DIABETES	**National Clinical Programmes for Diabetes and the Irish Diabetes Nurse Specialists Association**	IDNSA Irish Diabetes Nurse Specialist Association

National Insulin Titration Guideline for Nurses working with People with Diabetes who require Subcutaneous Insulin Injections

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Office of the Nursing & Midwifery Services Director

ROYAL COLLEGE OF PHYSICIANS OF IRELAND

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Disclaimer

This guideline represents the view of the National Clinical Programme for Diabetes and was arrived at following careful consideration and consultation with stakeholders. The expectation of the National Clinical Programme for Diabetes is that healthcare professionals will use clinical judgement, medical and nursing knowledge in applying the general principles contained in this document. The principles may not be appropriate in all circumstances and decisions to adopt specific principles should be made by the practitioner taking into account the circumstances presented by people with diabetes and available the resources.

1.0 Guideline statement / introduction

This guideline aims to support and assist nurses who are experienced in managing people with diabetes 16 years and over on how to titrate their insulin dosage in the :

- acute hospital setting
- outpatient/ambulatory care department
- community

In conjunction with local IT policy by:

- direct consultation
- telephone
- email
- fax
-

Blood glucose levels are influenced by many factors including illness, stress, activity and certain medication. The person with diabetes may seek expert advice to reduce the risks of hypoglycaemia, prolonged hyperglycaemia and ketoacidosis.

2.0 Purpose of guideline

The ethos of diabetes care is self management. However, people with diabetes require the support of diabetes nurses while they learn the skills of insulin titration. These guidelines aim to support diabetes nurses working in the area of diabetes care.

3.0 Scope of guideline

These guidelines are applicable to all registered nurses working in diabetes care with people with diabetes (16 years of age and older) and **who have already been prescribed insulin**. All nurses must be deemed competent to titrate insulin by their Director of Nursing/Midwifery.

This guideline is designed to provide the basis of a local policy document which must be agreed with the employer.

The guideline does **not** address the management of:

- Sick days and ketone management
- Steroids and other medications which may influence blood glucose levels
- Continuous subcutaneous insulin infusion pumps
- Insulin titration during pregnancy
- Children under the age of 16

4.0 Definitions

- **Registered Nurse:** A person whose name is entered in the relevant division of the live register of nurses and midwives with the Nursing and Midwifery Board of Ireland/An Bord Altranais agus Cnáimhseachais na hÉireann.
- **Registered Nurse Prescriber:** A nurse or midwife who is registered in the relevant division of the register of nurse prescribers of Nursing and Midwifery Board of Ireland/An Bord Altranais agus Cnáimhseachais Na hÉireann.
- **Clinical Nurse Specialist - Diabetes:** A nurse or midwife who is registered with the Nursing and Midwifery Board of Ireland/An Bord Altranais agus Cnáimhseachais na hÉireann and who has been approved or on the register as being a Clinical Nurse Specialist in Diabetes with the Nursing, Midwifery Planning and Development Units.
- **Scope of practice:** The range of roles, functions, responsibilities and activities in which a registered nurse is educated, competent and has autonomy to perform (Nursing and Midwifery Board of Ireland/An Bord Altranais agus Cnáimhseachais na hÉireann, 2000)
- **Insulin:** Insulin is a hormone secreted by the beta cells of the islets of langerhans in the pancreas which promotes glucose use, protein synthesis and the formation and storage of neutral lipids (Steadman 2008)
- **Titration:** Where medication has been prescribed within a range of dose, it is acceptable for registrants (nurses, midwives and specialist community public health nurses) to titrate doses according to patient response and symptom control and to administer within the prescribed range (Nursing and Midwifery Council UK, 2010)
- **Hyperglycaemia:** Hyperglycaemia refers to an elevated blood glucose level (>10mmo/L) due to a relative or absolute insulin deficiency (Dunning, 2003)
- **HbA_{1c} (Glycated Haemoglobin):** The attachment of glucose on haemoglobin over the lifetime of red blood cells, it is a measure of average glucose control over the preceding weeks and months (Pickup and Williams, 2011)
- **Type 1 diabetes:** Type 1 diabetes is characterised by autoimmune, cell-mediated, selective destruction of the insulin-producing beta cells of the pancreatic islets in genetically predisposed individuals (Krentz, 2000)
- **Type 2 diabetes:** Type 2 diabetes is characterised by a relative deficiency of endogenous insulin in the presence of impaired insulin action, leading to increased hepatic glucose production and decreased insulin-mediated glucose uptake due to post-receptor defect in muscle (Krentz, 2000)
- **Hypoglycaemia:** In diabetes mellitus, hypoglycaemia occurs when blood glucose levels fall bellow 4.0mmol/L (Royal College of Nursing, 2012).

- **Ketones:** Ketone bodies are produced by the liver and used peripherally as an energy source when glucose is not readily available (Laffel, 1999)
- **Diabetic ketoacidosis (DKA):** DKA results from absolute or relative deficiency of circulating insulin and the effects of increased levels of the counter regulatory hormones i.e.catecholamines, glucagon, cortisol and growth hormones (Foster and McGarry, 1983; Kitabchi et al, 2009).
- **Hypoglycaemia unawareness:** The clinical phenomenon of loss of awareness of hypoglycaemia and its associated increase in risk of severe hypoglycaemia is accompanied by measurable defects in the counter regulatory stress responses attributed at least in part to failure of central glucose sensing (Amiel, 2009).

5.0 General blood glucose targets for adults on insulin therapy

Blood glucose targets should be agreed with the individual patient taking into account age, co-morbidities, hypoglycaemia awareness, glomerular filtration rate, social circumstances and pre-conceptual care (Appendices 1 - 5).

Recommended blood glucose targets

Pre-breakfast	5.5 – 7.5mmol/L
Other meals	4.5 – 7.5mmol/L
Pre-bed	6.5 – 8.0mmol/L

(DAFNE, 2010)

Targets must be individualised and avoidance of hypoglycaemia must take precedent especially with the elderly and those with a history of hypoglycaemic unawareness.
(International Association of Gerontology and Geriatrics (IAGG), European Diabetes Working Party for Older People (EDWPOP), and International Task Force of Experts in Diabetes 2012 . The Asian-Pacific Type 2 diabetes policy group, 2005).

6.0 General principles of insulin titration for persons with diabetes already prescribed insulin

- Observe for a pattern over 3 – 4 days. Do not adjust in response to a single high or low result.
- Ensure timing of insulin doses are correct
- Insulin doses are usually increased or decreased in ten per cent increments
- Insulin sensitivity can vary greatly from person to person. Where an individual dose is >50Units, a twenty per cent adjustment might be necessary
- Ideally, change one insulin dose at a time to avoid confusion and to allow time for results of adjustments to become apparent
- Preventing hypoglycaemia should always take priority over correcting hyperglycaemia, consider the issue of rebound hyperglycaemia.
- If early morning hyperglycaemia is present consider nocturnal hypoglycaemia and check 3am blood glucose level
- Review insulin regime in response to one unexplained severe hypoglycaemic event

(Royal College of Nursing, 2012; Wansworth Diabetes Guidelines, 2011)

It is recommended that persons with diabetes use their finger tips when monitoring home blood glucose levels, when hypoglycaemic or when blood glucose levels are changing rapidly (Ellison et al, 2002).

6.1 Points to be considered when discussing insulin titration:

- Identify patient with name, address, telephone number and date of birth
- Identify type and duration of diabetes
- Ascertain whether patient received advice from another health care professional
- Identify cause for abnormal blood glucose readings
- Review blood glucose levels over the previous 3 days to establish patterns
- Identify if there are precipitating factors e.g.
    - Missed insulin dose(s)
    - Recent change in insulin regime
    - Lack of or more exercise than is usual
    - Change in diet / missed or delayed meals
    - Inter-current illness
    - Alcohol
    - Vaccinations
    - If taking any new medications e.g. steroids
    - Change in body weight
- If the patient has Type 1 diabetes, have they tested blood or urinary ketones
- Is the patient is feeling nauseated, vomiting or unable to tolerate fluids
- When did the patient last eat
- Insulin:
    - Current insulin regime, type and usual dose(s) of insulin
    - Identify when the patient last took insulin
    - Was the prescribed insulin administered
    - Was the correct injection technique used
    - When was the needle last changed
    - Was the insulin stored correctly
    - Was the insulin pen / cartridge / vial damaged
    - Is the patient rotating their injection sites
- Blood glucose monitoring:
    - Identify if the correct technique was used when monitoring blood glucose levels i.e. hand washing prior to test, meter working correctly, test strips in date

- Risk of pregnancy if of reproductive age:
    - Enquire if there is a possibility of pregnancy

7.0 Hyperglycaemia

- Refer to 6.1 above
- **If inter-current illness, / ketones present, follow sick day rules in accordance with local guidelines**
- **If patient is vomiting and unable to tolerate fluids, advise the patient to go to the Emergency Department / General Practitioner**

7.1 Titration of insulin for hyperglycaemia

7.1.1 General guidelines for titration of basal bolus / pre-meal insulin

(E.g. Glulisine, Aspart, Lispro, Humulin S, Insuman Rapid, Actrapid)

Caution: Hyperglycaemia prior to meals is usually related to the previous bolus insulin or a snack between meals not matched appropriately with bolus insulin. However, if there is a long interval between meals, consider that hyperglycaemia is caused by the basal insulin.

High blood glucose readings	Titrate insulin dose
Pre-lunch	Increase morning bolus insulin by 10%
Pre-evening meal	Increase lunch-time bolus insulin by 10%
Pre-bed	Increase tea-time bolus insulin by 10%

(National Health Service, Tayside Insulin Adjustment Guidelines, 2006)

7.1.2 General guidelines for titration of once daily basal insulin

(E.g. Glargine,Degludec, Toujeo Detemir, Isophane, Insuman Basal, Humulin I)

High blood glucose readings	Titrate insulin dose
Pre-breakfast	Increase basal insulin by 10%

(National Health Service, Tayside Insulin Adjustment Guidelines, 2006)

N.B Caution with Degludec.and Toujeo. Due to long half life allow at least 3-4 days between titrations

7.1.3 General guidelines for titration of twice daily basal insulin

(E.g. Glargine, Detemir, Isophane, Insuman Basal, Humulin I)

High blood glucose readings	Titrate insulin dose
Pre-breakfast	Increase evening basal insulin by 10%
Pre-evening meal	Increase morning basal insulin by 10%

(National Health Service, Tayside Insulin Adjustment Guidelines, 2006)

7.1.4 General guidelines for titration of twice daily (BD) mixed insulin

(e.g. Novomix 30, Humulin M3, Insuman Combi 25, Insuman Combi 50, Humalog Mix 25, Humalog Mix 50)

High blood glucose readings	Titrate insulin dose
Pre-breakfast	Increase evening dose by 10%
Pre-evening meal	Increase breakfast dose by 10%

(National Health Service, Tayside Insulin Adjustment Guidelines, 2006)

7.2 Insulin omission

- Omission of insulin is the leading cause of recurrent DKA, most prevalent among adolescents (Wolfsdorf et al, 2006)
- Regular insulin omission can have serious implications for future health and may need strategies or changes of treatment to improve compliance (Peyrot et al, 2010; Weinger and Beverly, 2010)
- Refer to 6.1 above
- Additional questions to ask to establish reasons for insulin omission:
    - What are the current blood glucose and ketone levels
    - What insulin injection was missed
    - How long is it since the last insulin injection
    - Why did they miss the injection
    - Is insulin omission a regular occurrence
- If ketones are present, treat as per ‘sick day’ as per sick day rules in accordance with local approved guidelines
- Advise persons with diabetes that they may experience high blood glucose levels for 24 – 48 hours post omission of insulin

7.2.1 Insulin omission for basal bolus regime

- **Bolus / mealtime insulin**
  - If it is within 1 hour of the meal, take normal bolus dose
  - If it is within 2 hours of the meal, take 75% of the normal dose of bolus insulin
  - If it is within 3 hours of the meal, take 50% of the normal bolus dose
  - If it is more than 4 hours since the meal, consider taking the next bolus injection early, followed by food
- **Basal insulin**
  - If it is within 4 hours of the usual time, the full dose can be taken
  - The full dose of insulin Degludec can be taken within 8 hours of the usual time.
  - If it is more than 4 hours late, calculate the number of hours late, divide by 24, multiply this by the usual dose of basal insulin, sub-tract this from the usual dose. For example, if the basal insulin dose is 34 Units and the insulin dose is 6 hours late:

$$\frac{6 \text{ hours}}{24} = 0.25 \times 34 \text{ Units basal insulin} = 8.5$$

34 – 8.5 = 25.5 i.e. 25 Units basal insulin

(Gernero T. (2011). http://www.dlife.com/diabetes/insulin/theresa_garnero/missed-insulin)

7.2.2 Insulin omission for twice daily (BD) mixed insulin regime

- Although twice daily pre-mixed insulins (e.g. Novomix 30, Humulin M3, Insuman Combi 25, Insuman Combi 50, Humalog Mix 25, Humalog Mix 50) may have different action profiles, there is no evidence to suggest that they should be treated differently
- Advise that higher blood glucose levels may be encountered for 24 – 48 hours post omission of insulin
- **Omission of morning dose of BD mixed insulin regime**
  - If it is before 12 mid-day, reduce the morning dose of mixed insulin by 30%
  - If it is after 12 mid-day, reduce the morning dose of mixed insulin by 50%
  - Take the normal evening dose which must be at least 5-6 hours post morning dose

(Beaumont Hospital Colonoscopy Guidelines, 2011)

- **Omission of previous evening dose of BD mixed insulin regime**
  - Follow guidelines for hyperglycaemia (see 6.0)
  - Increase morning dose of BD mixed insulin by 10 – 20%
  - If ketones are present on the day, follow local ‘sick day’ rules in accordance with local guidelines

8.0 Hypoglycaemia

- If the patient displays signs of hypoglycaemia when speaking with them:
    - Instruct the patient to correct hypoglycaemia before continuing the conversation
    - When the blood glucose level is above 4.0mmol/L continue with the assessment
    - If a patient has a severe hypoglycaemic event, the conversation may need to be postponed to another day (this is a reflection of the time it takes for the brain to recover from hypoglycaemia)
    - Refer to point 6.1 above
    - Additional questions to ask to establish reasons for hypoglycaemia:
        - Has the patient experienced recent weight loss
        - Is the patient on a reducing dose of steroids
        - Identify at what blood glucose level the patient normally recognises hypoglycaemia symptoms
        - Does the patient have hypoglycaemia unawareness
        - Is the patient breast feeding
        - Has there been a change in the weather which could have impacted on insulin absorption
- Advise re RSA driving regulations.

8.1 Insulin titration for hypoglycaemia

- **General guidelines on insulin titration for hypoglycaemia**
    - If a patient has unexplained hypoglycaemia, insulin should be reduced
    - If there is a reason for the hypoglycaemia, advise the patient to take action to prevent it from happening again
    - If a patient has a severe unexplained hypoglycaemic event consider reducing the relevant insulin by 20%

    (National Health Service, Tayside Insulin Adjustment Guidelines, 2006)

8.1.1 General guidelines for titrating bolus / pre-meal insulin

(E.g. Glulisine, Aspart, Lispro, Humulin S, Insuman Rapid, Actrapid)

Caution: In general, hypoglycaemia prior to meals is usually related to the previous dose of bolus insulin. However, if there is a long interval between meals, consider that hypoglycaemia is caused by the basal insulin

Low blood glucose reading	**Titrate insulin dose**
Pre-lunch	Decrease morning bolus insulin by 10%
Pre-evening meal	Decrease lunch-time bolus insulin by 10%
Pre-bed	Decrease tea-time bolus insulin by 10%

8.1.2 General guidelines for titrating once daily basal insulin

(e.g. Glargine, Degludec, Toujeo, Detemir, Isophane, Insuman Basal, Humulin I)

Low blood glucose readings	**Titrate insulin dose**
Pre-breakfast	Decrease basal insulin by 10%

NB Caution with Degludec and Toujeo .Due to long half life allow at least 3-4 days between titrations

8.1.3 General guidelines for titrating twice daily basal insulin

(E.g. Glargine, Detemir, Isophane, Insuman Basal, Humulin I)

Low blood glucose readings	**Titrate insulin dose**
Pre-breakfast	Decrease evening basal insulin by 10%
Pre-evening meal	Decrease morning basal insulin by 10%

8.1.4 General guidelines for titrating twice daily (BD) mixed insulin

(e.g. Novomix 30, Humulin M3, Insuman Combi 25, Insuman Combi 50, Humalog Mix 25, Humalog Mix 50)

Löw blood glucose readings	**Titrate insulin dose**
Pre-breakfast	Decrease evening dose by 10%
Pre-evening meal	Decrease breakfast dose by 10%

(Wandsworth Diabetes Centre, 2011)

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Appendix 1

Individualised Targets for glycaemic control

Individualisation is key.

Type 2 Diabetes

General Targets:
HbA_{1c} <53mmol/mol (7.0%) / mean plasma glucose 8.3 – 8.9mmol/L

Intensive Targets e.g. younger, healthier individuals:
HbA_{1c} 42 – 48mmol/mol (6.0 – 6.5%)

Less Intensive Targets e.g. older, co-morbidities, hypoglycaemia prone, low life expectancy, etc:
HbA_{1c} 58 – 64mmol/mol (7.5 – 8.0%)

(Inzucchi et al 2015)

Type 1 Diabetes

HbA1c 43-53mmol/mol (6.0-7.0%)

Blood glucose targets

Pre-breakfast	5.5 – 7.5mmol/L
Other meals	4.5 – 7.5mmol/L
Pre-bed	6.5 – 8.0mmol/L

(DAFNE 2010)

Appendix 2

Hypoglycaemia Unawareness

It is recommended that people with diabetes who have hypoglycaemia unawareness maintain their glucose levels at the higher end of the general glucose targets avoiding hypoglycaemia for a period of up to 6 weeks (DAFNE, 2010).

Appendix 3

Glycaemic control for Pre-conceptual Care

Recommended pre-conceptual blood glucose targets:

Fasting: 3.5 – 5.0mmol/L

One hour post prandial: <7.0mmol/L

(*Guidelines for the management of pre-gestational and gestational diabetes mellitus from pre-conception to the post natal period.* Health Service Executive, 2010 p20)

Appendix 4

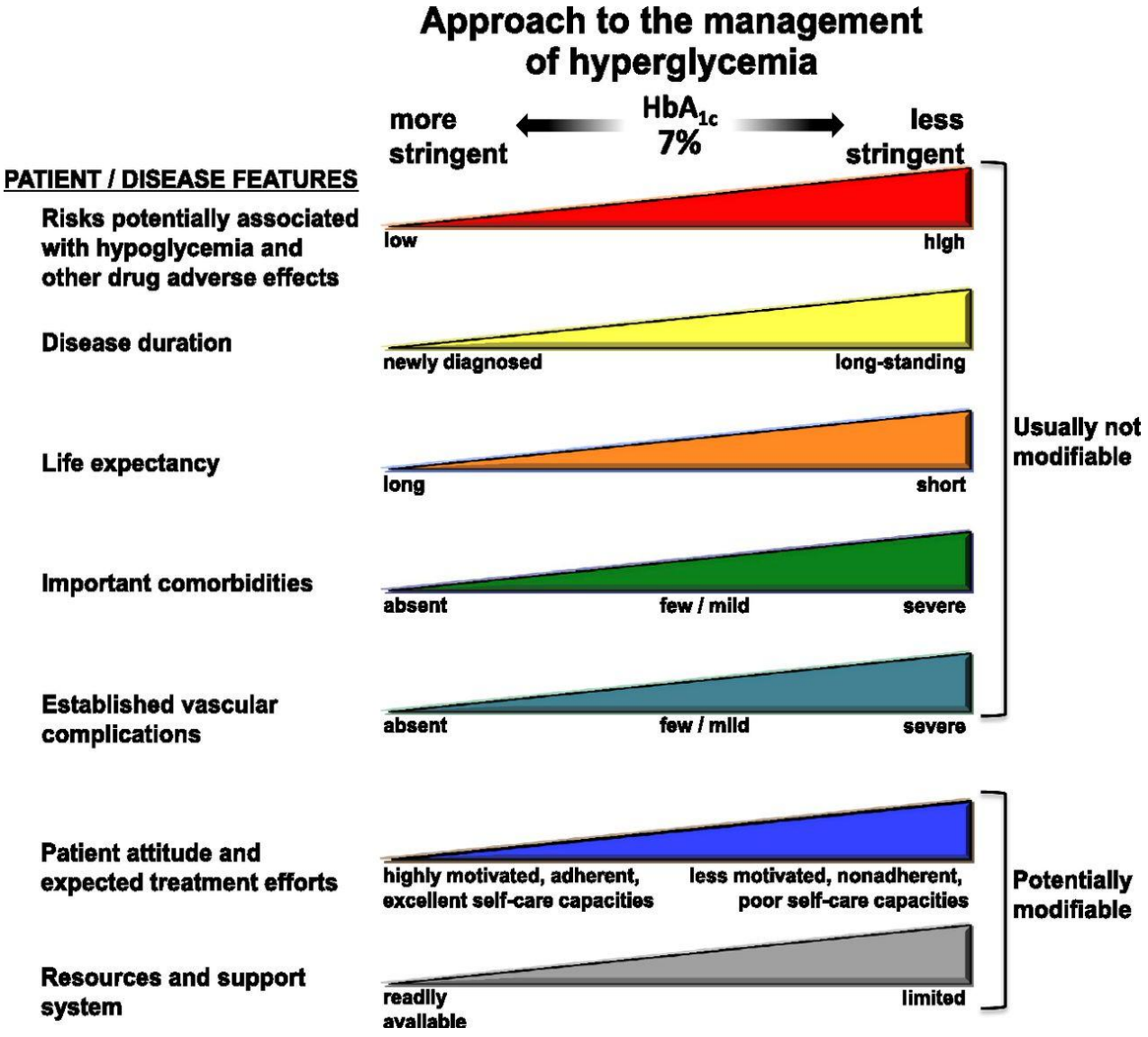
Framework for considering treatment of goals for glycaemia **in older adults with diabetes**

Patient characteristics / health status	Rationale	Reasonable HbA_{1c} goal*	Fasting or pre-prandial glucose	Bedtime glucose
Healthy (few co-existing chronic illnesses, intact cognitive functional status)	Longer remaining life expectancy	<58mmo/mol (7.5%)	5.0-7.2mmol/L	5.0-8.2mmol/L
Complex / intermediate (multiple co-existing chronic illnesses, or 2+ instrumental activities of daily living impairments or mild to moderate cognitive impairment)	Intermediate remaining life expectancy, high treatment burden, hypoglycaemia vulnerability, fall risk	<64mmol/mol (<8.0%)	5.0-8.3mmol/L	5.5-10.0mmol/L
Very complex/poor health (Long-term care or end-stage chronic illnesses or moderate to severe cognitive impairment or 2+ activities of daily living dependencies)	Limited remaining life expectancy makes benefit uncertain	<69mmol/mol (8.5%)	5.5-10.0mmol/L	6.1-11.1mmol/L

* A lower goal may be set for an individual if achievable without recurrent or severe hypoglycaemia or undue treatment burden

(Kirkham et al, 2012)

Appendix 5



Inzucchi.S.E. et al (2015)

Appendix 6

National Clinical Guideline Development Group

These guidelines were developed by the National Clinical Programme for Diabetes and the Irish Diabetes Nurse Specialist Association (IDNSA) to support and assist nurses who are working with people with diabetes on how to titrate insulin dosage:

Irish Diabetes Nurse Specialist Association Insulin Titration Guideline Working Group 2012 – 2015

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Irish Diabetes Nurse Specialist Association Insulin Titration Guideline Working Group 2011

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National Clinical Programme for Diabetes 2013 - 2014

Dr Ronan Canavan, Clinical Lead replaced Dr Diarmuid Smith in July 2013
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Appendix 7

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- National Working Group, National Diabetes Programme, Health Service Executive
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