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Insulin therapy with enteral and parenteral nutrition

Consensus report of the SGED/SSED

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Abbreviations

bw	Body weight
d	Day
EN	Enteral nutrition
IR	Insulin resistance
NPH	Neutral Protamine Hagedorn
PN	Parenteral nutrition
SF	Sensitivity factor (used in the electronic prescription system at USZ)
TDI	Total daily insulin
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus
IU	International units

Examples: Indicated in blue font

Abstract

Background: Nutritional support with enteral (EN) or parenteral nutrition (PN) is frequently required in hospitalized patients and can impair glycemic control. Despite its clinical importance, practical and uniform recommendations for insulin therapy are lacking.

Methods: The Swiss Society for Endocrinology and Diabetology (SGED/SSED) convened an expert panel to develop consensus guidance on insulin therapy for patients receiving EN or PN. The working group reviewed available evidence, international guidelines, and current practice in Swiss hospitals, and harmonized approaches across regions. The resulting statement provides strategies for insulin dosing in intermittent, continuous, and bolus EN, as well as PN, primarily for inpatient care, but also applicable to home-based nutritional support.

Recommendations: The dose of insulin depends on the (known or calculated) basal insulin requirement and the carbohydrate content of the EN or PN bag. For intermittent EN (infused over 12-14 hours), intermediate-acting insulin with a duration of action matching the duration of feeding is recommended. For continuous EN (over 24 hours), long-acting insulin is preferred. When EN is administered as boluses (2-3 hours each), short-acting insulin should be injected before each bolus, analogous to prandial dosing with meals. For PN, the addition of short-acting insulin directly into the PN bag is encouraged, as this ensures stable glycemic control without increasing the risk of hypoglycemia. Across all modalities, correction insulin should be prescribed according to institutional schemes and individualized requirements, with additional units of correction insulin incorporated into the subsequent day's basal and (par)enteral nutrition insulin dose. The statement further provides recommendations for glucose monitoring, safe transitions between regimens, and the management of unexpected interruptions in nutritional therapy.

Conclusions: This SGED/SSED consensus statement represents a nationwide framework for insulin therapy in patients receiving EN or PN in Switzerland. By standardizing insulin use, it aims to enhance safety, reduce glycemic variability, and improve outcomes in hospitalized patients as well as in those receiving specialized nutritional support at home.

Introduction

Nutritional support – whether enteral, parenteral, or oral – presents unique challenges in glucose control, particularly regarding insulin dosing and timing. Variability in nutritional intake, absorption rates, and metabolic response necessitates personalized insulin strategies to minimize the risk of hyper- and hypoglycemia. Given the potential for adverse events (1–3), the American Society for Parenteral and Enteral Nutrition recommends that "insulin use in parenteral nutrition should be done in a consistent manner adhering to a defined protocol, in which healthcare personnel have adequate knowledge" (4).

This consensus statement aims at providing practical guidance on insulin administration across different nutritional regimens, including enteral (continuous, intermittent and bolus) and parenteral (intravenous) nutritional support. The statement outlines available options for insulin prescription, detailing key considerations for dose adjustments, timing, and monitoring. The insulin needs with oral nutritional supplements is beyond the scope of this document, and can usually be managed similar to an insulin bolus administration for a meal/snack with known carbohydrate content (check online https://clinicalnutrition.science/en/nutripro/ for the different nutritional support products).

This guidance is primarily intended for hospital-based healthcare providers, including residents and consultant physicians managing inpatients requiring insulin therapy, as well as the on-call diabetes team. Our goal is to enhance the safety and effectiveness of insulin use in hospitalized patients receiving specialized nutrition support, ensuring better glycemic outcomes and overall patient care. With proper guidance and training, such protocols can also be safely used for home-based nutritional support.

	Brand name	Active compound	Active time
Short-acting insulins	NovoRapid®	Insulin aspart	3-5 hours
	Fiasp®	Insulin aspart	3-5 hours
	Humalog®	Insulin lispro	3-5 hours
	Lyumjev®	Insulin lispro	3-5 hours
	Apidra®	Insulin glulisine	3-5 hours
	Actrapid®	Regular insulin	5-8 hours
Intermediate-acting insulins	Huminsulin®	NPH insulin	12-18 hours
	Insulatard®	NPH insulin	12-18 hours
Long-acting insulins	Levemir®	Insulin detemir	12-24 hours
	Lantus® *	Insulin glargine	20-24 hours
	Abasaglar®	Insulin glargine	20-24 hours
Ultralong-acting insulins	Toujeo®	Insulin glargine U-300	Up to 36 hours
	Tresiba®	Insulin degludec	Up to 42 hours

Table 1: Overview of insulins mentioned in this statement, categorized by their duration of action. *Lantus: deductible of 40%. Abbreviations: NPH, Neutral Protamine Hagedorn; U, units.

With enteral or parenteral nutrition, we do not recommend the introduction of pre-mixed insulins (e.g. Humalog® Mix, Ryzodeg®) or those combining insulin and GLP-1 receptor agonist (e.g. Suliqua®, Xultophy®). Patients who are already on pre-mixed insulins should be switched to a regimen combining short- and long-acting insulins for better flexibility and glycemic control.

Be aware that some insulins will be discontinued as follows:

Available until fall 2025

- Rapid-acting insulins:
  - Actrapid® Penfill® - cartridge for pen
  - NovoRapid® FlexTouch®
- Intermediate-acting insulins:
  - Insulatard® Penfill® - cartridge for pen
  - Insulatard® FlexPen®

Available until approximately end of 2026

- Ultrarapid-acting insulins:
  - Fiasp® PumpCart® - cartridge for insulin pump
- Intermediate-acting insulins:
  - Levemir® Penfill®- cartridge for pen
  - Levemir® FlexPen®

Enteral nutrition (EN) in patients with diabetes

Option 1: Intermittent EN (over 12-14 hours)

When administering enteral nutrition (EN) over 12-14 hours, either diurnal or nocturnal, we do not recommend short-acting insulin, but an intermediate-acting insulin with a duration of action of approximately 12-18 hours (table 1; rationale: short-acting insulin would have to be administered every 4 hours). This makes it easier to adjust the insulin dosage when enteral nutrition is changed, as the durations approximately match.

Insulin cannot be added to the EN bag, as insulin would be digested and therefore inactivated. Therefore, insulin must be administered subcutaneously.

The dose of intermediate-acting insulin depends on the (known or calculated) basal insulin (see 'basal insulin' below) and the carbohydrate content of EN (see 'enteral nutrition insulin' below). As insulin sensitivity is difficult to estimate in the short term, adjustments must be made according to the additional correction insulin required (see 'correction insulin' below). Optimally, the intermediate-acting insulin should be administered within 1 hour before EN is started. However, in current practice, intermediate-acting insulin is often injected at the same time as the EN is started to avoid mistakes (e.g. inadvertent delays or concerns about low/normal glycemia), or for practical reasons (e.g. EN and insulin administration at home like Spitex, HomeCare, or similar services).

Enteral nutrition is preferably administered at night to allow more free time during the day for increased oral intake (when feasible), physical activity and mobility. However, this timing is considered less physiological with regards to circadian rhythms of anabolic and catabolic states. Thus, the actual timing of intermittent EN should be discussed to maximize the nutritional, physical rehabilitation, and diabetes goals.

- Glucose measurements when EN infusion is started, then every 4 hours until 2 hours after stopping EN.

- Basal insulin:
  If dose is known: use known total dose of basal insulin per day (d).
  If dose is unknown or unclear: calculate the insulin dose per day (d), as suggested below.

  Example: For a patient with a body weight (bw) of 70 kg:

Type 1 diabetes (T1DM):	0.3 IU/kg bw/d	→ 21 IU	→ 10-0-0-11 IU
Pancreatogenic (type 3c DM):	0.25 IU/kg bw/d	→ 18 IU	→ 9-0-0-9 IU
Type 2 diabetes (T2DM), SF 0.5*:	0.6 IU/kg bw/d	→ 42 IU	→ 21-0-0-21 IU
T2DM, SF 0.8*:	0.4 IU/kg bw/d	→ 28 IU	→ 14-0-0-14 IU

  *The sensitivity factor (SF) is used in some electronic prescription systems (e.g. at the University Hospital Zurich) to adjust for insulin sensitivity/resistance. The normal sensitivity factor (SF) is 1.0, e.g. in T1DM. A reduced sensitivity factor (i.e., between 0.5 and 0.9) occurs in patients with T2DM or generally severe illnesses. Each reduction of 0.1 causes a 20% increase in insulin demand. So, the lower the sensitivity factor, the higher the insulin resistance (IR), and the more insulin has to be administered.

  The basal insulin is then separated in 2 doses as indicated above, thus allowing separate adaptations of the morning and evening dose, when the EN is added or removed (see below).

- Enteral nutrition insulin: **This should be added to the evening basal insulin dose (in the case of nocturnal EN) or to the morning dose (for diurnal EN).**

Example: For EN containing 184 g of carbohydrates, we estimate 18 IU of intermediate-acting insulin for a patient with 'medium' insulin resistance, i.e., an insulin dose of 1 IU per 10 g of carbohydrates.

The basal insulin is split into two doses (as suggested above) and the enteral nutrition insulin is added to the basal dose administered during the time of EN (in our example, during the night).

For the same patient with a body weight (bw) of 70 kg and the parameters above:

T1DM:	10-0-0-11	+ 18 IU	→ 10-0-0-29 IU
Pancreatogenic:	9-0-0-9	+ 18 IU	→ 9-0-0-27 IU
T2DM, SF 0.5:	21-0-0-21	+ 18 IU	→ 21-0-0-39 IU
T2DM, SF 0.8:	14-0-0-14	+ 18 IU	→ 14-0-0-32 IU

- Correction insulin: Use the correction scheme from your institution if available.

  Example of a standard correction scheme based on the patient's total daily insulin dose as a proxy for insulin resistance, which should be adapted by each institution and according to the clinical context.

	Glc 10-12 mmol/l	Glc 12-15 mmol/l	Glc 15-18 mmol/l	Glc 18-22 mmol/l	Glc 22-25 mmol/l	Glc > 25 mmol/l
'Low' IR: TDI < 20 IU	+2 IU	+3 IU	+4 IU	+6 IU	+8 IU	+10 IU
'Medium' IR: TDI 20-50 IU	+3 IU	+4 IU	+6 IU	+8 IU	+10 IU	+12 IU
'High' IR: TDI > 50 IU	+4 IU	+6 IU	+8 IU	+10 IU	+12 IU	+14 IU

Abbreviations: Glc = glucose; IR = insulin resistance; TDI: total daily insulin.

Example of a correction scheme based on the sensitivity factor (SF, explanations above): The initial assumption is a SF of 1.0, corresponding to normal insulin sensitivity. Corrections are performed every 4 hours according to the line "0-10 g carbohydrates". The SF may require adjustments over time based on blood glucose.

In case of persistent hyperglycemic decompensation (glycemia > 20 mmol/l for > 24 hours), EN should be withheld until metabolic stabilization is achieved. EN can be resumed once glycemia is stable and < 15 mmol/l. However, prolonged interruption of EN should be avoided due to the risks of malnutrition, refeeding syndrome and ketogenesis.

- Daily adaptations of insulin regimen: The additional units of short-acting insulin corrections required can be added after evaluation by the day diabetes team the following day (e.g. if 4 IU of correction insulin was needed during the previous EN administration, then 4 IU of intermediate-acting insulin should be added to the insulin dose for the next EN administration).

- If additional food is eaten, mealtime insulin should be prescribed separately, as usually done for bolus insulin.

- Changing EN: Please contact the on-call diabetes team if you plan on changing the diet (fasting for instance) or artificial nutrition (change of product of EN, volume or duration of administration). If possible, taper down and discontinue EN in a planned manner.

In our **example**, the intermediate-acting insulin dose must be reduced to basal insulin after stopping EN (see above).

- Emergency stop of EN: If EN must be stopped urgently and the patient has already received the full dose of intermediate-acting insulin, monitor blood glucose every 2 hours for 12-24 hours and administer a glucose infusion if needed.

Option 2: Continuous EN (over 24 hours)

When administering enteral nutrition (EN) over 24 hours, we do not recommend short-acting insulin, but a long-acting insulin with a duration of action of approximately 24 hours (table 1; rationale: short-acting insulin would have to be administered every 4 hours). This makes it easier to adjust the insulin dosage when enteral nutrition is changed, as the durations approximately match.

Insulin cannot be added to the EN bag, as insulin would be digested and therefore inactivated. Therefore, insulin must be administered subcutaneously.

The dose of long-acting insulin depends on the (known or calculated) basal insulin (see 'basal insulin' below) and the carbohydrate content of EN (see 'enteral nutrition insulin' below). As insulin sensitivity is difficult to estimate in the short term, adjustments must be made according to the additional correction insulin required (see 'correction insulin' below).

- Glucose measurements when EN infusion is started, then every 4-6 hours.

- Basal insulin:
  If dose is known: use known total dose of basal insulin per day (d).
  If dose is unknown or unclear: calculate the insulin dose per day (d) as suggested below.

  Example: For a patient with a body weight (bw) of 70 kg:

T1DM:	0.3 IU/kg bw/d	→ 21 IU
Pancreatogenic:	0.25 IU/kg bw/d	→ 18 IU
T2DM, SF 0.5*:	0.6 IU/kg bw/d	→ 42 IU
T2DM, SF 0.8*:	0.4 IU/kg bw/d	→ 28 IU

  *The sensitivity factor (SF) is used in some electronic prescription systems (e.g. at the University Hospital Zurich) to adjust for insulin sensitivity/resistance. The normal sensitivity factor (SF) is 1.0, e.g. in T1DM. A reduced sensitivity factor (i.e., between 0.5 and 0.9) occurs in patients with T2DM or generally severe illnesses. Each reduction of 0.1 causes a 20% increase in insulin demand. So, the lower the sensitivity factor, the higher the insulin resistance (IR), and the more insulin has to be administered.

- Enteral nutrition insulin: **This should be added to the basal insulin**.

  Example: For EN containing 184 g of carbohydrates we estimate 18 IU of long-acting insulin for a patient with 'medium' insulin resistance, i.e., an insulin dose of 1 IU per 10 g of carbohydrates.

  Basal insulin and enteral nutrition insulin are added and given once daily.

  For the same patient with a body weight (bw) of 70 kg and the parameters above:

T1DM:	21 IU + 18 IU = 39 IU
Pancreatogenic:	18 IU + 18 IU = 36 IU
T2DM, SF 0.5:	42 IU + 18 IU = 60 IU
T2DM, SF 0.8:	28 IU + 18 IU = 46 IU

- Correction insulin: Use the correction scheme from your institution if available.

  Example of a standard correction scheme based on the patient's total daily insulin dose as a proxy for insulin resistance, which should be adapted by each institution and according to the clinical context.

	Glc 10-12 mmol/l	Glc 12-15 mmol/l	Glc 15-18 mmol/l	Glc 18-22 mmol/l	Glc 22-25 mmol/l	Glc > 25 mmol/l
'Low' IR: TDI < 20 IU	+2 IU	+3 IU	+4 IU	+6 IU	+8 IU	+10 IU
'Medium' IR: TDI 20-50 IU	+3 IU	+4 IU	+6 IU	+8 IU	+10 IU	+12 IU
'High' IR: TDI > 50 IU	+4 IU	+6 IU	+8 IU	+10 IU	+12 IU	+14 IU

Abbreviations: Glc = glucose; IR = insulin resistance; TDI: total daily insulin.

Example of a correction scheme based on the sensitivity factor (SF, explanations above): The initial assumption is a SF of 1.0, corresponding to normal insulin sensitivity. Corrections are performed every 4 hours according to the line "0-10 g carbohydrates". The SF may require adjustments over time based on blood glucose.

In case of persistent hyperglycemic decompensation (glycemia > 20 mmol/l for > 24 hours), EN should be withheld until metabolic stabilization is achieved. EN can be resumed once glycemia is stable and < 15 mmol/l. However, prolonged interruption of EN should be avoided due to the risks of malnutrition, refeeding syndrome and ketogenesis.

- Daily adaptations of insulin regimen: The additional units of short-acting insulin corrections required can be added after evaluation by the day diabetes team the following day (e.g. if 4 IU of correction insulin was needed during the previous EN administration, then 4 IU of long-acting insulin should be added to the insulin dose for the next EN administration).

- If additional food is eaten, mealtime insulin should be prescribed separately, as usually done for bolus insulin.

- Changing EN: Please contact the on-call diabetes team if you plan on changing the diet (fasting for instance) or artificial nutrition (change of product of EN, volume or duration of administration). If possible, taper down and discontinue EN in a planned manner.

  In our **example**, the long-acting insulin dose must be reduced to basal insulin after stopping EN (see above).

- Emergency stop of EN: If EN must be stopped urgently and the patient has already received the full dose of long-acting insulin: monitor blood glucose every 2 hours for 24-48h and administer a glucose infusion if needed.

- If a transition to an intermittent EN regimen is necessary, we recommend following section 'Option 1: Intermittent EN' above, and consulting the diabetes team for insulin adjustments during the transition. If EN needs to be interrupted for other medications, please also contact the diabetes team.

Option 3: EN given as 3 boluses like meals

When administering enteral nutrition (EN) as boluses over 2-3 hours each, we recommend using short-acting insulin with a comparable duration of action, to be injected before starting the EN (table 1; ideally 10-15 minutes beforehand, or, if not possible, to be injected at the start of the EN). If blood glucose is < 5 mmol/l, the insulin should be administered 10-15 minutes after starting EN). It must be clearly documented that, if an EN bolus is omitted (e.g., due to planned surgery, fasting for an examination, or patient refusal), the corresponding short-acting insulin must also be omitted - similar to how prandial insulin would be withheld if a meal/snack is skipped in a patient without EN.

The dose of short-acting insulin depends on the carbohydrate content of the EN (check online https://clinicalnutrition.science/en/nutripro/ for the different EN products). As insulin sensitivity is difficult to estimate in the short term, adjustments must be made according to the additional corrective insulin required.

- Standard glucose monitoring as for a patient with diabetes on multiple daily injections.

- Basal insulin:
  See section Option 1 for dosage of basal insulin.

- Enteral nutrition insulin:

  Example: For an EN product containing 60 g of carbohydrates administered three times a day, 6 IU of short-acting insulin should be given with each EN bolus in a patient with 'medium' insulin resistance, i.e., using an insulin dose of 1 IU per 10 g of carbohydrates.

- Correction insulin:
  As insulin sensitivity is highly variable, the correction scheme should be adjusted to assumed insulin sensitivity. For possible correction schemes, refer to section 'Option 1: Intermittent EN' above. Correction insulin is administered together with the EN insulin bolus at the start of EN.

  In case of persistent hyperglycemic decompensation (glycemia > 20 mmol/l for > 24 hours), EN should be withheld until metabolic stabilization is achieved. EN can be resumed once glycemia is stable and < 15 mmol/l. However, prolonged interruption of EN should be avoided due to the risks of malnutrition, refeeding syndrome and ketogenesis.

  Dosage of short-acting insulin should be adjusted daily according to the blood glucose profile and the additional correction doses required at each EN bolus on the previous day.

- If additional food is eaten (including oral nutrition supplements), we recommend giving the EN bolus together with meals, with glucose measurements before each EN bolus/meal. The short-acting insulin dose is calculated based on the total carbohydrate content (EN bolus + normal meal) and a correction dose is added according to the correction scheme described above.

- Changing EN: Please contact the on-call diabetes team if you plan on changing the diet (fasting for instance) or artificial nutrition (change of product of EN, volume or duration of administration). If possible, taper down and discontinue EN in a planned manner.

- If EN is expected to last a long time, the use of CGM should be considered. This might reduce the risk of both unnoticed hyper- and hypoglycemia.

Parenteral nutrition (PN) in patients with diabetes

The administration of parenteral nutrition (PN) which contains carbohydrates can lead to hyperglycemia, particularly in patients with preexisting diabetes or disease-related insulin resistance (5). This condition is linked to higher complication rates, including increased admissions to intensive care units, prolonged hospital stays, and greater mortality compared to patients without hyperglycemia (6–8). Hyperglycemia occurs in more than 50% of patients receiving PN (9). Management of hyperglycemia requires insulin therapy, which can be delivered subcutaneously, intravenously (infusion), or by incorporating insulin directly into the PN.

Incorporating short-acting insulin directly into the PN is an attractive method because it provides better glycemic control (10) without increasing the risk of hypoglycemia (11,12). While several factors are influencing insulin availability in the parenteral bag, as outlined in the Appendix, we believe these should not exclude the use of this method, as the insulin dose can be adjusted daily according to each patient's needs.

The insulin dose depends on the carbohydrate content of the PN bag. The direct addition of short-acting insulin in the PN bag means that the infusion rate does not affect the amount of insulin required, as the amount of insulin has been calculated for the carbohydrate content of the entire PN bag. In addition, if the PN bag is administered partially (e.g. only ¾), a proportional amount of insulin will be infused alongside in a safe manner, provided that the PN bag is thoroughly mixed after insulin addition. Proper mixing ensures distribution of insulin throughout the tri-compartment fluid and reduces binding to the inner plastic surface of the PN bags.

As insulin sensitivity is difficult to estimate in the short term, daily adjustments of insulin dosage are often required, in collaboration between the on-call diabetes and nutrition teams.

- Glucose measurements when PN infusion is started, then every 4 hours until the end of PN infusion.

- Parenteral nutrition and short-acting insulin added to the PN bag:

  Example: We assume an insulin dose of 1 IU per 10 g of carbohydrates.

Parenteral nutrition	Parenteral nutrition content	Insulin added to PN bag
Smofkabiven 493 ml	63 g carbohydrates, 550 kcal	+ 6 IU
Smofkabiven 986 ml	125 g carbohydrates, 1100 kcal	+ 12 IU
Smofkabiven 1477 ml	187 g carbohydrates, 1600 kcal	+ 19 IU
Smofkabiven 1970 ml	250 g carbohydrates, 2200 kcal	+ 25 IU

Parenteral nutrition	Parenteral nutrition content	Insulin added to PN bag
Omegaflex 625 ml	40 g carbohydrates, 480 kcal	+ 4 IU
Omegaflex 1250 ml	80 g carbohydrates, 960 kcal	+ 8 IU
Omegaflex 1875 ml	120 g carbohydrates, 1430 kcal	+ 12 IU
Omegaflex 2500 ml	160 g carbohydrates, 1900 kcal	+ 16 IU

- Correction insulin: Use the correction scheme from your institution if available.

Example of a standard correction scheme based on the patient's total daily insulin dose as a proxy for insulin resistance, which should be adapted by each institution and according to the clinical context.

	Glc 10-12 mmol/l	Glc 12-15 mmol/l	Glc 15-18 mmol/l	Glc 18-22 mmol/l	Glc 22-25 mmol/l	Glc > 25 mmol/l
'Low' IR: TDI < 20 IU	+2 IU	+3 IU	+4 IU	+6 IU	+8 IU	+10 IU
'Medium' IR: TDI 20-50 IU	+3 IU	+4 IU	+6 IU	+8 IU	+10 IU	+12 IU
'High' IR: TDI > 50 IU	+4 IU	+6 IU	+8 IU	+10 IU	+12 IU	+14 IU

Abbreviations: Glc = glucose; IR = insulin resistance; TDI: total daily insulin.

Example of a correction scheme based on the sensitivity factor (SF, explanations above): The initial assumption is a SF of 1.0, corresponding to normal insulin sensitivity. Corrections are performed every 4 hours according to the line "0-10 g carbohydrates". The SF may require adjustments over time based on blood glucose.

In case of persistent hyperglycemic decompensation (glycemia > 20 mmol/l for > 24 hours), PN should be withheld until metabolic stabilization is achieved. PN can be resumed once glycemia is stable and < 15 mmol/l. However, prolonged interruption of PN should be avoided due to the risks of malnutrition, refeeding syndrome and ketogenesis.

- Daily adaptations of insulin regimen: The additional units of short-acting correction insulin required over the previous 24 hours can be added directly to the next PN bag (e.g., if 4 IU of correction insulin was needed during the previous PN infusion, an additional 4 IU of short-acting insulin should be added to the insulin dose in the PN prescription).

- If additional food is eaten, mealtime insulin should be prescribed separately, as usually done for bolus insulin.

- Basal insulin: continue with the long-acting insulin if previously needed. Consider starting basal insulin depending on the clinical situation (i.e., type 1 diabetes, after total pancreatectomy or if insulin needs are very high). If the PN with insulin in the bag is administered continuously over 24 hours, one may consider combining the insulin doses, after discussion with the on-call diabetes team.

- Changing PN: Please contact the on-call diabetes team if you wish to change the diet or artificial nutrition (i.e. flow rate, type of diet). If possible, taper down and discontinue PN in a planned manner.

- Emergency stop of PN with added insulin: If PN must be stopped urgently, monitor blood glucose at the time of discontinuation and 2 hours later. Switch back to long-acting insulin (and potentially short-acting insulin) if needed in consultation with the on-call diabetes team.

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Appendix

Several factors influence the availability of the insulin in the parenteral nutrition (PN) bag such as the material of the PN bag (13), the presence of intravenous lipid emulsion (14) and the addition of micronutrients such as multivitamins and trace elements (15).

A study showed that insulin recovery was significantly higher in glass PN bag than in ethyl-vinyl-acetate (EVA) plastic bags (13). Nevertheless, the presence of intravenous lipid emulsion (ILE) seems to be the key factor affecting biosynthetic human recombinant short-acting insulin availability in standard PN contained in EVA plastic bags (14). Based on this study, when lipids comprised 3.75% of the total PN volume, the insulin recovery was 81% at T0 and 72.5% at T+24 hours. When the concentration of lipids was 3% of the total PN volume, the insulin recovery was only 20% (14). The presence of micronutrients in the PN bag can also increase insulin recovery (from 5% to 95% according to this study (15)).

In Switzerland, most PN solutions now come in ready-to-use tri-compartment plastic bags with a known concentration in lipid emulsion. Micronutrients are always added to the PN bag before infusion. Please refer to manufacturer information on the compatible insulins and maximum insulin dosage that can be added to the PN bag.

In conclusion, adding insulin directly to the PN bag is considered safe and effective, provided that the lipid content is known and micronutrients are added. Clinicians should be aware that insulin recovery may change when switching between regimens. Consistent glucose monitoring remains the key measure to detect and manage variations of glucose levels. In case of doubt, we recommend consulting the on-call diabetes team, the manufacturer's information, or the Swiss Compendium of Medications.

For more information on the content of EN / PN bags: https://clinicalnutrition.science/en/nutripro/