Appendix 1: Study search strategy for Pubmed and Embase

Embase

#1	(('risk prediction':ab,ti OR 'predictive model':ab,ti OR 'predictive equation':ab,ti OR 'prediction model':ab,ti OR 'risk calculator':ab,ti OR 'prediction rule':ab,ti OR 'risk model':ab,ti OR 'statistical model':ab,ti OR 'cox model':ab,ti OR 'regression model':ab,ti OR 'screening tool':ab,ti OR 'screening model':ab,ti OR 'screening score':ab,ti OR 'risk score':ab,ti OR 'risk scores':ab,ti OR 'Logistic model':ab,ti OR 'modeling':ab,ti OR 'assessment tool':ab,ti OR 'model development':ab,ti) NOT 'Decision Tree':ab,ti NOT 'Decision Trees':ab,ti NOT 'neural network':ab,ti NOT 'Machine learning':ab,ti NOT 'Association':ab,ti NOT 'Associations':ab,ti NOT 'Associated':ab,ti NOT 'specific risk':ab,ti NOT 'relation':ab,ti NOT 'relationship':ab,ti NOT 'correlation':ab,ti NOT 'Decision Trees'/exp NOT 'neural network'/exp NOT 'Machine learning'/exp
#2	('diabetes type 2':ti OR 'type 2 diabetes':ti OR 'diabetes mellitus':ti OR 'type 2 diabetes mellitus':ti OR 'diabetes mellitus type ii':ti OR 'type ii diabetes mellitus':ti OR 'diabetes':ti) NOT gestational:ti NOT 'type i':ti NOT 'type 1':ti NOT 'Medication':ti NOT 'Animal':ti NOT 'Children':ti NOT 'Adolescent':ti NOT 'patients with':ti NOT 'population with':ti NOT 'Pharmacoeconomic':ti NOT 'Pharmacology':ti NOT 'Pharmaceutic:ti NOT Preparations':ti NOT 'Pharmaceutical Products':ti NOT 'Pharmaceuticals':ti NOT 'Drug':ti NOT 'Drugs':ti NOT 'Gene':ti NOT 'Genetic':ti NOT 'Cistron':ti NOT 'Cistrons':ti NOT 'Exomes':ti NOT 'Therapeutic':ti NOT 'Therapy':ti NOT 'Therapies':ti NOT 'Treatment':ti NOT 'Treatments':ti NOT 'Base Sequences':ti NOT 'Nucleotide Sequence':ti NOT 'Nucleotide Sequences':ti NOT 'RNA Sequence':ti NOT 'RNA Sequences':ti NOT 'DNA Sequence':ti NOT 'DNA Sequences':ti NOT 'Pharmacology'/exp NOT 'Pharmaceutical Preparations'/exp NOT 'Gene'/exp NOT 'Exome'/exp NOT 'Therapeutics'/exp NOT 'Base Sequence'/exp)
#3	[1-11-2011]/sd NOT [1-11-2019]/sd NOT review:it NOT letter:it NOT 'review':ti AND [humans]/lim AND [english]/lim
#4	#1 AND #2 AND #3

Pubmed

((((((((((((((((((((("Diabetes Type 2" [Title])OR "type 2 diabetes" [Title]) OR "Diabetes Mellitus" [Title]) OR "Type 2 Diabetes Mellitus" [Title]) OR "Diabetes Mellitus Type II" [Title]) OR "Type II Diabetes Mellitus"[Title]) OR "diabetes"[Title]) OR type 2 diabetes [Title]) OR Diabetes Mellitus [Title]) OR Type II Diabetes Mellitus [Title]) OR diabetes [Title]))) NOT ((Gestational[Title]) OR Type I[Title]) OR type 1[Title]) OR Medication[Title]) OR animal[Title]) OR children[Title]) OR adolescent[Title]) OR patients with[Title]) OR population with[Title])OR Pharmacoeconomic[Title]) OR Pharmacology [Title]) OR Pharmaceutic Preparations[Title]) OR Pharmaceutical Products[Title]) OR Pharmaceuticals [Title]) OR drug[Title]) OR Drugs[Title]) OR Gene[Title]) OR genetic[Title]) OR Cistron[Title]) OR Cistrons[Title]) OR Exomes[Title]) OR Therapeutic[Title]) OR Therapy[Title]) OR Therapies[Title]) OR Treatment[Title]) OR Treatments[Title]) OR Base Sequences[Title]) OR Nucleotide Sequence[Title]) OR Nucleotide Sequences[Title]) OR RNA Sequence[Title]) OR RNA Sequences[Title]) OR DNA Sequence[Title]) OR DNA Sequences[Title]) OR Pharmacology [MeSH Terms]) OR Pharmaceutical Preparations [MeSH Terms]) OR Gene [MeSH Terms]) OR Exome [MeSH Terms]) OR Therapeutics [MeSH Terms]) OR Base Sequence [MeSH Terms])))))))) AND ((((((((((((((((((((("risk prediction" [Title/Abstract]) OR "predictive model"[Title/Abstract]) OR "predictive equation"[Title/Abstract]) OR "prediction model"[Title/Abstract]) OR "risk calculator"[Title/Abstract]) OR "prediction rule"[Title/Abstract]) OR "risk model"[Title/Abstract]) OR "statistical model"[Title/Abstract]) OR "cox model"[Title/Abstract]) OR "regression model"[Title/Abstract]) OR "screening tool"[Title/Abstract]) OR "screening model"[Title/Abstract]) OR "screening score"[Title/Abstract]) OR "risk score"[Title/Abstract]) OR "risk scores"[Title/Abstract]) OR "Logistic model"[Title/Abstract]) OR "modeling"[Title/Abstract]) OR "assessment tool"[Title/Abstract])))))))) NOT ((((((((((((((("Decision Tree"[Title/Abstract]) OR "Decision Trees"[Title/Abstract]) OR "neural network"[Title/Abstract]) OR "Machine learning"[Title/Abstract]) OR "association"[Title]) OR "associations"[Title/Abstract]) OR "associated"[Title/Abstract]) OR "specific risk"[Title/Abstract]) OR "relation"[Title/Abstract]) OR "relationship"[Title/Abstract]) OR "correlation"[Title]) OR Decision Trees [MeSH Terms]) OR neural network[MeSH Terms])OR Machine learning[MeSHTerms])))))) NOT (((((((((((review [publication type]) OR Meta-analysis [publication type]) OR bibliography [publication type]) OR News[publication type]) OR systematic review[Title/abstract]) OR meta-analysis [Title/abstract])))) Filters: Publication date from 2011/11/01 to 2019/11/01; Humans; English

Appendix 2: The details of the excluded or included articles of the previously published reviews			
	Author first name	**Inclusion /exclusion**	**Reason of exclusion**
1	Aekplakorn 2006 [1]	**Included**	
2	Alssema 2008 [2]	Excluded	Not English article
3	Alssema 2011[3]	Excluded	Evaluation and update study
4	Balkau 2008[4]	**Included**	
5	Bozorgmanesh 2011[5]	Excluded	Only validation study
6	Bozorgmanesh 2011[6]	**Included**	
7	Bozorgmanesh 2010 [7]	Excluded	Only validation study
8	Cameron 2008[8]	Excluded	Only validation study
9	Chen 2010[9]	**Included**	
10	Chien 2009[10]	**Included**	
11	Chuang 2011[11]	**Included**	
12	Collins 2011 [12]	Excluded	Only validation study
13	Gao 2009 [13]	**Included**	
14	Guerrero-Romero 2010 [14]	Excluded	Only validation study
15	Hippisley-Cox 2009[15]	**Included**	
16	Joseph 2010[16]	Excluded	Risk factor study
17	Kahn 2009[17]	**Included**	
18	Kanaya 2005[18]	**Included**	
19	Kolberg 2009[19]	Excluded	Genetic risk score
20	Lindstrom 2003[20]	Excluded	Several outcomes
21	Liu 2011[21]	Excluded	Undiagnosed T2DM score
22	Mainous 2007[22]	Excluded	Only validation study
23	Mann 2010[23]	Excluded	Only validation study
24	McNeely 2003[24]	Excluded	Specific variable effects on T2DM
25	Mehrabi 2010[25]	Excluded	Not English article
26	Meigs 2008[26]	Excluded	Genetic risk score
27	Nichols 2008[27]	Excluded	Only validation study
28	Rahman 2008[28]	Excluded	Not English article
29	Rathmann 2010[29]	Excluded	Genetic risk score
30	Rosella 2010[30]	**Included**	
31	Schmidt 2005[31]	**Included**	
32	Schulze 2007[32]	**Included**	
33	Schulze 2009[33]	Excluded	Genetic risk score
34	Simmons 2007[34]	Excluded	Specific variable effects on T2DM
35	Stern 1993[35]	**Included**	
36	Stern 2002[36]	Excluded	Only validation study
37	Sun 2009[37]	**Included**	
38	Talmud 2010[38]	Excluded	Genetic risk score
39	Urdea 2009[39]	Excluded	Only validation study
40	Von Eckardstein 2008[40]	**Included**	
41	Wannamethee 2011[41]	**Included**	
42	Wannamethee 2005[42]	Excluded	Specific variable effects on T2DM
43	Wilson 2007[43]	**Included**	
44	Gupta 2008[44]	Excluded	Randomized clinical trials
45	Tuomilehto 2010[45]	Excluded	Among pre-diabetes population

Appendix 3: Characteristics of studies (n=24) for prediction of incident type 2 diabetes

#	First author	Publication Year	country	Study design	Name of study or population	#Outcome/ Sample size for model development	Follow-up	Age (years) of model development population	Male,%	Definition of Diabetes as reported
1	Doi,Y., et.al[46]	2012	Japan	cohort	Hisayama population based cohort of CVD and risk factors	286/1935	14 y	57.2± 10.2	41	2-h BG≥11.1 mmol/l or FBS ≥7 mmol/l or treatment
2	Lim,N.K., et.al[47]	2012	Korea	cohort	The Korean Genome and Epidemiology Study (KoGES)	436/6342	4 y	51.6±8.7	47.6	FBS ≥126 mg/dL or 2-h BG≥200 mg/dL or HbA1c≥6.5% or treatment or self-reported clinical diagnosis
3	Heianza,Y., et.al[48]	2012	Japan	cohort	Toranomon Hospital Health Management Center Study 6 (TOPICS 6)	289/7654	5 y	50.2±6.9	71.1	FBS ≥7mmol/L orHbA1c≥6.5% or self-reported clinical diagnosis
4	Noto,D.,et.al[49]	2012	Italy	cohort	Ventimiglia heart study	103/858	10 y	57.0±11	46.6	FBS >7mmol/L (in two measurements) or 2-h BG>11.1mmol/L or FBS >11.1mmol/L
5	Ye,x., et.al[50]	2014	China	cohort	local communities in both urban and rural areas in Beijing and Shanghai	924/1912	6 y	M: 58.3±5.9 F: 57.9±6.0	41.9	FBS ≥7mmol/L or HbA1c≥6.5% or treatment or self-reported clinical diagnosis
6	Nanri,A., et.al[51]	2015	Japan	cohort	The Japan Epidemiology Collaboration on Occupational Health (J-ECOH) Study	1122/24950	3 y	45.5 ± 7.9	85.6	FBS ≥126 mg/dL or 2-h BG≥200 mg/dL or HbA1c≥6.5% or treatment
7	Zhang,M., et.al [52]	2016	China	cohort	Rural Chinese population	659/11564	6 y	Median (IQR): 51 (42, 59)	37.82	FBS ≥7mmol/L or treatment
8	Liu,X., et.al[53]	2016	China	cohort	Beijing longitudinal study on aging	144/1857	Median: 9.8 y	M: 69.88±8.55 W:69±8.81	49.8	FBS ≥7mmol/L or treatment or self- reported DM
9	McCoy, RG.,et.al[54]	2016	US	National data set	Optum Labs Data Warehouse (OLDW)	47536/473049	3 y	45.76±13.65	44.74	HEDIS definition
10	Miyakoshi,T.,et .al [55]	2016	Japan	Cohort	The Health Center of Aizawa Hospital	138/2080	Mean: 4.9 y	51.7±9.5	65	FBS ≥7mmol/L or 2-h BG≥11.1mmol/L or HbA1c≥6.5% or

FBS: fasting Blood sugar; 2-h PGC: 2-h BGBlood glucose; HbA1c: hemoglobin A1c;CVD:cardiovascular disease;NI: no information

Appendix 3 (continued): Characteristics of studies (n=24) for prediction of incident type 2 diabetes

#	First author	Publication Year	country	Study design	Name of study or population	#Outcome/ Sample size for model development	Follow-up	Age(years) of model development population	Male,%	Definition of Diabetes as reported
11	Wang,A.,et.al[56]	2016	China	cohort	The Kailuan study	4726/49325	Mean: 5.35 y	DM: 52.38± 10.46 Non-DM: 49.48 ± 12.16	78.9	FBS ≥7mmol/L or treatment or self- reported DM
12	Brateanu,A., et.al [57]	2017	US	cohort	The Cleveland Clinic Health System (CCHS)	872/5084	5 y	58.3 ± 13.3	60.3	HbA1c≥6.5%
13	Hippisley-Cox,J., et.al [58]	2017	UK	Cohort	population of primary care patients QResearch database	178314/8186705	10 y	44.9 ±15.3	49.6	UK health system codes for diabetes (C10%)
14	Zhang,H., et.al [59]	2017	China	Cohort	The rural district of Luoyang City in Henan Province of China	NI/12654 7.68/1000 person-years	Mean: 6 y	≥18 years	39.81	FBS ≥7mmol/L or treatment or self- reported DM
15	Chen,X., et.al [60]	2017	China	Cohort	randomly cluster sampled from eight rural communities	387/28251	Mean: 4.2 y	M: 57.4 ± 14.7 F: 56.6 ± 14.4	44.3	FBS ≥7mmol/L or treatment or self- reported DM
16	Wen,J., et.al[61]	2017	China	Cohort	Hanelan Eye Study Village-based cohort	145/2755*	6y	NI	43.4	FBS ≥7mmol/L or HbA1c≥6.5% or treatment or self- reported DM
17	Moreno,L.M., et.al [62]	2018	Spain	Cohort	PRODI2 study	42/273	15 y	DM: 54.88± 10.36 Non-DM: 49.28 ± 15.01	42.9	Random blood sugar level ≥200 mg/dl in the presence of diabetes symptoms (polyuria, polydipsia or unexplained weight loss) or FBS ≥126 mg/dL or 2-h BG≥200 mg/dL or HbA1c≥6.5%
18	Yatsuya,H., et.al [63]	2018	Japan	Cohort	The Aichi Workers' Cohort Study	342/3540	Median: 12.2 y	47.8 ± 7.0	NI	FBS ≥126 mg/dL or HbA1c≥6.5%
19	Ha,KH., et.al [64]	2018	Korean	Cohort	The National Health Insurance Service-National Health Screening Cohort (NHIS-HEALS)	37678/359349	Median: 10.8 y	M: 51.2±9.2 F: 52.5±9.6	53.20	FBS ≥126 mg/dL or 2-h BG≥200 mg/dL or HbA1c≥6.5% or self-reported DM

FBS: fasting blood glucose; 2-h BG: 2-h Blood glucose; HbA1c: hemoglobin A1c; *Estimated number

Appendix 3 (continued): Characteristics of studies (n=24) for prediction of incident type 2 diabetes

#	First author	Publication Year	country	Study design	Name of study or population	#Outcome/ Sample size for model development	Follow-up	Age(years) of model development population	Male,%	Definition of Diabetes as reported
20	Han,X.,[65] et.al	2018	China	Cohort	The Dang Feng-Tongji	1251/15921*	5y	No DM: 63.2±7.9 DM: 63.4±7.2	44.8	FBS ≥7 mmol/l or 2-h BG≥11.1 mmol/l or HbA1c≥6.5% or treatment or self- reported DM
21	Hu,H., et.al [66]	2018	Japan	Cohort	The Japan Epidemiology Collaboration on Occupational Health (J-ECOH) Study	2216/30500	7 y	45.4 ±7.7	85	FBS ≥126 mg/dL or Random plasma glucose≥200 mg/dL or HbA1c≥6.5% or treatment
22	Arellano-Campos,O., et.al [67]	2019	Mexico	Cohort	prospective observational cohort study including Mexican adults living in the large urban setting of Mexico	331/6144	3 y	≥ 20 y	43.4	FBS ≥126 mg/dL or treatment
23	Hu H.et.al¥[68]	2019	China	Cohort	The Dongfeng-Tongji (DFTJ) cohort study of low risk population †	171/4833	4.6 y	No DM: 60.8±7.8 DM: 61.04±7.5	41.9	FBS ≥7mmol/L or treatment or self- reported DM or HbA1c≥48 mmol/mol
24	Kraege V.et.al [69]	2019	Swezerland	Cohort	The CoLaus/PsyCoLaus study	405/5277	Mean: 10.9 y	Women No DM: 52.2 ± 10.5 DM: 57.5 ± 9 Men No DM: 50.5 ± 10.3 DM: 54.9 ± 10.1	45	FBS ≥7mmol/L or treatment or HbA1c≥6.5%

FBS: fasting blood glucose; 2-h BG: 2-h Blood glucose; HbA1c: hemoglobin A1c;
*Estimated number
† low risk population: participants without underlying disease as follows : (1) history of coronary heart disease (CHD), stroke, cancer, diabetes, and taking medication for diabetes mellitus; (2) yslipidemia: total cholesterol > 6.19 mmol/L, low-density lipoprotein cholesterol > 4.12 mmol/L, highdensity lipoprotein cholesterol < 1.05 mmol/L, triglyceride > 2.25 mmol/L, and taking cholesterol-lowering medications; (3) hypertension: systolic BP > 140 mm Hg and diastolic BP > 90 mm Hg and taking antihypertension medication; (4) obesity: BMI ≥ 28 kg/m2 and abdominal obesity (waist circumference: male > 90 cm, female > 85 cm);and (5) metabolic syndrome defined according to the AHA/NHLBI & IDF 2009 harmonized criteria
¥This study was considered two times in further consideration.

Appendix 4: Characteristics of studies (n=19) for prediction of undiagnosed type 2 diabetes

#	First author	Publication Year	country	Study design	Name of study or population	#Outcome/ Sample size for model development	Age (years) of model development population	Male,%	Definition of Diabetes as reported
26	Lee, YH., et.al[70]	2012	Korea	Cross-sectional	Korea National Health and Nutrition Examination Survey (KNHANES)	341/9602	≥20 y	49	FBS ≥7.0 mmol/L or non-fasting glucose ≥11.1mmol/L
27	Riaz M., et.al [71]	2012	Pakistan	Cross-sectional	Risk assessment of Pakistani individuals for diabetes (RAPID)	598/1822	41.47±9.48	70.77	WHO criteria Random blood sugar≥200 mg/dl
28	Gray,L.J. et.al [72]	2013	Portugal	Cross sectional	PORMETS study	388/3374	51.5 ±16.5	41.1	FBS ≥7.0 mmol/L
29	Handlos,L.N.et.al [73]	2013	Algeria	Cross sectional	Electronic data collection	188/2155	52.1 ±11.0	49.4	HbA1c≥6.5%
30	Handlos,L.N. et.al [73]	2013	Saudi Arabia	Cross sectional	Questionnaire based population	144/2446	40.4 ±8.0	46.4	HbA1c≥6.5%
31	Handlos,L.N. et.al [73]	2013	United Arab Emirates (UAE)	Cross sectional	Questionnaire based population	179/1987	40.3 ±8.7	70.9	HbA1c≥6.5%
32	Heianza Y.et.al[74]	2013	Japan	Cross sectional	Toranomon Hospital Health Management Center Study 10 (TOPICS 10)	965/33335	18-88 y	71.1	FBS ≥7.0 mmol/L or HbA1c≥6.5%
33	Bhowmik, B. et.al [75]	2015	Bangladesh	Cross sectional	Chandra Rural Study	181/2293	Mean (95% CI): 41.8 (41.2-42.4)	36.7	FBS ≥7.0 mmol/L or 2-h BG≥11.1mmol/L
34	Memish ZA.et.al[76]	2015	Saudia Arabia	Cross sectional	primary healthcare centers (PHCCs)	NI/1435	≥20 y	62	FBS ≥7.0 mmol/L or 2-h BG≥11.1mmol/L
35	Dugee O, .et.al[77]	2015	Mongolian	Cross sectional	WHO STEPwise approach in 2009	59/1018	46.4±8.1	38.4	FBS ≥6.1 mmol/L
36	Bernabe-Ortiz A, et.al [78]	2016	Peru	Cross-sectional	The National Survey of Nutritional and Biochemical Indicators for Non-communicable Diseases (ENINBSC in Spanish), conducted by the Peruvian National Institute of Health	48/2457	50.5 ±12.1	48.9	FBS ≥7.0 mmol/L or self-report of physician diagnosis
37	Zhou,H et.al [79]	2016	China	Cross sectional	The Rural Diabetes, Obesity and Lifestyle (RuralDiab) study	234/5453	48.18 ± 6.80	32	FBS ≥7.0 mmol/L

FBS: fasting plasma sugar; 2-h BG: 2-h Blood glucose; HbA1c: hemoglobin A1c: NI: no information.

Appendix 4: Characteristics of studies (n=19) for prediction of undiagnosed type 2 diabetes

#	First author	Publication Year	country	Study design	Name of study or population	#Outcome/ Sample size for model development	Age (years) of model development population	Male,%	Definition of Diabetes as reported
38	Katulanda P[80]	2016	Sri Lanka	Cross-sectional	The Sri Lanka Diabetes and Cardiovascular Study (SLDCS)	128/2826	45.3 ±15.1	39.6	1989 WHO criteria using fasting and 2-h OGTT plasma glucose
39	Asadollahi,K.et.al [81]	2017	Iran	Cross sectional	population-based survey performed in Ilam province	254/2158	45.5 ± 14	28	FBS ≥7.0 mmol/L
40	Barengo NC. et.al[82]	2017	Colombia	Cross sectional	health-care insurance company Mutual SER EPSS	105/2060	47.2±15.1	38	FBS ≥126 mg/dl or 2-h BG≥200 mg/dl
41	Sulaiman N.et.al[83]	2017	UAE	Cross sectional	The UAE National Diabetes and Lifestyle data	219/872	42.8±13.4	51.5	HbA1c≥6.5%
42	Félix-Martínez. et.al [84]	2018	Mexico	Cross sectional	The National Health and Nutrition Surveys (NHNS)2006	207/6995	42.14 ±15.46	38	FBS ≥126 mg/dl or 2-h BG≥200 mg/dl
43	Félix-Martínez. et.al [84]	2018	Mexico	Cross sectional	The National Health and Nutrition Surveys (NHNS)2012	51/4083	43.08 ±15.45	38.31	FBS ≥7.0 mmol/L or 2-h PGC≥11.1mmol/L
44	Štiglic G.et.al[85]	2018	Slovenia	Cross sectional	Electronic healthcare records	146/2073	UDM:59.8±9.4 IFG:58.8±9.4 NFG:53.5±11.4	45.8	FBS ≥7.0 mmol/L
45	Li W.et.al[86]	2018	China	Cross sectional	-	779/8096	49.1±12.5	31.4	FBS ≥7.0 mmol/L or 2-h BG≥11.1mmol/L or HbA1c≥6.5%
46	Zhang M.et.al[87]	2018	China	Cross sectional	Survey data	142/1432	18-60 y	NI	FBS ≥126 mg/dl or HbA1c≥6.5%
47	Wu, J et.al [88]	2019	China	Cross sectional	Shanghai Nicheng Cohort Study	1172*/7658	40-70 y	45.5	FBS ≥7.0 mmol/L or 2-h BG≥11.1mmol/L or HbA1c≥6.5%

FBS: fasting plasma sugar; 2-h BG: 2-h Blood glucose; HbA1c: hemoglobin A1c;UDM:undiagnosed diabetes; IFG: impaired fasting glucose; NFG: normal fasting glucose
*Estimated number

Appendix 5: Issue considered in model development for prediction of incident type 2 diabetes

#	First author	Treatment of continuous risk predictors	Treatment of missing data	Predictor selection	Statistical models	Risk predictors in the final model	Discrimination measures of the derived model	Risk score reported	Overall performance measures	Overfitting considered
1	Doi,Y., et.al[46]	All categorized	Complete case	Univariate	Stepwise backward Cox regression	Non-invasive: Age groups, sex, FHDM, central obesity, BMI categories, hypertension , smoking, Regular exercises Invasive: non-invasive+ baseline FBS levels	SEN, SPE, AUC	yes	NI	NI
2	Lim,N.K., et.al[47]	All categorized	Complete case	NI	logistic Regression	Basic model: Age, Parental or sibling history of diabetes, current smoking, BMI categories, hypertension Clinical model 1: Basic model + baseline FBS categories, HDL_C levels, TG levels Clinical model 2: Clinical model 1+baseline HbA1c levels	AUC	yes	NI	NI
3	Heianza,Y., et.al[48]	some Continuous and some categorical	Complete case	Univariate	Stepwise Logistic regression	Model 1: Age, sex, FHDM, current smoke, BMI Model 2: NLAb+baseline FBS Model 3: NLAb+HbA1c Model 4: NLAb+FBS+Hba1c	SEN, SPEC, PPV, NPV, LR+, LR- Youden index, AUC	yes	NI	NI
4	Noto,D.,et.al[49]	All categorized	NI	Stepwise Backward / Forward	Cox regression	Sex, LDL-C>160 mg/dL, BMI>30 kg/m^2 Metabolic syndrome, Smoking, Baseline FBG (10 mg/dL classes)	AUC	No	NI	NI
5	Ye,X,. et.al[50]	All categorized	Complete case	Literature review	Stepwise backward Logistic Regression	Sex, BMI categories, baseline FBS levels, baseline HbA1c levels, hypertension, C-reactive protein levels	SEN,SPEC, ,LR+,LR- ,Youden index, c-statistics, AUC	yes	NI	Bootstrapping

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR : likelihood ration; AUC: area under the curve; NI: No Information; BMI: Body mass index; FBS :Fasting blood sugar; HbA1c: hemoglobin A1c; FHDM: Family history diabetes; WC; waist circumference; WHR: waist to height ratio; NLAb:Non-Laboratory

Appendix 5 (continued): Issue considered in model development for prediction of incident type 2 diabetes

#	First author	Treatment of continuous risk predictors	Treatment of missing data	Predictor selection	Statistical models	Risk predictors in the final model	Discrimination measures of the derived model	Risk score reported	Overall performance measures	Overfitting considered
6	Nanri,A., et.al[51]	All categorized	Complete case	NI	Backward logistic Regression	Non-invasive: sex, age groups, BMI categories, abdominal obesity, smoking status, hypertension Full model: non-invasive+ dyslipidemia, baseline FBS levels, baseline HbA1c levels	SEN, SPEC, PPV, NPV, LR+, LR-, Youden, AUC	Yes	NI	NI
7	Zhang, M., et.al [52]	Keep continuous	NI	Literature review	Cox regression	Age, BMI, TG, baseline FBS	SEN, SPEC, AUC	Yes	NI	NI
8	Liu,X., et.al[53]	All categorized	Complete case	Univariate	Backward sub distribution hazard model	Age groups, BMI categories, baseline FBS level, self-related health, physical activity	SEN, SPEC, PPV, NPV, Youden, AUC, c-statistics	yes	NI	Bootstrapping
9	McCoy, RG.,et.al[54]	All categorized	NI	The agglomerative single-link clustering algorithm	Pure Lasso Logistic regression	Age groups (5-year), sex, minority category, Intestinal disaccharidase deficiencies and disaccharide Malabsorption, Dysmetabolic syndrome, Obstructive sleep apnea, Benign hypertensive heart disease without heart failure, Coronary atherosclerosis of native coronary artery, Congestive heart failure, unspecified, Acute respiratory failure, Other chronic nonalcoholic liver disease, Other acne, Hypersomnia with sleep apnea, unspecified, Unspecified sleep apnea, Polydipsia, Shortness of breath, Other dyspnea and respiratory abnormalities, Other abnormal blood chemistry, Polycystic ovaries, Glycosuria, Diphtheria–tetanus–pertussis, combined, Amlodipine besylate, Furosemide, Teriparatide, Benign neoplasm of skin, Delivery, Abnormal glucose, Ethinyl estradiol (multiple agents), Fenofibrate (multiple agents), Abnormal maternal glucose tolerance, Hyperlipidemia, Hypertension, Nonallopathic lesion, Overweight/obesity, Impaired glucose	SEN, SPEC, PPV, NPV, AUC	yes	R^2 And Brier statistics	Optimization pass through GLMNET (R package) And Bootstrapping

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR : likelihood ration; AUC: area under the curve; NI: No Information; BMI: Body mass index; FBS :Fasting

blood sugar; HbA1c: hemoglobin A1c; FHDM: Family history diabetes; WC; waist circumference; WHR: waist to height ratio

Appendix 5 (continued): Issue considered in model development for prediction of incident type 2 diabetes

#	First author	Treatment of continuous risk predictors	Treatment of missing data	Predictor selection	Statistical models	Risk predictors in the final model	Discrimination measures of the derived model	Risk score reported	Overall performance measures	Overfitting considered
10	Miyakoshi,T.,et. al [55]	All categorized	NI	NI	Cox regression	Non-invasive risk score: sex, FHDM, Age, ≥55 y, SBP, ≥130 mmHg, BMI, ≥25 kg/m2 Invasive score without 2hPG: sex, FHDM, Age, ≥55 y, SBP, ≥130 mmHg, FPG, ≥5.3 mmol/L, HbA1c, ≥5.6%, TG, ≥1.13 mmol/L Full score: sex, FHDM, Age, ≥55 y, SBP, ≥130 mmHg,current smoker, FPG, ≥5.3 mmol/L, HbA1c, ≥5.6%,	SEN, SPEC, Youden, AUC, c-statistics	Yes	NI	NI
11	Wang,A.,et.al[56]	All categorized	Complete case	stepwise	Cox regression	Age groups, sex, BMI category, FHDM, education level, BP category, resting heart rate category, baseline FBS, TG levels or taking lipid-lowering medication	SEN, SPEC, AUC	Yes	NI	NI
12	Brateanu,A., et.al [57]	Keep continuous	NI	Univariate	Backward Cox regression	Age, BMI, active smoking, FHDM, HDL_C, TG, alanine Aminotransferase, baseline HbA1c	c-statistics	No	NI	Bootstrapping
13	Hippisley-Cox,J., et.al [58]	Keep continuous	Multiple imputation	Literature review And Qdiabetes-2017 risk factors	Cox regression	Model A: Townsend score (deprivation score), ethnic groups, smoking status, FHDM, treated hypertension, CVD, Schizophrenia or bipolar affective disorder, Learning disability, (Gestational diabetes, Polycystic ovary syndrome; among women), statin, Atypical antipsychotics, Corticosteroids, fractional polynomial terms for age (age0.5, age3) and body mass index (BMI, BMI3) with interaction terms between age and atypical antipsychotics, statins, learning disability, body mass index, and family history of diabetes	NI	yes	AIC	Considering at least 10 events per predictor variable
						Model B: Model A+fractional polynomial terms for fasting blood glucose (fasting glucose−1, fasting glucose−1 log (fasting glucose)) and interaction terms between age and fasting glucose.				
						Model c: model A+fractional polynomial terms for HBA1c (HBA1c0.5, HBA1c) and interaction terms between age and HBA1c				

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR : likelihood ration; AUC: area under the curve; NI: No Information; BMI: Body mass index; FBS :Fasting blood sugar; HbA1c: hemoglobin A1c; FHDM: Family history diabetes; WC; waist circumference; WHR: waist to height ratio, TG; triglycerides

Appendix 5 (continued): Issue considered in model development for prediction of incident type 2 diabetes

#	First author	Treatment of continuous risk predictors	Treatment of missing data	Predictor selection	Statistical models	Risk predictors in the final model	Discrimination measures of the derived model	Risk score reported	Overall performance measures	Overfitting considered
14	Zhang,H., et.al [59]	All categorized	NI	Univariate analysis	Forward Cox regression	Drinking tea frequently, BMI ≥28.0 kg/m^2, WHtR ≥0.5, Tg levels, baseline FBS levels	SEN, SPEC, AUC	Yes	NI	NI
15	Chen,X., et.al [60]	All categorized	NI	NI	Cox Regression	Age groups, BMI categories, FHDM, diet, hypertension, IFG	SEN, SPEC, PPV, NPV, LR+, LR-, AUC, c-statistics	yes	NI	Bootstrapping
16	Wen,J., et.al [61]	All categorized	Complete case	Literature review	Forward stepwise logistic Regression	Age groups, BMI categories, waist circumference, FHDM	AUC	Yes	NI	NI
17	Moreno,L.M., et.al [62]	Keep continuous	NI	NI	logistic Regression	Heart attack father, History of DM2 in mother or father, Waist perimeter, Hip perimeter	NI	No	NI	NI
18	Yatsuya,H., et.al [63]	All categorized	Complete case	Univariate	Backward Cox Regression	Age groups, BMI categories, smoking status, FHDM, TG levels, baseline FBS levels	SEN, SPEC, c-statistics, Kaplan Meier AUC	Yes	NI	NI
19	Ha,K.H., et.al [64]	Some continuous, some categorized	NI	Literature review	Cox Regression	Male: age, FHDM, Alcohol intake levels, smoking status, physical activity levels, Antihypertensive therapy, Statin therapy, BMI category, SBP levels, TC levels, baseline FBS levels, Female: age, FHDM, smoking status, physical activity levels, Antihypertensive therapy, Statin therapy, BMI category, SBP levels, TC levels, baseline FBS levels, log (γ glutamyl transferase)	C-statistic	Yes	NI	NI
20	Han,X.,[65] et.al	All categorized	Complete case	Univariate	Cox Regression	BMI categories, baseline FBS levels, Hyperlipidemia, hypertension, current smoking, FHDM	SEN, SPEC, AUC	yes	NI	NI
21	Hu,H., et.al [66]	All categorized	Complete case	Backward selection	Cox Regression	Non-invasive model: sex, age group, BMI category, WC category, smoking status, hypertension Invasive model including FPG: age group, BMI category, smoking status, hypertension, dyslipidemia, baseline FPG category	AUC	No	NI	NI

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR : likelihood ration; AUC: area under the curve; NI: No Information; BMI: Body mass index; FBS :Fasting blood sugar; HbA1c: hemoglobin A1c; FHDM: Family history diabetes; WC; waist circumference; WHR: waist to height ratio

Appendix 5 (continued): Issue considered in model development for prediction of incident type 2 diabetes										
#	**First author**	**Treatment of continuous risk predictors**	**Treatment of missing data**	**Predictor selection**	**Statistical models**	**Risk predictors in the final model**	**Discrimination measures of the derived model**	**Risk score reported**	**Overall performance measures**	**Overfitting considered**
22	Hu,H., et.al [66] (Continued:)					Continued: Invasive model including HbA1c: age group, BMI category, smoking status, hypertension, dyslipidemia, baseline HbA1c category Invasive model including FPG and HbA1c: age group, BMI category, smoking status, hypertension, dyslipidemia, baseline FPG category, , baseline HbA1c category				
23	Arellano-Campos,O., et.al [67]	All categorized	Complete case	NI	Cox Regression	Office-based model: age>40y, FHDM, WHr>0.5, Arterial hypertension, BMI ≥30 kg/m^2, Physical activity Biochemical model: age>40y, TG>150 mg/dl, baseline FBS levels, Arterial hypertension, Abdominal obesity	Sommer's Dxy C-statistic, AUC	yes	NI	k-fold bootstrap cross validation
24	Hu H.et.al[68]	All categorized	NI	Literature review	Cox Regression	Model 1: Sex, age, smoking status, physical activity, BMI (≥ 22 kg/m^2), TG (≥ 1.06 mmol/L), FPG (≥ 5.4 mmol/L) Model 2: Sex, age, smoking status, physical activity, BMI (≥ 24 kg/m^2), TG (≥ 1.1 mmol/L), FPG (≥ 5.89 mmol/L) Model 3: Sex, age, smoking status, physical activity, BMI (≥ 24 kg/m^2), TG (≥ 1.7 mmol/L), FPG (≥ 5.6 mmol/L)	SEN, SPEC, Youden, AUC C-statistic	No	NI	NI
25	Kraege V.et.al [69]	All categorized	Complete case	NI	Logistic regression	Age group, WC category, FHDM, physical activity, hypertension	SEN, SPEC, PPV, NPV, AUC	Yes	R^2, AIC, BIC	NI

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR : likelihood ration; AUC: area under the curve; NI: No Information; BMI: Body mass index; FBS :Fasting blood sugar; HbA1c: hemoglobin A1c; FHDM: Family history diabetes; WC; waist circumference; WHR: waist to height ratio

Appendix 6: Issue considered in model development for prediction of undiagnosed type 2 diabetes

#	First author	Treatment of continuous risk predictors	Treatment of missing data	Predictor selection	Statistical models	Risk predictors in the model	Discrimination measures of model derivation	Risk score	Overall performance measures	Overfitting
26	Lee, YH., et.al[19]	All categorized	NI	Literature review	Backward Logistic Regression	Age groups, FHDM, hypertension, WC categories, smoking status, alcohol intake	SEN, SPEC, PPV, NPV, LR+, LR, Youden index, AUC	Yes	NI	NI
27	Riaz M., et.al [71]	All categorized	NI	Stepwise	Logistic Regression	Age groups, FHDM, WC categories,	SEN, SPEC, PPV, NPV, AUC	Yes	NI	NI
28	Gray,L.J. et.al [72]	All categorized	Multiple imputation	Univariate	Logistic Regression	Age group, sex, BMI categories, current hypertension	AUC	Yes	NI	Rule of thumb of 10 event per variable
29	Handlos,L.N.et.al [73]	All categorized	NI	Univariate	Stepwise backward Logistic Regression	Age group, BMI group, Parent(s) with diabetes, Number of siblings with diabetes, GDM (women)	SEN, SPEC, AUC	Yes	NI	Bootstrapping
30	Handlos,L.N. et.al [73]	All categorized	NI	Univariate	Stepwise backward Logistic Regression	Age group, BMI group, sex, Number of siblings with diabetes, history GDM (women), Ethnicity (Asian/other)	SEN, SPEC, AUC	Yes	NI	Bootstrapping
31	Handlos,L.N. et.al [73]	All categorized	NI	Univariate	Stepwise backward Logistic Regression	Age group, BMI group, sex, Ethnicity (Asian/other)	SEN, SPEC, AUC	Yes	NI	Bootstrapping
32	Heianza Y.et.al[74]	All categorized	NI	Univariate	Logistic Regression	Age group, BMI group, sex, FHDM, hypertension, current smoking	SEN, SPEC, PPV, NPV,LR+, LR-, Youden index, AUC	Yes	NI	NI
33	Bhowmik, B. et.al [75]	All categorized	Complete case	Backward stepwise	Logistic Regression	Age group, sex, BMI categories, WHR levels, hypertension status levels	SEN, SPEC, PPV, NPV, AUC	Yes	NI	Rule of thumb of 10 event per variable
34	Memish ZA.et.al[76]	All categorized	Complete case	Univariate	Logistic Regression	Age group, history GDM (women), smoking status, FHDM, central obesity	SEN, SPEC, PPV, NPV, AUC	Yes	NI	Bootstrapping
35	Dugee O, .et.al[77]	All categorized	Complete case	Univariate	Logistic Regression	Sex, WC category, hypertension or medication, history of elevated glucose, Leisure time physical activity daily, Sitting time 6h or more/day	SEN, SPEC, PPV, NPV, AUC	Yes	NI	Bootstrapping
36	Bernabe-OrtizA, et.al [78]	All categorized	Complete case	Univariate	Stepwise backward Logistic Regression	age≥55y, Diabetes in relatives, Waist circumference categorized	SEN, SPEC, PPV, NPV,LR+, LR-, AUC	Yes	NI	Bootstrapping
37	Zhou,H et.al [79]	All categorized	Complete case	Literature review	Forward stepwise Logistic Regression	Sex, age group, FHDM, physical activity, waist circumference category, History of dyslipidemia, Diastolic blood pressure levels, BMI category	SEN, SPEC, PPV, NPV,LR+, LR-, AUC	Yes	NI	NI

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR : likelihood ration; AUC: area under the curve, AIC; Akaike information criterion; NI: No Information; BMI: Body mass index; FBS :Fasting blood sugar; HbA1c: hemoglobin A1c; FHDM: Family history diabetes; WC; waist circumference; WHR: waist to height ratio

Appendix 6(continued): Issue considered in model development for prediction of undiagnosed type 2 diabetes

#	First author	Treatment of continuous risk predictors	Treatment of missing data	Predictor selection	Statistical models	Risk predictors in the model	Discrimination measures of model derivation	Risk score	Overall performance measures	Overfitting
38	Katulanda P[80]	All categorized	NI	Univariate	Logistic Regression	Age groups, BMI categories, WC categories, hypertension, FHDM, physical activity, Gestational diabetes, Balanitis or vulvitis, Osmotic symptoms	AUC	yes	NI	NI
39	Asadollahi,K et.al [81]	All categorized	NI	Univariate	Logistic Regression	Age group, sex, BMI categories, Physical activities, History of hypertension, Family diabetes, Smoking, Place of life, waist circumference category	SEN, SPEC, PPV, NPV, AUC	Yes	NI	NI
40	Barengo NC. et.al[82]	All categorized	Complete case	Univariate	Logistic Regression	Age group, WC group (95cm), blood pressure medication, FHDM	SEN, SPEC, PPV, NPV, AUC	Yes	NI	NI
41	Sulaiman N.et.al[83]	All categorized	NI	Univariate	stepwise Logistic Regression	Age group, FHDM, hypertension status, BMI category, WHR	SEN, SPEC, PPV, NPV	Yes	NI	NI
42	Félix-Martínez [84]	Keep continuous	Complete case	Literature review	Backward Logistic Regression	Age, waist circumference, SBP	SEN, SPEC, AUC	No	NI	10-fold cross validation
43	Félix-Martínez [84]	Keep continuous	Complete case	Literature review	Backward Logistic Regression	Age, waist circumference, height, FHDM	SEN, SPEC, AUC	No	AIC	10-fold cross validation
44	Štiglic G.et.al[85]	Keep continuous	Complete case	Univariate	Logistic Regression	Age, WC, sex,physical activity, Blood sugar history	SEN, SPEC, PPV, NPV, AUC	Yes	AIC, BIC	Bootstrapping
45	Li W.et.al[86]	All categorized	Complete case	Backward Stepwise	Logistic Regression	Non-lab model: age, sex, ethnic groups, vegetable daily consumption, hypertension, FHDM, BMI, WC Semi-lab model: Non-lab model + Glycosuria qualitative+Glycosuria qualitative*sex	SEN, SPEC, AUC	Yes	NI	Bootstrapping
46	Zhang M.et.al[87]	All categorized	Complete case	NI	Logistic Regression	Age group, FHDM, hypertension, current smoker, WC category, BMI category, vegetable daily consumption, Fruits daily consumption	SEN, SPEC, AUC	Yes	NI	NI
47	Wu, J et.al [88]	All categorized	Complete case	Univariate	Backward Logistic Regression	Age group, FHDM, BMI category, central obesity, hypertension	AUC	yes	AIC, BIC	NI

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR : likelihood ration; AUC: area under the curve, AIC; Akaike information criterion; NI: No Information; BMI: Body mass index; FBS :Fasting blood sugar; HbA1c: hemoglobin A1c; FHDM: Family history diabetes; WC; waist circumference; WHR: waist to height ratio

Appendix 7: Issue considered in model validation for prediction of incident type 2 diabetes											
#	**First author**	**Apparent**	**Internal validation method**	**External validation**	**Discrimination for validation (internal or external)**	**Overall performance measures (internal or external validation)**	**Goodness of fit / calibration (internal or external validation)**	**Recalibration**	**Classification**	**Clinical usefulness**	**Citation tracking (google scholar)**
1	Doi,Y., et.al[46]	yes	-	Yes	AUC, SEN, SPEC	Score distribution comparison	HL test	-	-	-	33
2	Lim,N.K., et.al[47]	-	10-fold cross validation	-	NI	NI	HL test	-	NRI-IDI	NI	34
3	Heianza,Y., et.al[48]	yes	-	yes	NI	NI	HL test	-	NRI-IDI	NI	31
4	Noto,D.,et.al[49]	Yes	-	-	NI	NI	HL test	-	-	NI	9
5	Ye,x., et.al[50]	-	10-fold cross validation	-	NI	NI	HL test	-	NRI-IDI	NI	14
6	Nanri,A., et.al[51]	-	2/3 for model development 1/3 model validation	-	AUC	NI	HL test/ Observed-predicted plot	-	NRI-IDI	NI	23
7	Zhang,M., et.al [52]	-	90% for model development 10% model validation	-	SEN, SPEC, AUC	NI	HL test	-	-	NI	14
8	Liu,X., et.al[53]	Yes	Bootstrap cross validation	-	NI	NI	Observed-predicted plot	-	-	NI	2
9	McCoy, RG.,et.al[54]	-	8-fold cross validation and bootstrapping and random split (30:70)	Yes	SEN, SPEC, PPv,NPV, c-statistics	NI	NI	-	-	NI	3
10	Miyakoshi,T.,et.al [55]	-	random split (50:50)	-	SEN, SPEC, PPv,NPV,LR+, LR- c-statistics	NI	HL test/ Observed-predicted plot	-	-	NI	4
11	Wang,A.,et.al[56]	-	2/3 for model development 1/3 model validation	-	SEN, SPEC, AUC	NI	Observed-predicted plot	-	-	NI	8
12	Brateanu,A., et.al [57]	-	Bootstrap iteration	-	NI	NI	Observed-predicted plot	-	-	NI	0

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR: likelihood ration; AUC: area under the curve; HL; Hosmer Lemesho; NRI: Net reclassification index; IDI: Integrated discrimination improvement; r^2: R-squared; NI: No Information; citation search was done on 1 OCT 2019

Appendix 7(continued): Issue considered in model validation for prediction of incident type 2 diabetes

#	First author	Apparent	Internal validation method	External validation	Discrimination for validation (internal or external)	Overall performance measures (internal or external validation)	Goodness of fit / calibration (internal or external validation)	Recalibration	Classification	Clinical usefulness	Citation tracking (google scholar)
13	Hippisley-Cox,J., et.al [58]	-	2/3 for model development 1/3 model validation	-	Harrell's C, D statistics	R2	Observed-predicted plot	-	SEN, SPEC	Net benefit	17
14	Zhang,H., et.al [59]	-	4/5 for model development 1/5 model validation	-	AUC	NI	Observed-predicted incidence comparisons	-	-	NI	4
15	Chen,X., et.al [60]	yes	-	-	NI	NI	HL test	-	-	NI	14
16	Wen,J.,et.al [61]	-	2/3 model development 1/3 model validation	-	SEN, SPEC, PPV, NPV, LR+, LR- ,Youden index, AUC	NI	HL test	-	-	NI	1
17	Moreno,L.M., et.al [62]	Yes	-	-	-	NI	NI	-	-	NI	0
18	Yatsuya,H., et.al [63]	Yes	-	-	c-statistics	NI	Observed-predicted plot	-	-	NI	0
19	Ha,KH., et.al [64]	Yes	-	Yes	c-statistics	NI	Observed-predicted plot	-	-	NI	1
20	Han,X.,[65] et.al	-	90% model development 10% model validation	-	AUC	NI	NI	-	-	NI	1
21	Hu,H., et.al [66]	-	2/3 model development 1/3 model validation	-	AUC	NI	Observed-predicted plot	-	NRI, IDI	NI	2
22	Arellano-Campos,O., et.al [67]	-	k-fold bootstrap cross validation	-	-	NI	NI	-	-	NI	0
23	Hu H.et.al[68]	Yes	-	-	-	NI	NI	-	-	NI	0
24	Kraege V.et.al [69]	Yes	-	Yes	SEN, SPEC, PPV, NPV, AUC	NI	HL test	-	-		0

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR: likelihood ration; AUC: area under the curve; HL; Hosmer Lemesho; NRI: Net reclassification index; Integrated discrimination improvement; r^2: R-squared; NI: No Information; citation search was done on 1 OCT 2019

Appendix 8: Issue considered in model validation for prediction of undiagnosed type 2 diabetes											
#	**First author**	**Apparent**	**Internal validation method**	**External validation**	**Discrimination for validation (internal or external)**	**Overall performance measures (internal or external)**	**Goodness of fit / calibration (internal or external)**	**Recalibration**	**Classification**	**Clinical usefulness**	**Citation tracking (google scholar)**
25	Lee, YH., et.al[19]	Yes	-	Yes	SEN, SPEC, PPV, NPV, LR+, LR-, Youden index, AUC	NI	NI	-	-	-	66
26	Riaz M., et.al [71]	yes	-	Yes	SEN, SPEC, PPV, NPV, AUC	NI	NI	-	-	-	15
27	Gray,L.J. et.al [72]	Yes	-	Yes	SEN, SPEC, PPV, NPV, LR+, LR-, AUC	NI	HL test	-	-	-	9
28	Handlos,L.N.et.al [73]	Yes	-	-	-	NI	NI	-	-	-	9
29	Handlos,L.N. et.al [73]	Yes	-	-	-	NI	NI	-	-	-	9
30	Handlos,L.N. et.al [73]	Yes	-	-	-	NI	NI	-	-	-	9
31	Heianza Y.et.al[74]	yes		Yes	SEN, SPEC, PPV, NPV, LR+, LR-, Youden index, AUC	NI	NI	-	-	-	22
32	Bhowmik, B. et.al [75]	yes	-	Yes	SEN, SPEC, PPV, NPV, AUC	NI	NI	-	-	-	4
33	Memish ZA.et.al[76]	-	96% development, 4% validation	-	SEN, SPEC, AUC	NI	HL test	-	-	-	5
34	Dugee O, .et.al[77]	-	Bootstrap sampling	-	SEN, SPEC, PPV, NPV, AUC	NI	HL test/ Observed-predicted plot	-	-	-	8
35	Bernabe-Ortiz A, et.al [78]	Yes	Bootstrap sampling	Yes	SEN, SPEC, PPV, NPV, LR+, LR-, AUC	NI	HL test	-	-	-	7
36	Zhou,H et.al [79]	Yes	-	Yes	SEN, SPEC, PPV, NPV, LR+, LR-, AUC	NI	HL test	NRI	-	-	11

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR: likelihood ration; AUC: area under the curve, AIC; Akaike information criterion; HL; Hosmer Lemesho; NRI: Net reclassification index; NI: No Information; citation search was done on 1 OCT 2019

Appendix 8 (continuous): Issue considered in model validation for prediction of undiagnosed type 2 diabetes

#	First author	Apparent	Internal validation method	External validation	Discrimination for validation (internal or external)	Overall performance measures (internal or external)	Goodness of fit / calibration (internal or external)	Recalibration	Classification	Clinical usefulness	Citation tracking (google scholar)
37	Katulanda P[80]	-	2/3 development, 1/3 validation	-	SEN, SPEC, PPV, NPV, AUC	NI	NI	-	-	-	8
38	Asadollahi,K et.al [81]	Yes	-	Yes	AUC	NI	Observed-predicted plot	-	-	-	1
39	Barengo NC. et.al[82]	Yes	-	-	-	NI	HL test	-	-	-	21
40	Sulaiman N.et.al[83]	Yes	-	Yes	SEN, SPEC, PPV, NPV, AUC	NI	NI	-	-	-	4
41	Félix-Martínez [84]	-	80% development, 20% validation	Yes	SEN, SPEC, AUC	NI	NI	-	-	-	0
42	Félix-Martínez [84]	-	80% development, 20% validation	Yes	SEN, SPEC, AUC	NI	NI	-	-	-	0
43	Štiglic G.et.al[85]	-	Bootstrap resampling	-	AUC	NI	NI	-	-	-	2
44	Li W.et.al[86]	-	2/3 development, 1/3 validation and bootstrapping	yes	SEN, SPEC, AUC	NI	Observed-predicted plot	-	-	Net benefit	1
45	Zhang M.et.al[87]	yes	-	-	-	-	-	-	-	-	0
46	Wu, J et.al [88]	-	50% development, 50% validation	-	SEN, SPEC, PPV, NPV, LR+, LR- AUC	NI	HL test	-	-	-	0

SEN: sensitivity; SPEC; specificity, PPV: positive predictive value; NPV: negative predictive value; LR: likelihood ration; AUC: area under the curve, AIC; Akaike information criterion; HL; Hosmer Lemesho; NRI: Net reclassification index; NI: No Information; citation search was done on 1 OCT 2019

Appendix 9: Assessment of Risk of bias for the incident of type 2 diabetes according to the Prediction model Risk Of Bias Assessment Tool (PROBAST)												
Study reference (N=24)	1[46]	2[47]	3[48]	4[49]	5[50]	6[51]	7[52]	8[53]	9[54]	10[55]	11[56]	12[57]
Participants												
Were appropriate data sources used, e.g., cohort, RCT, or nested case-control study data?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were all inclusions and exclusions of participants appropriate?	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	PY
Predictors												
Were predictors defined and assessed in a similar way for all participants?	Y	Y	Y	Y	Y	Y	Y	PY	Y	Y	Y	Y
Were predictor assessments made without knowledge of outcome data?	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY
Are all predictors available at the time the model is intended to be used?	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Outcome												
Was the outcome determined appropriately?	Y	Y	Y	Y	Y	Y	Y	PY	Y	Y	Y	PY
Was a pre-specified or standard outcome definition used?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were predictors excluded from the outcome definition?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the outcome defined and determined in a similar way for all participants?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the outcome determined without knowledge of predictor information?	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Was the time interval between predictor assessment and outcome determination appropriate (≥3 years)?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Analysis												
Were there a reasonable number of participants with the outcome?	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Were continuous and categorical predictors handled appropriately?	N	PY	PY	Y	PY	PY	PY	N	Y	Y	Y	PY
Were all enrolled participants included in the analysis?	N	N	N	N	N	N	N	N	NI	NI	N	N
Were participants with missing data handled appropriately?	N	N	N	NI	NI	N	N	N	NI	NI	Y	N
Was selection of predictors based on univariable analysis avoided?	Y	NI	N	Y	NI	Y	Y	N	Y	NI	Y	N
Were complexities in the data (e.g., censoring, competing risks, sampling of control participants) accounted for appropriately?	NI	NI	NI	NI	NI	NI	NI	Y	NI	NI	NI	NI
Were relevant model performance measures evaluated appropriately?	Y	NI	Y	Y	NI	NI	NI	NI	Y	Y	Y	Y
Were model overfitting, underfitting, and optimism in model performance accounted for?	NI	NI	N	NI	NI	NI	N	Y	Y	NI	NI	Y
Do predictors and their assigned weights in the final model correspond to the results from the reported multivariable analysis?	Y	PY	N	Y	NI	N	Y	NI	Y	Y	Y	N
Overall judjment	H	U	H	U	U	U	H	H	L	U	L	U
Y: Yes; N: No; PY: Possibly yes; NI: No information; H:High; L:Low;U:unclear												

Appendix 9 (continued): Assessment of Risk of bias for the incident of type 2 diabetes according to the Prediction model Risk Of Bias Assessment Tool (PROBAST)

Study reference (N=24)	13[58]	14[59]	15[60]	16[61]	17[62]	18[63]	19[64]	20[65]	21[66]	22[67]	23[68]	24[69]
Participants												
Were appropriate data sources used, e.g., cohort, RCT, or nested case-control study data?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were all inclusions and exclusions of participants appropriate?	Y	Y	Y	Y	PY	Y	PY	Y	Y	Y	Y	Y
Predictors												
Were predictors defined and assessed in a similar way for all participants?	Y	PY	Y	Y	NI	Y	PY	Y	Y	Y	Y	Y
Were predictor assessments made without knowledge of outcome data?	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY
Are all predictors available at the time the model is intended to be used?	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Outcome												
Was the outcome determined appropriately?	PY	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was a pre-specified or standard outcome definition used?	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were predictors excluded from the outcome definition?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the outcome defined and determined in a similar way for all participants?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the outcome determined without knowledge of predictor information?	NI	Y	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Was the time interval between predictor assessment and outcome determination appropriate (≥3 years)?	Y	NI	Y	Y	Y	Y	Y	Y	Y	N	N	N
Analysis												
Were there a reasonable number of participants with the outcome?	Y	Y	NI	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were continuous and categorical predictors handled appropriately?	PY	Y	Y	Y	PY	Y	PY	Y	Y	Y	Y	Y
Were all enrolled participants included in the analysis?	N	PY	N	N	N	N	N	N	N	N	NI	N
Were participants with missing data handled appropriately?	N	Y	NI	NI	N	N	NI	N	Y	N	NI	Y
Was selection of predictors based on univariable analysis avoided?	N	Y	N	Y	N	N	Y	N	Y	NI	Y	NI
Were complexities in the data (e.g., censoring, competing risks, sampling of control participants) accounted for appropriately?	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Were relevant model performance measures evaluated appropriately?	Y	Y	Y	Y	NI	Y	Y	Y	Y	Y	Y	Y
Were model overfitting, underfitting, and optimism in model performance accounted for?	Y	Y	NI	NI	NI	NI	NI	NI	NI	Y	NI	NI
Do predictors and their assigned weights in the final model correspond to the results from the reported multivariable analysis?	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y
Overall judjment	H	L	U	U	H	H	H	H	L	H	H	U

Y: Yes; N: No; PY: Possibly yes; NI: No information; *total score is the sum of yes (1), PY (0.5) and N/NI (0) ; H:High; L:Low;U:unclear

Appendix 10: Assessment of Risk of bias for undiagnosed type 2 diabetes according to the Prediction model Risk of Bias Assessment Tool (PROBAST)													
Study reference (N=19)													
	26[70]	27[71]	28[72]	29[73]	30[73]	31[73]	32[74]	33[75]	34[76]	35[77]	36[78]	37[79]	38[80]
Participants													
Were appropriate data sources used, e.g., cohort, RCT, or nested case-control study data?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were all inclusions and exclusions of participants appropriate?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Predictors													
Were predictors defined and assessed in a similar way for all participants?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	PY
Were predictor assessments made without knowledge of outcome data?	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY	PY
Are all predictors available at the time the model is intended to be used?	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Outcome													
Was the outcome determined appropriately?	Y	PY	Y	PY	PY	PY	Y	Y	Y	N	Y	Y	Y
Was a pre-specified or standard outcome definition used?	Y	PY	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Were predictors excluded from the outcome definition?	PY	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the outcome defined and determined in a similar way for all participants?		PY	Y	Y	Y	Y	PY	Y	PY	PY	Y	Y	Y
Was the outcome determined without knowledge of predictor information?	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Was the time interval between predictor assessment and outcome determination appropriate (≥3 years)?	-	-	-	-	-	-	-	-	-	-	-	-	-
Analysis													
Were there a reasonable number of participants with the outcome?	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	PY
Were continuous and categorical predictors handled appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were all enrolled participants included in the analysis?	NI	N	Y	Y	Y	Y	N	N	N	N	N	Y	NI
Were participants with missing data handled appropriately?	NI	NI	Y	NI	NI	NI	NI	N	Y	Y	N	N	NI
Was selection of predictors based on univariable analysis avoided?	Y	Y	N	N	N	N	N	Y	N	NI	N	Y	N
Were complexities in the data (e.g., censoring, competing risks, sampling of control participants) accounted for appropriately?	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Were relevant model performance measures evaluated appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were model overfitting, underfitting, and optimism in model performance accounted for?	NI	NI	NI	NI	NI	NI	NI	Y	NI	Y	Y	NI	NI
Do predictors and their assigned weights in the final model correspond to the results from the reported multivariable analysis?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Overall judjment	U	U	L	H	H	H	U	L	U	L	L	U	U
Y: Yes; N: No; PY: Possibly yes; NI: No information; ; H:High; L:Low;U:unclear													

Appendix 10(continued): Assessment of Risk of bias for undiagnosed type 2 diabetes according to the Prediction model Risk Of Bias Assessment Tool (PROBAST)

Study reference (N=20)									
	39[81]	40[82]	41[83]	42[84]	43[84]	44[85]	45[86]	46[87]	47[88]
Participants									
Were appropriate data sources used, e.g., cohort, RCT, or nested case-control study data?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were all inclusions and exclusions of participants appropriate?	PY	Y	Y	Y	Y	Y	Y	PY	Y
Predictors									
Were predictors defined and assessed in a similar way for all participants?	Y	Y	Y	PY	PY	Y	Y	Y	Y
Were predictor assessments made without knowledge of outcome data?	PY	PY	PY	PY	PY	PY	PY	PY	PY
Are all predictors available at the time the model is intended to be used?	NI	NI	NI	NI	NI	NI	NI	NI	NI
Outcome									
Was the outcome determined appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was a pre-specified or standard outcome definition used?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were predictors excluded from the outcome definition?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the outcome defined and determined in a similar way for all participants?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the outcome determined without knowledge of predictor information?	NI	NI	NI	NI	NI	NI	NI	NI	NI
Was the time interval between predictor assessment and outcome determination appropriate (≥3 years)?	-	-	-	-	-	-	-	-	-
Analysis									
Were there a reasonable number of participants with the outcome?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were continuous and categorical predictors handled appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were all enrolled participants included in the analysis?	N	N	NI	N	N	N	N	NI	N
Were participants with missing data handled appropriately?	Y	Y	NI	N	N	Y	Y	Y	N
Was selection of predictors based on univariable analysis avoided?	N	N	N	Y	Y	N	N	NI	N
Were complexities in the data (e.g., censoring, competing risks, sampling of control participants) accounted for appropriately?	NI	NI	NI	NI	NI	NI	NI	NI	NI
Were relevant model performance measures evaluated appropriately?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were model overfitting, underfitting, and optimism in model performance accounted for?	Y	NI	NI	Y	Y	Y	Y	NI	NI
Do predictors and their assigned weights in the final model correspond to the results from the reported multivariable analysis?	Y	Y	Y	Y	N	Y	Y	Y	N
Overall judjment	L	U	U	L	L	L	L	U	H

Y: Yes; N: No; PY: Possibly yes; NI: No information; ; H:High; L:Low;U:unclear

Appendix 11: Study quality and performance measurements between the Previously published reviews and the updated review

Previously published reviews Collins,G., et.al[89] and Noble, D.,[90] (Risk prediction models*=18)			Updated review (Current review) (N=25)		
	AUC/ C-statistics†	Citation tracking¶		AUC/ C-statistics†	Citation tracking¥
von Eckardstein,A.,[40]	0.793	147	Doi,Y., et.al[46]	0.78	33
Schmidt, MI.,[31] ARIC risk score	0.80	469			
Kanaya, AM.,[18] Finish risk score	0.71	108	Lim,N.K., et.al[47]	0.77	34
Aekplakorn,W.,[1]	0.81	275	Heianza,Y., et.al[48]	0.808	31
			Noto,D.,et.al[49]	-	9
Stern,MP.,[35]	-	89	Ye,x., et.al[50]	0.714	14
Wilson,PW.,[43] Framingham risk score	-	754	Nanri,A., et.al[51]	0.882	23
Schulze,MB.,[32] EPIC risk score	0.82	410	Zhang,M., et.al [52]	0.766	14
Balkau,B.,[4] DESIR risk score	0.83	212	Liu,X., et.al[53]	0.791	2
			McCoy, RG.,et.al[54]	0.8171	3
Hippisley-Cox,J.,[15] QDScore	W:0.85 M:0.83	317	Miyakoshi,T.,et.al [55]	0.80	4
			Wang,A.,et.al[56]	0.66 0.77	8
			Brateanu,A., et.al [57]	0.809	0
Gao,WG.,[13]	W:0.64 M:0.62	28	Hippisley-Cox,J., et.al [58]	W:0.889 M:0.866	17
Kahn,HS.,[17] ARIC risk score	0.79	178	Zhang,H., et.al [59]	-	4
Chien,K.,[10]	0.7	126	Chen,X., et.al [60]	-	14
Sun,F.,[37]	0.84	66	Wen,J.,et.al [61]	0.686	1
Chen,L.,[9] AUSDRISk risk score	0.79	226	Moreno,L.M., et.al [62]	-	0
			Yatsuya,H., et.al [63]	0.77	0
Rosella,LC.,[30] DPoRT risk score	W:0.78 M:0.77	78	Ha,KH., et.al [64]	0.751	1
Wannamethee,SG.,[41]	0.81	34	Han,X.,[65] et.al	0.751	1
			Hu,H., et.al [66]	In:0.73 Non-in:0.86	2
Chuang ,SY.,[11]	0.80	12	Arellano-Campos,O., et.al [67]	0.741	0
			Hu H.et.al[68]	0.7 0.728	0
Bozorgmanesh,M.,[6] TLGS risk score	0.83	45	Kraege V.et.al [69]	0.788 0.807	0
Median (IQR)	0.8(0.77-0.83)	137(61-286)	Median (IQR)	0.78(0.74-0.82)	4(1-17)
Mean±SD	0.78±0.06	199±191	Mean±SD	0.78(0.06)	10.4±11.5

*Only original development English articles without genetic concentration.

†The validation (internal or external) AUC/C-statistics that were reported in the same articles were reported.

¶ The citation rate was 1.7 per year.

¥The citation rate was 1.85 per year.

AUC: Area under the curve; IQR; Interquartile range; SD: standard deviation; in:invasive; non-in:non-invasive

Appendix **12: Number of the developed model for the incident and undiagnosed type 2 DM between November, 2011 and 2019 by country**

	Incident Type 2 DM	Undiagnosed T2DM
North America		
- **US**	2	
- **Mexico**	1	1
- **South America**		
- **Colombia**		1
- **Peru**		1
Europe		
- **Switzerland**	1	
- **Slovenia**		1
- **Italy**	1	
- **UK**	1	
- **Spain**	1	
- **Portugal**		1
Asia		
- **Korea**	2	1
- **Japan**	6	1
- **Mongolia**		1
- **China**	9	4
- **Pakistan**		1
- **Bangladesh**		1
- **Sri Lanka**		1
Middle East and Africa		
- **Saudi Arabia**		2
- **United Arab Emirates**		2
- **Algeria**		1
- **Iran**		1

DM: diabetes
*For undiagnosed T2DM, one study used the information from 3 different countries.

Abbreviations

- Undiagnosed type 2 diabetes (U-T2DM)
- Incident type 2 diabetes (I-T2DM)
- Finnish Diabetes Risk Score (FINDRISC)
- Australian Type 2 Diabetes Risk (AUSDRISK)
- Framingham offspring (FOS)
- American diabetes association (ADA)
- Transparent Reporting of a multivariable prediction model for individual prognosis or diagnosis (TRIPOD)
- Prediction model Risk of Bias Assessment Tool (PROBAST)
- Risk of bias (ROB)
- Critical appraisal and data extraction for systematic reviews of prediction modeling studies (CHARMS)
- Area under the receiver curve: AUC
- Akaike information criteria: AIC
- Cardiovascular disease: CVD
- Fasting blood sugar (FBS)
- Bayesian information criteria: BIC
- Hemoglobin A1c (HbA1c)
- Multiple imputations (MI)

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