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## Cost-Effectiveness of Self-Monitoring of Blood Glucose in Type 2 Diabetic Patients Not Receiving Insulin

Response to Davidson

In his counterpoint article, Davidson (1) argues that self-monitoring of blood glucose (SMBG) in type 2 diabetic subjects not using insulin is a waste of money. However, as the discussions accompanying and following publication of a new meta-analysis by Welschen et al. (2) demonstrate, the evidence is far from conclusive either for or against use of SMBG in this patient group.

As pointed out by Ipp et al. (3), many of the trials of SMBG conducted thus far have been underpowered to detect a significant impact and therefore individually cannot reliably conclude that SMBG does or does not influence HbA<sub>1c</sub> (A1C). In an attempt to bring some clarity to the current situation, Welschen et al. performed a meta-analysis based upon pooling of more recent randomized trials with the conclusion that SMBG affords a modest but significant 0.39% reduction in A1C. According to Davidson, even if this effect is clinically relevant, it is likely to be outweighed by the cost of providing SMBG. To accurately answer that claim, we undertook a cost-effectiveness analysis of SMBG using a Markov state model of diabetes to assess the clinical impact and related cost when SMBG is provided to non-insulin-requiring patients within the German health care system. Assuming a modest improvement in A1C of 0.39%, the result was a slight increase in life expectancy (0.083 years) and reduced cost of complications (70% attributable to microvascular events). This finding is in line with the results of the U.K. Prospective

Diabetes Study, in which a 1% reduction in A1C corresponded to a reduction in complications (4). In our analysis, the cost per life-year gained was ~€31,000 and therefore, from a health insurance perspective, acceptable. Over a 10-year period and taking into consideration cost savings due to reduced complications, SMBG employed at a frequency of seven times/week would account for ~6% of the total direct costs covered by health insurance.

While current evidence is not perfect, it supports, on both clinical and economic grounds, the use of SMBG in type 2 diabetic subjects not using insulin. Therefore, it would be premature to consider withdrawal of this treatment option. As noted by Ipp et al. (3), now is the time for industry to fund large multicenter trials with sufficient power to confirm the findings obtained by pooling small randomized controlled trials.

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## Cost-Effectiveness of Self-Monitoring of Blood Glucose in Type 2 Diabetic Patients Not Receiving Insulin

Response to Neeser et al.

Neeser et al. (1) challenge my argument that self-monitoring of blood glucose (SMBG) in type 2 diabetic patients not taking insulin is not beneficial for lowering glycemia and therefore is a waste of (a lot of) money (2).

In a meta-analysis of six randomized controlled trials, Welschen et al. (3) found a significant reduction of 0.39% in HbA<sub>1c</sub> (A1C) levels in type 2 diabetic patients not taking insulin who performed SMBG. Welschen et al. did point out that the reduction was only significant in two of the trials and that the conclusion that SMBG was beneficial “should be interpreted with caution, as the methodological quality of the trials . . . was limited in four of the six included studies.” A large number of nonrandomized studies were also negative (2,3). Be that as it may, Neeser et al. (1), using a Markov model on data from the German health care system, state that a 0.39% reduction of A1C levels resulted in a 30-day (0.083 years) increase of life expectancy and “reduced cost of complications (70% attributable to microvascular events).” The cost per life-year gained was ~€31,000 (or \$36,400) and “therefore, from a health insurance perspective, acceptable.” They conclude that it is “premature to consider withdrawal of this treatment option” and suggest that industry should fund large multicenter trials to determine whether SMBG is helpful in this situation.

Several points can be made in response. Although we are not given the costs of SMBG in non-insulin-requiring patients in the German health care system, I would emphasize that in the U.S., a conservative estimate of the cost of SMBG in these patients is nearly \$1.5 billion/year (2). This is a tremendous amount of money for an activity for which there is little (to be charitable) or no evidence for a beneficial outcome. If this were a drug, it certainly would not have received Food and Drug Administration approval. In a sense, therefore, SMBG in patients not taking insulin represents a very expensive “off-label” use. Of course, calls for larger

studies are usually appropriate, but realistically speaking, why would industry fund studies that have an excellent chance of showing what a number of smaller studies have already shown, especially since they are making a lot of money in that market already? And, if a larger study were negative, wouldn't there be cries to do even larger ones? After all, one can really never prove a negative. There is always the possibility that another slight twist or an even larger study could be positive. If it takes a very large number of subjects to show a significant positive result, the clinical benefit must be difficult to uncover. At some point, one has to conclude that enough is enough and we have to accept the results at hand. In the meantime, large amounts of money are being diverted from better uses in our health care system.

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## An Evaluation of the Efficacy of Methods Used in Screening for Lower-Limb Arterial Disease in Diabetes

Response to Williams et al.

We have read with interest the report by Williams et al. (1) on diabetic limbs without critical ischemia. We have recently performed a

similar study in 106 diabetic patients with polyneuropathy, 61 of whom had critical ischemia (2), which confirms the poor performance of ankle-brachial pressure index in these patients (1,2). At variance to Williams et al. (1), we were, however, able to demonstrate the usefulness of the pulsatility index to predict critical ischemia. A pulsatility index <1.2 recorded at the ankle arteries predicted critical limb ischemia with reasonably good sensitivity (0.87) and specificity (0.62); the positive and the negative predictive values were 0.64 and 0.86, respectively. We explain our differences to the findings of Williams et al. by the different Doppler devices that were employed. While Williams et al. had used a 8-MHz Doppler probe (1), we used a 10-MHz linear ultrasound probe with a color-flow duplex machine (Accuson 128XP10; Acuson, Mountain View, CA) in our study.

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## An Evaluation of the Efficacy of Methods Used in Screening for Lower-Limb Arterial Disease in Diabetes

Response to Janssen and Chantelau

We thank Janssen and Chantelau (1) for their interest in our study (2), which analyzed the efficacy of several commonly used lower-limb arterial screening modalities in diabetes.

We demonstrated that qualitative, operator interpretation of the continuous Doppler waveform at the ankle for limbs without critical ischemia was more sensitive than quantitative analysis in detecting peripheral arterial occlusive disease. In our hands, qualitative waveform analysis achieved a sensitivity of 94% and specificity of 66% in the presence of clinically detectable peripheral neuropathy. Pulsatility index and other quantitative waveform analyses invariably failed to detect more severe peripheral arterial occlusive disease, with an overall sensitivity of 52%. In your study of limbs with and without critical ischemia, pulsatility index was demonstrated to achieve greater sensitivity at 87% (3).

There appear to be two fundamental differences between the respective studies. First, this study focused on the ability of commonly used screening methods to detect hemodynamically significant arterial disease not their ability to predict the presence of critical ischemia. Patients with critical ischemia were therefore excluded from our study. Further, we employed a relatively simple, single-crystal, continuous waveform analyzer and not a more complex device with a linear crystal array and color-flow facility. Color duplex imaging with waveform analysis of the lower limb has been demonstrated to be effective in detecting peripheral arterial occlusive disease (4). Our study used this modality as a gold standard not as a screening modality.

It is not surprising, therefore, that the results of quantitative analysis differ between the two studies.

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