Haemoglobin A1c (HbA1c) — a term that is sometimes used interchangeably with "glycated haemoglobin") measurements are an indicator of time-averaged blood glucose levels (previous 2–3 months), and are used as the best marker of long-term diabetes control. A recent consensus statement on the worldwide standardisation of HbA1c measurement has updated previous international recommendations on the standardisation of HbA1c measurement and reporting. Here, we provide the rationale and guidance for implementation of HbA1c reporting in the new Système International (SI) units in Australia. This article represents the views of the Australasian Association of Clinical Biochemists, the Australian Diabetes Educators Association, the Australian Diabetes Society and the Royal College of Pathologists of Australasia, and was prepared by a working party of representatives of these organisations.

The International HbA1c Consensus Committee recommends that all HbA1c levels be reported in SI units (mmol/mol, no decimal places) — with results directly traceable to the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) reference method — and in the currently used, National Glycohemoglobin Standardization Program (NGSP) units (percentage, one decimal place). We recommend that dual reporting in Australia begins in July 2011, and that reporting of percentages ceases one decimal place). We recommend that dual reporting in Australia begins in July 2011, and that reporting of percentages ceases 2 years later. In New Zealand, dual reporting commenced in August 2009.

The key reasons for implementing this recommendation in Australia are that:

- the SI units relate to a scientifically valid measure of HbA1c;
- the SI units remove potential confusion between HbA1c values as a percentage and blood glucose values in mmol/L;
- the change is in keeping with the international consensus statement; and
- the change has already been initiated in New Zealand and a number of countries in the European Union.

Until now, all HbA1c measurements performed in Australia have been reported as percentages (HbA1c as a percentage of total haemoglobin) that are aligned with those produced in the Diabetes Control and Complications Trial. These units and this standardisation have been promoted by the NGSP in the United States, and the activities of this organisation have produced marked improvement in the accuracy of HbA1c results worldwide. More recently, the IFCC has developed a reference method that is more specific for HbA1c and more analytically robust. The IFCC method is now used as the reference system by the NGSP and for all routine methods for measurement of HbA1c, although a numerical conversion is required during the calibration process. The changes recommended here will provide results that are directly aligned with the IFCC method. As the IFCC method is more specific for HbA1c, not measuring several other haemoglobin–sugar complexes, the results are 10% to 40% lower than those from the NGSP system, depending on HbA1c concentration. Because reporting these results as percentages may lead to confusion (eg, producing a result of 5.3% rather than 7.0%), the units are changed to mmol/mol (millimoles HbA1c per mole of total haemoglobin [53 mmol/mol in the previous example]), which is consistent with the SI units recommended for use in Australia.

There is a linear relationship between results from the two methods, and the “master equation” is used to convert results between the two methods: HbA1c SI unit (mmol/mol) = 10.93 x HbA1c NGSP unit (%). To make the conversion easier for clinicians, it is important to translate current treatment advice to the new units. A general conversion table for clinical use is provided in Box 1. The general HbA1c target of 7.0% for patients with type 1 and type 2 diabetes mellitus equates to ≤ 53 mmol/mol, although these values need to be individualised for patients. The recently updated diabetes treatment guidelines are shown with SI units in Box 2 and Box 3, and recommendations for reporting HbA1c levels in Australia are summarised in Box 4. In addition, supporting material for doctors and patients will be presented in SI units in the future.

The routine reporting of an estimated average glucose (eAG) value may be useful for consultations with individual patients. However, the working party strongly agrees with the revised consensus statement that routine reporting of eAG with all requests for HbA1c analysis is not appropriate. The reasons for this include variability in the methods used to measure eAG, the risk of confusing a measure of long-term glycaemia (eAG) with a measure of short-term blood glucose control (actual blood glucose level), and its lack of applicability in the majority of patients with type 2 diabetes (in whom blood glucose levels are not measured at frequent intervals). Nonetheless, eAG values will be used as an eduka-

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**1 Conversion table for haemoglobin A1c (HbA1c) values**

<table>
<thead>
<tr>
<th>HbA1c as percentage (old units)</th>
<th>HbA1c in mmol/mol (new units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>31</td>
</tr>
<tr>
<td>6.0</td>
<td>42</td>
</tr>
<tr>
<td>6.5</td>
<td>48</td>
</tr>
<tr>
<td>7.0</td>
<td>53</td>
</tr>
<tr>
<td>8.0</td>
<td>64</td>
</tr>
<tr>
<td>9.0</td>
<td>75</td>
</tr>
<tr>
<td>10.0</td>
<td>86</td>
</tr>
<tr>
<td>11.0</td>
<td>97</td>
</tr>
<tr>
<td>12.0</td>
<td>108</td>
</tr>
</tbody>
</table>

ABSTRACT

- An international consensus statement recommends that dual reporting of haemoglobin A1c (HbA1c) levels — in the current units (percentage) and Système International (SI) units (mmol/mol) — be used as an interim measure for a 2-year transition period before progressing towards the use of SI units only.
- This recommendation is supported by the Australasian Association of Clinical Biochemists, the Australian Diabetes Educators Association, the Australian Diabetes Society and the Royal College of Pathologists of Australasia.
- The SI units are a true measure of HbA1c, and remove potential confusion between HbA1c values and blood glucose values.

MJA 2011; 195: 45–46

Graham RD Jones, George Barker, Ian Goodall, Hans-Gerhard Schneider, Mark DS Shephard and Stephen M Twigg
Achievement of HbA1c targets must be balanced against risk of severe hypoglycaemia. Where practical, suggest blood glucose target level < 15 mmol/L (American Heart Association grading); incurable malignancy; and moderate to severe hypoglycaemia, especially among older people. Examples of major comorbidities include chronic medical conditions, such as developing type 2 diabetes at a young age, it might be considerably longer. The duration might be considered to be > 10–20 years, but for a person who develops type 2 diabetes at a young age, it might be considerably longer. Examples of major comorbidities include chronic medical conditions, such as chronic kidney disease stages 4 or 5, heart failure stages III or IV (New York Heart Association grading); incurable malignancy; and moderate to severe dementia. Where practical, suggest blood glucose target level < 15 mmol/L to help minimise risk of infection.

### Competing interests

Graham Jones has received travel expenses from Roche Diagnostics and Bio-Rad, and his institution has received research support (not related to this article) from Roche Diagnostics. Stephen Twigg has received payment for advisory board membership from Sanofi-Aventis, Novartis and Novo Nordisk, and has received speaker fees from GlaxoSmithKline and Eli Lilly. His institution has received a grant from the Novo Nordisk Regional Diabetes Support Scheme. Hans-Gerhard Schneider has received payment, paid to his institution, for providing consultancy to Amgen and for providing expert testimony relating to legal cases, and has also received grants, paid to his institution, from Janssen-Cilag and Boisite. Mark Sheppard has received a research grant from Siemens and payment to cover airfare and accommodation to attend a Siemens conference, all paid to his institution.

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### References


Provenance: Not commissioned; externally peer reviewed.

*(Received 21 Feb 2011, accepted 30 May 2011)*

See page 7.