

Diabetes cost calculator – User’s guide

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I. Overall setup

This calculator estimates the total annual national direct medical cost of providing clinical care for people with diabetes mellitus for low- and middle-income countries. It is based on prevalence estimates for diabetes (types 1 and 2) and associated complications; normative estimates and values from the literature about adherence to recommended treatment guidelines; and price information for routine care and for treatment of complications. The user can opt to use pre-populated model parameters, or can enter new data for certain parameters including epidemiologic information and unit prices.

The results from the calculator are not intended to be a precise “price tag” nor a benchmark. The objective of the calculator is to provide an estimate for policymakers, health system financiers and other key stakeholders about the approximate degree of financing that may be necessary to fully address diabetes mellitus in a given country context. In this way, the model takes a normative perspective: it does not aim to reflect a current situation, but rather to estimate the total direct medical cost if a country were to provide comprehensive diabetes care at-scale.

II. Data sources and assumptions

A. Epidemiology:

- 1) Diabetes prevalence: The model is prepopulated with country-specific data on the number of people living with diabetes mellitus, from the most recent data (2015) in the *Global Burden of Disease GHDx database* [1]. This was then divided across diabetes type 1 and 2 by using information from the *IDF Diabetes Atlas 7* [2].
- 2) Complication prevalence: The proportion of people with diabetes who experience each of 8 key complications (i.e., diabetic ketoacidosis, hypoglycaemia, diabetic foot ulcer, high blood pressure, ischemic heart disease, nephropathy, retinopathy, and stroke) was obtained from a review of the literature. Whenever possible we used systematic reviews and meta-analysis that reported on the prevalence of each complication. [3-42] This prevalence of each complication was estimated separately for people with diabetes types 1 and 2.
- 3) Note: A user can choose to utilize these prepopulated data, or can enter their own values for: (1) the number of people in a country with diabetes mellitus, by type; and/or (2) the number of people in a country with each diabetic complication.

B. Elements of routine care

- 1) The elements of routine care for people with type 1 diabetes were obtained from the *IDF/ISPAD Pocketbook for Management of Diabetes in Childhood and Adolescence in Under-Resourced Countries* [43]. For people with type 2 diabetes, the *IDF Global Guideline for Type 2 Diabetes* [44] was used to identify elements of routine care; specifically, the recommendations for “limited care” settings were utilized.

C. Care coverage

- 1) Overall engagement in clinical care: This model takes a normative perspective and therefore assumes that nearly all people with diabetes (type 1 or 2) are engaged in clinical care – i.e., receiving regular screening for complications, counseling for disease management (e.g. dietary choices, exercise), and laboratory testing for key clinical indicators.
 1. This model subsequently estimates specific components of clinical care – including routine care, care for complications, and pharmacotherapy. Therefore not all patients receiving clinical care are utilizing these elements, please see below (II.C.2, II.C.3 and II.C.4).
- 2) Patient monitoring (pharmacotherapy): The model estimates the utilization rate of patient monitoring and maintenance (each medicine as relevant for type 1 or 2, plus glucose meters and strips for all patients using insulin) based on a literature search including empirical analyses and clinical recommendations. Due to the model’s normative approach, it utilizes estimates from high-income settings – i.e., it assumes that patients worldwide would manage their diabetes similarly to the steps taken by patients in settings where access to care barriers to accessing care are minimal.
 1. We recognize that national protocols for diabetes care vary, and received preliminary feedback for this to be reflected in the model. To this end, extra rows have been added for additional care components (“Other intervention 1 [or 2 or 3]”). Examples might be other medications, or programs/care for diabetic patients that is not represented in this sheet. These cells are included for illustrative purposes only, and they are not currently activated for use. We would be happy to advise model users who wish to incorporate this information into national estimates; please contact the model authors as indicated in the About tab and above.
- 3) Routine clinical care: This category is divided into consultations, and laboratory tests to assess disease status and control. The model makes the normative assumption that 95% of all patients in clinical care (type 1 or 2) would receive these services.
- 4) Complication care: It is assumed that 95% of all patients in clinical care (type 1 or 2) would receive treatment for any diabetes-related complications that arise.

D. Prices

- 1) Patient monitoring (pharmacotherapy): The prepopulated prices in this model are derived from the Management Sciences for Health International Medical Product Price Guide [45] using the most recent (2016, if available) price. If multiple prices per commodity were offered, the model uses the supplier median price as its input. For medicines, the standard Defined Daily Dose (DDD) is used to estimate an annual quantity required. The number of glucose meter test strips needed per patient per year, and the usable lifespan of a glucose meter, were estimated based on National Health Service (NHS) information and guidelines. The prepopulated price information assumptions are as follows:
 1. Insulin and syringes: 4 injections per patient per day
 2. Meters and strips: 4 tests per day; meter usable life of 3.5 years
 3. Metformin: 2g per patient per day
 4. Sulfonylurea (glibenclamide): 10mg per patient per day
- 2) Routine clinical care: The prepopulated prices for routine outpatient visits, and for laboratory tests, were derived from the results of a systematic literature review. Annual

per-patient prices were estimated as the median cost of this care component within the group of upper-middle income countries, and the group of low- plus lower-middle income countries. For whichever specific country is run through this model, the median price for its income group is utilized for outpatient visits and laboratory tests. (Since the literature review analyzed per-visit outpatient costs, this was converted to an annual cost by multiplying by 11, which is approximately the recommended number of visits for patients in high-income settings – again, taking a normative approach to care utilization patterns.)

3) Complication care: Most of the prepopulated per-case annual prices for complication care are from a high-quality, large-sample study in China that was identified via a systematic review [46]. This article was however only focused on type 2 diabetes; so the costs of treating diabetic ketoacidosis and hypoglycemia were estimated to be the approximate median of these other complication costs (as they also require inpatient care).

III. Guide to use

This Excel-based workbook is largely preprogrammed to estimate annual national direct medical costs of diabetes care. There are only a few places where user input is required:

A. Setup:

1) Select country name from the drop-down.

The screenshot shows a form with four dropdown menus. The first dropdown, labeled "Choose country:", is open, displaying a list of countries including Afghanistan, Albania, Algeria, American Samoa, Angola, Argentina, Armenia, Azerbaijan, Bangladesh (highlighted in blue), Belarus, Belize, and Benin. The other three dropdowns are closed and show "prepopulated)?" as their selected options.

2) Choose whether you want to use prepopulated diabetes prevalence values (as described in II.A.1), or whether you want to input your own data about the number of people with each type of diabetes mellitus (type 1 and 2) in this country.

The screenshot shows the same form as above, but with the dropdown menus updated. The "Choose country:" dropdown is now set to "Bangladesh". The "Choose method for estimating population with diabetes:" dropdown is set to "Based on estimated prevalence values (pre-populated)?". The "Choose method for estimating diabetic population with complications:" dropdown is also set to "Based on estimated prevalence values (pre-populated)?". The "Choose source for calculating unit costs:" dropdown is set to "Use estimated prices (pre-populated)".

1. If you want to input prevalence data, select “Enter a patient population size value” and then go to the Epidemiology tab to enter these values in column F, rows 4 and 6 for types 1 and 2 respectively.
2. Note: If you choose to enter data, you must enter values for both types 1 and 2.

If entering data on patient population size:

Number of people with type 1 diabetes in your country:

Number of people with type 2 diabetes in your country:

- 3) Choose whether you want to use prepopulated complication prevalence values (as described in II.A.2), or whether you want to input your own data about the number of people with each type of diabetes complication in this country.

Choose country:

Choose method for estimating population with diabetes:

Choose method for estimating diabetic population with complications:

Choose source for calculating unit costs:

1. If you want to input prevalence data, select “Enter a patient population size value” and then go to the Epidemiology tab to enter these values in column F, rows 14-21 for each complication.
2. Note: If you choose to enter data, you must enter values for all complications.

If entering data on patient population size:

Number of people with each complication in your country:

Diabetic Ketoacidosis	300000
Hypoglycaemia	450000
Diabetic foot ulcer	
High blood pressure	
Ischemic heart disease	
Nephropathy	
Retinopathy	
Stroke	

- 4) Choose whether you want to use prepopulated price data (as described in II.D.1), or whether you want to input country-specific prices.

Choose country: Bangladesh

Choose method for estimating population with diabetes: Enter a patient population size value?

Choose method for estimating diabetic population with complications: Based on estimated prevalence values (pre-populated)?

Choose source for calculating unit costs:

- Use estimated prices (pre-populated)
- Use country-specific price list
- Use estimated prices (pre-populated)

1. If you want to input price data, select “Use country-specific price list” and then go to the Prices tab to enter these values in column F.
 - a. Users may wish to enter weighted price data, e.g. for different types of insulin. This calculation should be performed outside the model, and the weighted average price should then be typed into the relevant cell. For example, if 40% of the insulin purchased and used in your country costs \$100 per patient per year, and 60% of the insulin purchased and used in your country costs \$300 per patient per year, the weighted total cost $[(0.4 * \$100) + (0.6 * \$300) = \$220]$ would be typed into the highlighted cell for Insulin cost per patient per year.

If entering data on prices:

Routine care:

Insulin	80
Meter	4
Meter strips	350
Metformin	
Sulfonylurea	
Syringes	
Clinical consultations	
Laboratory tests	

- B. If you want to override the default assumptions in the Care Coverage tab, you can do so by typing into the relevant cells of that sheet.
- C. All other tabs will autofill based on the values entered in the Setup tab (and the Epidemiology and Prices tabs, as relevant based on choices in the Setup tab, described in III.A above).
- D. Model output can be found in the tab labeled Output. An overall annual cost of treating diabetes in the selected country can be found in row 5. A breakdown of this price, by patient self-management and routine clinical care (for both diabetes types 1 and 2, and the combined full diabetic patient population), and care of complications, is presented below.

Country name: **Bangladesh**
 All costs presented in: 2016 USD
 Total cost of care (Type 1 and 2 routine + complications) **\$ 19,114,324,475**

Number of people with type 1 diabetes 783,360
 Number of people with type 2 diabetes 7,050,238

Annual cost of routine care:	For Type 1 population		For Type 2 population
	Medicine and supplies	\$ 403,875,207	\$ 817,953,338
Outpatient care and laboratory tests	\$ 59,181,481	\$ 532,633,327	
			For routine care (total)
			\$ 1,813,643,354
Annual cost of complication care:	Per complication		
Diabetic Ketoacidosis	\$ 357,212,064		
Hypoglycaemia	\$ 620,420,953		
Diabetic foot ulcer	\$ 961,965,821		
High blood pressure	\$ 8,377,233,921		
Ischemic heart disease	\$ 1,556,927,581		
Nephropathy	\$ 1,736,121,133		
Retinopathy	\$ 2,133,872,066		
Stroke	\$ 1,556,927,581		
			For all complications (total)
			\$ 17,300,681,122

IV. References

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