

There are a number of situations that patients taking insulin should be aware of how to troubleshoot.



Sick day management⁷²

- Counsel patients as follows when they are sick (e.g., vomiting, diarrhea, fever, dehydration):
 - Monitor blood glucose more often (e.g., every 1-2 hours)
 - If at risk of dehydration (i.e., cannot keep food/liquid down), temporarily stop agents from the SADMANS list (see [Type 2 diabetes and sick days: Medications to pause](#))
 - **Secretagogues** (e.g., glimepiride, glyburide, repaglinide)
 - **ACE inhibitors**
 - **Diuretics**, direct renin inhibitors
 - **Metformin**
 - **ARBs**
 - **NSAIDs**
 - **SGLT2is**
 - Adjust insulin amount depending on changes in food/liquid intake
 - When feeling better (i.e., able to eat/drink well), restart agents from the SADMANS list and regular insulin routine



Diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS)

- Risk factors³
 - Type 1 diabetes (4.6-8 / 1,000 patient-years), type 2 diabetes (0.32-2 / 1,000 patient-years)^{73,74}
 - New diabetes diagnosis
 - Non-adherence to insulin therapy
 - Severe infection
 - Surgery
 - Trauma
 - Myocardial infarction
 - Stroke
 - Thyrotoxicosis
 - Use of specific medications and drugs (e.g., SGLT2i, cocaine, atypical antipsychotics, interferon, diuretics, glucocorticoids, lithium)
 - Ultra low carb or keto diet
- Pregnant patients³
 - Pregnant patients in DKA typically present with lower blood glucose levels than non-pregnant patients
 - There are case reports of euglycemic DKA in pregnancy
- Clinical presentation of DKA or HHS:

	Symptoms	Signs
DKA	Urge to breathe deeply, nausea, vomiting, abdominal pain, altered sensorium	Kussmaul respiration, acetone-odoured (fruity-smelling) breath
HHS	Polyuria, polydipsia, weakness	Extracellular fluid volume depletion, seizures, stroke-like state

- Management of mild DKA at home (mild = alert; not drowsy, not in stupor or coma)³
 - In usual care, patients can self-manage early DKA if clinically stable and able to drink fluids
 - Monitor every 1-2 hours: blood glucose, nausea, vomiting, extreme thirst, ketones (with a reader/meter that accepts ketone strips, e.g., FreeStyle Libre®, FreeStyle Insulinx®, FreeStyle Precision Neo®)
- Hospitalization³
 - For patients with clinical decline (and/or a positive ketone test), recommend an evaluation at the emergency department given the concern of a rapid clinical decline (patients should not drive themselves)



Physical activity

- Encourage patients to participate in regular physical activity
- Insulin dose adjustments may be needed due to physical activity
 - Exact insulin dose adjustments cannot be provided
 - Adjustments will range (e.g., minimal to 50%), depending on the type/duration of exercise and blood glucose levels
- Counsel patients who plan to participate in physical activity:^{75,76}
 - Monitor blood glucose before, during and a few hours after any physical activity
 - Adjust insulin as needed
 - Always carry rapid-acting carbohydrates (e.g., dextrose tablets)
 - Consider insulin timing when physical activity is planned
 - Avoid injecting insulin into subcutaneous tissue next to the primary muscle used (activity will increase insulin absorption)
 - Eat before before any physical activity
 - Ensure proper hydration and watch for signs and symptoms of dehydration (e.g., increased thirst, nausea, severe fatigue, blurred vision or headache)³



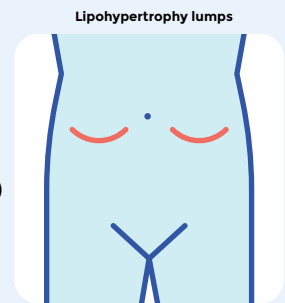
Driving

- Risk
 - Diabetes, the use of insulin and its complications can affect driving performance
 - Possible risks include: impaired sensory or motor function, impaired cognition, diabetic eye disease, nerve damage, kidney disease, cardiovascular disease, peripheral vascular disease, stroke and incidents of hypoglycemia³
- Assessment
 - All drivers taking insulin should have fitness to drive assessed every 2 years³
 - Driver's license may be suspended if a patient is determined unfit to drive or experiences an accident caused by hypoglycemia⁷⁸
 - Medical professionals in Ontario have a legal obligation to report to the appropriate regulatory body patients who have conditions that impair their driving ability (see [Reporting a driver for medical review](#))^{3,77}
- Counsel patients on insulin secretagogues and/or insulin to (see [Drive safe with diabetes](#))³
 - Measure blood glucose levels immediately before driving (must be >4.0 mmol/L)
 - Re-test at least every 4 hours while driving
 - At least every 2 hours if the patient has a history of severe hypoglycemic episodes (e.g., loss of consciousness) or hypoglycemia unawareness (e.g., lack of early warning symptoms of hypoglycemia, such as tremor, sweatiness and palpitations)
 - If blood glucose <4.0 mmol/L, treat hypoglycemia (i.e., ingestion of 15g of carbohydrate). Re-test and wait 40 minutes after blood glucose returns to >4.0 mmol/L before driving
 - Eat next meal or snack (containing carbohydrate and protein) within an hour
 - Always keep an emergency supply of fast-acting carbohydrates (e.g., dextrose tablets) and a glucose monitoring system inside the vehicle
- Commercial vehicle licensing^{3,78}
 - Canadians with diabetes (with or without insulin) can be licensed to drive a commercial vehicle in Canada (and now the United States) if medical standards are met



Lipohypertrophy⁵¹

- Presentation
 - Lipohypertrophic area(s) can develop under the skin where the same injection or infusion site is used repeatedly
 - Lipohypertrophy usually presents as thickened or rubbery lesions (can vary in size and shape)
 - Some lesions are easily seen (e.g., a large bulge), while others require detected by palpation (e.g., a hard lump) or ultrasound
- Risk factors
 - Lipohypertrophy can develop from repeated use of the same area, reusing insulin needles, more frequent insulin injections, higher dose insulin and a lack of systematic rotation
- Effect on insulin
 - Lipohypertrophy can decrease the rate of insulin absorption or make it more erratic/delayed, resulting in higher doses of insulin needed to achieve glycemic targets
- Prevention
 - Assess patients on insulin regularly for lipohypertrophy
 - Palpate injection area(s) regularly during patient appointments
 - Counsel patients on proper insulin injection techniques and pen needle use (see [Type 2 diabetes: insulin therapy > Safe insulin injection techniques and pen needle use](#))
- Treatment
 - Have patient avoid injecting in the site
 - Lipohypertrophy may take 3-6 months to reduced or resolve



Insulin and pre-surgery/procedure⁷⁹

- Counsel patients
 - Night before surgery:
 - Consider reducing long-acting, intermediate-acting or premixed insulin by 20-25%
 - Stop prandial (bolus) insulin when fasting begins
 - Morning of surgery (defer to any pre-op information patient has been given if available):
 - Patients on a twice-daily dosing of basal insulin should consider reducing the normal morning dose by 20%
 - If morning blood glucose > 6.7 mmol/L: reduce intermediate-acting or premixed insulin to 50% of the usual dose
 - If morning blood glucose < 6.7 mmol/L: do not take intermediate-acting or premixed insulin. This will minimize the risk of hypoglycemia



Travel⁸⁰⁻⁸²

- The primary goal is to avoid/prevent hypoglycemia during travel
- Counsel patients on general diabetes travel tips (see [Air travel: Traveling can be a breeze if you follow a few tips^{iii\)}](#))
- Recommendations for insulin adjustment during air travel vary significantly and are mostly based on expert opinion

Travel	Insulin adjustment	Example
Eastward travel, crossing more than 5 time zones (lose hours, shorter day) <ul style="list-style-type: none"> • Example: Toronto, Ontario to London, England 	Once-daily insulin: <ul style="list-style-type: none"> • Inject the usual dose on the day of travel • Inject 2/3 of the usual dose on the day destination is reached (travellers lose a few hours and may consume fewer calories) • Patients on long-acting insulin can also keep time of administration on Canadian time 	<ul style="list-style-type: none"> • Glargine 60 units at bedtime on day of travel in Canada • Glargine 40 units at bedtime in Europe on day 1, then 60 units every night at bedtime thereafter
	Twice-daily insulin: <ul style="list-style-type: none"> • Inject 2/3 of the usual morning dose on the day of arrival at the destination • Usual dinner dose is the same • Usual dose followed from day 2 onwards 	<ul style="list-style-type: none"> • Detemir 30 units twice daily in Toronto • In Europe, detemir 20 units in the morning and 30 units in the evening, then 30 units twice daily thereafter
	Basal-prandial (bolus) therapy <ul style="list-style-type: none"> • Usual dosing schedule • If a meal is missed during travel, then the prandial (bolus) dose should be skipped 	<ul style="list-style-type: none"> • Glargine 60 units at bedtime and lispro 20 units three times daily with meals – no change
Westward travel, crossing 5 or more time zones (gain hours, longer day) <ul style="list-style-type: none"> • Example: London, England to Toronto, Ontario 	<ul style="list-style-type: none"> • No insulin dose change, but may require extra prandial (bolus) insulin with extra meal if prandial (bolus) insulin is used 	<ul style="list-style-type: none"> • No insulin dose change
Travel within North America	<ul style="list-style-type: none"> • No insulin dose change 	<ul style="list-style-type: none"> • No insulin dose change



Specific diets

- Refer patients with specific diet requirements to a dietitian (see [Local services for patients living with type 2 diabetes^{iv\)}](#))
- For information on common specific diets for patients with type 2 diabetes:
 - [Patients observing Ramadan⁸³](#)
 - [Low carbohydrate diets⁸⁴](#)
 - [Intermittent fasting⁸⁵](#)



Glucocorticoid-induced hyperglycemia^{86,87}

- Glucocorticoid-induced hyperglycemia can occur in patients with or without diabetes
- Monitoring
 - Monitor blood sugar three times daily
- Indications to consider treatment
 - Blood glucose >12 mmol/L on two occasions within a 24-hour period (consider checking ketones if indicated)
- Treatment options
 - If NOT on insulin: adding a sulfonylurea or adjusting current sulfonylurea dose may be considered. Insulin may be needed.
 - If ON insulin: adjust basal insulin daily (may need >30% increase)
- Treatment considerations should be individualized based on glucocorticoid drug (e.g., prednisone has mid-day peak, dexamethasone is longer acting), treatment duration, and patient risks of hyperglycemia and hypoglycemia. A second opinion from a specialist may be considered (e.g., e-Consult)
- Careful monitoring and subsequent decreases in antihyperglycemic therapy is prudent when steroid dose is tapered and/or when clinical status changes

Patient resources

- [i] [RxFiles Type 2 diabetes and sick days: Medications to pause](#)
- [ii] [Diabetes Canada Drive safe with diabetes](#)
- [iii] [Diabetes Canada Air travel: Traveling can be a breeze if you follow a few tips](#)
- [iv] [Centre for Effective Practice local services for patients living with type 2 diabetes](#)

References

See [Type 2 Diabetes: Insulin Therapy tool](#)

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