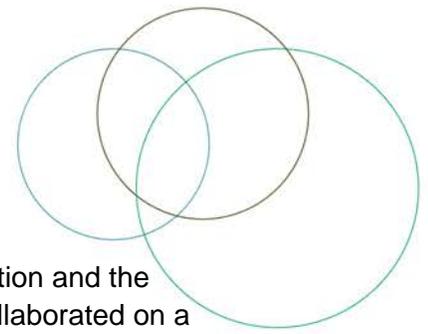


HOSPITAL HARM IMPROVEMENT RESOURCE

Hypoglycemia



ACKNOWLEDGEMENTS



The Canadian Institute for Health Information and the Canadian Patient Safety Institute have collaborated on a body of work to address gaps in measuring harm and to support patient safety improvement efforts in Canadian hospitals.

The Hospital Harm Improvement Resource was developed by the Canadian Patient Safety Institute to complement the Hospital Harm measure developed by the Canadian Institute for Health Information. It links measurement and improvement by providing evidence-informed resources that will support patient safety improvement efforts.

The Canadian Patient Safety Institute acknowledges and appreciates the key contributions of Carolyn Lawton, RN (EC), Diabetes Nurse Practitioner, Sunnybrook Health Sciences Centre for the review and approval of this Improvement Resource.

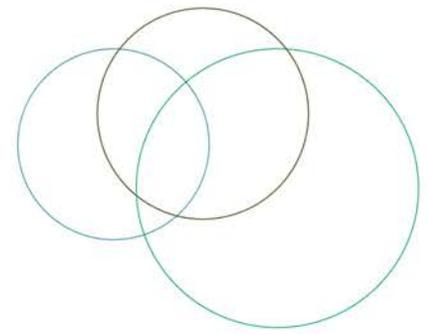




DISCHARGE ABSTRACT DATABASE (DAD) CODES INCLUDED IN THIS CLINICAL CATEGORY:

A07: Hypoglycemia					
Concept	Hypoglycemia in diabetic and non-diabetic patients identified during a hospital stay.				
Notes	This clinical group excludes hypoglycemia associated with incorrect administration or dosage of medications (refer to A10: Medication Incidents).				
Selection criteria	<table border="1" style="width: 100%;"> <tr> <td style="width: 30%;">E10.63 E11.63 E13.63 E14.63 E15</td> <td>Identified as diagnosis type (2)</td> </tr> <tr> <td>E16.0</td> <td>Identified as diagnosis type (2) AND Y40–Y59 in the same diagnosis cluster</td> </tr> </table>	E10.63 E11.63 E13.63 E14.63 E15	Identified as diagnosis type (2)	E16.0	Identified as diagnosis type (2) AND Y40–Y59 in the same diagnosis cluster
	E10.63 E11.63 E13.63 E14.63 E15	Identified as diagnosis type (2)			
E16.0	Identified as diagnosis type (2) AND Y40–Y59 in the same diagnosis cluster				
Exclusions	Events selected from a diagnosis cluster that is also selected for A10: Medication Incidents				
Codes	Code descriptions				
E10.63	Type 1 diabetes mellitus with hypoglycemia				
E11.63	Type 2 diabetes mellitus with hypoglycemia				
E13.63	Other specified diabetes mellitus with hypoglycemia				
E14.63	Unspecified diabetes mellitus with hypoglycemia				
E15	Nondiabetic hypoglycemic coma				
E16.0	Drug-induced hypoglycemia without coma				
Additional Codes					
Inclusions					
Y40-Y59	Drugs, medicaments and biological substances causing adverse effects in therapeutic use (refer to Appendix 6)				





OVERVIEW AND IMPLICATIONS

Altered blood glucose: Introduction

Hypoglycemia

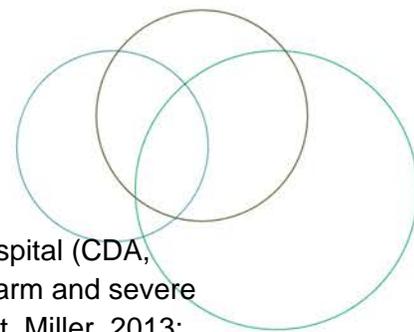
Hypoglycemia is defined as any blood glucose less than 4.0 mmol/L. When blood glucose decreases to 2.8 mmol/L, cognitive impairment ensues (CDA, Clayton, Woo, Yale, 2013). Hypoglycemia is a widely recognized cause of acute, potentially fatal events. Patients with or without diabetes may experience hypoglycemia in the hospital due to co-morbidities such as heart failure, renal or liver disease, malignancy, infection or sepsis or in association with an altered nutritional state. Additional triggering events include sudden reduction of corticosteroid dose, altered ability of the patient to report symptoms, reduced oral intake, emesis, new “nothing by mouth” (NPO) status, inappropriate timing of short- or rapid-acting insulin in relation to meals, and unexpected interruption of enteral feedings or parenteral nutrition (ADA, 2015; CDA, Houlden, Capes, Clement, Miller, 2013; Rubin & Golden, 2013). Patients with diabetes are at a higher risk of hypoglycemia than other patients due to the added risk of medication errors involving insulin (Rubin & Golden, 2013). Hypoglycemia is associated with increased length of stay and inpatient mortality (Nirantharakumar et al., 2012). In patients with type 2 diabetes and established cardiovascular disease (or very high risk for cardiovascular disease), symptomatic hypoglycemia (<2.8 mmol/L) is associated with increased mortality (CDA, Clayton, Woo, Yale, 2013).

Symptoms of hypoglycemia are sweating, shakiness, tachycardia, anxiety, hunger, weakness, fatigue, dizziness, difficulty concentrating, confusion and blurred vision. In extreme cases, hypoglycemia may lead to coma and death (Desimone & Weinstock, 2016). The Canadian Diabetes Association (CDA, Clayton, Woo, Yale, 2013) lists the symptoms of hypoglycemia according to neurogenic (autonomic) and neuroglycopenic symptoms (see Table 1 below).

Table 1: Symptoms of hypoglycemia

Neurogenic (autonomic)	Neuroglycopenic
Trembling	Difficulty concentrating
Palpitations	Confusion
Sweating	Weakness
Anxiety	Drowsiness
Hunger	Vision changes
Nausea	Difficulty speaking
Tingling	Headache
	Dizziness





Hypoglycemia with diabetes mellitus, type 1 or type 2

Insulin is the most appropriate agent for effectively controlling glycemia in-hospital (CDA, Houlden, Capes, Clement, Miller, 2013). However, insulin causes the most harm and severe adverse events of the high alert medications (CDA, Houlden, Capes, Clement, Miller, 2013; ISMP, 2016). Mild hypoglycemic events are common in medical and surgical patients with type 2 diabetes who are receiving subcutaneous insulin therapy. Increasing age, impaired renal function, daily insulin dose, and insulin regimen (basal/bolus versus SSI) are important predictors of hypoglycemia in patients with type 2 diabetes mellitus who are on insulin therapy (Farrokhi et al., 2012).

Nondiabetic hypoglycemic coma and drug-induced hypoglycemia without coma

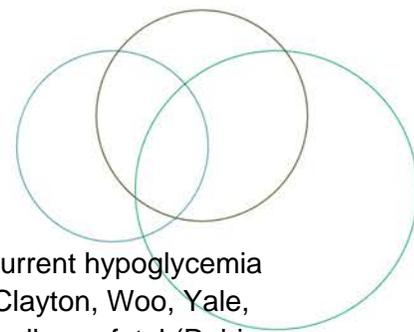
Hypoglycemia is uncommon in patients who do not have diabetes. Drugs are the most common cause of nondiabetic hypoglycemia. Other causes are malnutrition and alcohol use. Hypoglycemia may also follow bariatric surgery.

Drugs that may lead to hypoglycemia include: Bactrim (sulfamethoxazole and trimethoprim), beta-blockers, haloperidol, MAO (monoamine oxidase) inhibitors, pentamidine, quinidine, quinine, ACE (angiotensin-converting enzyme) inhibitors, lithium and second generation antipsychotic agents as well as medications used in the treatment of diabetes, such as insulin or oral medications used for management of type 2 diabetes (Cryer, 2011; Desimone & Weinstock, 2016; Murad et al., 2009; Suzuki et al., 2009). Hypoglycemia secondary to these drugs is higher in elderly patients and in patients with sepsis, and renal or hepatic disease (Murad et al., 2009).

GOAL

Reduce the incidence of hypoglycemia in diabetic and non-diabetic patients during a hospital stay.





IMPORTANCE FOR PATIENTS AND FAMILIES

Hypoglycemia causes tremor, anxiety, sweats and cognitive impairment. Recurrent hypoglycemia may impair the individual's ability to sense subsequent hypoglycemia (CDA, Clayton, Woo, Yale, 2013). In severe cases it may be fatal, although inpatient hypoglycemia is usually nonfatal (Rubin & Golden, 2013). Patients and families can play an important role in reducing errors and harm to the patient by understanding the medications the patient is taking, what each medication is for and when it should be taken and the dosage. (IHI Improvement Map, 2012)

Patient Story

Wife passes out in hospital after untreated hypoglycemic episode

"...my wife, Lisa, age 42, an insulin-dependent diabetic, collapsed into a coma while in a hospital. At the time she was discovered she had no pulse and was not breathing and her blood glucose level was almost non-existent at 2mg/dL. Records finally extracted from the hospital showed that Lisa had had an episode of low blood glucose three hours earlier, but the nurses had ignored both the hospital's own printed protocol for treating hypoglycemia and a doctor's written order to follow the protocol if Lisa became hypoglycemic..."

EVIDENCE-INFORMED PRACTICE

Assess and identify at risk patients

(ADA, 2015; CDA, Houlden, Capes, Clement, Miller, 2013)

1. Elicit any history of diabetes from all patients admitted to hospital.
2. Clearly identify diagnosis of diabetes on the patient's medical record.

Monitoring blood glucose

(CDA, Houlden, Capes, Clement, Miller, 2013).

1. Monitor blood glucose on a routine, individualized basis in all patients with diabetes (Rubin & Golden, 2013). Consider performing glucose monitoring before meals and at bedtime in patients who are eating. Consider performing glucose monitoring every four to six hours in patients who are NPO (nothing by mouth) or receiving continuous enteral feeding. Monitor glucose every one to two hours for patients on continuous IV insulin.

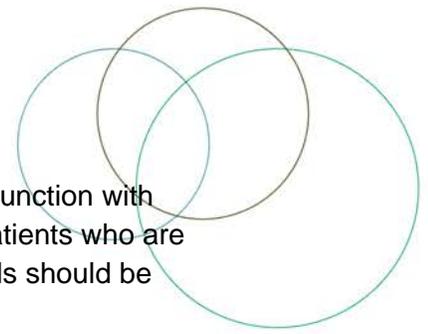
Insulin therapy

(ADA, 2015; CDA, Houlden, Capes, Clement, Miller, 2013; IHI, Reduce adverse drug events, 2012; Moghissi et al., 2009; Roberts et al., 2012; Rubin & Golden, 2013)

1. Patients with type 1 diabetes must be maintained on insulin therapy at all times to prevent diabetic ketoacidosis (DKA).
2. Use a proactive approach in all patients with diabetes (either type 1 or type 2) being treated with insulin by using basal, bolus and correction (supplemental) doses of insulin.
3. Avoid use of sliding-scale insulin (SSI) as the sole regimen for the management of hyperglycemia.



Hypoglycemia



4. Preprandial blood glucose targets should be 5.0 to 8.0 mmol/L in conjunction with random BG values <10.0 mmol/L for the majority of non-critically ill patients who are treated with insulin. When patients are critically ill, blood glucose levels should be maintained between 8.0 and 10.0 mmol/L.
5. Provided that their medical conditions, dietary intake and glycemic control are acceptable, people with diabetes should be maintained on their pre-hospitalization oral anti-hyperglycemic agents or insulin regimens.
6. Consider using intravenous insulin for patients who are critically ill, patients who are not eating or those who require prompt improvement in their glycemic control.
7. Use insulin infusion protocols when administering IV insulin to minimize the risk of hypoglycemia.
8. Except in the case of hyperglycemic emergencies (e.g. diabetic ketoacidosis, hyperosmolar hyperglycemic state), patients receiving IV insulin should receive some form of glucose (e.g. IV glucose or through total parenteral nutrition or enteral feeding).

Insulin with enteral or parenteral feedings

(CDA, Houlden, Capes, Clement, Miller, 2013)

1. Consider administration of insulin with the nutrition when insulin is required.
2. To determine the total daily dose (TDD) of insulin required in enteral or parenteral feeding, consider using an IV infusion of regular insulin.
3. Consider using subcutaneous correction (supplemental) insulin in addition to the insulin mixed with the parenteral nutrition for unusual hyperglycemia.
4. Patients with type 1 diabetes must be given subcutaneous insulin if the total parenteral nutrition (TPN) is interrupted to prevent diabetic ketoacidosis.

Peri-operative patients

(CDA, Houlden, Capes, Clement, Miller et al., 2013)

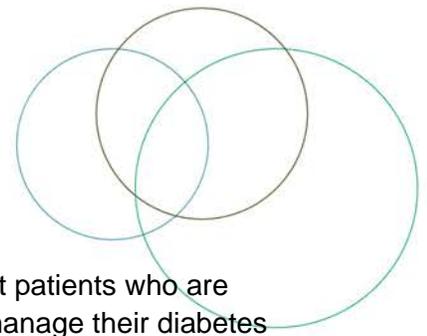
1. Maintain perioperative glycemic levels between 5.0 and 10.0 mmol/L for most surgical situations.
2. During surgery, ensure that insulin therapy and glucose monitoring are conducted with an appropriate protocol.
3. Ensure that perioperative staff has received training in the safe and effective implementation of diabetes therapy.

Patients receiving corticosteroid therapy

(CDA, Houlden, Houlden, Capes, Clement, Miller, 2013).

1. When patients are receiving corticosteroids in conjunction with insulin therapy, ensure both patient and staff know that when the corticosteroid dose is being tapered the insulin dosage will likely need to be decreased to prevent hypoglycemia.





Patient self-management

(ADA, 2015; CDA, Houlden, Capes, Clement, Miller, 2013)

1. Consider patient self-management of insulin for select youth and adult patients who are competent, have stable daily insulin requirements, successfully self-manage their diabetes at home, have physical skills to self-administer insulin, are able to perform self-monitoring of blood glucose, have adequate oral intake, are proficient in carbohydrate counting, use multiple daily insulin injections /or insulin pump therapy, and understand sick-day management of insulin therapy.
2. When patients are self-managing insulin, ensure that adjustments are made to accommodate for differences in meals and activity levels, the effects of illness and the effects of other medications.
3. For patients on insulin pump therapy, ensure that the hospital has clear policies and procedures in place.

Nutrition therapy

(ADA, 2015; CDA, Houlden, Capes, Clement, Miller, 2013; Curll et al., 2010; Gosmanov et al., 2012)

1. Ensure that all patients with and without diabetes undergo nutrition assessment on admission with subsequent implementation of physiologically sound caloric support.
2. For patients with diabetes, ensure the use of a consistent carbohydrate diabetes meal-planning system that is based on the total amount of carbohydrate offered rather than on specific calorie content at each meal.

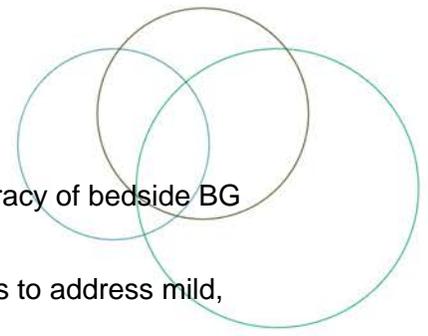
Organizational actions

(ADA, 2015; CDA, Houlden, Capes, Clement, Miller, 2013)

1. In hospitalized patients, hypoglycemia should be avoided. Protocols for hypoglycemia avoidance, recognition and management should be implemented with nurse-initiated treatment, including glucagon for severe hypoglycemia when IV access is not readily available. Patients at risk of hypoglycemia should have ready access to an appropriate source of glucose (oral or IV) at all times, particularly when NPO or during diagnostic procedures.
2. Establish individualized patient plans for preventing and treating hypoglycemia.
3. Record and track episodes of hypoglycemia in the medical record.
4. Ensure that there are standardized orders for scheduled and correction-dose insulin.
5. If not already present, create a multidisciplinary steering committee to provide educational programs, implement policies to assess and monitor the quality of glycemic management, and produce standardized order sets, protocols and algorithms for diabetes care within the institution.
6. Establish order sets for basal-bolus-supplemental insulin regimens and insulin management algorithms.



Hypoglycemia



7. Implement and maintain a quality control program to ensure the accuracy of bedside BG Point of Care Testing.
8. Ensure that there are standardized nurse-initiated treatment protocols to address mild, moderate and severe hypoglycemia.
9. Ensure there is staff education/awareness on factors that increase the risk of hypoglycaemia; such as sudden reduction in oral intake, discontinuation of PN or enteral nutrition, unexpected transfer from the nursing unit after rapid-acting insulin administration or a reduction in corticosteroid dose.

Transition from hospital to home

(CDA, Houlden, Capes, Clement, Miller, 2013)

1. Ensure that patients and their family or caregivers receive written and oral instructions regarding their diabetes management at the time of hospital discharge. Ensure that these instructions include recommendations for timing and frequency of home glucose monitoring; identification and management of hypoglycemia; a reconciled medication list, including insulin and other glucose-lowering medication; and identification and contact information for healthcare providers responsible for ongoing diabetes care and adjustment of glucose-lowering medication. Patients and their primary care providers should be aware of the need for potential adjustments in insulin therapy that may accompany adjustments of other medications prescribed at the time of discharge, such as corticosteroids or octreotide.

Non-diabetic hypoglycemic coma and drug-induced hypoglycemia without coma

1. Monitor blood glucose level after starting patients on drug therapy with Bactrim (sulfamethoxazole and trimethoprim, an antibiotic), beta-blockers, haloperidol, MAO (monoamine oxidase) inhibitors, pentamidine, quinidine, quinine, ACE (angiotensin-converting enzyme) inhibitors, lithium and second generation antipsychotic agents (Cryer, 2011; Desimone & Weinstock, 2016; Murad et al., 2009; Suzuki et al., 2009).
2. Monitor blood glucose level if patients receive insulin or medications for type 2 diabetes by error.
3. Monitor blood glucose in patients who are using alcohol.
4. Monitor blood glucose following bariatric surgery.

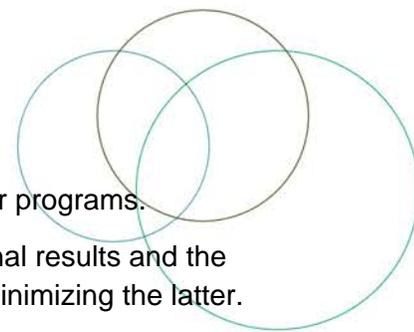
MEASURES

Vital to quality improvement is measurement, and this applies specifically to implementation of interventions. The chosen measures will help to determine whether an impact is being made (primary outcome), whether the intervention is actually being carried out (process measures), and whether any unintended consequences ensue (balancing measures).

Below are some recommended measures to use, as appropriate, to track your progress. In selecting your measures, consider the following:



Hypoglycemia



- Whenever possible, use measures you are already collecting for other programs.
- Evaluate your choice of measures in terms of the usefulness of the final results and the resources required to obtain them; try to maximize the former while minimizing the latter.
- Try to include both process and outcome measures in your measurement scheme.
- You may use different measures or modify the measures described below to make them more appropriate and/or useful to your particular setting. However, be aware that modifying measures may limit the comparability of your results to others.

Posting your measure results within your hospital is a great way to keep your teams motivated and aware of progress. Try to include measures that your team will find meaningful and exciting (IHI, 2011).

For more information on measuring for improvement contact the Canadian Patient Safety Institute Central Measurement Team measurement@cpsi-icsp.ca

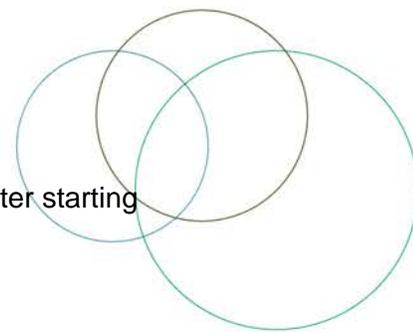
Outcome Measures

1. Percentage of patients with type 1 and/or type 2 diabetes with blood glucose below 4.0 mmol/L.
2. Percentage of non-diabetic patients with blood glucose below 4.0 mmol/L.

Process Improvement Measures

1. Percentage of patients assessed for a medical history of diabetes on admission to hospital.
2. Percentage of patients with diabetes whose condition is clearly identified on their medical record.
3. Percentage of patients with diabetes with appropriate blood glucose monitoring according to their medical status and anti-hyperglycemic agents.
4. Percentage of patients with diabetes that are prescribed anti-hyperglycemic medication in accordance with CDA 2013 clinical practice guidelines.
5. Percentage of patients that had their insulin adjusted appropriately with the tapering of corticosteroid.
6. Percentage of patients undergoing nutrition assessment on admission or during hospital stay.
7. Percentage of patients with diabetes receiving hospital nutrition counselling.
8. Percentage of patients at risk of hypoglycemia who have ready access to an appropriate source of glucose (oral or IV/glucagon) at all times.
9. Percentage of staff that received education regarding glucose (diabetes) management.
10. Percentage of patient and/or caregivers who received diabetes education and home management instructions prior to discharge.





11. Percentage of patients that had their blood glucose level monitored after starting medications known to cause hypoglycemia.

STANDARDS AND REQUIRED ORGANIZATIONAL PRACTICES

Accreditation Canada does not have any Standards or Required Organizational Practices that are directly related to altered blood glucose.

GLOBAL PATIENT SAFETY ALERTS

Global Patient Safety Alerts provides access and the opportunity to learn from other organizations about specific patient safety incidents including alerts, advisories, recommendations and solutions for improving care and preventing incidents. Learning from the experience of other organizations can accelerate improvement.

Recommended search terms:

- Insulin
- Diabetes
- Hypoglycemia

SUCCESS STORIES

Toolkit for Safe Implementation of Insulin Pens

Insulin safety is a key priority nationally for healthcare organizations, the Institute for Safe Medication Practice (ISMP) Canada and provincial governments. There is a growing interest in the adoption of insulin pens in the hospital setting as a means to improve insulin administration safety and ensure continuity of insulin product use by the patient from the community to the hospital setting and at discharge.

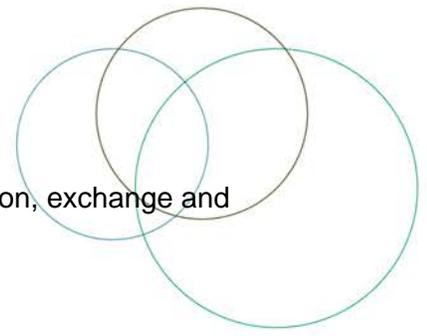
The Pharmacy leaders at the University Health Network (UHN) and Hamilton Health Sciences (HHS) agreed to collaborate for insulin pen implementation in 2013, as both organizations were undertaking conversion to insulin pens at one or more of their sites. The knowledge gained from this project led to the development of a toolkit to provide guidance and stewardship to other healthcare organizations in the safe implementation of insulin pen use in a variety of adult patient care settings.

The collaboration examined the following:

- To evaluate the effectiveness of the toolkit tools in the safe conversion to insulin pens on selected patient care areas at HHS and UHN.
- To evaluate outcome measures related to insulin administration to further inform healthcare organizations.
- To evaluate the work flow and workload changes related to conversion from insulin vials and syringes.



Hypoglycemia



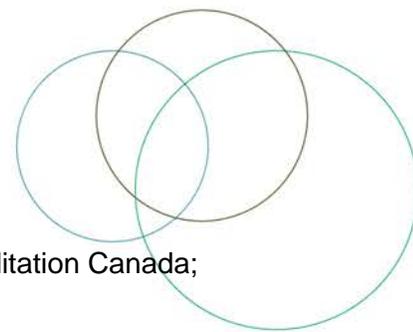
- To facilitate knowledge translation principles of synthesis, dissemination, exchange and application of knowledge to improve health services.
- To evaluate outcome measures related to insulin administration.
- To capture lessons learned for the benefit of other healthcare organizations.
- To develop a best practice education and implementation plan for replication by other healthcare organizations across the country.

In order to help other organizations embark on the shift in clinical practice to use of insulin pens, UHN and HHS have developed a toolkit within the framework of five guiding dimensions of what is required to successfully achieve such a practice change. This framework is supplemented, in a series of appended documents, with checklists designed as considerations for healthcare organizations to take into account as they contemplate this clinical practice change.

The framework offered in the toolkit captures the essence of the UHN and HHS experience and is offered from an evidence based perspective as an essential component for successful adoption of clinical practice changes related to insulin administration.

(Accreditation Canada, 2015)



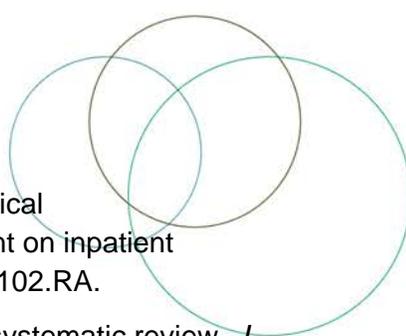


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ALTERED BLOOD GLUCOSE: RESOURCES

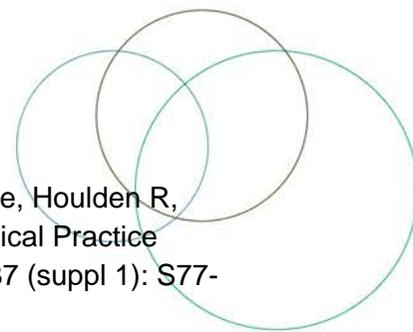
Professional Associations and Helpful Websites

- American Diabetes Association www.diabetes.org
- Canadian Diabetes Association www.diabetes.ca
- Institute for Safe Medication Practices www.ismp.org
- Institute for Healthcare Improvement (IHI) www.ihl.org
- Public Health Agency of Canada: [Your Guide to Diabetes](#)

Diabetes Clinical Practice Guidelines

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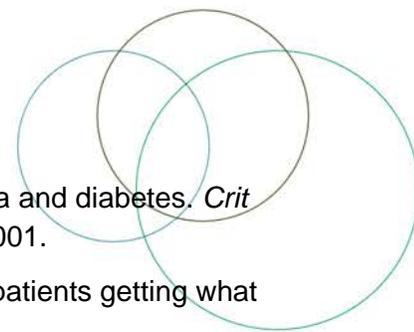


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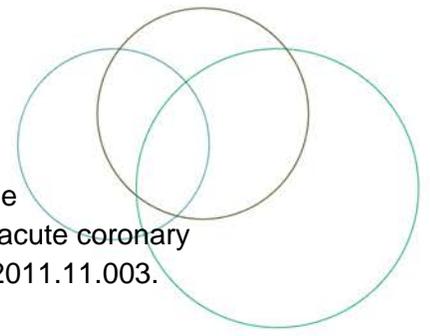




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