Clinical Pearls
- Objective of blood glucose (BG) testing: Inform therapy decisions to help assess the effectiveness of glucose lowering interventions, prevent hypoglycemia, and provide feedback to patients on lifestyle interventions.
- For individuals using insulin ≥1 time/day, SMBG should be used as an essential part of diabetes self-management for T1DM and T2DM.
- If using insulin or secretagogues, consider if cost of SMBG (>50% expenditure for BG strips comes from these payments: "cost shifting"") will result in improved treatment or behavioral change.

<table>
<thead>
<tr>
<th>Type 2 Diabetes</th>
<th>Evidence Summary for SMBG</th>
<th>Bottom Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet alone or prediabetes</td>
<td>SMBG vs no SMBG: Improvements in glycemic control were less pronounced (ΔA1c = 0.05%).</td>
<td></td>
</tr>
</tbody>
</table>

Not using insulin
- Self-testing (>7 times per week) is associated with a statistically significant, but not clinically relevant, improvement (ΔA1c = 0.25%).
- Benefits are small up to 6 mos (ΔA1c = 0.3%) and subside by 12 mos.

Using insulin
- Low-quality evidence suggests the use of SMBG appears to be associated with improvements in glycemic control.
- There is insufficient clinical evidence to determine the optimal frequency of testing but should be individualized.

Table 1: Recommendations for Self-Monitoring Blood Glucose in People with Type 2 Diabetes CADDH '16

Table 2: If self-monitoring blood glucose, when? DC'18 There is no gold standard, reassess often.

Table 3: Consider More Frequent SMBG

To ensure accuracy of meters: Results should be compared with lab measurements of simultaneous venous FBS (8-hour fast) at least annually and not more than once per week.

<table>
<thead>
<tr>
<th>Accu-Chek</th>
<th>7, 14, 30, 90 day averaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile</td>
<td>Connect App &amp; online resource</td>
</tr>
<tr>
<td>Next</td>
<td>For insulin users: calculates bolus dose, no AST.</td>
</tr>
<tr>
<td>Next ONE &amp; 2.4</td>
<td>No strip handling (50 tests on a strip) Integrated lancing device (pocket) Acoustic mode for visually impaired AST: palm, thumb, upper arm, calf, thigh</td>
</tr>
</tbody>
</table>

Accuracy of data: "Variability <15% acceptable".
ONLINE EXTRAS: SELF-MONITORING OF BLOOD GLUCOSE IN TYPE 2 DIABETES

Background considerations:

- **Weighing the benefits & risks of intensive therapy:** [See also Diabetes - Landmark Outcome Trials Chart]
  - The results of clinical trials evaluating outcomes of intensive glycemic control have been somewhat disappointing. Achieving an A1c of less than 6.5% may ↓ microvascular endpoints, but over 100,000 patient years of RCT data have failed to show a benefit on CV endpoints. (The 10 year observational follow-up to the UKPDS suggests CV benefit of intensive glycemic control ([FBG<6]; mean baseline A1c 7.9% vs 8.5%) especially with metformin.)
  - Individualization of antihyperglycemic therapy has become a common theme as some evidence & experience suggests that some patients may do worse with more intensive regimens (e.g. mortality (NNH=95/3.5yrs) in patients randomized to achieve an intensive A1c of 6% vs 7-8%; actual A1c achieved was 6.4% vs 7.5%).
  - Although as an A1c of <7% is suggested for most, individual patient & treatment regimen factors may result in acceptance of less aggressive targets. For example the American Geriatric Society noted that an A1c of 8% may be more suitable in frail elderly & those with a life expectancy <5yrs.
  - A recent observational cohort trial found a "U" shaped curve for mortality related to A1c. An A1c of 7.5% was associated with the lowest mortality, with higher mortality seen at higher and lower A1c values.

If practice changes to reflect the evidence, $450 million to $1.2 billion* could be freed up between 2012 and 2015 for spending on antidiabetes interventions that are proven effective. Patient health would not be affected negatively.

*These results were prepared using data from Brogan Inc., a unit of IMS, PharmaStat®, Public and Private Drug Plans Databases, 2008.

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**A1c**=hemoglobin A1c, **ac**=before meals, **AST**=Alternate Site Testing, **BG**=blood glucose, **CADTH**=Canadian Agency for Drugs & Technologies in Health, **CI**=confidence interval, **COMPUS**=Canadian Optimal Medication Prescribing and Utilization Service, **CV**=cardiovascular, **Eng/Fre**=English and French, **Exp**=Expiration, **Fx(s)**=Function(s), **Glu**=glucose, **IFR**=infrared data transfer, **IP**=Insulin Pump, **Ket**=ketones, **OAHA**=oral anti-hyperglycemic agent, **RCT**=randomized controlled trial, **SMBG**=self-monitor blood glucose pc=after meals, **T2DM**=Type 2 diabetes, **TS**=Touch Screen, **WMD**=weighted mean difference.

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Cost to drug plans public + private = $330 million 2006 Canadian data.
Cost per QALY (quality adjusted life year) is estimated at $113,643 for routine use of SMBG (at least 1 strip each day on average).
Annual cost per patient: $165 - $2,400 (see Table below).

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**Patients with diabetes who are not using insulin**

$317,000,000

**Patients with diabetes who are using insulin**

$183,000,000

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Thanks to CADTH-COMPUS for assistance the development of this document.
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References for SMBG meters:


Malanda UL, Welschen LM, Riphagen I, et al. Self-monitoring of blood glucose in patients with type 2 diabetes mellitus who are not using insulin. Cochrane Database Syst Rev. 2012 Jan 18;181:CDB005690. [From this review, we conclude that when diabetes duration is over one year, the overall effect of self-monitoring of blood glucose on glycemic control in patients with type 2 diabetes who are not using insulin is small up to six months after initiation and subsides after 12 months. Furthermore, based on a best evidence synthesis, there is no evidence that SMBG affects patient satisfaction, general well-being or general health-related quality of life. More research is needed to confirm the importance of psychological impact of SMBG and its impact on diabetes specific quality of life and well-being, as well as the impact of SMBG on hypoglycaemia and diabetic complications.]


Additional articles for SMBG meters:


Cameron, C., Viranti, A., Dean, H., et al. Utilization and Expenditure on Blood Glucose Test Strips in Canada. Canadian Journ...
The evidence and clinical experience available. According to a notice posted on the Ontario Public Drug Programs (OPDP) website, research indicates that Continuous Glucose Test Strips (BGTS) have a limited clinical benefit for many patients who don’t take insulin. Based on this evidence, Ontario will restrict the number of BGTS allowed in a 365-day period, while ensuring continued access to those who need test strips to manage their blood glucose. The province’s Health Network System (HNS) will track and determine the reimbursement level based on each patient’s diabetes treatment. Under the new rules, patients managing diabetes with insulin will be allowed 3,000 BGTS a year, while patients managing diabetes with anti-diabetes medication with high risk of causing hypoglycemia will get 400 BGTS. Patients managing diabetes using anti-diabetes medication with low risk of causing hypoglycemia and those who are managing diabetes through diet/insulin therapy only will be allowed 200 BGTS.


Malanda UL, Welschen LM, Ripphagen II, et al. Self-monitoring of blood glucose in patients with type 2 diabetes who are not using insulin. Cochrane Database Syst Rev. 2012 Jan 18;1:CD005060. [From this review, we conclude that when diabetes duration is over one year, the overall effect of self-monitoring of blood glucose on glycemic control in patients with type 2 diabetes who are not using insulin is small up to six months after initiation and subsides after 12 months. Furthermore, based on a best evidence synthesis, there is no evidence that SMBG affects patient satisfaction, general wellbeing or general health-related quality of life. More research is needed to explore the psychological impact of SMBG and its impact on diabetes specfic quality of life and well-being, as well as the impact of SMBG on hypoglycemia and diabetic complications.]


