

## Supplementary Materials for HbA1C DTA meta-analysis in Africa

**Supplementary Table 1: Table of excluded studies**

First author and year	Reason for exclusion
Skinner 2019 <sup>1</sup>	Included participants with established diabetes
Famuyiwa 1983 <sup>2</sup>	Included participants with established diabetes
Makulo 2010 <sup>3</sup>	Included participants with established diabetes
van Deventer 2013 <sup>4</sup>	Full text not available. Conference presentation
Erasmus 1983 <sup>5</sup>	Full text not available
Hill 2020 <sup>6</sup>	Diagnostic accuracy data (TP, FP, TN, FN) not available and not calculable
Huangfu 2019 <sup>7</sup>	Duplicate data from Grint 2018
West 2016 <sup>8</sup>	Modelling study
Grint 2018 <sup>9</sup>	Participants not fasting
Chume 2019 <sup>10</sup>	Included Brazilian participants

### References for studies in Supplementary Table 1

1. Skinner S, Diaw M, Mbaye MN, Joly P, Renoux C, Masson C, et al. Evaluation of agreement between hemoglobin A1c, fasting glucose, and fructosamine in Senegalese individuals with and without sickle-cell trait. *PloS one*. 2019;14(2).
2. Famuyiwa OO, Akanji AO, Bella AF. Haemoglobin A1 levels in Nigerian diabetic patients using microcolumn affinity chromatography. *African Journal of Medicine & Medical Sciences*. 1986;15(1-2):49-53.
3. Makulo JR, Nseka NM, Lepira FB, Bieleli E, Nge OA. [Correlation between capillary fasting glucose and HbA1c: study on 181 type 2 diabetics patients in Democratic Republic of the Congo]. *Medecine Tropicale*. 2010;70(5-6):513-6.
4. Van Deventer M, Reddi K. Haemoglobin A1c for the diagnosis of diabetes mellitus in South Africa. *Journal of Endocrinology, Metabolism and Diabetes of South Africa*. 2013;18(1):43.
5. Erasmus RT, Osotimehin B, Ugboode C, Famuyiwa OO. HbA(1C) measured by colorimetric method in normal and diabetic Nigerian subjects. *African Journal of Medicine and Medical Sciences*. 1983;12(3-4):177-82.
6. Hill J, Peer N, Jonathan D, Mayige M, Sobngwi E, Kengne AP. Findings from community-based screenings for type 2 diabetes mellitus in at risk communities in Cape Town, South Africa: A pilot study. *International Journal of Environmental Research and Public Health*. 2020;17(8).
7. Huangfu P, Laurence YV, Alisjahbana B, Ugarte-Gil C, Riza AL, Walzl G, et al. Point of care HbA1c level for diabetes mellitus management and its accuracy among tuberculosis patients: a study in four countries. *International Journal of Tuberculosis and Lung Disease*. 2019;23(3):283-92.
8. West C, Ploth D, Fonner V, Mbwanbo J, Fredrick F, Sweat M. Developing a Screening Algorithm for Type II Diabetes Mellitus in the Resource-Limited Setting of Rural Tanzania. *Am J Med Sci*. 2016;351(4):408-15.
9. Grint D, Alisjahbana B, Ugarte-Gil C, Riza AL, Walzl G, Pearson F, et al. Accuracy of diabetes screening methods used for people with tuberculosis, Indonesia, Peru, Romania, South Africa. *Bulletin of the World Health Organization*. 2018;96(11):738-49.

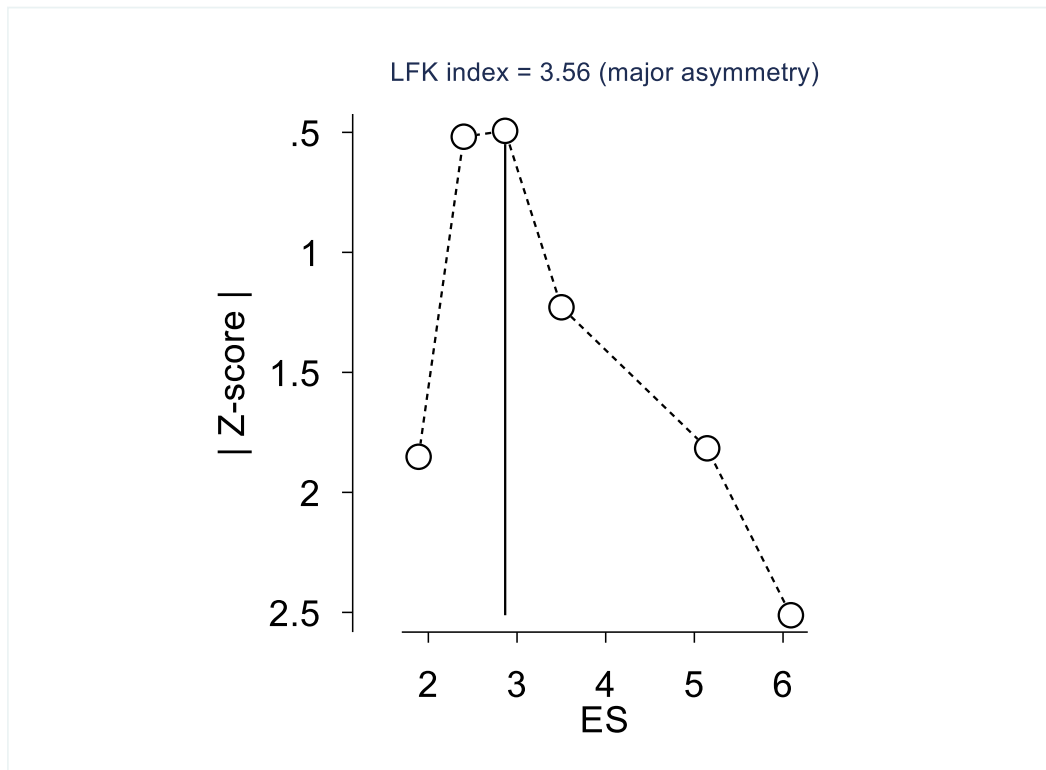
10. Chume FC, Kieling MH, Correa Freitas PA, Cavagnolli G, Camargo JL. Glycated albumin as a diagnostic tool in diabetes: An alternative or an additional test? PloS one. 2019;14(12):e0227065.

**Supplementary Table 2: QUADAS assessment**

Could the patient flow have introduced bias?	Low Risk	Low Risk	Low Risk
Were all patients included in the analysis?	Yes	Yes	Yes
Did patients receive the same reference standard?	Yes	Yes	Yes
Did all patients receive a reference standard?	Yes	Yes	Yes
Was there an appropriate interval between index test(s) and reference standard?	Yes	Yes	Yes
Is there concern that the target condition as defined by the reference standard does not match the review question?	Low Risk	Low Risk	Low Risk
Could the reference standard, its conduct, or its interpretation have introduced bias?	Unclear	Low Risk	Low Risk
Were the reference standard results interpreted without knowledge of the results of the index test?	Yes	Yes	Yes
Is the reference standard likely to correctly classify the target condition?	Unclear	Yes	Yes
Is there concern that the index test, its conduct, or interpretation differ from the review question?	Low Risk	Low Risk	Low Risk
Could the conduct or interpretation of the index test have introduced bias?	Low Risk	Low Risk	Low Risk
If a threshold was used, was it pre-specified?	Yes	Yes	Yes
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear	Unclear	Unclear
Is there concern that the included patients do not match the review question?	High Risk	Unclear	Low Risk
Could the selection of patients have introduced bias?	High Risk	Unclear	Low Risk
Did the study avoid inappropriate exclusions?	No	Yes	Yes
Was a case-control design avoided?	Yes	Yes	Yes
Was a consecutive or random sample of patients enrolled?	No	Yes	Yes
Study	Adamu et al. 2010	Chivese et al. 2019	Christiansen et al. 2009

Low Risk	Low Risk	Low Risk	Unclear	Unclear	Low Risk	Unclear	Low Risk
Yes	Yes	No	No	No	No	No	No
Yes	Yes	Yes	No	No	Yes	Yes	Yes
Yes	Yes	Yes	No	No	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Low Risk	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk	Low Risk
Low Risk	Low Risk	Low Risk	Unclear	Unclear	Unclear	Low Risk	Low Risk
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	Yes
Low Risk	Low Risk	Low Risk	Unclear	Unclear	Unclear	Yes	Yes
Low Risk	Low Risk	Low Risk	Unclear	Unclear	Unclear	Low Risk	Low Risk
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
Low Risk	Low Risk	High Risk	Unclear	Low Risk	Low Risk	Low Risk	High Risk
Low Risk	Low Risk	Low Risk	Unclear	Unclear	Low Risk	Low Risk	Low Risk
Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hare et al. 2013	Hird et al. 2016	Jeremiah et al. 2020	Mayega et al. 2014	Muchira et al. 2019	Prakashandra et al. 2018	Rathod et al. 2018	Zemlin et al. 2011

**Supplementary Fig. 1: Doi plot for publication bias assessment for HbA1C6.5% vs OGTT.**



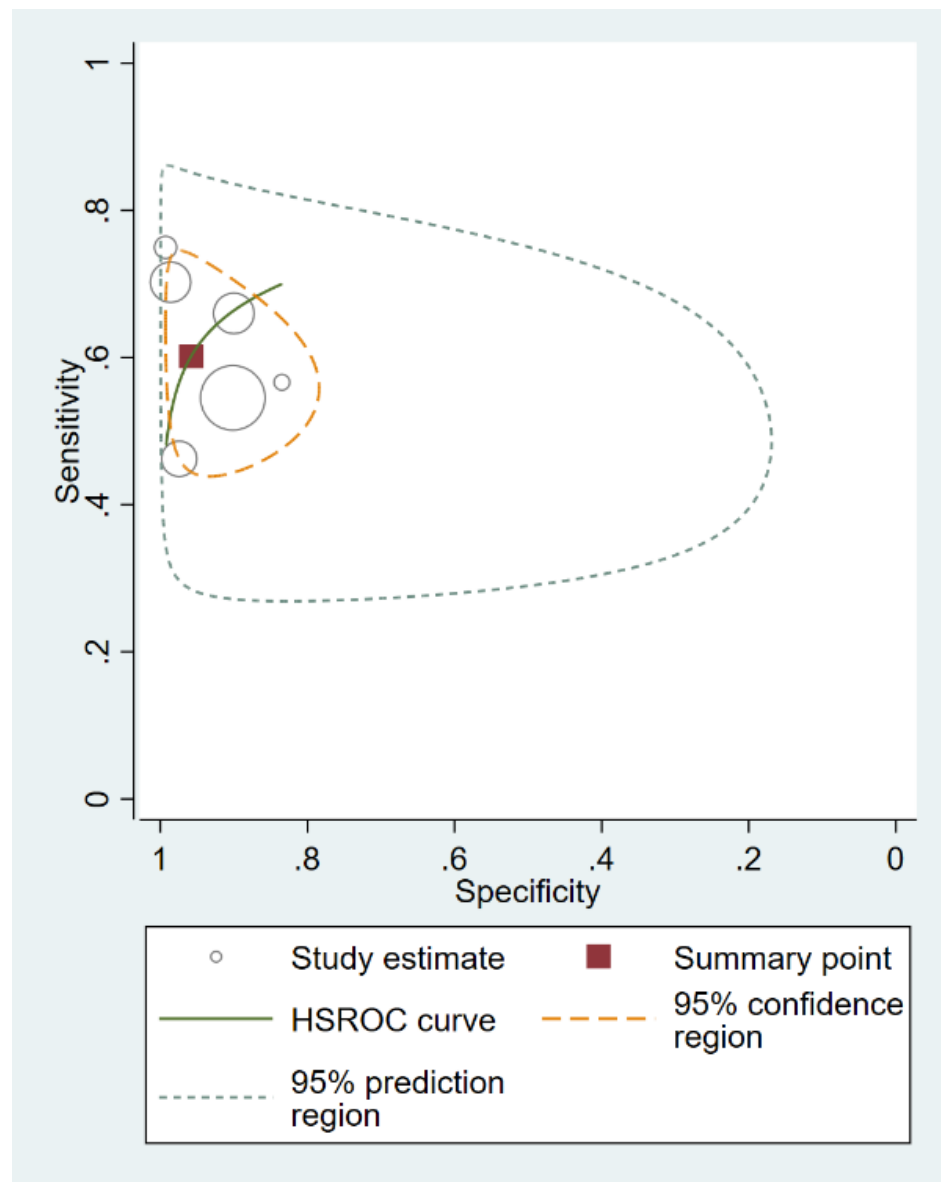
**Supplementary Table 3: Bivariate Models for HbA1C 6.5%=48mmol/mol VS OGTT and HbA1C 6.5%=48mmol/mol vs FPG.**

	HbA1C 6.5%=48mmol/mol VS OGTT			HbA1C 6.5%=48mmol/mol VS FPG		
	Coef.	Lower 95% CI	Upper 95% CI	Coef.	Lower 95% CI	Upper 95% CI
Bivariate						
E(logitSe)	0.41	0.07	0.76	0.62	0.11	1.13
E(logitSp)	3.13	2.16	4.10	2.91	2.06	3.75
Var(logitSe)	0.11	0.02	0.73	0.35	0.07	1.64
Var(logitSp)	1.36	0.38	4.87	1.39	0.46	4.20
Corr(logits)	0.35	-0.64	0.90	0.27	-0.61	0.85
HSROC						
Lambda	2.45	1.33	3.57	2.93	1.76	4.11
Theta	-0.45	-1.12	0.21	-0.59	-1.37	0.20
beta	1.25	0.16	2.33	0.70	-0.24	1.63
s2alpha	1.06	0.20	5.48	1.76	0.44	7.04
s2theta	0.13	0.03	0.53	0.25	0.07	0.96
Summary pt.						
Se	0.60	0.52	0.68	0.65	0.53	0.76
Sp	0.96	0.90	0.98	0.95	0.89	0.98
DOR	34.54	11.36	105.05	34.06	11.60	99.99
LR+	14.36	5.42	38.00	12.54	5.31	29.63
LR-	0.42	0.33	0.52	0.37	0.26	0.52
1/LR-	2.41	1.92	3.01	2.72	1.93	3.83

The bivariate and HSROC methods are random effects hierarchical methods which account for the correlation between specificity and sensitivity in included studies, in addition to accounting for the between study variation in test performance (1). Although the two methods use different parameters, they are mathematically equivalent in the absence of other covariates (1). Both methods first model the frequencies of the 2X2 tables for each study and then model the between study heterogeneity. The bivariate model jointly models pairs of logit transformed sensitivity and specificity and the correlation between them using a linear mixed random effect model, assuming a bivariate

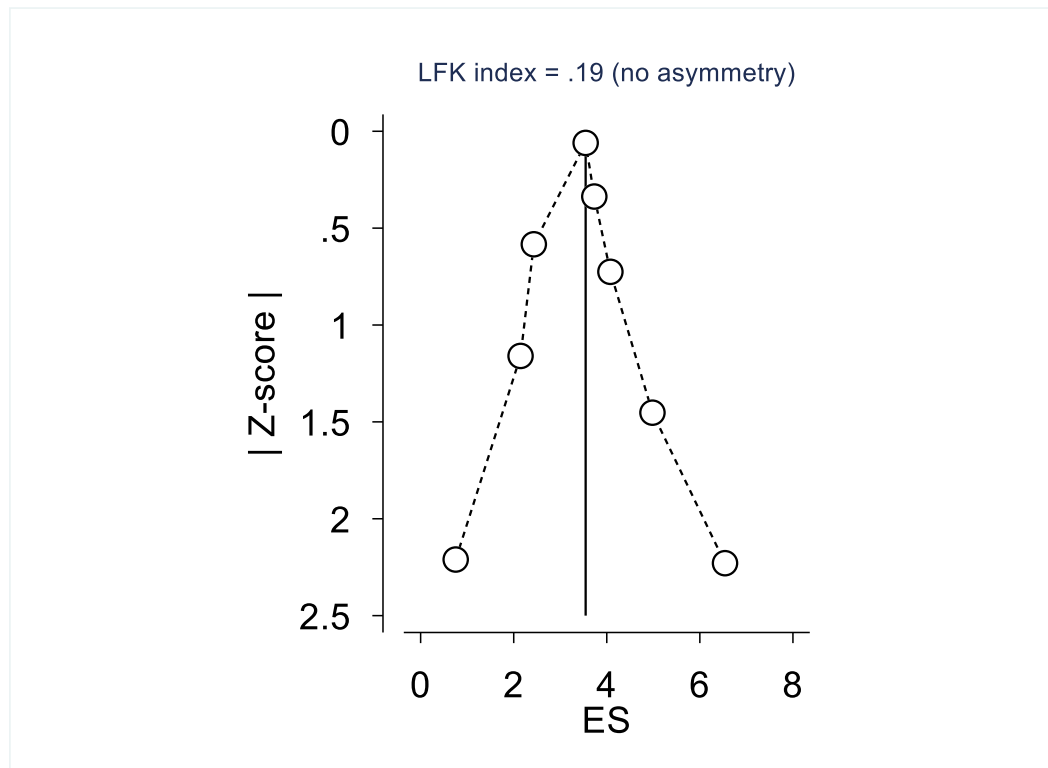
normal distribution of the logit sensitivity and logit specificity (2), whereas the HSROC is a multilevel non-linear generalized mixed model which uses scale and accuracy parameters of functions of specificity and sensitivity to describe an assumed underlying ROC curve. The bivariate parameters are log transformed sensitivity [ $E(\text{logitSE})$ ] and specificity [ $E(\text{logitSp})$ ], the variance parameters [ $\text{Var}(\text{logitSe})$ ] and [ $\text{Var}(\text{logitSp})$ ] and the correlation [ $\text{Corr}(\text{logits})$ ]. The HSROC model are represented by alpha for accuracy of the curve, **beta** for the asymmetry of the curve. The accuracy parameter, alpha, has a mean represented by **Lambda**, a variance represented by **s2alpha**. The positivity parameter has a mean represented by **Theta**, and variance represented by **s2theta**

**Supplementary Fig. 2: HSROC HbA1c 6.5%=48mmol/mol vs OGTT.**



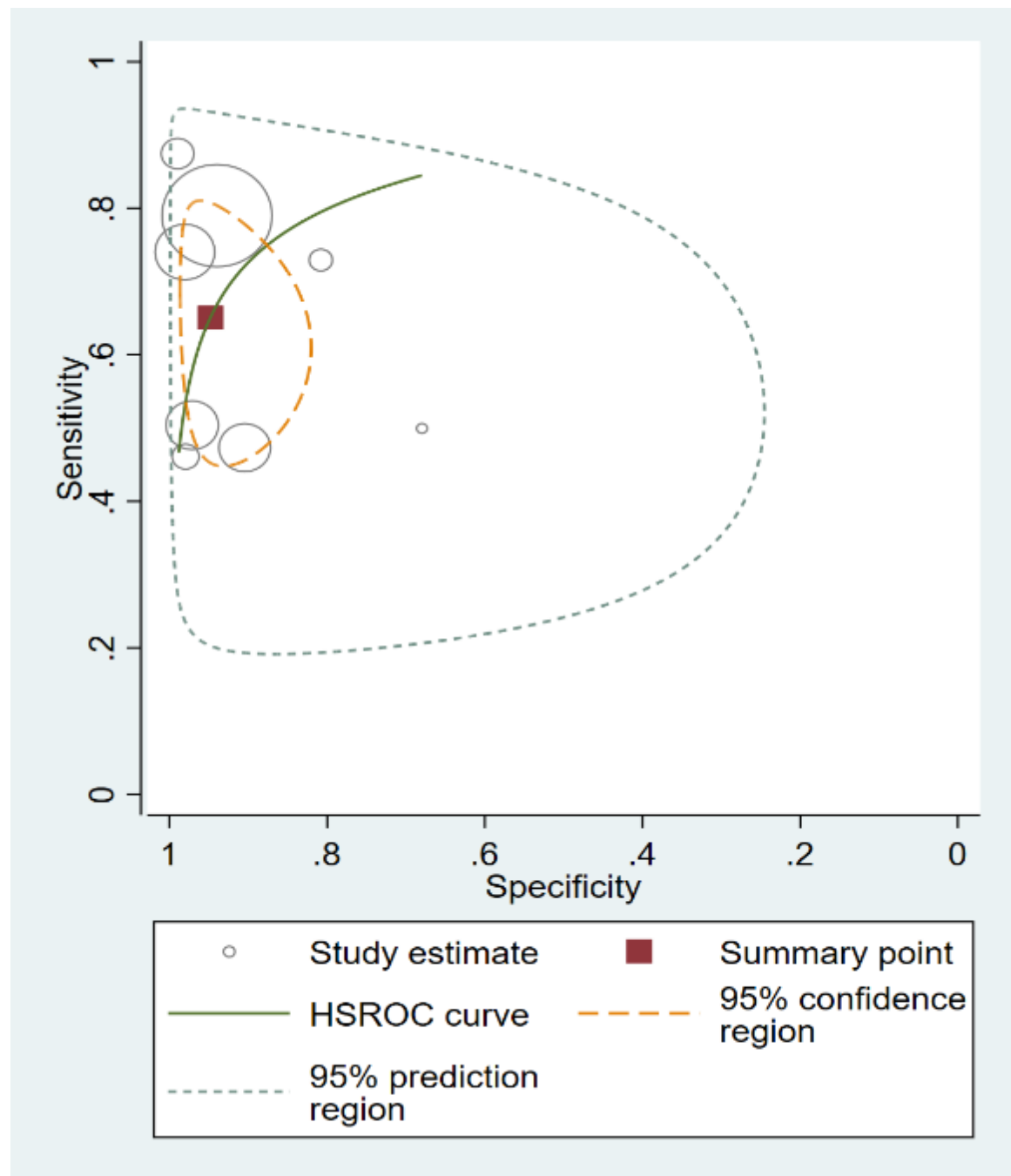
The shows a summary curve for the HSROC model, the small square shows a summary operating point for the summary values for the pooled sensitivity and specificity, a 95% confidence region for the summary operating point, and finally, a 95% prediction region which represents a confidence region of the true sensitivity and specificity.

**Supplementary Fig. 3. Doi plot for publication bias assessment for HbA1c 6.5%=48mmol/mol vs FPG**





**Supplementary Fig. 4: HSROC HbA1c 6.5%=48mmol/mol vs FPG**



The shows a summary curve for the HSROC model, the small square shows a summary operating point for the summary values for the pooled sensitivity and specificity, a 95% confidence region for the summary operating point, and finally, a 95% prediction region which represents a confidence region of the true sensitivity and specificity.

## Supplementary Document S1- Search Strategy

Algeria OR Angola OR Benin OR Botswana OR Burkina Faso OR Burundi OR Cabo Verde OR Cape Verde OR Cameroon OR Central African Republic OR CAR OR Chad OR Comoros OR Congo OR Democratic Republic of Congo OR DRC OR Republic of Congo OR Cote d'Ivoire OR Ivory Coast OR Djibouti OR Egypt OR Equatorial Guinea OR Eritrea OR Eswatini OR Swaziland OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR Guinea Bissau OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Rwanda OR Sao Tome and Principe OR Senegal OR Seychelles OR Sierra Leone OR Somalia OR South Africa OR South Sudan OR Sudan OR Tanzania OR Togo OR Tunisia OR Uganda OR Zambia OR Zimbabwe OR Africa OR African OR Southern Africa OR Central Africa OR Western Africa OR Eastern Africa OR Northern Africa OR Sub-Saharan Africa OR Sub Saharan Africa OR Western Sahara OR South of the Sahara

MESH – Diabetes mellitus

Diabetes Mellitus OR Diabetes Mellitus, Type 2 OR diabetes type 2 OR T2DM OR T2D OR diabetes Type II OR diabetes OR glucose intolerance OR insulin resistance OR Hyperglycemia OR Hypoglycemia glucose regulation OR blood glucose OR gestational diabetes

MESH - HBA1C

HbA1c OR HBA1C OR HbA1c OR A1c OR A1c OR A1C OR Glycated hemoglobin A1C OR Glycated haemoglobin A1C OR glycosylated haemoglobin A1C OR glycosylated hemoglobin A1C OR Hemoglobin A1C, Glycosylated OR hemoglobin A1C OR haemoglobin A1C

## Pubmed search

Search: (((((Diabetes Mellitus, Type 1[MeSH Terms]) OR (IDDM OR T1DM OR Diabetes Mellitus Insulin-Dependent OR Diabetes Mellitus Insulin Dependent OR Type 1 Diabetes Mellitus OR Type 1 Diabetes OR Type I Diabetes Mellitus OR Juvenile-Onset Diabetes OR Diabetes, Juvenile-Onset OR Juvenile Onset Diabetes OR Diabetes Mellitus, Juvenile-Onset OR Diabetes Mellitus, Juvenile Onset OR Juvenile-Onset Diabetes Mellitus OR Insulin-Dependent Diabetes Mellitus)) OR (Diabetes Mellitus, Type 2[MeSH Terms])) OR (NIDDM OR T2DM OR Diabetes Mellitus Non-Insulin-Dependent OR Diabetes Mellitus Noninsulin-Dependent OR Diabetes Mellitus Noninsulin Dependent OR Type 2 Diabetes Mellitus OR Type 2 Diabetes OR Type II Diabetes Mellitus)) AND (Africa OR African OR Algeria OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR "Cabo Verde" OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote

d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR Egypt OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea- Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR "Saint Helena" OR "Sao Tome" OR Senegal OR Seychelles OR "Sierra Leone" OR Somalia OR "St Helena" OR Sudan OR Swaziland OR Tanzania OR Togo OR Tunisia OR Uganda OR "Western Sahara" OR Zaire OR Zambia OR Zimbabwe)) AND ((HBA1C[MeSH Terms]) OR (HbA1c OR HBA1C OR HbA1C OR A1c OR A1C OR A1C OR Glycated hemoglobin A1C OR Glycated haemoglobin A1C OR glycosylated haemoglobin A1C OR glycosylated hemoglobin A1C OR Hemoglobin A1C, Glycosylated OR hemoglobin A1C OR haemoglobin A1C))

### **Additional References**

1. Takwoingi Y, Guo B, Riley RD, Deeks JJJSmimr. Performance of methods for meta-analysis of diagnostic test accuracy with few studies or sparse data. 2017;26(4):1896-911.
2. Reitsma JB, Glas AS, Rutjes AWS, Scholten RJPM, Bossuyt PM, Zwinderman AH. Bivariate analysis of sensitivity and specificity produces informative summary measures in diagnostic reviews. Journal of clinical epidemiology. 2005;58(10):982-90.