des 2022		
Usia														
17- 45 thn	1	0	1	1	0	2	3	3	0	0	1	0	12	7,32
46 – 65 thn	11	6	13	12	7	12	13	8	8	14	8	5	117	71,34
66 – 95 thn	5	5	1	8	1	5	0	2	1	4	1	2	35	21,34
Mean ± SD	59,71 ± 9,18	63,54 ± 7,09	57,46 ± 8,46	62,28 ± 10,95	57,62 ± 6,47	57,57 ± 13,38	52,68 ± 7,88	58,46 ± 11,68	58,11 ± 4,93	61,38 ± 5,89	56,3 ± 6,97	60,29 ± 7,29	58,78 ± 2,52	
Total	17	11	15	21	8	19	16	13	9	18	10	7	164	100
Jenis kelamin														
Perempuan	12	9	11	14	5	16	13	8	7	10	10	5	120	73,2
Laki-laki	5	2	4	7	3	3	3	5	2	8	0	2	44	26,8
Total	17	11	15	21	8	19	16	13	9	18	10	7	164	100
IMT														
Kurus < 18,4	1	1	1	2	0	0	0	0	1	0	0	0	6	3,66
Normal 18,5 – 25	11	4	5	11	4	12	10	11	4	6	7	3	88	53,66
Gemuk > 25	5	6	9	8	4	7	6	2	4	12	3	4	70	42,68
Mean ± SD	23,07 ± 3,07	24,89 ± 4,93	25,94 ± 4,12	24,44 ± 4,94	24,85 ± 2,39	24 ± 4,16	24,15 ± 3,52	23,26 ± 2,33	25,48 ± 5,98	26,37 ± 3,92	23,71 ± 3,82	25,40 ± 3,06	24,63 ± 1,08	
Total	17	11	15	21	8	19	16	13	9	18	10	7	164	100

122

123 The description of DM and or without comorbidities at the Bokor Turen Salvation Army Hospital
 124 showed that the most patients with a diagnosis of DM and Hypertension (HT) were 34 patients
 125 (20.73%), followed by patients with a diagnosis of Type 2 DM as many as 28 patients (18.29%). At
 126 the same time, DM patients with other comorbidities have fewer than ten patients (Table 2).

127

128

Table 2. Description of Patients with Diabetes Mellitus and or Without Comorbidities

Diagnosis dengan Komorbid	Jumlah (n = 164)	%
DM (HT)	34	20,73
DM T2	28	18,29
DM (HT, CAD)	6	3,66
DM (Anemia)	5	3,05
DM (CAD)	5	3,05
DM (CKD)	5	3,05
DM (CVA)	5	3,05
DM (COPD)	5	3,05
DM (CVA, HT)	4	2,44
DM (Anemia, Thalasemia)	3	1,83
DM (Dispepsia)	3	1,83
DM (GERD, HT)	3	1,83
DM (HT, Anemia)	3	1,83
DM (Asma)	2	1,22
DM (DKD)	2	1,22
DM (DKD, HT)	2	1,22
DM (HT, CKD)	2	1,22
DM (HT, HF)	2	1,22
DM (HT, Vertigo)	2	1,22
DM (STEMI)	2	1,22
DM (Vertigo)	2	1,22
DM (GERD)	1	0,61
DM (Anemia, PAD)	1	0,61
DM (AKI)	1	0,61
DM (Anemia, CKD)	1	0,61
DM (Anemia, Dispepsia)	1	0,61
DM (Angina, Thalasemia)	1	0,61
DM (CAD, COPD)	1	0,61
DM (CAD, CVA, HT)	1	0,61
DM (CAD, HT)	1	0,61
DM (CAD, STEMI)	1	0,61
DM (CAD, TB)	1	0,61

Table 2. Description of Patients with Diabetes Mellitus and Without Comorbidities

(Continued)

Comment [AR5]: Add abbreviations

129
130
131

Diagnosis dengan Komorbid	Jumlah (n = 164)	%
DM (CKD, HT, TB)	1	0,61
DM (CKD, STEMI)	1	0,61
DM (CKD, Thalasemia)	1	0,61
DM (COPD, Dispepsia)	1	0,61
DM (COPD, HT)	1	0,61
DM (CVA, susp covid)	1	0,61
DM (Gastritis)	1	0,61
DM (GERD, HF)	1	0,61
DM (Hepatitis)	1	0,61
DM (HF)	1	0,61
DM (HF, CAD, COPD)	1	0,61
DM (HF, Hepatitis)	1	0,61
DM (HT, HF, dispepsia)	1	0,61
DM (HT, CA infark)	1	0,61
DM (HT, CAD, Gerd)	1	0,61
DM (HT, CAD, Parkinson)	1	0,61
DM (HT, COPD, CVA)	1	0,61
DM (HT, COPD, Dispepsia)	1	0,61
DM (HT, Dispepsia)	1	0,61
DM (HT, HF, CAD)	1	0,61
DM (HT, STEMI)	1	0,61
DM (Myalgia)	1	0,61
DM (PAD)	1	0,61
DM (PAD, Vertigo)	1	0,61
DM T1 (HT)	1	0,61
Total	164	100

132

133 Based on the DM treatment profile seen in the 12 months of 2022, it shows that the use of anti-diabetic
 134 drugs is the most in the use of glargine drugs with a dose strength of 100U/ml in as many as 71
 135 patients. Followed by glulisine drugs with a dose strength of 100U / ml for as many as 57 patients. The
 136 third highest use was aspart 100U / ml, as many as 54 patients. Concerning the administration interval
 137 of most anti-diabetic drugs given every 24 hours a day with the duration of most drug administration
 138 for 4-6 days (Table 3).

139

140

141

142

143

144

145

Table 3. Profile of Anti-diabetic Drug Use

Karakteristik	Bulan (Tahun 2022)												Total (n=293)	%
	Jan 2022	Feb 2022	Mar 2022	Apr 2022	Mei 2022	Jun 2022	Jul 2022	Agust 2022	Sept 2022	Okt 2022	Nov 2022	Des 2022		
Nama obat														
Acarbos 50 mg	1	0	0	0	0	1	2	0	0	0	0	1	5	1,7
Glulisin 100U/ml	4	7	8	10	5	7	2	3	1	5	3	2	57	19,5
Glargine 100U/ml	8	9	8	8	4	9	4	4	5	7	3	2	71	24,2
Glibenklamid 5 mg	1	0	0	0	0	0	1	1	0	0	0	0	3	1,0
Glikuidon 30 mg	2	0	4	1	0	1	1	1	1	4	2	1	18	6,1
Glimepirid 2 mg	2	0	0	3	2	3	3	3	2	0	0	0		
Glimepirid 4 mg	0	0	0	1	0	1	1	0	2	0	0	0	18	6,1
Glimepirid 3 mg	0	0	0	0	1	0	0	0	0	0	0	0		
Lispro 100U/ml	1	0	0	0	0	1	2	0	1	0	0	2	7	2,4
Detemir 100U/ml	2	0	3	6	3	5	4	2	2	7	2	2	38	13,0
Metformin 500 mg	2	1	0	4	1	2	3	3	1	1	1	1	20	6,8
Aspart 100U/ml	6	3	3	4	2	8	7	4	5	8	4	0	54	18,4
Pioglitazon 30 mg	0	0	0	0	0	0	0	1	0	0	0	0	1	0,3
Degludec-Aspart 100U/ml	0	1	0	0	0	0	0	0	0	0	0	0	1	0,3
Total	29	21	26	36	17	37	29	22	18	32	15	11	293	100
Interval pemberian														
24 jam	15	10	16	20	9	18	14	11	9	20	9	6	157	53,6
12 jam	2	1	0	3	1	3	3	2	3	2	1	0	21	7,2
8 jam	12	10	10	13	7	16	12	9	6	10	4	5	114	38,9
6 jam	0	0	0	0	0	0	0	0	0	0	1	0	1	0,3
Total	29	21	26	36	17	37	29	22	18	32	15	11	293	100

146

Karakteristik	Bulan (Tahun 2022)												Total (n=293)	%
	Jan 2022	Feb 2022	Mar 2022	Apr 2022	Mei 2022	Jun 2022	Jul 2022	Agust 2022	Sept 2022	Okt 2022	Nov 2022	Des 2022		
Durasi														
1-3 Hari	7	15	12	10	5	20	14	13	9	15	4	3	127	43,3
4 - 6 Hari	22	6	14	26	12	17	15	9	9	17	11	8	166	56,7
Total	29	21	26	36	17	37	29	22	18	32	15	11	293	100

147

148

149 **b. Evaluation of the Use of Anti-diabetic Drugs with ATC/DDD and DU 90% Methods**

150 The results of the evaluation of the use of anti-diabetic drugs using the ATC / DDD method showed
 151 that the use of antidiabetics that are often used is glulisine drugs with a dose strength of 100U / ml of
 152 589.02 DDD / 100 days of hospitalization, which means that during 100 days of treatment in the
 153 hospital around 589 diabetic patients received glulisine amounting to 40 IU every day. The total
 154 number of patients hospitalized and using anti-diabetic drugs from January to December 2022 was 568
 155 days. The second most significant use of anti-diabetic medications is aspart with a dose strength of
 156 100U / ml of 519.72 DDD / 100 days of hospitalization, which means that during 100 days of
 157 hospitalization in the hospital around 520 DM patients received aspart drugs of 40 IU (Table 4).

158

159

160

161

162

163

164

Table 4. Analysis of the Use of Anti-diabetic Drugs using the ATC / DDD Method

No.	Kode ATC	Nama Obat	DDD (WHO)	LOS (Hari)	DDD/100 Hari rawat inap
1	A10AB06	Glulisin 100 U/ml	40 UI		589,02
2	A10AB05	Aspart 100 U/ml	40 UI		519,72
3	A10BB12	Glimepirid 2 mg, 3 mg, 4 mg	2 mg		474,28
4	A10AE04	Glargine 100 U/ml	40 UI		426,85
5	A10AE05	Detemir 100 U/ml	40 UI		221,38
6	A10BA02	Metformin 500 mg	2 g	568 Hari	198,80
7	A10BB08	Glikuidon 30 mg	60 mg		129,22
8	A10AB04	Lispro 100 U/ml	40 UI		85,20
9	A10BF01	Acarbos 50 mg	0,3 g		43,55
10	A10BB01	Glibenklamid 5 mg	10 mg		31,24
11	A10BG03	Pioglitazon 30 mg	30 mg		22,72
12	A10AD06	Degludec-Aspart 100 U/ml	40 UI		11,36

165

166 The 90% DU in this study was used to evaluate the use of anti-diabetic drugs in the top 90% of
 167 services in the population. There were 12 anti-diabetic assessed drugs in 90% DU and showed that
 168 glulycin, aspart, glimepiride 2 mg, glimepiride 3 mg, glimepiride 4 mg, glargine 100U/ml, detemir
 169 100U/ml, and metformin 500 mg were anti-diabetic drugs that accounted for 90% of the highest anti-
 170 diabetic drug use in the DM patient population at the Bokor Turen Salvation Army Hospital (Table 5).

171

172

Table 5. Profile of Anti-diabetic Drug Use with DU Method 90%

Kode ATC	Nama Obat	DDD/100 Hari rawat inap	Persentase	Persentase Kumulatif	Segmen
A10AB06	Glulisin 100 U/ml	589,02	21,39%	21,39%	Du 90%
A10AB05	Aspart 100 U/ml	519,72	18,88%	40,27%	

173

174

175

176

Table 5. Profile of Anti-diabetic Drug Use with DU Method 90% (Continued)

	Glimepirid 2 mg				
A10BB12	Glimepirid 3 mg	474,28	17,23%	57,49%	
	Glimepirid 4 mg				
A10AE04	Glargine 100 U/ml	426,85	15,50%	73,00%	
A10AE05	Detemir 100 U/ml	221,38	8,04%	81,04%	
A10BA02	Metformin 500 mg	198,80	7,22%	88,26%	
A10BB08	Glikuidon 30 mg	129,22	4,69%	92,95%	
A10AB04	Lispro 100 U/ ml	85,20	3,09%	96,05%	
A10BF01	Acarbos 50 mg	43,55	1,58%	97,63%	
A10BB01	Glibenklamid 5 mg	31,24	1,13%	98,76%	Du 10%
A10BG03	Pioglitazon 30 mg	22,72	0,83%	99,59%	
A10AD06	Degludec- Aspart 100 U/ ml	11,36	0,41%	100,00%	
		2753,33	99,99		

177

178

179 DISCUSSION

180 Insulin glulisine (Apidra) in this study occurred in patients with Type 2 diabetes with comorbidities,
 181 such as hypertension, coronary artery disease (CAD), and chronic kidney disease (CKD). On average,
 182 DM patients who get apidra drugs are given every 8 hours, and this drug is widely presented to 76% of
 183 female patients with an age range of 58-61 years. This insulin is widely recommended at the Bokor
 184 Turen Salvation Army Hospital because it can lower blood sugar levels quickly and has a more
 185 negligible risk of hypoglycemia. Following the 2021 PERKENI guidelines, Apidra is insulin rapid-
 186 acting, generally used with food. Apidra is designed to decrease glucose levels in the blood after a
 187 meal rapidly or when blood glucose levels are high. Apidra is commonly combined with basal insulins
 188 such as Lantus (insulin glargine) and Levemir (insulin detemir) (Soelistijo et al., 2021). A study
 189 examining the clinical effects of Type 2 DM patients with cardiovascular comorbidities where patients
 190 used insulin rapid-acting showed that it could have beneficial effects from insulin glulisine
 191 administration associated with death and stroke. Still, there was no difference in coronary heart disease
 192 (CHD) or cardiovascular disease (CVD) (Svensson et al., 2017).

193

194 Insulin aspart (novorapid) is given to patients with type 2 diabetes with comorbid HT accompanied by
 195 CAD, ST-Elevation Myocardial Infarction (STEMI), and Heart Failure (HF). The interval of insulin

196 administration averaged every 8 hours per day and was used by 66% of female patients with an
197 average of 58-61 years. Like glulisine insulin, this insulin can also quickly lower blood sugar levels
198 and has a low risk of hypoglycemia. This insulin is also rapid-acting, which provides therapeutic
199 effectiveness after 15 minutes, with the peak of therapeutic efficacy occurring within 1-2 hours and
200 can last up to 4-6 hours. In the case of the population in Japan, administering insulin aspart to type 2
201 DM patients can significantly reduce cardiovascular complications within 5 to 10 years, resulting in
202 improved quality of life and lower costs compared to *human insulin* (Pollock et al., 2011).

203

204 The third most significant use of anti-diabetic drugs is glimepiride doses of 2mg, 3 mg, and 4 mg. This
205 drug is given to patients with type 2 diabetes with cardiovascular comorbidities and an interval of 24
206 hours per day and primarily female patients (83%) with an average age of 58 years. Regular
207 glimepiride is combined with insulin or another oral medication such as metformin. In the case study
208 of type 2 DM patients with CVD, the average patient suffering from DM was around 5.7 ± 4.8 years.
209 CVD suffered by type 2 DM patients in the form of hypertension (68.5% of patients); dyslipidemia
210 (47.9% of patients); CAD (25.4% of patients); Transient Ischemic Attack (TIA) in 3.6% of patients;
211 peripheral artery disease (PAD) accounted for 4.8% of patients and heart failure in 2.9% of patients.
212 Type 2 DM patients with various comorbidities receive the drug glimepiride/metformin Fixed Dose
213 Combination (FDC) as a first-line therapy. As many as 68.2% of FDC patients achieved blood
214 pressure within optimal limits. Most of the other patients experienced an increase in glycemic
215 parameters and a change in body weight of about 18.4%. 59.2% of patients experienced weight loss
216 (Ray et al., 2022). Glimepiride is a sulfonylurea class drug that has pharmacological effects to increase
217 insulin production by pancreatic beta cells. The most common side effects are hypoglycemia and
218 weight gain.

219

220 The limitation of this study is that data were taken only retrospectively from patient medical record
221 data and did not make direct observations on DM patients.

222

223 **CONCLUSION**

224 Based on the analysis of demographic data and treatment profiles of DM patients, DM patients are
225 dominated by the age group of 46-65 years, with women who use anti-diabetic drugs more. Patients
226 with comorbidities use more anti-diabetic medications than patients with non-comorbid DM.
227 Evaluation of anti-diabetic drugs ATC / DDD method shows that insulin glulisine (Apidra) is most
228 used in DM patients with and without comorbidities. Through the DU method, 90% of glulisine,
229 aspart, glargine, glimepiride, detemir, and metformin drugs were most widely used in DM patients.

230

231 **CONFLICT OF INTEREST**

232 All authors declare no conflict of interest.

233 **REFERENCES**

234

235 Ali, M.D. *et al.* (2022) 'Evaluation of drug utilization pattern and cost associated with diabetes
236 mellitus Type two management in Saudi Arabia', *Brazilian Journal of Pharmaceutical
237 Sciences*, 58, p. E20681. Available at: <https://doi.org/10.1590/s2175-97902022e20681>.

238 Almasdy, D. *et al.* (2015) 'Evaluation of the Use of Anti-diabetic Drugs in Type-2 Diabetes Mellitus
239 Patients in a Government Hospital of Padang City – West Sumatra', *Journal of
240 Pharmaceutical & Clinical Science*, 2(1), p. 104. Available at:
241 <https://doi.org/10.29208/jsfk.2015.2.1.58>.

242 DiPiro, J.T. (ed.) (2020) *Pharmacotherapy: a pathophysiologic approach*. Eleventh edition. New
243 York: McGraw Hill Medical.

244 Okoro, R.N., Nmeka, C. and Erah, P.O. (2018) 'Utilization study of antidiabetes medicines at a tertiary
245 care hospital in Nigeria', *Future Journal of Pharmaceutical Sciences*, 4(2), pp. 109–115.
246 Available at: <https://doi.org/10.1016/j.fjps.2017.11.004>.

247 Pitasari, N.W.N., Andayani, T.M. and Wijayanti, T. (2022) 'Evaluation of the Use of Antidiabetic
248 Drugs in Patients of Back-Referral Program at the Demak District Pharmacy', *Journal of
249 Management and Pharmacy Practice*, 12(2), p. 125. Available at:
250 <https://doi.org/10.22146/jmpf.73841>.

251 Pollock, R.F. *et al.* (2011) 'The cost effectiveness of rapid-acting insulin aspart compared with human
252 insulin in type 2 diabetes patients: an analysis from the Japanese third-party payer perspective',
253 *Journal of Medical Economics*, 14(1), pp. 36–46. Available at:
254 <https://doi.org/10.3111/13696998.2010.541045>.

255 Ray, S. *et al.* (2022) 'Usage Pattern of Glimepiride/Metformin Fixed-dose Combination in Type 2
256 Diabetes Patients with CVD or at Risk of CVD: An Experience in Indian Setting', *Asian
257 Journal of Diabetology*, 23(2), pp. 13–19.

258 RI, K. (2017) 'Technical Guidelines for Evaluation of Drug Use in Health Facilities'.

259 Soelistijo, S.A. dkk. (2021) 'Guidelines for the management and prevention of adult type 2 diabetes
260 mellitus in INDONESIA - 2021', *PB. PERKENI*, p. 119.

261 Svensson, A.-M. *et al.* (2017) 'Clinical effects, cardiovascular and renal outcomes associated with
262 rapid-acting insulin analogs among individuals with type 2 diabetes: a nation-wide
263 observational cohort study', *Clinical Diabetes and Endocrinology*, 3(1), p. 5. Available at:
264 <https://doi.org/10.1186/s40842-017-0043-2>.

Comment [AR6]: All English and all authors in references must be written in full

- 265 Tahar, N.dkk. (2020) 'EVALUATION OF THE USE OF ORAL ANTI-DIABETIC DRUGS IN TYPE
266 2 DIABETES MELLITUS PATIENTS USING ATC/DDD AND DU 90% METHODS', *The*
267 *2nd Alauddin Pharmaceutical Conference and Expo (ALPHA-C) 2020* [Preprint]. Available
268 at: <https://doi.org/10.24252/kesehatan.v1i1.18380>.
- 269 WHO (2023) *Diabetes*. Available at: <https://www.who.int/news-room/fact-sheets/detail/diabetes>
270 (Accessed: September 21, 2023).