



# Systematic Literature Review of Costs Related to Patients With Type 2 Diabetes Mellitus Experiencing a Stroke or Myocardial Infarction

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## BACKGROUND

Type 2 diabetes mellitus (T2DM) is a metabolic disorder that puts patients at increased risk of myocardial infarction (MI) or stroke compared with patients without T2DM.<sup>1-3</sup> Both comorbidities may impact patients' health-related quality of life and increase the economic burden on the health care system.

## OBJECTIVE

To review published cost estimates of stroke and MI in patients with T2DM to better understand the associated economic burden.

## METHODS

A systematic literature review was conducted in PubMed, Embase, and the Cochrane Library (2001-2011); conference abstracts (2009-2011); bibliographies of included studies; and review articles, using medical subject heading terms and title words for MI, stroke, T2DM, and cost.

### Inclusion Criteria

- Studies presenting costs related to MI and/or stroke for patients with T2DM.
- Studies where patients had T2DM prior to having an MI or stroke.

### Exclusion Criteria

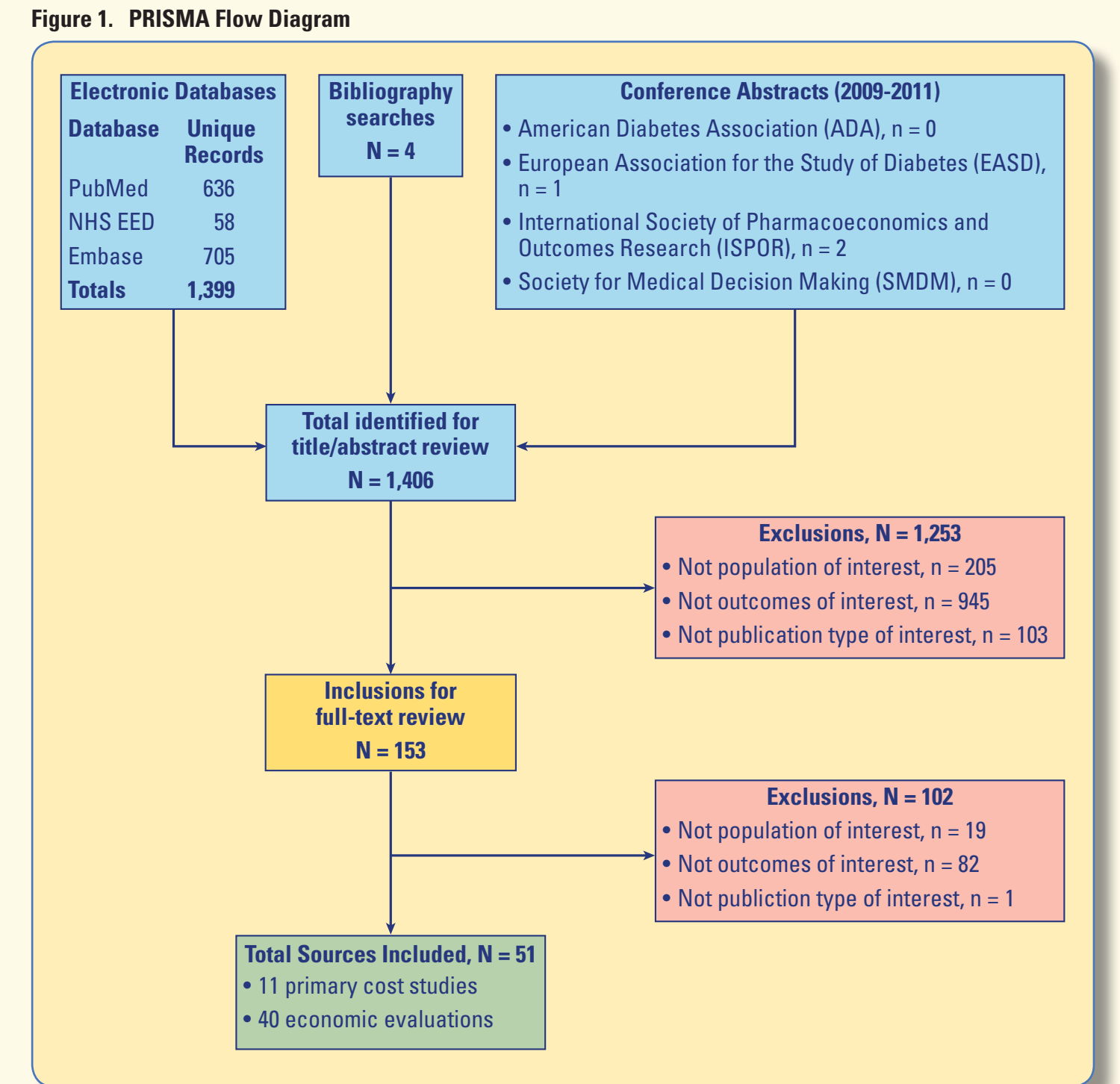
- Study population not meeting the inclusion criteria, no cost outcomes, publication type was not of interest (reviews were excluded, but examined for other relevant publications).

### Data Extraction

- Costs attributed to other publications were traced to original sources, and these were also included.
- All non-United Kingdom (UK) costs were converted to year 2011 pounds sterling (GBP) using purchasing-power parity exchange rates and relevant inflation factors as specified in the National Institute for Health and Care Excellence (NICE) Guidelines Manual.<sup>4,6</sup>

## RESULTS

- Of 1,399 records screened, 51 cost studies were included (Figure 1).



PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-analyses.

## MI Costs

Forty-seven studies reported costs for an MI in patients with T2DM. Eleven were primary cost studies (1 of which was a burden of illness study that estimated annual direct cost per patient and the cost of treating diabetes and macrovascular complications).<sup>7</sup> Thirty-six were economic evaluations.

### Fatal MI

#### Primary Cost Studies

One of the 11 studies estimated the impact of diabetes-related complications, including MI, in the UK and was based on the data collected from 5,102 patients in the UK Prospective Diabetes Study. The estimated annual hospital inpatient costs for a fatal MI corresponded to £2,463.<sup>8</sup>

#### Economic Evaluations

Fourteen of the 36 studies included costs for a fatal MI, and all of these costs corresponded to the year of the MI. Thirteen of the cost estimates ranged from £1,594 to £5,549.<sup>9-10</sup> However, a study from the United States (US) reported a cost of 14,297.<sup>11</sup>

### Nonfatal MI/Year of the Event

Ten of 11 primary cost studies and 36 economic evaluations reported a cost per nonfatal MI or a cost for the year of the event. The 11th cost study reported a national annual cost of an MI.<sup>12</sup>

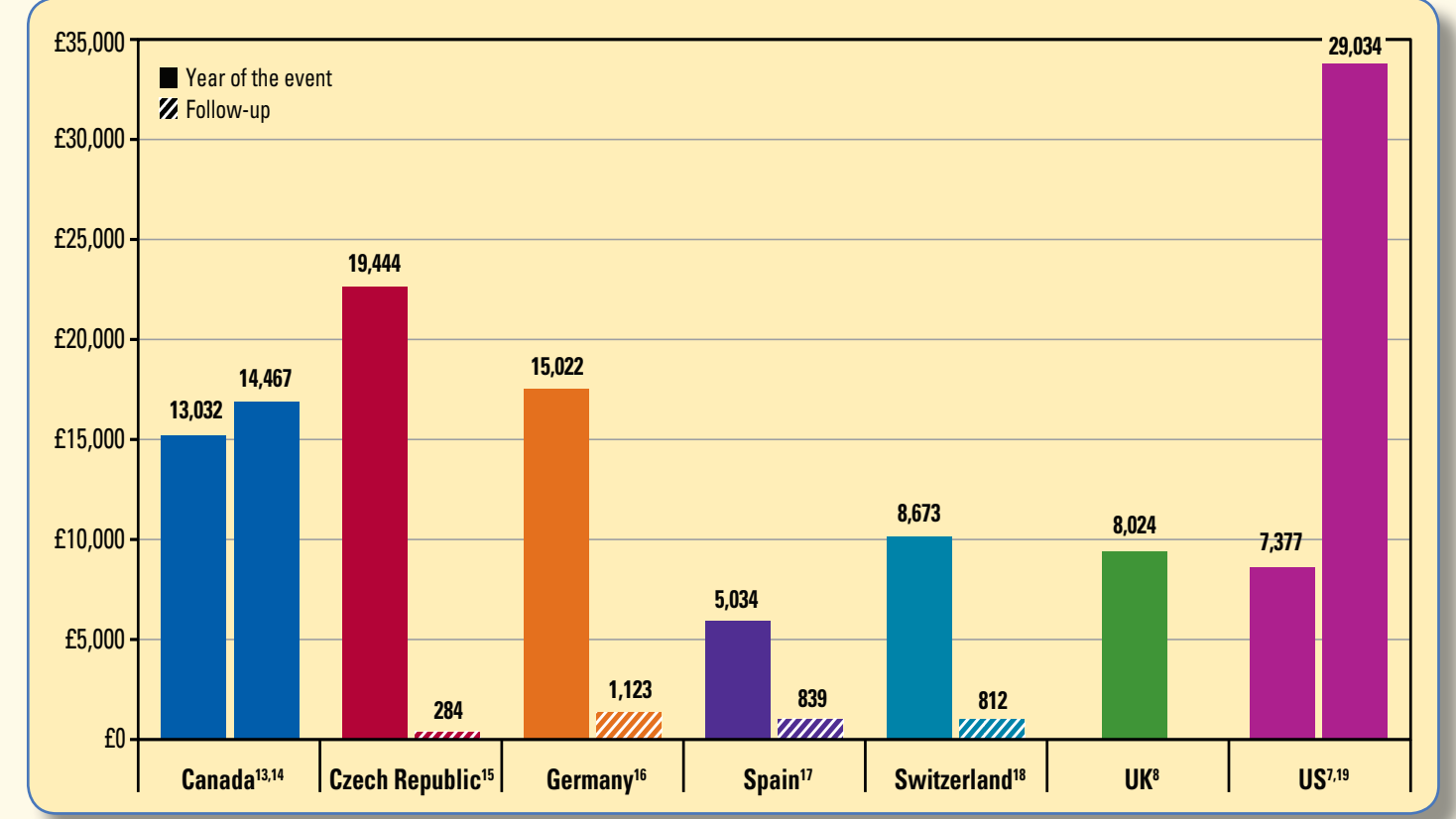
#### Primary Cost Studies

Figure 2 shows the costs per patient identified in 9 of the 10 primary cost studies reporting an estimate for this cost item.<sup>7,8,13-19</sup> The 10th study was not included in Figure 2, because it estimated only a national annual cost of treatment for patients with T2DM who experience an MI, which is equal to £27,168,463.<sup>12</sup>

#### Economic Evaluations

All economic evaluations included direct costs for the year of the MI. Estimates ranged from £1,022 to £33,655.<sup>20,21</sup> The lowest estimate reported costs for Poland<sup>20</sup> and the highest for the US.<sup>21</sup>

**Figure 2. The Cost of a Nonfatal MI in the Year of the Event and of Annual Follow-up From Primary Cost Studies**



### Nonfatal MI Maintenance/Subsequent Years

Of the 47 studies reporting costs for an MI, 27 reported costs for follow-up and maintenance after the year of the event.

#### Primary Cost Studies

Of these 27 studies, 5 were primary cost studies.<sup>15-18,22</sup> Four studies provided estimates for all costs incurred after the year of the event (range, £284-£1,123,<sup>15,16</sup>) (Figure 2). One study provided a state annual cost of £1,605, which could be applied annually to all years following the event.<sup>19</sup>

#### Economic Evaluations

Twenty-two of the 36 economic evaluations included direct costs for MI maintenance/follow-up in subsequent years, and cost estimates ranged from £614 to £5,849.<sup>20</sup>

## Stroke Costs

Forty-six studies reported costs for a stroke in patients with T2DM. Of these, 11 were primary cost studies, and 35 were economic evaluations.

### Fatal Stroke

#### Primary Cost Studies

One of 11 primary cost studies estimated direct costs for a fatal stroke. Clarke et al.<sup>8</sup> included only direct costs, which equated to £6,645.

#### Economic Evaluations

Eighteen of 35 economic evaluations included costs for a fatal stroke. All studies applied these estimates for the year of the stroke. Cost estimates were identified for seven countries and ranged from £72 to £14,721.<sup>22,23</sup> The lowest estimate reported costs for Sweden (no detail on included resources), and the highest for Canada (range, £4,864 to £14,721).

### Nonfatal Stroke/Year of the Event

Of the 46 studies reporting costs for a stroke, 45 studies reported either a cost per nonfatal stroke or a cost for the year of the event. Of these, 10 were primary cost studies and 35 were economic evaluations.

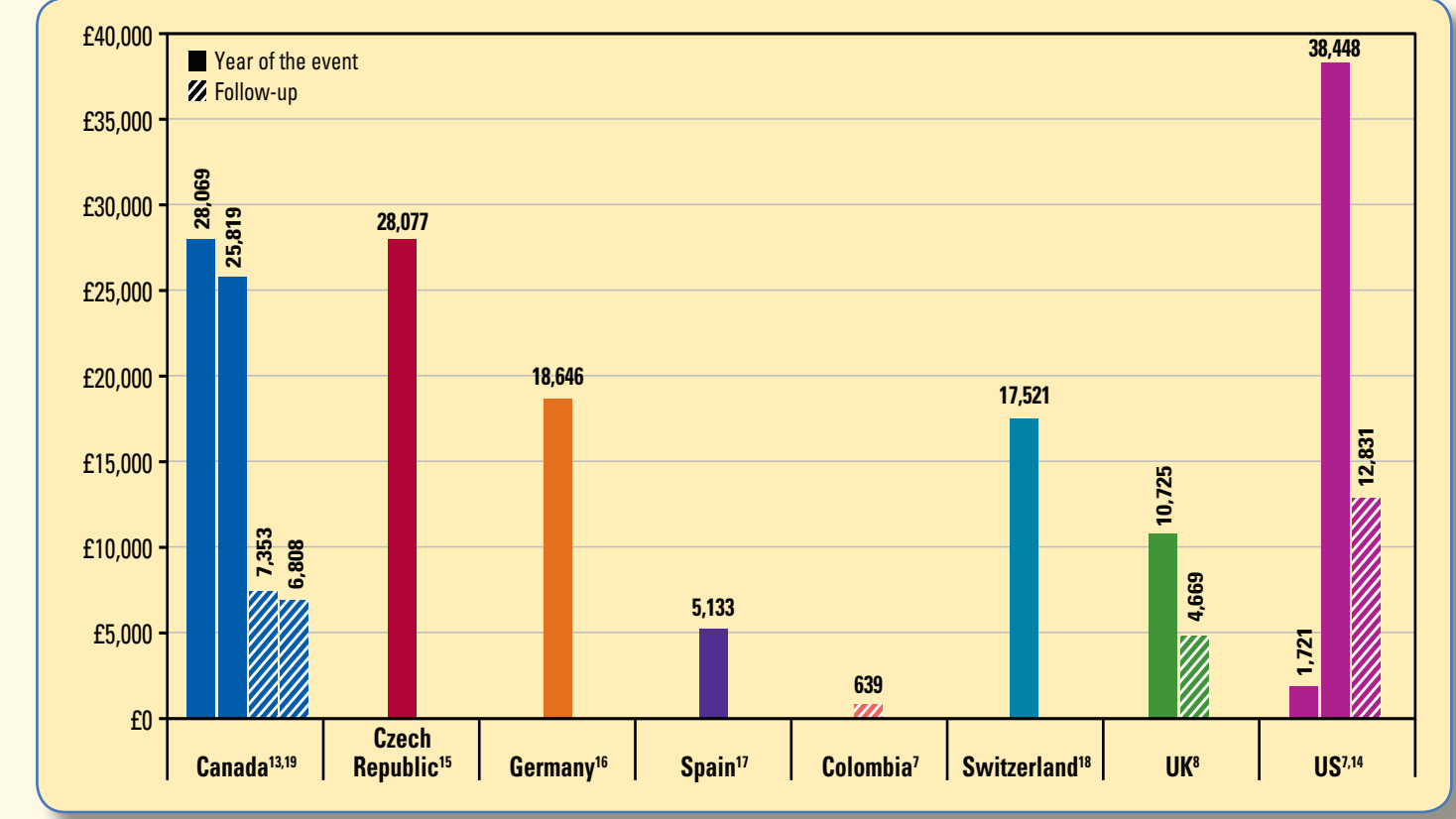
#### Primary Cost Studies

Figure 3 shows the costs identified in 9 of the 10 primary cost studies.<sup>7,8,13-19</sup> The 10th study estimated a national annual cost of £12,713,462 for treatment for patients with T2DM who experience a stroke; the study did not report a per-patient estimate and is not included in Figure 3.<sup>12</sup>

#### Economic Evaluations

All 35 economic evaluations included direct costs for the index year of the stroke. Estimates ranged from £1,008 to £49,680.<sup>20,24</sup>

**Figure 3. The Cost of a Stroke in the Year of the Event and of Annual Follow-up From Primary Cost Studies**



### Nonfatal Stroke Maintenance/Subsequent Years

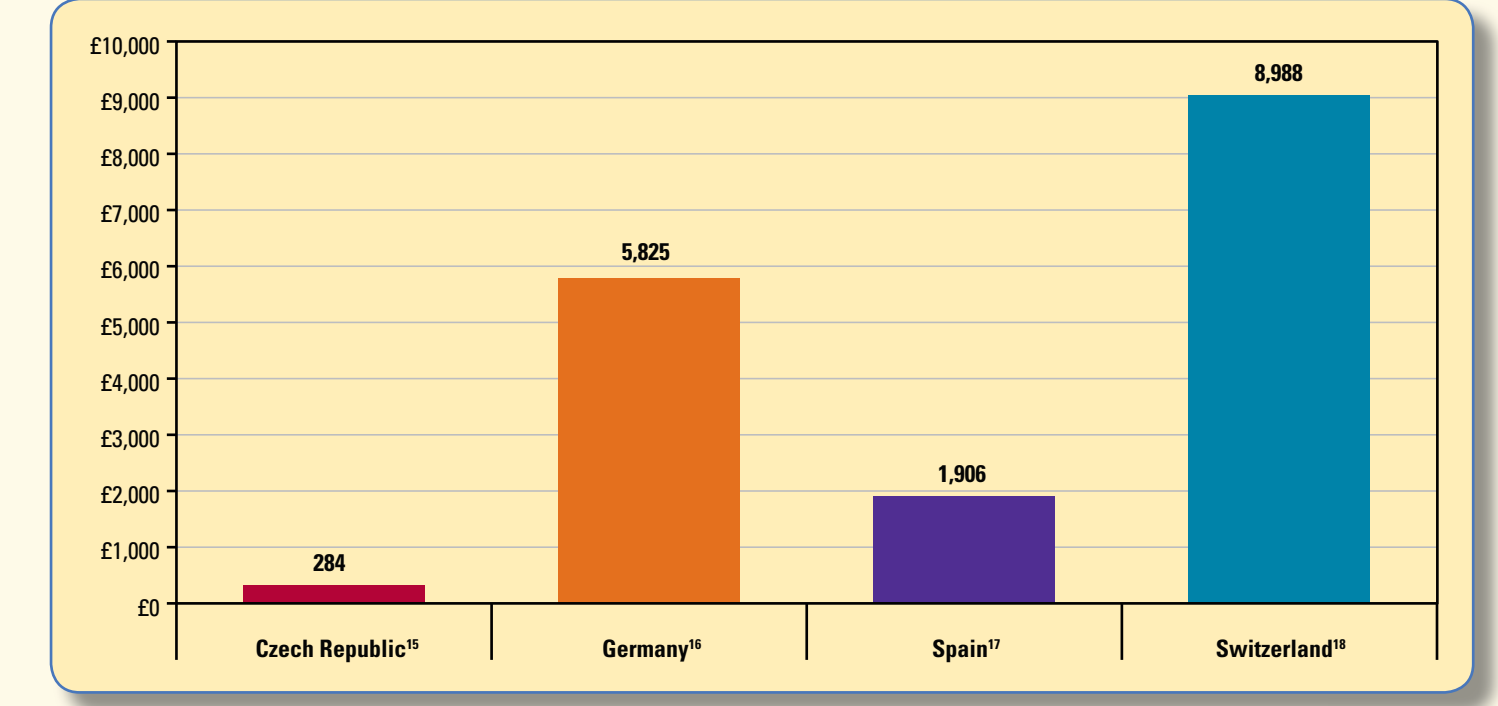
#### Primary Cost Studies

Nine of 11 primary cost studies reported a cost for follow-up/maintenance for the years following the event.<sup>7,8,13-19</sup> Five of the nine studies reported annual costs.<sup>7,8,13,14,19</sup> These estimates ranged from £639 to £12,831<sup>7,14</sup> (Figure 3). Four of the nine studies provided estimates for all costs incurred after the year of the initial event for a mean follow-up of 6.5 years.<sup>15-18</sup> These estimates ranged from £284 to £8,988<sup>15,18</sup> (Figure 4).

#### Economic Evaluations

Twenty-nine of 35 economic evaluations included direct costs for MI maintenance/follow-up for subsequent years. Cost estimates ranged from £345 to £19,587.<sup>9,24</sup>

**Figure 4. The Cost of a Stroke Follow-up (Over Mean Trial Duration of 6.5 Years)**



### Economic Evaluation Data Sources

The source of cost estimates used in the 40 economic evaluations varied, with 10 of the 40 studies using 1 of the primary studies as a source. Four other studies used estimates from studies not specific to patients with T2DM. The remaining 26 economic evaluations used alternative types of sources such as, country-specific tariffs and personal communication.

## LIMITATIONS AND DATA GAPS

### Primary Cost Studies

- None of the identified cost studies reported disaggregated cost components.
- Only one of the identified cost studies reported indirect costs associated with an MI or stroke in patients with T2DM.
- None of the cost studies estimated indirect costs in terms of premature mortality for a fatal MI or stroke.
- None of the studies provided cost estimates for a pediatric population.
- None of the studies identified costs according to the severity of the MI or stroke.

### Economic Evaluations

- None of the economic evaluations identified estimated indirect costs in terms of premature mortality for a fatal MI or stroke.
- Of the 40 economic evaluations identified, only 1 reported indirect costs.<sup>25</sup>
- Thirty-six of the economic evaluations estimated event costs from a cohort of patients with T2DM; the remaining four used costs estimated in studies not specific to patients with T2DM.

## CONCLUSIONS

- Literature on costs for MI and stroke in patients with T2DM is sparse, and studies have been performed in only a few countries.
- The ranges of costs for MI and stroke are broad both within and between countries.
- Further studies are needed to provide reliable cost estimates by severity of MI or stroke in patients with T2DM.
- Further, high-quality cost studies are needed to report disaggregated cost components, which would allow the reader to gain a greater insight into the individual cost components, explore the differences in clinical practice and resource use, and gain insight into true differences between cost estimates.

## FUNDING

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## REFERENCES

Please see handout.

## CONTACT INFORMATION

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