The Economic Impact and Cost-Effectiveness of Glucose Monitoring

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Why Perform Cost-Effectiveness Analyses?

- Resources are limited
- Choices must be made
- Choices should consider costs and outcomes
Value for Money
• What are the costs of self-monitoring of blood glucose (SMBG)?
• What determines the cost-effectiveness of an intervention?
• What is the cost-effectiveness of SMBG?
What are the costs of SMBG?
Annual Per Capita Cost of Diabetic Supplies by Age, U.S., 2007 vs 2012

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>&lt;45</th>
<th>45-64</th>
<th>≥65</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 $ (% total)</td>
<td>77 (2.0)</td>
<td>107 (2.1)</td>
<td>106 (1.1)</td>
<td>102 (1.5)</td>
</tr>
<tr>
<td>2012 $ (% total)</td>
<td>73 (1.7)</td>
<td>98 (1.7)</td>
<td>120 (1.0)</td>
<td>103 (1.3)</td>
</tr>
</tbody>
</table>

ADA. Diabetes Care 31:596, 2008
ADA. Diabetes Care 36:1033, 2013
Total Annual Cost of Diabetic Supplies, US, 2007 vs 2012

2007 ($) 1,783,000,000
2012 ($) 2,296,000,000

(a 29% increase over 5 years)

ADA. Diabetes Care 31:596, 2008
ADA. Diabetes Care 36:1033, 2013
What determines the cost-effectiveness of an intervention?

- Characteristics of the target population
- Effectiveness of the intervention
- Cost of the intervention and cost of outcomes
- Impact of the intervention and outcomes on health-related quality-of-life
Characteristics of the Target Population

- Type 1 diabetes
- Insulin-treated type 2 diabetes
- Non-insulin-treated type 2 diabetes
• SMBG is an integral and necessary part of therapy for patients with type 1 and insulin-treated type 2 diabetes

• SMBG should be available to diabetic patients with non-insulin-treated type 2 diabetes
Additional Characteristics of the Target Population

- Age
- Duration of diabetes
- HbA1c
- Adherence
- Blood pressure
- Cholesterol
- Smoking status
- Complications
Effectiveness of the Intervention

- Change in HbA1c
- Persistence of effect over time
- Time horizon
Cost of Intervention and Complications

- Cost of test strips, lancets, meters
- Frequency of monitoring
- Patient and clinician education
- Data management
- Antidiabetic medications
- Complications
Impact on Quality-of-Life

- SMBG
- Treatments
- Complications
2012 Cochrane Review

Systematic review of 12 randomized controlled trials assessing the effects of SMBG in patients with type 2 diabetes not using insulin

Malanda UL et al. Cochrane Database of Systematic Reviews 2012, Issue 1
How are SMBG data used clinically?  
“Structured SMBG”

Frequency and timing  
- Set regular times over a period of days

Patient knowledge and skills  
- When and why to test, how to use data

Clinician knowledge, skills, and access to data  
- Pattern detection, appropriate medication adjustments

Display of data  
- Easy-to-read online profile sheet

Polonsky WH. Diabetes Care 36:179, 2013
But...

Structured SMBG will substantially increase the costs of SMBG
The Effectiveness of SMBG in Patients with Newly Diagnosed Type 2 Diabetes Not Using Insulin

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. of Studies</th>
<th>No. of Participants</th>
<th>Effect Size (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c @ 12 months follow-up</td>
<td>2</td>
<td>345</td>
<td>-0.52 (-0.89, -0.14)</td>
</tr>
</tbody>
</table>

Malanda UL et al. Cochrane Database of Systematic Reviews 2012, Issue 1
The Effectiveness of SMBG in Patients with Established Type 2 Diabetes (>1 year Duration) Not Using Insulin

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. of Studies</th>
<th>No. of Participants</th>
<th>Effect Size (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c @ 6 months follow-up</td>
<td>9</td>
<td>2,324</td>
<td>-0.26 (-0.39, -0.13)</td>
</tr>
<tr>
<td>HbA1c @ 12 months follow-up</td>
<td>2</td>
<td>493</td>
<td>-0.13 (-0.31, 0.04)</td>
</tr>
</tbody>
</table>

Malanda UL et al. Cochrane Database of Systematic Reviews 2012, Issue 1
Patient-Reported Outcomes

There is no significant evidence that SMBG has a beneficial effect on:

- Health-related quality-of-life (3/3 trials)
- Well-being (4/4 trials)
- Satisfaction (4/4 trials)

Malanda UL et al. Cochrane Database of Systematic Reviews 2012, Issue 1
Hypoglycemia

SMBG increases the frequency of reported asymptomatic and symptomatic hypoglycemia (3/4 trials)

Malanda UL et al. Cochrane Database of Systematic Reviews 2012, Issue 1
Conclusions

• SMBG in patients with newly diagnosed T2DM is effective in lowering HbA1c at one year (-0.52%)

• In patients with established T2DM, introduction of SMBG is effective in lowering HbA1c at six months (-0.26%), but by one year, the effect subsides

• SMBG has no relevant effect on health-related quality-of-life, well-being, or satisfaction

• SMBG increases reported hypoglycemic episodes

Malanda UL et al. Cochrane Database of Systematic Reviews 2012, Issue 1
What is the cost-effectiveness of SMBG in non-insulin treated T2DM?
453 patients randomized to:

- Usual care
- SMBG
- SMBG and training

12-months follow-up

Cost-utility from a health system perspective

Cost-Effectiveness of SMBG in Patients with Non-insulin Treated Type 2 Diabetes: Economic Evaluation from the Diabetes Glycaemic Education and Monitoring Trial Group

## Differences in Costs and Outcomes Over 1 Year

<table>
<thead>
<tr>
<th></th>
<th>SMBG vs Usual Care</th>
<th>SMBG &amp; Training vs Usual Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ cost</td>
<td>£92</td>
<td>£84</td>
</tr>
<tr>
<td>Δ utilities</td>
<td>-0.027*</td>
<td>-0.075*</td>
</tr>
</tbody>
</table>

* due to increased levels of anxiety and depression

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Conclusions

• In patients with non-insulin treated T2DM, SMBG with or without training is associated with higher costs and lower quality-of-life

• SMBG is unlikely to be cost-effective in addition to usual care

Analysis using simulation modeling have reported a wide range of incremental cost-effectiveness ratios.
In analyses using simulation modeling, SMBG is more cost-effective in type 2 diabetic patients not using insulin if...
The target population is:

- Less healthy (higher HbA1c, BP, lipids, etc.)
- More adherent
The effectiveness of the intervention is:
  – Substantial (more HbA1c lowering)
  – Persistent
The cost of the intervention is:

- Low (and monitoring is less frequent)
The quality-of-life impact of the intervention is:

- Positive (for example, improves self-efficacy and does not increase anxiety)

Cameron C. CMAJ 182:28, 2010
Tunis SL. Appl Health Econ Health Policy 9:351, 2011
The frequency and cost of late diabetic complications is:

- High
The quality-of-life impact of late complications is:

- Substantial (complications are associated with large decrement in quality-of-life)
Conclusion regarding the cost-effectiveness of SMBG in non-insulin-treated type 2 diabetes...
“the cost, effort, and time involved in the procedures may be better directed to supporting other health-related behaviors”