Supplemental Online-Only Materials to Accompany:

Diabetes, Drug Treatment and Mortality in COVID-19: A Multinational Retrospective Cohort Study

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eTable 1: Current medications for all patients with T2DM with a COVID-19 diagnosis or positive SARS-CoV-2 test

	All T2DM (n=29,516)	Alive at 28 days[a] (n=27,595)	Deceased at 28 days (n=1,921)	P
Current Medications[b], No. (%)				
Insulin	9,149 (31.0)	7,645 (27.7)	1,504 (78.3)	< .001
Antihypoglycemics	6,535 (22.1)	5,162 (18.7)	1,373 (71.5)	< .001
Glucagon	3,401 (11.5)	2,635 (9.5)	766 (39.9)	< .001
Glucose	6,443 (21.8)	5,071 (18.4)	1,372 (71.4)	< .001
Oral hypoglycemic agents	6,563 (22.2)	6,229 (22.6)	334 (17.4)	< .001
Metformin	5,077 (17.2)	4,844 (17.6)	227 (11.8)	< .001
Pioglitazone	300 (1.0)	291 (1.1)	<10 (-)	-
Acarbose	16 (0.1)	16 (0.1)	0 (0.0)	.33
Repaglinide	51 (0.2)	51 (0.2)	<10 (-)	-
Hypoglycemic agents, other	1,033 (3.5)	998 (3.6)	35 (1.8)	< .001
Dulaglutide	557 (1.9)	538 (1.9)	19 (1)	.005
Exenatide	84 (0.3)	84 (0.3)	<10 (-)	-
Liraglutide	300 (1.0)	300 (1.1)	<10 (-)	-
Lixisenatide	27 (0.1)	27 (0.1)	<10 (-)	-
Semaglutide	192 (0.7)	192 (0.7)	<10 (-)	-
Alogliptin	31 (0.1)	31 (0.1)	<10 (-)	-
Linagliptin	258 (0.9)	234 (0.8)	24 (1.2)	.14
Saxagliptin	23 (0.1)	23 (0.1)	<10 (-)	-
Sitagliptin	745 (2.5)	685 (2.5)	60 (3.1)	.15
Canagliflozin	129 (0.4)	129 (0.5)	<10 (-)	-
Dapagliflozin	149 (0.5)	149 (0.5)	<10 (-)	-
Empagliflozin	501 (1.7)	476 (1.7)	25 (1.3)	.09
Ertugliflozin	13 (<0.1)	13 (<0.1)	0 (0.0)	.37
Glimepiride	654 (2.2)	608 (2.2)	46 (2.4)	.37
Glipizide	1,044 (3.5)	995 (3.6)	49 (2.6)	.03
Glyburide	140 (0.5)	140 (0.5)	<10 (-)	-
Antihypertensive combinations	129 (0.4)	116 (0.4)	13 (0.7)	.08
Adrenal corticosteroids	8,799 (29.8)	7,476 (27.1)	1,323 (68.9)	< .001
Ace inhibitors	3,922 (13.3)	3,568 (12.9)	354 (18.4)	< .001
Angiotensin II inhibitors	2,955 (10.0)	2,690 (9.7)	265 (13.8)	< .001
Antilipemic agents	8,249 (27.9)	7,288 (26.4)	961 (50.0)	< .001

[a] Patients with the term "deceased" in the EMR within 28 days of a diagnosis of COVID-19 or positive test for SARS-CoV-2 were included in the "Deceased" group while all others were assigned to the "Alive" group.
[b] Medications listed in the EMR within 6 months up to the time of diagnosis of COVID-19 or positive test for SARS-CoV-2.
P values indicate significance between "Alive" and "Deceased" groups.

eTable 2: Current medications for No-G/D/P cohort with a COVID-19 diagnosis or positive SARS-CoV-2 test

	No-G/D/P[a] (n=23,714)	Alive at 28 days[b] (n=22,270)	Deceased at 28 days (n=1,443)	P
Current Medications[c], No. (%)				
Insulin	6,887 (29.0)	5,800 (26.0)	1,087 (75.3)	< .001
Antihypoglycemics	5,406 (22.8)	4,419 (19.8)	987 (68.4)	< .001
Glucagon	2,904 (12.2)	2,423 (10.9)	481 (33.3)	< .001
Glucose	5,325 (22.5)	4,339 (19.5)	986 (68.3)	< .001
Oral hypoglycemic agents	3,885 (16.4)	3,716 (16.7)	169 (11.7)	< .001
Metformin	3,315 (14.0)	3,180 (14.3)	135 (9.4)	< .001
Pioglitazone	0 (0.0)	0 (0.0)	0 (0.0)	-
Acarbose	<10 (-)	<10 (-)	0 (0.0)	-
Repaglinide	21 (0.1)	21 (0.1)	<10 (-)	-
Hypoglycemic agents, other	<10 (-)	<10 (-)	<10 (-)	-
Dulaglutide	0 (0.0)	0 (0.0)	0 (0.0)	-
Exenatide	0 (0.0)	0 (0.0)	0 (0.0)	-
Liraglutide	0 (0.0)	0 (0.0)	0 (0.0)	-
Lixisenatide	0 (0.0)	0 (0.0)	0 (0.0)	-
Semaglutide	0 (0.0)	0 (0.0)	0 (0.0)	-
Alogliptin	0 (0.0)	0 (0.0)	0 (0.0)	-
Linagliptin	0 (0.0)	0 (0.0)	0 (0.0)	-
Saxagliptin	0 (0.0)	0 (0.0)	0 (0.0)	-
Sitagliptin	0 (0.0)	0 (0.0)	0 (0.0)	-
Canagliflozin	43 (0.2)	43 (0.2)	0 (0.0)	.09
Dapagliflozin	56 (0.2)	56 (0.3)	<10 (-)	-
Empagliflozin	209 (0.9)	198 (0.9)	11 (0.8)	88
Ertugliflozin	<10 (-)	<10 (-)	<10 (-)	-
Glimepiride	342 (1.4)	316 (1.4)	26 (1.8)	.20
Glipizide	609 (2.6)	580 (2.6)	29 (2.0)	.26
Glyburide	88 (0.4)	79 (0.4)	<10 (-)	-
Antihypertensive combinations	102 (0.4)	95 (0.4)	<10 (-)	-
Adrenal corticosteroids	7,248 (30.6)	6,284 (28.2)	964 (66.8)	< .001
Ace inhibitors	2,765 (11.7)	2,519 (11.3)	246 (17.0)	< .001
Angiotensin II inhibitors	2,077 (8.8)	1,894 (8.5)	183 (12.6)	< .001
Antilipemic agents	5,886 (24.8)	5,200 (23.3)	686 (47.5%)	< .001

[a] The No-G/D/P cohort consisted of patients with T2DM with a diagnosis of COVID-19 or positive test for SARS-CoV-2 that did not have any GLP-1R agonists, DPP-4 inhibitors, or pioglitazone in the EMR.
[b] Patients with the term "deceased" in the EMR within 28 days of a diagnosis of COVID-19 or positive test for SARS-CoV-2 were included in the "Deceased" group while all others were assigned to the "Alive" group.
[c] Medications listed in the EMR within 6 months up to the time of diagnosis of COVID-19 or positive test for SARS-CoV-2.
P values indicate significance between "Alive" and "Deceased" groups.

eTable 3: Current medications for patients with T2DM with a COVID-19 diagnosis or positive SARS-CoV-2 test by medication cohort

	No-G/D/P[a] (n=23,714)	GLP-1 (n=1,774)	P	DPP-4 (n=2,264)	P	Pioglitazone (n=469)	P	Any Meds[b] (n=5,606)	P
Current Medications[c], No. (%)									
Insulin	6,877 (29.0)	756 (42.6)	< .001	937 (41.4)	< .001	159 (33.9)	.03	2,405 (42.9)	< .001
Antihypoglycemics	5,407 (22.8)	373 (21.0)	.07	616 (27.2)	< .001	116 (24.7)	.30	1,452 (25.9)	< .001
Glucagon	2,893 (12.2)	254 (14.3)	.01	387 (17.1)	< .001	71 (15.1)	.05	975 (17.4)	< .001
Glucose	5,336 (22.5)	367 (20.7)	.09	604 (26.7)	< .001	114 (24.3)	.32	1,435 (25.6)	< .001
Oral hypoglycemic agents	3,889 (16.4)	742 (41.8)	< .001	1,134 (50.1)	< .001	220 (46.9)	< .001	2,736 (48.8)	< .001
Metformin	3,320 (14.0)	608 (34.3)	< .001	607 (26.8)	< .001	136 (29.0)	< .001	1,766 (31.5)	< .001
Pioglitazone	0 (0.0)	0 (0.0)	-	0 (0.0)	-	469 (100.0)	< .001	1,009 (18.0)	< .001
Repaglinide	24 (0.1)	<10 (-)	-	18 (0.8)	< .001	<10 (-)	-	28 (0.5)	< .001
Hypoglycemic agents, other	0 (0.0)	1,774 (100.0)	< .001	0 (0.0)	-	0 (0.0)	-	1,928 (34.4)	< .001
Dulaglutide	0 (0.0)	857 (48.3)	< .001	0 (0.0)	-	0 (0.0)	-	1,351 (24.1)	< .001
Exenatide	0 (0.0)	255 (14.4)	< .001	0 (0.0)	-	0 (0.0)	-	415 (7.4)	< .001
Liraglutide	0 (0.0)	786 (44.3)	< .001	0 (0.0)	-	0 (0.0)	-	1,177 (21.0)	< .001
Lixisenatide	0 (0.0)	43 (2.4)	< .001	0 (0.0)	-	0 (0.0)	-	73 (1.3)	< .001
Semaglutide	0 (0.0)	348 (19.6)	< .001	0 (0.0)	-	0 (0.0)	-	533 (9.5)	< .001
Alogliptin	0 (0.0)	0 (0.0)	-	72 (3.2)	< .001	0 (0.0)	-	118 (2.1)	< .001
Linagliptin	0 (0.0)	0 (0.0)	-	675 (29.8)	< .001	0 (0.0)	-	919 (16.4)	< .001
Saxagliptin	0 (0.0)	0 (0.0)	-	97 (4.3)	< .001	0 (0.0)	-	163 (2.9)	< .001
Sitagliptin	0 (0.0)	0 (0.0)	-	1,795 (79.3)	< .001	0 (0.0)	-	1,502 (26.8)	< .001
Canagliflozin	47 (0.2)	25 (1.4)	< .001	25 (1.1)	< .001	<10 (-)	-	78 (1.4)	< .001
Dapagliflozin	47 (0.2)	39 (2.2)	< .001	32 (1.4)	< .001	<10 (-)	-	107 (1.9)	< .001
Empagliflozin	213 (0.9)	124 (7.0)	< .001	79 (3.5)	< .001	18 (3.8)	< .001	325 (5.8)	< .001
Ertugliflozin	<10 (-)	<10 (-)	-	<10 (-)	-	0 (0.0)	-	11 (0.2)	-
Glimepiride	332 (1.4)	67 (3.8)	< .001	111 (4.9)	< .001	29 (6.2)	< .001	314 (5.6)	< .001
Glipizide	617 (2.6)	99 (5.6)	< .001	174 (7.7)	< .001	49 (10.4)	< .001	432 (7.7)	< .001
Glyburide	95 (0.4)	12 (0.7)	.02	18 (0.8)	.004	<10 (-)	-	56 (1.0)	< .001
Adrenal corticosteroids	7,256 (30.6)	600 (33.8)	.005	765 (33.8)	< .001	125 (26.7)	.07	1,906 (34.0)	< .001
Ace inhibitors	2,775 (11.7)	353 (19.9)	< .001	453 (20.0)	< .001	100 (21.3)	< .001	1,160 (20.7)	< .001
Angiotensin II inhibitors	2,087 (8.8)	314 (17.7)	< .001	358 (15.8)	< .001	61 (13.0)	< .001	953 (17.0)	< .001
Antilipemic agents	5,881 (24.8)	766 (43.2)	< .001	960 (42.4)	< .001	193 (41.2)	< .001	2,500 (44.6)	< .001
Antihypertensive combinations	95 (0.4)	16 (0.9)	.002	<10 (-)	-	0 (0.0)	.18	39 (0.7)	.02

[a] The "No-G/D/P" cohort consisted of patients with T2DM with a diagnosis of COVID-19 or positive test for SARS-CoV-2 that did not have any GLP-1R agonists, DPP-4 inhibitors, or pioglitazone in the EMR.

[b] The "Any Meds" cohort consisted of patients with T2DM with a diagnosis of COVID-19 or positive test for SARS-CoV-2 that had GLP-1R agonists, DPP-4 inhibitors, and/or pioglitazone in the EMR.

[c] Medications listed in the EMR within 6 months up to the time of diagnosis of COVID-19 or positive test for SARS-CoV-2.

P values indicate significance compared with the No-G/D/P cohort.

eTable 4: Laboratory values for hospitalized patients with a COVID-19 diagnosis or positive SARS-CoV-2 test at the time of admission and after hospitalization

	Before Propensity Matching		After Propensity Matching[a]		
			Matched No-G/D/P Cohort	Matched Drug Cohort	
	Mean (SD)	*P*			*P*
Blood Glucose, mean (SD), mg/dL					
At time of Admission[b]					
No-G/D/P[d]	146.8 (64.9)				
GLP-1	148.0 (55.8)	.87	140.9 (50.9)	148.0 (55.8)	.33
DPP-4	153.9 (64.6)	.01	142.9 (64.7)	158.9 (66.8)	< .001
Pioglitazone	143.6 (62.5)	.64	139.4 (61.4)	142.6 (66.0)	.76
Any Meds[e]	153.6 (64.9)	.002	142.7 (66.3)	156.0 (68.1)	< .001
After Hospitalization[c]					
No-G/D/P[d]	140.7 (62.3)				
GLP-1	142.3 (57.2)	.81	147.7 (63.4)	143.2 (61.9)	.67
DPP-4	153.2 (64.2)	< .001	133.6 (55.5)	157.0 (65.7)	< .001
Pioglitazone	153.4 (72.5)	.05	141.1 (53.5)	156.8 (77.1)	.15
Any Meds[e]	153.0 (66.3)	< .001	137.8 (58.5)	156.7 (69.5)	< .001
Hemoglobin A1c, mean (SD), %; mmol/mol					
At time of Admission[b]					
No-G/D/P[d]	8.4 (2.4); 68 (26.2)				
GLP-1	8.3 (2.1); 67 (23)	.88	8.4 (2.3); 68 (25.1)	8.3 (2.1); 67 (23)	.96
DPP-4	8.2 (2.2); 66 (24)	.29	8.0 (2.3); 64 (25.1)	8.2 (2.2); 66 (24)	.38
Pioglitazone	7.7 (1.7); 61 (18.6)	.11	7.1 (1.3); 54 (14.2)	7.5 (1.7); 58 (18.6)	.40
Any Meds[e]	8.4 (2.2); 68 (24)	.90	7.9 (2.2); 63 (24)	8.3 (2.2); 67 (24)	.03
After Hospitalization[c]					
No-G/D/P[d]	8.3 (2.4); 67 (26.2)				
GLP-1	8.1 (2.0); 65 (21.9)	.65	8.0 (2.1); 64 (23)	8.2 (2.1); 66 (23)	.77
DPP-4	8.2 (2.2); 66 (24)	.50	7.8 (2.2); 62 (24)	8.2 (2.1); 66 (23)	.04
Pioglitazone	7.8 (1.6); 62 (17.5)	.17	8.0 (2.2); 64 (24)	7.6 (1.6); 60 (17.5)	.48
Any Meds[e]	8.4 (2.1); 68 (23)	.49	7.9 (2.2); 63 (24)	8.3 (2.2); 67 (24)	.02
Oxygen Saturation, mean (SD), %					
At time of Admission[b]					
No-G/D/P[d]	85.6 (19.2)				
GLP-1	85.1 (18.6)	.87	88.9 (14.6)	85.1 (18.6)	.27
DPP-4	87.0 (18.7)	.28	88.0 (17.0)	87.6 (18.8)	.80
Pioglitazone	83.0 (21.0)	.37	80.8 (24.6)	80.9 (22.2)	.97
Any Meds[e]	85.5 (19.7)	.89	87.0 (19.0)	85.6 (20.2)	.33
After Hospitalization[c]					
No-G/D/P[d]	85.4 (19.2)				
GLP-1	86.0 (22.0)	.84	88.1 (14.9)	86.0 (23.8)	.63
DPP-4	86.6 (18.6)	.28	85.0 (19.3)	87.1 (18.8)	.23
Pioglitazone	84.4 (19.9)	.71	85.6 (20.3)	83.5 (20.7)	.67
Any Meds[e]	85.9 (19.0)	.57	86.3 (19.9)	87.0 (18.0)	.64

[a] Propensity matching balanced cohorts according to age, sex, race, ethnicity, BMI, and the presence of essential (primary) hypertension; ischemic heart disease; cerebrovascular disease; heart failure; chronic kidney disease; or overweight and obesity in the EMR within 6 months prior to COVID-19 diagnosis.
[b] Values are the latest available record occurring following diagnosis of COVID-19 or positive test for SARS-CoV-2 up to 28 days after.
[c] Values are the latest available record occurring two days prior up to and including the day of hospitalization.
[d] The "No-G/D/P" cohort consisted of patients with T2DM with a diagnosis of COVID-19 or positive test for SARS-CoV-2 that did not have any GLP-1R agonists, DPP-4 inhibitors, or pioglitazone in the EMR.
[e] The "Any Meds" cohort consisted of patients with T2DM with a diagnosis of COVID-19 or positive test for SARS-CoV-2 that had GLP-1R agonists, DPP-4 inhibitors, and/or pioglitazone in the EMR.
P values indicate significance compared with the No-G/D/P cohort.

eTable 5: Laboratory values at the time of admission and during hospitalization among patients who continued compared or discontinued specified medications after hospitalization

	Prior to Propensity Matching			After Propensity Matching[a]		
	Continued[b]	Discontinued	*P*	Continued	Discontinued	*P*
Blood Glucose, mean (SD), mg/dL						
At time of Admission[c]						
No-G/D/P[e]	144.9 (63.2)	-	-	-	-	-
GLP-1	145.5 (49.9)	155.0 (68.8)	.31	147.5 (55.1)	153.3 (67.5)	.69
DPP-4	157.8 (61.2)	148.0 (62.2)	.07	154.6 (60.0)	146.8 (60.9)	.21
Pioglitazone	167.7 (66.9)	131.9 (57.4)	.009	172.3 (71.3)	132.7 (47.8)	.02
Any Meds[f]	153.2 (59.3)	150.4 (64.8)	.50	156.9 (61.7)	154.7 (65.7)	.70
After Hospitalization[d]						
No-G/D/P[e]	139.9 (62.4)	-	-	-	-	-
GLP-1	135.1 (50.3)	156.0 (67.8)	.02	136.6 (51.7)	151.0 (65.4)	.20
DPP-4	153.7 (71.2)	152.7 (61.6)	.86	152.6 (71.3)	152.6 (62.6)	.99
Pioglitazone	161.3 (69.8)	149.3 (75.8)	.47	158.0 (57.1)	139.1 (71.3)	.34
Any Meds[f]	148.5 (66.9)	153.7 (65.1)	.21	148.5 (67.1)	152.2 (61.6)	.42
Hemoglobin A1c, mean (SD), %; mmol/mol						
At time of Admission[c]						
No-G/D/P[e]	8.5 (2.5); 69 (27.3)	-	-	-	-	-
GLP-1	8.6 (2.3); 70 (25.1)	8.7 (2.3); 72 (25.1)	.88	8.2 (2.4); 66 (26.2)	7.8 (1.8); 62 (19.7)	.69
DPP-4	8.1 (2.1); 65 (23)	8.1 (2.2); 65 (24)	.96	8.2 (2.2); 66 (24)	8.0 (2.2); 64 (24)	.66
Pioglitazone	8.4 (1.7); 68 (18.6)	7.2 (1.6); 55 (17.5)	.07	8.1 (1.7); 65 (18.6)	6.9 (1.8); 52 (19.7)	.23
Any Meds[f]	8.3 (2.1); 67 (23)	8.3 (2.2); 67 (24)	.77	8.2 (2.1); 66 (23)	8.5 (2.2); 69 (24)	.35
After Hospitalization[d]						
No-G/D/P[e]	8.3 (2.4); 67 (26.2)	-	-	-	-	-
GLP-1	8.4 (2.1); 68 (23)	8.9 (2.5); 74 (27.3)	.36	8.4 (2.0); 68 (21.9)	9.1 (2.5); 76 (27.3)	.24
DPP-4	8.2 (2.1); 66 (23)	8.0 (2.1); 64 (23)	.59	8.1 (2.1); 65 (23)	8.1 (2.1); 65 (23)	.94
Pioglitazone	8.4 (1.6); 68 (17.5)	7.3 (1.5); 56 (16.4)	.05	8.5 (2.0); 69 (21.9)	6.9 (1.6); 52 (17.5)	.07
Any Meds[f]	8.3 (2.0); 67 (21.9)	8.2 (2.2); 66 (24)	.65	8.3 (2.1); 67 (23)	8.4 (2.1); 68 (23)	.83
Oxygen Saturation, mean (SD), %						
At time of Admission[c]						
No-G/D/P[e]	85.5 (19.1)	-	-	-	-	-
GLP-1	85.4 (19.7)	83.3 (22.4)	.64	84.4 (20.7)	83.8 (24.3)	.94
DPP-4	90.8 (13.9)	86.0 (19.7)	.05	90.8 (14.3)	87.6 (18.7)	.23
Pioglitazone	84.2 (20.2)	82.8 (18.9)	.83	86.0 (20.4)	82.5 (20.2)	.69
Any Meds[f]	87.9 (17.2)	85.2 (19.8)	.15	88.8 (17.2)	84.0 (21.1)	.06
After Hospitalization[d]						
No-G/D/P[e]	85.1 (19.2)	-	-	-	-	-
GLP-1	85.0 (23.1)	84.5 (20.0)	.92	85.6 (22.8)	85.7 (20.6)	.99
DPP-4	91.5 (14.1)	84.4 (20.5)	.003	91.4 (14.6)	85.2 (18.8)	.01
Pioglitazone	87.1 (14.0)	84.5 (19.5)	.67	86.4 (16.4)	84.9 (21.6)	.85
Any Meds[f]	88.2 (17.9)	85.3 (19.3)	.09	88.1 (18.0)	85.3 (19.5)	.14

[a] Propensity matching balanced cohorts according to age, sex, race, ethnicity, BMI, and the presence of essential (primary) hypertension; ischemic heart disease; cerebrovascular disease; heart failure; chronic kidney disease; or overweight and obesity in the EMR within 6 months prior to COVID-19 diagnosis.
[b] Patients with the specified medication listed in the EMR after hospitalization within 28 days of a diagnosis of COVID-19 or positive test for SARS-CoV-2 were included in the "Continued" group while those without the specified medications were assigned to the "Discontinued" group.
[c] Values are the latest available record occurring following diagnosis of COVID-19 or positive test for SARS-CoV-2 up to 28 days after.
[d] Values are the latest available record occurring two days prior up to and including the day of hospitalization.
[e] The "No-G/D/P" cohort consisted of patients with T2DM with a diagnosis of COVID-19 or positive test for SARS-CoV-2 that did not have any GLP-1R agonists, DPP-4 inhibitors, or pioglitazone in the EMR.
[f] The "Any Meds" cohort consisted of patients with T2DM with a diagnosis of COVID-19 or positive test for SARS-CoV-2 that had GLP-1R agonists, DPP-4 inhibitors, and/or pioglitazone in the EMR.
P values indicate significance between "Continued" and "Discontinued" groups.