



SAFE AND EFFECTIVE USE OF INSULIN IN SECONDARY CARE

Recommendations for Treating Hyperglycaemia in Adults

August 2006

Published by the Clinical Resource Efficiency Support Team (CREST) these guidelines have been produced by a sub-group of health care professionals from varied backgrounds including Nursing, Physicians and Pharmacists, chaired by Professor Gary McVeigh. The members of the sub group are Mrs Elizabeth Qua OBE, Ms Rosemary Donnelly, Ms Kathryn King, Mr Daryl Connolly and Dr Hamish Courtney.

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FOREWORD

Recent data suggests that stricter control of blood glucose levels in hospitalised patients can result in improved clinical outcomes. Insulin provides the greatest flexibility in the hospital setting to achieve optimal blood glucose control. As protocols for tight glucose control are introduced in a variety of hospital settings it will be essential to implement safeguards to minimise the risk of hypoglycaemia and ensure patient safety. The systemic problems that create obstacles to appropriate and safe care of patients receiving insulin in hospital are well recognised. Insulin administration errors could be minimised and clinical outcomes improved by thorough analysis of the setting, additional training, collective establishment of goals focussed on patient safety, insertion of backup checks, and encouragement of sharing key clinical information.

These guidelines have been published by the Clinical Resource Efficiency Support Team (CREST) and endorsed by the DHSSPS to address issues surrounding the safe and effective use of insulin in secondary care. CREST comprises a small team of health care professionals established under the auspices of the Central Medical Advisory Committee in 1988. The aims of CREST are to promote clinical efficiency in the health service in Northern Ireland, while ensuring the highest possible standard of clinical practice is maintained.

These recommendations complement previous work conducted by the Northern Ireland Medicines Governance Team - Recommendations to improve the safe use of insulin in secondary care in Northern Ireland, distributed by the DHSSPS in December 2005. It is recommended that Trusts review both documents when determining their appropriate action plans.

A handwritten signature in black ink, appearing to read "David Stewart".

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A handwritten signature in black ink, appearing to read "Elizabeth Mitchell".

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SAFE AND EFFECTIVE USE OF INSULIN IN SECONDARY CARE

Rationale for Treating Hyperglycaemia

There is increasing awareness of the importance of controlling blood glucose in order to improve patient outcomes in the hospital setting¹. Studies in critical care medicine^{2,3}, acute myocardial infarction^{4,5} and cardiac surgery^{6,7} demonstrate a strong association between high glucose levels and morbidity and mortality among patients in intensive care units. Hyperglycaemia (fasting blood glucose > 7 mmol/L; random blood glucose > 11.1 mmol/L) on general medical and surgical units has been associated with an 18-fold increase in hospital mortality, increased length of stay (9 Vs 4.5 days) and a greater risk of infection⁸. Recent evidence also indicates that elevated glucose is common, rarely treated, and associated with increased mortality risk in elderly acute myocardial infarction patients, particularly those without recognised diabetes mellitus⁹.

In these patient populations hyperglycaemia has multiple causes including stress, decompensation of type 1 and type 2 diabetes mellitus and iatrogenic factors associated with the administration of pharmacological agents^{10,11}. When high blood glucose is treated along with the presenting acute illness outcomes are generally improved¹². The recognition that hyperglycaemia in hospitalised patients complicates numerous illnesses and is an independent risk factor for adverse outcomes, has led to the publication of guidelines for glucose targets in the hospital management of patients with diabetes mellitus¹³. The guidelines recommend upper limit blood glucose targets of 6.1 mmol/L for patients in intensive care units and 6.1 - 10 mmol/L in non-critical care settings. The recommendations have broad based support from scientific and clinical communities¹³. The American College of Endocrinology (ACE) sponsored the consensus conference that produced the position statement co-sponsored by the American Diabetes Association, American Heart Association, American Society of Anaesthesiologists, the Society of Critical Care Medicine, the Society of Hospital Medicine, the Society of Thoracic Surgeons and the Endocrine Society with the American College of Cardiology as

a participating organisation. In addition to recommending standards for glucose control, the consensus panel suggested techniques by which the goals and targets could be achieved.

Using Insulin to Control Hyperglycaemia

Whether the patient has had previously recognised diabetes or not, insulin provides the greatest flexibility to meet rapidly changing requirements in different hospital settings to achieve optimal blood glucose control^{10;14}. Intravenous infusion of insulin is the only insulin treatment strategy specifically developed for use in the hospital setting. According to ACE, indications for intravenous insulin infusion include but are not limited to: critical care illness; the post-operative period following heart surgery; patients on “nil by mouth” status; type 1 diabetes mellitus; general pre-operative, intra-operative and post-operative care; organ transplantation; stroke (possibly); hyperglycaemia during high-dose corticosteroid therapy; labour and delivery; and other acute illness for which prompt glycaemic control is judged important to recovery such as prevention or treatment of infection¹³. Intravenous insulin is also employed to treat diabetic emergencies¹⁵.

Obstacles to the Safe and Effective Use of Insulin

Although insulin therapy can be life saving in the hospital setting, it can be life threatening if used inappropriately. Insulin has a narrow therapeutic index (the difference between the effective and toxic dose of a drug) and evidence reported in medical literature has identified insulin therapy errors as a large and clinically important problem^{16;17}. Insulin has been labelled as one of the top 5 “high-risk medications” in the inpatient setting^{18;19}. Studies from the United States indicate that 33% of the medical errors that cause death within 48 hours of the error involved insulin therapy and administration in the care of a hospitalised patient¹⁷. Over a 9 month period in 2004, 199 medication incidents involving the use of insulin were reported in 8 Northern Ireland hospitals, some of which had serious consequences.

Medication errors involving insulin can occur at any stage in the process of prescribing, preparation of the order and administration of the medication to the patient. Computerised Physician Order Entry (CPOE), in which medication orders are written online, can significantly reduce errors. The orders are structured, legible and are routinely and automatically checked for allergies, drug interactions and inappropriate doses. The introduction of CPOE in the secondary care setting has been accompanied by a significant reduction in medication errors²⁰.

Optimising control of blood glucose in line with recent recommendations brings new challenges in relation to patient safety. While specific glycaemic targets have been recommended, it is not known what level of blood glucose is considered ideal to achieve the most benefit combined with the lowest risk of adverse events. Local expert opinion may regard any initiative that promotes more stringent glucose control as inadvisable in certain hospital settings without first having systems and safeguards in place to ensure patient safety. To implement new glycaemic targets safely and effectively will require the analysis and redesign of systems to develop a culture of safety that will ultimately reduce insulin-related medical errors whilst yielding better outcomes.

The majority of patients with diabetes are admitted to hospital to address and treat complications associated with the disease¹⁴. Control of blood glucose often becomes subordinate to the care of the primary diagnosis requiring admission. In patients without diabetes who develop hyperglycaemia during an acute illness, high glucose levels are often ignored or treated inappropriately. Poor glycaemic control is common among inpatients with diabetes, particularly in those treated with insulin, for many reasons. Poorly defined management plans, poor co-ordination of care, overly high glycaemic targets, lack of therapeutic adjustment, over utilisation of “sliding scales” and under utilisation of insulin infusions represent some of the reasons for poor control of blood glucose^{14;15}. A further important contributing factor has been the fear of provoking hypoglycaemia. However, recent guidance emphasises that poor control of hyperglycaemia, as well as the provocation of hypoglycaemia, must now be recognised as a patient safety

issue^{1-6;10;14;15}. A balanced approach that addresses the need for stricter glucose control whilst minimising the risk of hypoglycaemia is required. The establishment of multidisciplinary committees in each Trust should address procedures and pathways surrounding insulin administration and therapy that ensures the safe and effective use of insulin in different clinical settings.

Insulin Protocols and Monitoring

Insulin, given either intravenously or subcutaneously, is the most effective way of achieving recommended glucose targets in hospitalised patients^{13;15}. A number of protocols for insulin infusion/administration that facilitate standardisation of treatment regimes and monitoring and have proven track records for efficacy and safety have been published^{15;21-29}. However, no large studies have compared the safety and efficacy of different hospital-based protocols^{10;15}. The ideal insulin protocol should be easy to use, effective, safe and easy to follow. If well designed, the protocols can contain the necessary complexity to achieve glucose targets yet be ordered by a single signature. Protocols should contain mechanisms for altering insulin administration in response to “alert” or “hold” values for glucose levels that triggers physician contact, have clear monitoring instructions and explicit provisions for treating hypoglycaemia. Ward-based protocols and hospital policies should be developed that permit appropriate nursing responses to “triggering” events. Triggering events could include transportation off the ward causing meal delay, new “nil by mouth” status, interruption of intravenous glucose, interruption of total parenteral nutrition, interruption of enteral feedings, or interruption of continuous renal replacement therapy. A multidisciplinary approach is needed to implement such protocols with support from physician, nursing, administration, dietetic and pharmacy staff^{10;13-15;27}. The protocols should be printed, available in hospital units, and nurses and physicians should undergo training in using the protocols. A video of physician education sessions and a related information package, made available to all medical staff, coupled with actual case studies of infusion use, represent examples of approaches employed to ensure appropriate use of insulin therapy²⁷. The hospital should assess system pathways and routines

to ensure protocols can be implemented in a safe and effective fashion²⁷.

Aspects of clinical guidelines are often incorporated in the prescription chart to encourage more appropriate use of both intravenous and subcutaneous insulin in hospital. Modern protocols for subcutaneous insulin administration reflect the need for basal (or background) and nutritional insulin requirements. The use of the traditional “sliding scale” as the sole form of insulin coverage is widely regarded as inappropriate and its use should be discouraged^{10;14;15;26;30;31}. However, the detail contained within the protocol employed may be of secondary importance to the care and skill exercised in its implementation. Use of only relatively few protocols for insulin administration will reduce implementation errors. Therefore it is illogical for each physician to have a personalised method for insulin administration. Rather physicians should agree a common set of protocols for use within Trusts. In the intensive care unit setting a regional protocol for insulin administration should be an achievable goal. Recent evidence indicates that morbidity and mortality, in response to intensive insulin therapy, may differ between patients admitted to surgical and medical intensive care units. Glucose targets may need to be revised in light of this evidence to account for underlying illness and predicted duration of stay in the intensive care unit³². In medical and surgical settings, differences in protocols and procedures for insulin administration may reflect the circumstances that exist within respective Trusts. However, regional audit of protocols and procedures within Trusts would provide information that would facilitate the development of a common protocol for use on a regional basis.

RECOMMENDATIONS:

The recommendations are presented in four sections: Education and Training; Protocols and Administration; Medical Incidents and Discharge Planning; and Audit.

EDUCATION AND TRAINING

Recommendation 1:

Sufficient time set aside in the undergraduate curricula for training in insulin prescribing and administration. Baseline levels of competency training for undergraduate medical students, pre-registration nurses and pharmacists should be such that levels of knowledge are attained to ensure patient safety. Ideally opportunities should be provided for practical “hands on” teaching.

- **For action by:** Queen’s University Belfast, University of Ulster and The Open University

Recommendation 2:

Insulin use (prescribing, administering, dispensing and monitoring) should be part of the induction courses in all Trusts for pre-registration house officers, nurses and other new clinical staff as appropriate.

- **For action by:** HPSS Boards and Trusts

Recommendation 3:

All Trusts in Northern Ireland should employ diabetes specialist nurses. Diabetes specialist nurses provide link nurse programmes for primary care, secondary care and nursing homes. The link nurses should receive in-service training to a standard that ensures patient safety and be provided with opportunities for refresher courses. The content of the programme should be formalised, attendance should be mandatory and the programme rolled out on a regional basis.

- **For action by:** HPSS Boards and Trusts, Diabetes Specialist Nurse Forum

Recommendation 4:

Educational case studies on infusion rates, monitoring and switching from intravenous to subcutaneous administration should be devised. Attendance for all disciplines involved with insulin administration should be mandatory and courses be provided on a regular basis.

- **For action by:** HPSS Boards and Trusts

Recommendation 5:

All staff involved in the administration of insulin should receive practical training in how to draw up a dose from a vial correctly using an insulin syringe.

- **For action by:** HPSS Trusts

Recommendation 6:

All staff involved in the administration of insulin should receive training and be educated in the strength of licensed soluble insulin (100units/ml).

- **For action by:** HPSS Boards and Trusts

Recommendation 7:

All staff involved in the administration of insulin should receive practical training in how to prepare a dose correctly using an injection device, for example a pre-filled injection pen.

- **For action by:** HPSS Trusts

Recommendation 8:

All relevant staff should receive training in the use of an infusion device before using it. All other staff must be aware that they must not handle or in anyway interfere with an infusion device in use.

- **For action by:** HPSS Trusts

PROTOCOLS AND ADMINISTRATION

Recommendation 9:

Specific management protocols, treatment algorithms and clinical pathways should be developed for different clinical settings within Trusts where insulin is administered to control hyperglycaemia. Hospitals should establish multiprofessional committees to evaluate procedures surrounding insulin administration and therapy for safety issues. The committees should explicitly designate and co-ordinate roles and responsibilities for physicians, nurses, dieticians, pharmacists and discharge planners in order to optimise patient care. Each committee should have a named lead and the committee should link into established clinical and social care governance procedures within Trusts.

- **For action by:** HPSS Trusts

Recommendation 10:

When a protocol is being employed this should be documented in the patient's medical notes.

- **For action by:** HPSS Trusts

Recommendation 11:

A separate insulin prescription and diabetes control/monitoring chart should be employed when prescribing and administering insulin. Insulin should be prescribed on the drug Kardex as: "see insulin prescription and diabetes control chart".

- **For action by:** HPSS Trusts

Recommendation 12:

Frequency of monitoring of blood glucose should be clear and explicit and indicated on the insulin prescription chart.

- **For action by:** HPSS Trusts

Recommendation 13:

A regional standardised insulin infusion should be employed e.g. 50 units of Actrapid[®] insulin in 50 ml sodium chloride 0.9%. Ideally this should be supplied in a ready to use formulation, although this may not be possible in all Trust pharmacies. The infusion must always be administered via an infusion pump.

- **For action by:** Hospital pharmacies

Recommendation 14:

The management of infusion devices in Trusts should be in accordance with the current National Patient Safety Agency, Safer Practice Notice 01 (2004) (NHS), endorsed by the DHSSPS and the Controls Assurance Standards for Medical Devices and Equipment Management.

- **For action by:** HPSS Trusts

Recommendation 15:

A second practitioner should perform an independent second check of insulin doses. This second check must:

- include all aspects of administration of insulin irrespective of the route or method of administration;
- be conducted from preparation through to actual administration of the prepared dose to the correct patient and documentation of administration;
- include the use of any infusion devices and calculations where applicable.

This requirement for a second check of insulin doses should be included in Use and Control of Medicines (DHSSPS).

- **For action by:** HPSS Trusts, DHSSPS

Recommendation 16:

Specific guidance should be given on which practitioners can perform a second check and that one of the practitioners should be a registered nurse.

- **For action by:** HPSS Trusts

MEDICAL INCIDENTS AND DISCHARGE PLANNING

Recommendation 17:

Continue to detect and report insulin incidents and adverse events so that the systems in place can be improved as necessary.

- **For action by:** HPSS Trusts

Recommendation 18:

To reduce medication errors implementation of a regionally validated electronic prescribing system would address many of the issues associated with prescribing of insulin and other medicines.

- **For action by:** DHSSPS, HPSS Trusts

Recommendation 19:

Patients may be discharged on new insulin regimens sometimes with altered organ function, body weight and nutritional intake. Such patients should be seen by the diabetic specialist nurse prior to discharge. The discharge plan should contain specific guidance to intercept excessive upward or downward trends in blood glucose that triggers contact with trust staff. The discharge plan should contain contact information so patients and care givers can contact members of staff within the Trust. Early post-discharge outpatient assessment and ongoing patient education is essential.

- **For action by:** HPSS Trusts

AUDIT

Recommendation 20:

The standard of prescribing in relation to insulin, should be audited regularly. This audit should consider adherence to current guidance in the Use and Control of Medicines, including legibility, use of inappropriate abbreviations, “trailing zeros, and clear decimal points”.

- **For action by:** HPSS Trusts, Regional Multiprofessional Audit Group (RMAG)

Recommendation 21:

Audit of Safety and Effectiveness of protocols should be conducted regularly. Standards for audit could include the number of consecutive occasions that glucose levels exceeded defined upper limits, frequency of hypoglycaemia and corrective actions employed in each circumstance. Information collated on a regional basis would permit refinement of protocols and facilitate development of a regional protocol employed by all Trusts.

- **For action by:** HPSS Trusts, RMAG

Recommendation 22:

Regional audit of procedures related to the storage and handling of insulin in secondary care should be undertaken on a regular basis to ensure compliance and identify areas for improvement that would enhance patient safety.

- **For action by:** HPSS Trusts, RMAG

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