Supplementary Materials

Appendix S1

Terms	Diabetes Device Category
Continuous Glucose Monitoring	Continuous glucose monitoring
CGM	Continuous glucose monitoring
Glucose sensor	Continuous glucose monitoring
Sensor	Continuous glucose monitoring
Flash glucose monitor	Continuous glucose monitoring
FGM	Continuous glucose monitoring
Dexcom	Continuous glucose monitoring
Guardian sensor	Continuous glucose monitoring
Flash Glucose monitoring	Continuous glucose monitoring
Freestyle Libre	Continuous glucose monitoring
BG	Self-monitoring of blood glucose
FS Glucose	Self-monitoring of blood glucose
Blood Glucose	Self-monitoring of blood glucose
Finger stick	Self-monitoring of blood glucose
Fingerstick	Self-monitoring of blood glucose
Self monitor blood glucose	Self-monitoring of blood glucose
SMBG	Self-monitoring of blood glucose
Self monitoring blood glucose	Self-monitoring of blood glucose
Glucometer	Self-monitoring of blood glucose
meter	Self-monitoring of blood glucose
ACCU-CHEK	Self-monitoring of blood glucose
OneTouch	Self-monitoring of blood glucose
CONTOUR NEXT	Self-monitoring of blood glucose
Freestyle	Self-monitoring of blood glucose
Freestyle lite	Self-monitoring of blood glucose
Freestyle lancets	Self-monitoring of blood glucose
Insulin injection	Insulin injection
Insulin pen injection	Insulin injection
Multiple daily injections	Insulin injection
MDI	Insulin injection
pen injection	Insulin injection
shots of insulin	Insulin injection
insulin shots	Insulin injection
Medtronic pump	Insulin pump

Minimed pump	Insulin pump
Insulin pump	Insulin pump
insulin infusion	Insulin pump
CSII	Insulin pump
OmniPod	Insulin pump
Cozmo	Insulin pump
Deltec Cozmo	Insulin pump
T slim	Insulin pump
T:slim	Insulin pump

Table S1. Univariate comparison of device (either CGM or CSII) user vs. non-user within 6 month of disease diagnosis

Variable	User	Non-users	P value
N	451	649	
Age, median (IQR)	16.7 (23.6)	13.5 (8.5)	<0.001
Gender, n (%)			0.886
Male	232 (51.4)	331 (51.0)	
Female	219 (48.6)	318 (49.0)	
Race, n (%)			0.005
White	268 (59.4)	330 (50.8)	
Non-White	183 (40.6)	319 (49.2)	
Ethnicity, n (%)			<0.001
Hispanic	63 (14.0)	162 (25.0)	
Non-Hispanic	326 (72.3)	372 (57.3)	
Insurance, n (%)			<.001
Private	360 (79.8)	442 (68.1)	
Public	91 (20.2)	207 (31.9)	
Baseline HbA1c, mean$\pm$sd	8.1$\pm$1.4	8.1$\pm$1.6	0.412

Table S2. Results of mixed effects regression model analyses for HbA1c between CGM users and non-users

Variable	β	Std. Error	P value
Intercept	2.989	0.188	<0.001
Group			
CGM users	-0.162	0.078	0.039
CGM non-users (reference)			
Time			
Time1 (reference)			
Time2	0.142	0.031	<0.001
Time3	0.208	0.033	<0.001
Time4	0.252	0.035	<0.001
Age	-0.006	0.002	0.004
Baseline HbA1c	0.578	0.022	<0.001
Ethnicity			
Hispanic	0.354	0.094	<0.001
Non-Hispanic (reference)			
Insurance			
Private (reference)			
Public	0.506	0.078	<0.001

Table S3. Results of mixed effects regression model analyses for HbA1c between CSII users and non-users

Variable	β	Std. Error	P value
Intercept	3.369	0.208	<0.001
Group			
CSII users	-0.136	0.071	0.057
CSII non-users (reference)			
Time			
Time1 (reference)			
Time2	0.149	0.030	<0.001
Time3	0.215	0.032	<0.001
Time4	0.268	0.034	<0.001
Age	-0.009	0.002	<0.001
Baseline HbA1c	0.553	0.023	<0.001
Ethnicity			
Hispanic	0.326	0.092	<0.001
Non-Hispanic (reference)			
Insurance			
Private (reference)			
Public	0.596	0.079	<0.001

Table S4. Results of mixed effects regression model analyses for HbA1c by four group

Variable	β	Std. Error	P value
Intercept	2.997	0.191	<0.001
Group			
CGM+Pump	-0.311	0.094	<0.001
CGM+MDI	0.046	0.121	0.705
CSII+SMBG	-0.182	0.104	0.079
MDI+SMBG (reference)			
Time			
Time1 (reference)			
Time2	0.149	0.030	<0.001
Time3	0.215	0.032	<0.001
Time4	0.267	0.034	<0.001
Age	-0.006	0.002	0.004
Baseline HbA1c	0.580	0.023	<0.001
Ethnicity			
Hispanic	0.312	0.092	<0.001
Non-Hispanic (reference)			
Insurance			
Private (reference)			
Public	0.525	0.078	<0.001

Adapted Klompas Phenotype Algorithm for Type 1 and type 2 Diabetes Mellitus

1. Introduction:

This document describes the Stanford University algorithm to extract individuals with diabetes and the type of diabetes from electronic health records (EHRs). There are two main tasks of this phenotype development: 1) to extract patients with diabetes (gestational diabetes is excluded), and 2) to discriminate between type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM). Instead of identifying all diabetes cases, we aim to reduce the number of false positives in our diabetes cohort. The prior is crucial for public health surveillance, yet we aim to achieve the later for clinical research use.

2. Algorithm Description:

Individuals with diabetes were identified by having diagnosis codes combined with either having abnormal laboratory results or being prescribed with diabetes-related medications. We then modified the Klompas (2013) algorithm[1] by including additional ICD-10 diagnosis codes to classify T1DM vs. T2DM. Structured data required from EHRs include:

- Diagnosis code (ICD-9 and ICD-10)
- Prescribed medication (RxNorm)
- Laboratory test results (LOINC)

2.1. Diabetes Cohort Selection

Individuals with diabetes were identified using the following criteria. Diagnosis and medication codes are available in the Appendix.

- ICD-9 and/or ICD-10 codes for type 1 and/or type 2 diabetes *AND **ANY*** of the following criteria

  ➢ With abnormal lab
    - Random glucose > 200 mg/dl
    - Fasting glucose ≥ 125 mg/dl
    - Hemoglobin A1c ≥ 6.5%

 ➢ Being prescribed with diabetes-related medication

- Insulin
- glucagon
- glucagon-like peptide-1 (GLP-1) receptor agonists
- biguanides
- sulfonylurea
- thiazolidinediones
- meglitinides
- biguanides
- α -glucose inhibitor
- DPP-4 inhibitors
- SGLT2 inhibitors
- Cycloset

2.2. Classification algorithm for T1DM and T2DM

- Based on the Klompas (2013) algorithm, a patient will be classified as T1DM if *ANY* of the following present:

  ➢ Ratio of T1DM to T2DM codes > 0.5 and prescription for glucagon
  ➢ Ratio of T1DM to T2DM codes > 0.5 and no record of an oral hypoglycemic other than metformin

- A patient who did not meet the criteria for T1DM were presumptively classified as T2DM.

Flow Diagram

This is a schematic representation of the phenotype definition logic described above.
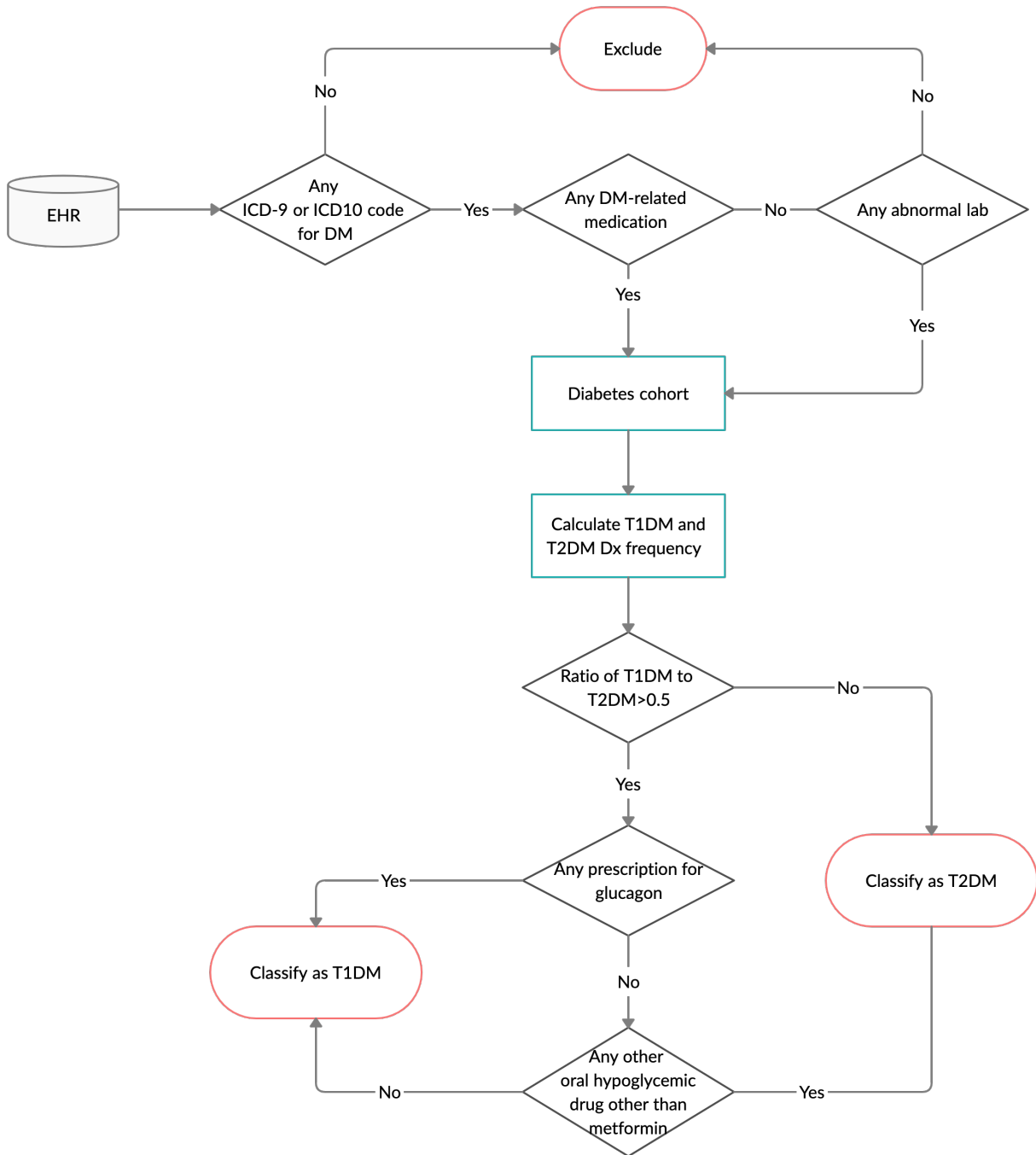
Diagnosis and Medications

Diagnosis code for diabetes

- ICD-9 code: 250.x
- ICD-10 code: E10.x, E11.x

RxNorm/RXCUI codes for diabetes-related medications

Generic Name	RxNorm CUI
Oral hypoglycemic medications	
Biguanides	
Metformin	6809
Sulfonylureas	
Glipizide	4821
Glyburide	4815
Gliclazide	4816
Glimepiride	25789
Thiazolidinediones	
Rosiglitazone	84108
Pioglitazone	33738
Meglitinides	
Repaglinide	73044
Nateglinide	274332
α-Glucosidase inhibitors	
Acarbose	16681
Miglitol	30009
DPP-4 inhibitors	
Sitagliptin	593411
Saxagliptin	857974
Vildagliptin	596554
Linagliptin	1100699
Alogliptin	1368001
SGLT2 inhibitors	
Dapagliflozin	1488564
Canagliflozin	1373458
GLP-1 receptor agonists	

Exenatide	60548
Lixisenatide	1440051
Liraglutide	475968
Semaglutide	1991302
Dulaglutide	1551291
Cycloset	
Bromocriptine	1760
Glucagon	4832
Insulin	139825
	274783
	314684
	352385
	400008
	51428
	5856
	86009

LOINC codes for diabetes laboratory test

Laboratory test	LOINC code
Random glucose	2339-0
	2345-7
Fasting glucose	1558-6
Hemoglobin A1c	4548-4
	17856-6
	4549-2
	17855-8

Reference

1. Klompas M, Eggleston E, McVetta J, Lazarus R, Li L, Platt R. Automated detection and classification of type 1 versus type 2 diabetes using electronic health record data. *Diabetes Care*. 2013 Apr 1;36(4):914-21.