Recommendation from the Danish Health Technology Council concerning

Glucose monitoring for the treatment of adult patients with type 1 diabetes

Recommendation from the Danish Health Technology Council:
The Danish Health Technology Council recommends that sensor-based glucose monitors with alarms be offered in the treatment of all adult patients with type 1 diabetes.

About this recommendation:
The recommendation is based on the fact that the use of sensor-based glucose monitors with alarms lead to pronounced positive clinical effects, and that the technology results in improved health for patients with diabetes. In addition, sensor-based glucose monitors increase patients' treatment satisfaction, disease insight, and quality of life. However, the Council stresses that individual patient needs should be considered when choosing a glucose monitoring method and that the finger-prick method should remain available to all patients.

The Council notes that there is currently a non-uniform practice in the allocation of sensor-based glucose monitors across the country, and therefore recommends that sensor-based glucose monitors be offered in a uniform national model to ensure equal access to the technology.

The Council notes that it is a prerequisite for safe use of the equipment, and thus patient safety, that patients receive training in the use of sensor-based glucose monitors.

The Council sees potential in sensor-based glucose monitors increasing the possibility of patients' active involvement in their own treatment. This may substantiate a development within diabetes treatment, where the need for contact with clinicians is reduced.

The Council encourages the Danish regions to continuously monitor how consultation patterns are influenced by the use of the sensor-based glucose monitors. The Council calls on the producers of the sensor-based glucose monitors to contribute to the improvement of the sensors' compatibility with the electronic patient records.

The Council draws attention to the fact that the budget impact analysis only describes regional expenditures. Expenses in the municipalities are not included in the analysis.

About the technology	Sensor-based glucose monitors with alarm are patient-controlled monitors that are used to measure the glucose level in the interstitial fluid and allow the patient to access the information on a digital reader or mobile phone. The sensors can alert the user if the blood glucose level deviates from the normal range.
Patient population	This recommendation concern adult patients (≥19 years) with type 1 diabetes mellitus. The patients are treated with insulin either through an insulin pump or through subcutaneous insulin injection with a pen. The analysis posits that the patient population is motivated and manages the monitoring of their blood glucose themselves.
Scope	This recommendation applies to Danish public hospitals.
Implementation	The Danish Health Technology Council notes that implementation of the recommendation requires the supply or putting aside funds for the purchase of sensors. The Danish Health Technology Council further notes that the recommendation is expected to result in an increased draw on resources at the country's diabetes clinics and Steno Diabetes Centres. This remark is based on the expectations that: • More patients are expected to start using the sensor, some of which will have to go through a training course prior to the allocation of the sensor and for whom the need for contact is expected to be higher in the first year(s) after allocation. It is expected that personnel resources will have to be allocated to this. • There will be a need for an initial and ongoing training of the personnel responsible for patients' treatment, so that they possess relevant competences for the use of a technology which is in constant development. In the same way, it may be necessary to allocate resources for ongoing technical support of the users. • The ongoing administrative work with the allocation of sensors requires IT-systems that can support this, including the possibility of conducting ongoing quality control, handling of complaints, etc. If a rapid implementation of the recommendation is desired, this will likely result in an even higher draw on, among other things, personnel resources. For these reasons, implementation of the recommendation should result in

additional resources for staff and supporting administrative systems, in order to provide education to the expected number of patients. It may also be relevant to standardize the education courses across the country.

The Danish Health Technology Council also notes that there is potential for improvement in relation to handling, including uploading and integration into the electronic patient record, etc., of data from the sensor-based glucose monitors to practitioner-controlled platforms.

Finally, the Danish Health Technology Council notes that, in connection with the implementation of the recommendation, it is relevant to share knowledge with organizations that have already gained experience with the tasks that arise and are expanded, by scaling up the supply of sensors as treatment tools.

Tendering procedure	A renewal the national tender at the end of the existing joint regional agreement is proposed.

Summary of the analysis report

About the analysis

This recommendation from the Danish Health Technology Council is based on the expert committee's analysis report regarding the use of glucose monitoring methods for the treatment of adult patients with type 1 diabetes. The purpose of the analysis is to answer the following question:

Should sensor-based glucose monitors be offered as treatment tool to all adult patients with type 1 diabetes?

Clinical effectiveness and safety

The analysis of clinical effectiveness and safety includes 24 papers reporting the results from 12 studies. Based on the findings regarding the clinical effectiveness and safety, the expert committee concludes that the use of sensors entails important clinical and patient-relevant effects.

The expert committee attaches great importance to the findings regarding the outcome 'time in range' (TIR), where sensors lead to a clinically relevant difference in effect compared to the finger prick method. Furthermore, the included literature demonstrates clinically relevant differences in the outcomes 'HbA1c' and 'non-serious hypoglycaemic events' in favour of sensors. The use of sensors also affects the outcome 'glycaemic variability', by a significant reduction compared to the finger prick method, but this does not exceed the established minimally clinically important difference. For the outcome 'severe hypoglycaemic events' and 'fear of hypoglycaemia', no difference in the effect could be demonstrated between sensors and the finger prick method. However, due to the limited evidence base, the expert committee considers that this result cannot be transferred to the general population.

Overall, the analysis shows that sensors are associated with significant benefits in terms of clinical effectiveness and safety. The expert committee attaches great importance to the findings regarding TIR and HbA1c, and at the same time points out that all other outcomes, that are supported by evidence, are positively affected by the use of sensors. For several of these outcomes, a clinically relevant effect is demonstrated, and for others a positive trend is seen in the effect of sensors. This contrasts with other efforts, where achieving the HbA1c target has been limited by the risk of deterioration in other parameters.

The quality of the evidence varies across the outcomes. For the outcomes TIR and ‘non-severe’ hypoglycaemia the quality of the evidence is judge to be ‘moderate’. For severe hypoglycaemia the evidence is judge to be of ‘low’ quality in regards to GRADE. The remaining outcomes are judged to consist of ‘very low’ quality evidence. The low quality of the evidence for the outcome HbA1c imparts uncertainty in the *cost utility* analysis (CUA), as this is outcome is used to estimate the occurrence of diabetes-related complications.

The expert committee assesses that the use of sensors provides a significantly better clinical effect and safety than the finger prick method.

Patient perspective

Glucose monitoring is a prerequisite for patients with T1DM. The type of glucose monitoring method affects many aspects of daily life. The literature indicates that

the use of sensors, compared to the finger prick method, can alleviate some of the challenges that patients with T1DM experience in managing their disease. However, the use of sensors cannot solve all challenges and is not without errors and shortcomings. Their everyday life is particularly affected by the following diabetes-related themes in different ways the use of the different glucose monitoring methods:

- The glycemic control
- Self-assurance in taking care of their own diabetes treatment
- The insight into one's own body and health
- The social life
- Visibility of the disease to the surrounding world
- The night's sleep
- The ability to exercise
- The degree of diabetes distress

In the literature, and through the survey carried out by the Danish Health Technology Council, both positive and negative aspects have been identified in the use of both sensors and the finger prick method. The expert committee assesses that there are considerably more advantages of using sensors than disadvantages and that these outweigh the disadvantages, and that there are more advantages to using sensors compared to the finger prick method. The expert committee adds that the choice of glucose monitoring method should always take the patient's preferences into account.

In the survey carried out by the Danish Health Technology Council, the majority of respondents (75%) preferred the use of sensors over the finger prick method. However, about 10% of the respondents preferred to use the finger prick method. In accordance with this, it is the expert committee's assessment that a large proportion of the patient population with T1DM would prefer the use of sensors over the finger prick method as their glucose monitoring method if they had the choice.

The overall picture that is formed by reviewing the literature and the newly acquired empirical evidence is that the use of sensors for a large part of the patient population with T1DM makes everyday life and glucose monitoring easier and safer, and can support healthy habits, and that the patients achieve a better quality of life.

Organisational implications

The expert committee finds that, despite a joint regional guideline on the topic, there are different practices for the provision of sensors across the Danish regions. This is particularly evident in the variation in the proportion of the patient population that has a sensor as a treatment tool in the individual regions. In addition, the proportion of patients who have sensors provided as auxiliary tool in the municipalities varies substantially. The expert committee notes that the field is progressing rapidly, and that the estimated proportions of provided sensors must therefore be regarded as point estimates in a rapidly developing field.

The expert committee notes that the rapid development in the provision of sensors expectedly is caused by several aspects, including the clinicians' primary focus on offering the best possible treatment in relation to the patient's needs. The expert committee considers that the evidence presented substantiates that

	the use of sensors contributes to optimization of the treatment. The expert committee notes that the influence that optimization of the treatment is expected to have on everyday life, is in accordance with the findings in the patient perspective. The expert committee notes the sensors' potential of optimization of the treatment, but at the same time assesses that it will in all likelihood also have local organizational implications in the event of a positive recommendation on the use of sensors as a treatment tool. This is because the use of sensors will likely affect the patient contacts in terms of both the number, type, and duration of consultations. The expert committee notes that it is currently not possible to identify how the resource consumption will be affected in the long term, but assesses, based on its own experience and on the respondents' answers, that a greater resource consumption will be expected in the first year, when patients begin using the sensor. In continuation of this, the expert committee notes that it is not expected that there will be a sectoral move or displacement of work tasks, although an impact on the use of personnel resources must be expected. In the expert committee's interviews of healthcare personnel, great support for the use of sensors for the treatment of patients with T1DM was found. The expert committee assesses that the interviewees are representative of clinicians in all regions. There was a consensus that the use of sensors generally affects patient contact positively by enabling better insight into the glycemic values with a subsequent possibility of improving treatment, as well as more meaningful dialogue with and education of the patients. However, some respondents also noted that the increased amount of data can be more complex to interpret. On the one hand, it requires more time for analysis for the clinicians, on the other hand it forms the basis for better treatment in collaboration with the patient. There was a consensus among the interviewees that training in the use of the sensors is important for the patients to use the sensor technology appropriately. Based on the interviewees' responses, however, the expert committee also notes that patient education is nevertheless carried out significantly differently across the country. The expert committee notes that it may be necessary to allocate additional personnel resources to oversee training courses in the use of sensors, if there is a positive recommendation for the use of sensors as a treatment tool and at the same time a rapid implementation of the recommendation.
Health economics	Based on the results of the health economic analyses, the expert committee assesses that the use of sensors generates high value in relation to the patients' quality of life and clinical effect relative to their economic consequences, compared to the finger prick method. Cf. the cost-utility analysis (CUA) the use of sensor dominates the use of the finger prick method with a smaller cost accumulation (-DKK35,364) and higher effect (1,670 quality-adjusted life years). The expert committee notes that the result of the CUA reflects that sensors are both clinically better and cost-effective in the long term compared to the finger prick method. In the cost-effectiveness analysis, the use of a sensor leads to higher effect (difference in TIR of 7.05% points), but also higher cost accumulation (difference: DKK 9,156), which corresponds to an average increase in TIR of 1 hour

and 41 minutes per day during the first year after start-up at an annual additional cost of DKK 9,156 when using a sensor instead of the finger prick method.

The budget impact analysis showed that a positive recommendation of the use of sensors as a treatment tool will result in a budgetary impact of DKK143 million over a five-year period. The expert committee draws attention to the fact that the budget impact analysis exclusively describes the additional regional expenses associated with a positive recommendation, cf. the framework for the Danish Health Technology Council's budget impact analysis. However, a positive recommendation will also be expected to reduce municipal expenses associated with glucose monitoring, which the analysis does not reflect.

Applicable to the results of both the health economic analyses and the budget impact analysis is that the costs of sensor technology are weighted based on the estimated consumption pattern of the sensors that are included in the current joint regional tender. If the use of sensors as a treatment tool changes differently than estimated for the analyses, the expert committee draws attention to the fact that the results of the analyses may change significantly. The same will happen if the consumption pattern in relation to the different types of sensors changes, or if substantial price changes occur.

The quality of evidence

Clinical effectiveness and safety:
Based on the GRADE[1]-assessment, the quality of the evidence varies across outcomes from 'moderate' for TIR and non-severe hypoglycaemia, to 'low' for 'severe' hypoglycaemia and 'very low' for HbA1c, fear of hypoglycaemia and glycaemic variability. The varying quality of evidence means that there is uncertainty about the size of the effect of the sensors, and that new research can potentially change the results.

The patient perspective:
No formal assessment of the quality of evidence of the included scientific literature has been performed, as the literature was used to identify and illuminate themes that are important to life with T1DM and where the use of sensor and the finger prick method can be expected to differ in significance.

The survey carried out by the Danish Health Technology Council and used in the perspective had a limited population sample, and it cannot be assessed whether its results are representative of all persons with T1DM.

Organizational implications:
As the majority of the evidence base does not consist of scientific literature, no formal assessment of the quality of the evidence for the organizational implications has been performed.

Health economics:
No formal assessment of the quality of evidence has been carried out for the perspective regarding health economics, as no scientific health economic studies have been identified that could be used to answer the two research questions herein.

[1] GRADE: Grading of Recommendations Assessment, Development and Evaluation

About the recommendation from the Danish Health Technology Council

The Danish Health Technology Council's recommendation is intended as an aid for regions when deciding on the use of a given health technology or with regard to organising a treatment area. The analysis report includes a review of the following perspectives: 1) clinical effectiveness and safety, 2) patient perspective, 3) organisational implications and 4) health economics.

This recommendation is based on the Danish Health Technology Council's analysis report regarding glucose monitoring methods in the treatment of adult patients with type 1 diabetes, which was prepared collaboratively by the expert committee and the secretariat. The analysis report was prepared with outset in the analysis design and the Danish Health Technology Council's process guide and methodological guidelines. These documents as well as the expert committee's terms of reference are available on the Danish Health Technology Council's website.

Information about this document		
Approved by the Council: Document number: Version number:	23.03.2023 Version number from ESDH: 5543 1.1	
Version no.:	Date:	Amendment(s):
1.1	May 4 2023	Correction to the result of the budget impact analysis, cf. an update of the analysis report
1.0	March 23 2023	Approved of the Danish Health Technology Council