Annex 12B. Methodology for Cost-Effectiveness Analyses

Supplementary material for: Ali, M., K. Siegal, E. Chandrasekar, N. Tandon, P.A. Montoya, and others. 2017. "Diabetes: An Update on the Pandemic and Potential Solutions." In *Cardiovascular, Respiratory, and Related Disorders* edited by D Prabhakaran, S Anand, TA Gaziano, J-C Mbanya, Y Wu, and R Nugent. Volume 5 of *Disease Control Priorities, third edition.* Washington, DC: World Bank.

To identify and compare the value of different diabetes-focused interventions, we reviewed and synthesized the available literature regarding cost-effectiveness of interventions to detect, prevent, and manage diabetes and its complications. We also conducted a two-round Delphi process to identify priority interventions for the prevention and control of diabetes. This annex presents the methodology used in these two endeavors.

Literature Review

We compiled data from published articles indexed in leading medical literature databases up to July 2013 and conducted separate searches for data from high-income countries (HICs) and low- and middle-income countries (LMICs). The databases consulted included the National Library of Medicine, Scopus, Google Scholar, Cochrane Library, and EMBASE. We supplemented our findings by manually reviewing the reference lists of recently published comprehensive reviews.

To be included, articles had to meet four criteria. First, they had to be English-language original research papers, not review articles or editorials. Second, they had to include participants with type 1 or type 2 diabetes mellitus or at high risk for diabetes, but not uncommon forms of diabetes (secondary to chronic pancreatitis). Third, they had to report cost-effectiveness or cost-utility of diabetes screening, prevention, or management interventions based on economic evaluations from either within-trial analyses or economic modeling. Finally, they had to achieve of minimum score of 7 out of 10 on Drummond's checklist of criteria (Drummond and others 2005). We assigned a single point for each criteria. Checklist items covered aspects of quality of reporting, credibility of data (in particular, presence of a counterfactual condition), and usefulness of data. This approach is very similar to the newer Consolidated Health Economic Evaluation Reporting Standards (CHEERS) (Husereau and others. 2013). Two researchers independently determined the relevance of all articles, and the research team resolved any discrepancies by consensus. Data were extracted using a standardized abstraction form.

We then categorized all interventions into four categories:

1. Screening for diabetes, prediabetes, or gestational diabetes (screening alone, screening plus lifestyle intervention for persons with prediabetes)
2. Preventing type 2 diabetes in high-risk individuals
3. Managing diabetes (lifestyle interventions, self-management education, self-monitoring of blood glucose, intensive control of glucose, blood pressure and cholesterol, case management of diabetes)
4. Screening for, prevention, and management of diabetes-related complications (retinopathy, neuropathy, nephropathy).

Within each category, we classified studies as being either within-trial or modeling studies. In some categories, we stratified data from specific populations (for example, data regarding screening for gestational diabetes were separated from data regarding screening for undiagnosed diabetes or prediabetes) or data regarding different interventions (for example, data regarding glucose, blood pressure, and lipid control were synthesized separately). Where possible, we reported data from LMICs separately.

Cost-effectiveness estimates for diabetes-related interventions originate from evaluations in diverse settings and time periods. To aid comparability, we converted originally reported estimates to 2012 U.S. dollars using exchange and inflation rates published for each country and year by the World Bank.[1] Where different estimates were available, we prioritized incremental cost-effectiveness ratio (ICER) estimates for each intervention reported as costs per quality-adjusted life year (QALY) gained. Then, for LMICs and HICs separately, we inventoried the number of studies reporting cost-effectiveness of each intervention from both health system and societal perspectives (table X.B1). Lastly, under each subset of LMIC and HIC studies for each broad intervention category, we calculated medians and ranges of cost-effectiveness estimates. Where an estimate used any metric other than "per QALY," we reported and labeled it as such.

This process identified 94 unique studies: 81, 11, and 2 with economic data regarding diabetes interventions from HICs, LMICs, and both HICs and LMICs, respectively. Of these, we report detailed data from 59 studies. In some cases, these studies provide estimates for multiple unique categories. Therefore, we present 77 economic estimates from HICs (60 health system and 17 societal perspective) and 7 data-points emanating from LMICs (5 health system and 2 societal perspectives). The studies included in online annex X.C that are not included in synthesized estimates used different denominators, such as cost per life year gained (LYG) or cost reductions.

Among 77 estimates from HICs, 8 and 4 estimates reported data regarding screening for diabetes and gestational diabetes, respectively; 19 estimates (10 within-trial and 9 modeled estimates, where 13 were aimed at individuals and 6 involved group interventions) reported data on preventing type 2 diabetes among high-risk persons; 3 were related to lifestyle interventions for people with diabetes; 4 focused on diabetes self-management education; 3 assessed self-monitoring of blood glucose; 10 (6 within-trial and 4 modeled), 3 (1 within-trial and 2 modeled), and 4 (1 within-trial and 3 modeled) focused on glucose, blood pressure, and lipid control, respectively; and 4 were economic evaluations of case management.

A total of 15 estimates from HICs were related to interventions to prevent diabetes complications: retinopathy screening and treatment (4), foot care (3), and screening (2), and prevention of chronic kidney disease (6).

Among 7 economic estimates from LMICs, the data available came from studies regarding screening for gestational diabetes (2), diabetes self-management education (2), intensive glycemic management (1), and retinopathy screening (2).

[1]. World Bank data on official exchange rates are available at http://data.worldbank.org/indicator/PA.NUS.FCRF.

Study details regarding population, intervention, outcomes, and cost-effectiveness analyses, as well as main findings, are provided in online annex 5C.

Table 12.B.1 Median Incremental Cost-Effectiveness Ratios for Diabetes-Related Interventions, by Country-Income Status and Perspective (2012 US$)

	LMIC estimate		HIC estimate	
Intervention	**Health system**	**Societal**	**Health system**	**Societal**
Screening (+/–preventive intervention)				
Undiagnosed diabetes or prediabetes				
Screening	n=0	n=0	n=4 11,249.77 (5,120.67–87,746.78)	n=0
Screening + intervention	n=0	n=0	n=3 10,907.71 (470.91–19,231.44)	n=1 13,644.86 (12,127.47– 27,491.79)
Gestational diabetes				
Screening	n=0	n=0	n=1 20,362.32 (17,572.10–21,412.08)	n=2 25,927.04 (10,531.64–41,322.44)
Screening + intervention (cost per DALY)	n=1 13.47	n=1 1,934.86	n=0	n=1 1925.63
Preventing type 2 diabetes among high-risk individuals				
Within trial				
Individual	n=0	n=0	n=2 17,750.03 (15,929.68–44,146.26)	n=3 60,112.17 (21,202.47–72,017.30)
Group	n=0	n=0	n=3 12,380.08 (1,581.73–124,660.68)	n=2 24,522.69 (9,002.38–40,043.00)
Modeled				
Individual	n=0	n=0	n=5 7,582.06 (1,091.39–197,099.99)	n=3 32,396.19 (12,129.23–86,282.93)
Group	n=0	n=0	n=0	n=1 36,287.00
Diabetes management				
Lifestyle change	n=0	n=0	n=2 48,792.58 (33,768.88–226,158.45)	n=1 21,766.91
Diabetes self-management education				
Within-trial	n=1	n=0	n=1	n=0

	LMIC estimate		HIC estimate	
Intervention	**Health system**	**Societal**	**Health system**	**Societal**
	629.10 (622.86–635.34)		3,881.73	
Modeled	n=0	n=1 335.98 (135.58– 758.26)	n=3 9,995.64 (4,494.95–35,657.95)	n=0
Self-monitoring of blood glucose				
Modeled	n=0	n=0	n=3 12,262.08 (7,760.44–124,169.98)	n=0
Intensive glycemic control				
Within trial	n=0	n=0	n=5 20,719.66 (568.82–45,552.17)	n=1 37,861.45
Modeled	n=1 19,272.85	n=0	n=4 30,304.09 (2,542.95–60,577.08)	n=0
Intensive blood pressure control				
Within trial	n=0	n=0	n=1 1,164.42 (741.46–1,587.39)	n=0
Modeled	n=0	n=0	n=2 2,974.17 (2,867.55–3,080.79)	n=0
Lipid control				
Within trial	n=0	n=0	n=1 13,179.81	n=0
Modeled	n=0	n=0	n=3 73,115.47 (23,306.99–105,201.87)	n=0
Case management				
Within trial	n=0	n=0	n=2 12,944.06 (1,786.97–88,821.41)	n=0
Modeled	n=0	n=0	n=2 23,034.91 (3,880.70–42,189.13)	n=0
Screening for and preventing diabetes complications				
Retinopathy screening	n=2 2,992.90 (858.63–8,388.40)	n=0	n=4 49,322.41 (5,908.08–148,183.35)	n-0
Foot care and assessments	n=0	n=0	n=3 25,858.98	n=0

	LMIC estimate		HIC estimate	
Intervention	**Health system**	**Societal**	**Health system**	**Societal**
Urine assessments	n=0	n=0	(6,354.75–310,006.37) n=2	n=0
Preventing CKD and ESRD	n=0	n=0	75,241.36 (24,688.57–182,225.17) n=4 35,816.54 (415.88–57,734.12)	n=2 9,913.20 (9098.83–10,727.57)

Note: LMIC = low- and middle-income country; HIC = high-income country; n = number of studies; DALY = disability-adjusted life year; CKD = chronic kidney disease; ESRD = end-stage renal disease.