

There are a number of complex events that can occur for patients taking insulin. Counsel patients on how to prevent and manage these events.



**Sick day management<sup>72</sup>**

- 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 factors<sup>3</sup>
  - Type 1 diabetes (4.6-8 / 1,000 patient-years), type 2 diabetes (0.32-2 / 1,000 patient-years)<sup>73,74</sup>
  - 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 patients<sup>3</sup>
  - 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)<sup>3</sup>
  - 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®)
- Hospitalization<sup>3</sup>
  - 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:<sup>75,76</sup>
  - 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)<sup>3</sup>



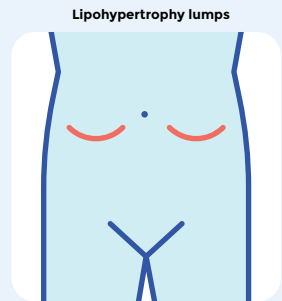
### Driving

- 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 hypoglycemia<sup>3</sup>
- Assessment
  - All drivers taking insulin should have fitness to drive assessed every 2 years<sup>3</sup>
  - Driver's license may be suspended if a patient is determined unfit to drive or experiences an accident caused by hypoglycemia<sup>78</sup>
  - 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](#))<sup>3,77</sup>
- Counsel patients on insulin secretagogues and/or insulin to (see [Drive safe with diabetes](#))<sup>3</sup>
  - 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<sup>3,78</sup>
  - 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



### Lipohypertrophy<sup>51</sup>

- 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/procedure<sup>79</sup>

- 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



**Travel<sup>80-82</sup>**

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



**Specific diets**

- Refer patients with specific diet requirements to a dietitian (see [Local services for patients living with type 2 diabetes<sup>iv\)</sup>](#))
- For information on common specific diets for patients with type 2 diabetes:
  - [Patients observing Ramadan<sup>83</sup>](#)
  - [Low carbohydrate diets<sup>84</sup>](#)
  - [Intermittent fasting<sup>85</sup>](#)



**Glucocorticoid-induced hyperglycemia<sup>86,87</sup>**

- 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

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- [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

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

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