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L'Unité d'évaluation des technologies et des modes d'intervention en santé (UETMIS) du Centre Universitaire de Santé McGill (CUSM)

Health Technology Assessment Unit (TAU) of the MUHC

December 19, 2025

Preoperative Complex Carbohydrate Loading for Enhancing Recovery after Surgery

Health Technology Assessment Report
Report no. 104

Report prepared for the Technology Assessment Unit (TAU) of the McGill University Health Centre (MUHC)

by

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Reviewed by the Policy Committee of the TAU on December 19, 2025

Mission Statement

The MUHC Health Technology Assessment Unit (TAU) advises hospital administrators and clinical teams in difficult resource allocation decisions. Using an approach based on independent, critical evaluations of the available scientific evidence and a transparent, fair decision-making process, novel and existing medical equipment, drugs and procedures used by healthcare professionals are prioritized on a continuous basis ensuring the best care for life with the best use of resources.

TAU Policy Committee

Declaration of Conflicts of Interest

Members of TAU's research staff and policy committee declare no conflicts of interest.

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- Claudiane Poisson, inf., BSc, MSc, ERAS Program Nurse Coordinator, Royal Victoria Hospital, MUHC
- Sonia Sandberg, RN, BN, Surgical Care Pathway Coordinator, Montreal General Hospital, MUHC
- Debbie Watson, RN, MN, ERAS Program Nurse Coordinator, Montreal General Hospital, MUHC
- Mohamed El Qachchach, Program Coordinator, Institut Cardiologie de Montréal

REPORT REQUESTOR

There is an interest in homogenizing the administration of complex carbohydrate drinks before surgery, part of the Enhanced Recovery After Surgery (ERAS) protocol, across the McGill University Health Center (MUHC). Loïca Ducheine, nursing advisor in the Products Procurement division of the nursing directorate of the MUHC, requested the Technology Assessment Unit (TAU) to conduct an evaluation of complex versus simple carbohydrate loading on post-surgical outcomes to inform the policy change.

TYPES OF RECOMMENDATIONS ISSUED BY THE TAU COMMITTEE

Type of recommendation	Explanation
Approved	• Evidence for relevant decision criteria, including efficacy, safety, and cost, as well as context-specific factors such as feasibility, is sufficiently strong to justify a recommendation that the technology be accepted, used and funded through the institutional operating budget
Approved for evaluation	• There is a reasonable *probability* that relevant decision criteria, including efficacy, safety, and cost, as well as context-specific factors such as feasibility, are favorable but the evidence is not yet sufficiently strong to support a recommendation for permanent and routine approval. • The evidence is sufficiently strong to recommend a *temporary* approval in a restricted population for the purposes of evaluation, funded through the institutional operating budget.
Not approved	• There is insufficient evidence for the relevant decision criteria, including efficacy, safety, and cost; • The costs of any use of the technology (e.g. for research purposes) should not normally be covered by the institutional budget.

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The Technology Assessment Unit ("TAU") of the McGill University Health Centre ("MUHC") was created in order to prepare accurate and trustworthy evidence to inform decision-making and when necessary to make policy recommendations based on this evidence. The objective of the TAU is to advise the hospitals in difficult resource allocation decisions, using an approach based on sound, scientific technology assessments and a transparent, fair decision-making process. Consistent with its role within a university health centre, it publishes its research when appropriate, and contributes to the training of personnel in the field of health technology assessment.

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LIST OF ABBREVIATIONS

CI	Confidence interval
CADTH	Canadian Agency for Drugs and Technologies in Health
ERAS	Enhanced Recovery After Surgery
ERACS	Enhanced Recovery After Cardiac Surgery
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HbA1C	Glycohemoglobin
HEC	Hyperinsulinemic euglycemic glucose clamp
I^2 statistic	The percentage of variation across studies in a meta-analysis that is due to heterogeneity rather than chance
ICM	Institut de Cardiologie de Montréal
ICU	Intensive Care Unit
INAHTA	International network of agencies for health technology assessment
IQR	Interquartile range
LOS	Length of stay
MD	Mean difference
MGH	Montreal General Hospital
MUHC	McGill University Health Center
NICE	National Institute for Health and Care Excellence
PICO	Population, intervention, control, and outcome
RCT	Randomized clinical trial
RGV	Residual gastric volume
ROB	Risk of Bias Tool for Randomized Trials
RVH	Royal Victoria Hospital
TAU	MUHC Technology Assessment Unit
VAS	Visual analogue scale

PLAIN LANGUAGE SUMMARY

Can the use of complex carbohydrate-rich drinks before surgery improve outcomes in adult surgery patients at the MUHC?

KEY MESSAGES

- Complex carbohydrate drinks administered before surgery may have little or no clinical benefit on residual gastric volume and insulin sensitivity compared to simple carbohydrate drinks (e.g. fruit juice without pulp).
- The certainty of evidence (three small clinical trials) was low to moderate, meaning the results are not fully reliable and may change with future research.

What are preoperative complex carbohydrate drinks?

It is a clear drink that contains a type of complex carbohydrate called maltodextrin that is given to patients about 2–3 hours before surgery**.** It works by preparing the body for the energy demands of surgery, thereby potentially improving recovery post-surgery.

What did we want to find out?

We wanted to know whether giving adult patients a complex carbohydrate drink (maltodextrin-based) before surgery provides clinical benefits compared with simple carbohydrate drinks (like clear juices mainly containing fruit sugar). Moreover, we would like to know whether it would be worth the cost for the McGill University Health Centre (MUHC) to standardize its use across sites.

What did we do?

We conducted a systematic search and found three relevant clinical trials**.** We looked at key outcomes such as residual gastric volume (how much liquid remains in the stomach before surgery) as a measure of safety and insulin sensitivity (how well the body responds to insulin) as a measure of the metabolic condition that will impact on how well a patient is recovering**.** We also estimated the annual cost if all adult surgical patients at the MUHC were to receive the complex carbohydrate drink.

What did we find?

- Clinical Outcomes: No meaningful difference in insulin sensitivity between complex and simple carbohydrate drinks.
- Safety: No difference in residual gastric volume
- Cost: Providing complex carbohydrate drinks to all adult surgical patients at the MUHC would result in a cost increase of $76,100 per year.

How reliable is the evidence?

The evidence is rated as low to moderate certainty. This means we cannot be fully confident in the results, and future studies might change the conclusions.

Bottom line

Replacing simple with complex carbohydrate drinks before surgery does not appear to offer clinical benefits for patients, based on current measures of insulin sensitivity and residual gastric volume. Impact on the hospital budget is minimal. More research is needed on other clinical outcomes that matter to patients (comfort, nausea, time to recovery) and to see if certain high-risk patient groups might benefit from this change.

EN BREF

La consommation de boissons riches en glucides complexes avant une intervention chirurgicale peut-elle améliorer les résultats chez les patients adultes opérés au CUSM ?

MESSAGES CLÉS

- Les boissons à base de glucides complexes administrées avant une intervention chirurgicale pourraient n'avoir que peu ou pas d'effet bénéfique sur le volume gastrique résiduel et la sensibilité à l'insuline, comparativement aux boissons à base de glucides simples (p. ex., jus de fruits sans pulpe).
- Le niveau de preuve (trois petits essais cliniques) était faible à modéré, ce qui signifie que les résultats ne sont pas entièrement fiables et pourraient évoluer avec de futures recherches.

Qu'est-ce qu'une boisson préopératoire à base de glucides complexes ?

Il s'agit d'une boisson transparente contenant un type de glucide complexe appelé maltodextrine, administrée aux patients environ 2 à 3 heures avant l'intervention chirurgicale. Elle prépare l'organisme aux besoins énergétiques de l'opération, ce qui peut potentiellement améliorer la récupération postopératoire.

Que souhaitions-nous déterminer ?

Nous souhaitions savoir si l'administration d'une boisson à base de glucides complexes (à base de maltodextrine) aux patients adultes avant une intervention chirurgicale présente des avantages cliniques par rapport aux boissons à base de glucides simples (comme les jus de fruits clairs contenant principalement du sucre de fruits). De plus, nous souhaitions déterminer si le coût de la standardisation de son utilisation dans tous les établissements du Centre universitaire de santé McGill (CUSM) serait justifié.

Comment avons-nous procédé ?

Nous avons effectué une recherche systématique et avons trouvé trois essais cliniques pertinents. Nous avons examiné des critères d'évaluation clés tels que le volume gastrique résiduel (la quantité de liquide restant dans l'estomac avant l'opération) comme mesure de sécurité et la sensibilité à l'insuline (la façon dont le corps réagit à l'insuline) comme mesure de l'état métabolique qui aura un impact sur la qualité du rétablissement du patient. Nous avons également estimé le coût annuel si tous les patients adultes opérés au CUSM recevaient cette boisson à base de glucides complexes.

Qu'avons-nous constaté ?

- Résultats cliniques : Aucune différence significative de sensibilité à l'insuline n'a été observée entre les boissons à base de glucides complexes et celles à base de glucides simples.
- Sécurité : Aucune différence n'a été constatée au niveau du volume gastrique résiduel.
- Coût : Offrir des boissons à base de glucides complexes à tous les patients adultes opérés au CUSM entraînerait une augmentation des coûts de 76 100 $ par année.

Quelle est la fiabilité des données probantes ?

Le niveau de preuve est faible à modéré. Cela signifie que nous ne pouvons pas avoir une confiance totale dans les résultats et que de futures études pourraient modifier les conclusions.

Conclusion

Selon les mesures actuelles de la sensibilité à l'insuline et du volume gastrique résiduel, le remplacement des boissons à base de glucides simples par des boissons à base de glucides complexes avant une intervention chirurgicale ne semble pas offrir d'avantages cliniques aux patients. L'incidence sur le budget de l'hôpital est minime. Des recherches supplémentaires sont nécessaires sur d'autres résultats cliniques importants pour les patients (confort, nausées, délai de rétablissement) et pour déterminer si certains groupes de patients à haut risque pourraient bénéficier de ce changement.

EXECUTIVE SUMMARY

BACKGROUND

- Preoperative carbohydrate loading is a modern nutrition strategy in Enhanced Recovery After Surgery (ERAS) protocols, wherein carbohydrate-rich drinks (like juice or maltodextrin solutions) are given to patients a few hours before surgery.
- It replaces traditional prolonged fasting, which was previously recommended to prevent pulmonary aspiration. Studies in the early 2000s demonstrated that, compared with prolonged fasting, administering a carbohydrate-rich drink up to two hours before surgery was safe and improved metabolic responses, particularly by maintaining insulin sensitivity. Consequently, some ERAS guidelines, published between 2012 and 2023, endorsed preoperative carbohydrate loading up to two hours before surgery.
- Recent studies on clinical outcomes have been mixed: while ERAS guidelines recommend that preoperative carbohydrate loading might improve insulin sensitivity, they note that it offers no advantage in comfort or clinical outcomes over standard short fasting protocols (i.e. clear liquids up to 2 hours before surgery).
- Since 2019, patients at the Montreal General Hospital (MGH) have been instructed to take complex carbohydrate drinks (primarily maltodextrin-based), while those at the Royal Victoria Hospital (RVH) follow earlier ERAS guidelines to drink no-pulp juice containing simple carbohydrate (primarily glucose and fructose).
- The MUHC is now considering standardizing the type of preoperative carbohydrate drink used. However, current evidence does not directly compare simple vs. complex carbohydrates, and has been restricted to carbohydrate loading vs. fasting.

POLICY QUESTION

Should the MUHC standardize pre-operative complex carbohydrate loading for adult patients undergoing surgery under general anesthesia?

EVALUATION QUESTIONS (OBJECTIVES OF THIS REPORT)

The objectives of this report were:

1. To evaluate the benefit of pre-operative complex carbohydrate loading (e.g., containing maltodextrin) compared to simple carbohydrate loading (e.g. fruit juice without pulp) on clinical outcomes.
2. To estimate the budget impact of administering pre-operative complex carbohydrate loading across all MUHC sites.

METHODS

Scoping Review and Meta-analysis

We searched PubMed, Medline and Embase to identify studies that met our population, intervention, control, and outcome (PICO) criteria:

- Population: Adult patients undergoing surgery under general anesthesia
- Intervention: Preoperative complex carbohydrate (e.g. maltodextrin) loading
- Control: Preoperative simple carbohydrate (e.g. no-pulp juice) loading
- Outcomes:
    - Safety: residual gastric volume (RGV)
    - Clinical effectiveness: insulin sensitivity and postoperative complications
    - Patient reported outcomes: Patient health status or wellbeing

Experiential Data

We gathered information on experience with complex carbohydrate loading at the MGH and the Institut Cardiologie de Montréal (ICM).

Budget Impact Analysis

We estimated the additional cost of administering preoperative complex carbohydrate for all surgical patients at the MUHC. We obtained annual surgical volumes and nursing costs from the Finance Department of the MUHC and the cost of the commercial carbohydrate drink used at the MGH from Sonia Sandberg (Surgical Care Pathway Coordinator, MGH), Debbie Watson, ERAS Program Nurse Coordinator, MGH), and Claudiane Poisson (ERAS Program Nurse Coordinator, RVH).

RESULTS

Clinical Impact: Evidence from scoping review and meta-analysis

We identified nine randomized clinical trials (RCTs) from inception until 2025, but only three met our PICO. One RCT was conducted at the MUHC involving 30 non-diabetic patients scheduled for elective laparoscopic colon resection. One RCT enrolled cancer patients undergoing pancreaticoduodenectomy, while the other recruited all types of elective surgery.

Residual gastric volume (RGV): Measurement of RGV, the amount of residual liquid in the stomach, is primarily intended to prevent pulmonary aspiration, where stomach contents enter the lungs and can lead to severe complications like pneumonia. A value <100 mL is considered normal.

- Pooled estimates from three RCTs (165 participants) showed that the mean difference in residual gastric volume was 1.05 mL (95% CI: -3.61 to 5.71) (low certainty evidence).
- This indicates that pre-operative complex carbohydrate loading may have **little or no effect** on residual gastric volume compared to simple carbohydrate.

Insulin sensitivity: Surgery often leads to insulin resistance, which is linked to complications, slower recovery, and longer hospital stays. Insulin sensitivity is measured using the hyperinsulinemic euglycemic clamp (HEC), which produces an M-value: higher values mean better insulin sensitivity; values <5.5 mg/kg/min indicate insulin resistance.

- Based on one RCT (29 participants) done at the MUHC, the mean difference in the insulin sensitivity index was 0.5 mg/kg/min (95% CI: -2.2 to 3.2; M values: 8.3 in simple vs. 8.8 in complex) (moderate certainty evidence).
- This indicates that pre-operative complex carbohydrate loading probably has **little or no effect** on the insulin sensitivity index compared to simple carbohydrate.

Other outcomes: Postoperative complications and well-being were reported as secondary outcomes in two RCTs. None showed significant differences between the simple and complex carbohydrate groups.

Experiential Data

MUHC

- Commercially available complex carbohydrate drinks have been used at the MGH since 2019. However, data on patient safety (e.g., aspiration risk), clinical outcomes such as length of stay, or patient comfort measures (e.g., thirst, hunger, postoperative nausea and vomiting) have not been formally collected.

Institut Cardiologie de Montréal (ICM)

- Since 2019, the ICM has implemented preoperative complex carbohydrate drinks as part of Enhanced Recovery After Cardiac Surgery (ERACS), replacing midnight fasting; eligible patients (hemoglobin A_{1c} <7%) receive a single 400 mL dose two hours before surgery, with defined exclusions.
- A 2022 retrospective audit of 400 patients found no aspiration events and suggested better intraoperative glucose control and lower insulin use among diabetic patients who received preoperative complex carbohydrate compared with fasting.
- Although no formal statistical testing was performed, these observations reassured clinicians and supported continued use within the ERACS program at the ICM.

Budget Impact

- At the MGH, patients currently purchase complex carbohydrate drinks directly from the hospital hospitality shop at a cost of $2 per unit. Across MUHC sites, there were 6,252 adult surgeries at RVH and 8,565 at MGH in the 2023/2034 fiscal year. If the hospital were to cover the cost of complex carbohydrate drinks for all adult surgical patients, the annual product cost would be about $29,634. The estimated nursing cost, based on roughly four additional minutes per patient for education, brings the total annual cost to $76,100 for the MUHC.

CONCLUSIONS

- **Clinical benefit**: Low to moderate certainty evidence, derived from three RCTs, indicates that pre-operative complex carbohydrate loading may have little or no clinical benefit on residual gastric volume and insulin sensitivity compared to simple carbohydrate loading. These results align with the more recent ERAS guidelines that conclude that preoperative carbohydrate loading does not offer a clear clinical advantage in comfort or clinical outcome over standard short fasting protocols (i.e. solids for 6 hours, clear liquids for 2 hours before anesthesia).
- **Budget impact**: Administering pre-operative complex carbohydrate at the MUHC for adult surgery patients could yield a modest annual cost increase ($76,100) from the product and nursing costs.

RECOMMENDATION

The TAU Policy Committee, made up of stakeholders from across the McGill University Health Centre, reviewed the evidence and issued the following recommendation: Not approved.

This recommendation was driven by the following:

- Based on the best available evidence on insulin sensitivity and residual gastric volume, there is **insufficient evidence** to justify standardizing complex carbohydrate drinks MUHC-wide at this time.
- Any remaining uncertainty can only be meaningfully addressed through well-designed, adequately powered, and controlled **research studies** focused on specific surgical populations and patient-centred outcomes. Small, uncontrolled, or underpowered pilot projects would be unlikely to establish causal relationships or answer the key clinical questions, and therefore risk inefficient use of clinical and organizational resources. As such, any research studies should not be funded through the MUHC's operating budget.

SOMMAIRE

CONTEXTE

- La charge glucidique préopératoire est une stratégie nutritionnelle moderne des protocoles de Récupération Améliorée Après Chirurgie (RAAC), consistant à administrer aux patients des boissons riches en glucides (comme des jus de fruits ou des solutions de maltodextrine) quelques heures avant l'intervention.
- Elle remplace le jeûne prolongé traditionnel, autrefois recommandé pour prévenir l'inhalation pulmonaire. Des études menées au début des années 2000 ont démontré que, comparativement au jeûne prolongé, l'administration d'une boisson riche en glucides jusqu'à deux heures avant l'intervention était sûre et améliorait les réponses métaboliques, notamment en maintenant la sensibilité à l'insuline. Par conséquent, quelques recommandations RAAC, publiées entre 2012 et 2023, préconisent la charge glucidique préopératoire jusqu'à deux heures avant l'intervention.
- Les études récentes sur les résultats cliniques ont donné des résultats mitigés : bien que les lignes directrices ERAS suggèrent qu'une charge glucidique préopératoire puisse améliorer la sensibilité à l'insuline, elles indiquent qu'elle n'offre aucun avantage en termes de confort ou de résultats cliniques par rapport aux protocoles de jeûne court standard (c.-à-d. liquides clairs jusqu'à 2 heures avant l'intervention).
- Depuis 2019, les patients de l'Hôpital général de Montréal (HGM) reçoivent la consigne de consommer des boissons riches en glucides complexes (principalement à base de maltodextrine), tandis que ceux de l'Hôpital Royal Victoria (HRV) suivent les anciennes lignes directrices ERAS et consomment des jus sans pulpe contenant des glucides simples (principalement du glucose et du fructose).
- Le CUSM envisage actuellement de standardiser le type de boisson glucidique préopératoire utilisée ; toutefois, les données actuelles ne comparent pas directement les glucides simples et complexes et se limitent à la comparaison entre la charge glucidique et le jeûne.

QUESTION DECISIONELLE

Le CUSM devrait-il standardiser la charge glucidique préopératoire pour les patients adultes subissant une intervention chirurgicale sous anesthésie générale ?

QUESTIONS D'ÉVALUATION (OBJECTIFS DU RAPPORT)

Les objectifs du présent rapport étaient les suivants :

1. Évaluer les bénéfices d'une charge préopératoire en glucides complexes (p. ex., contenant de la maltodextrine) comparativement à une charge en glucides simples (p. ex., jus de fruits sans pulpe) sur la sensibilité à l'insuline et le volume gastrique résiduel.
2. Estimer l'incidence budgétaire de l'administration d'une charge préopératoire en glucides complexes dans tous les sites du CUSM.

MÉTHODES

Revue exploratoire et méta-analyse

Nous avons effectué une recherche dans PubMed, Medline et Embase afin d'identifier les études répondant à nos critères PICO (population, intervention, contrôle, résultat) :

- Population : Patients adultes subissant une intervention chirurgicale sous anesthésie générale
- Intervention : Administration préopératoire de glucides complexes (p. ex. maltodextrine)
- Contrôle : Administration préopératoire de glucides simples (p. ex. jus sans pulpe)
- Résultats :
    - Mesure de sécurité : volume gastrique résiduel (VGR)
    - Mesure du bénéfice clinique : sensibilité à l'insuline et complications postopératoires
    - Résultats rapportés par les patients : état de santé et bien-être des patients

Données empiriques

Nous avons recueilli des données sur l'expérience acquise avec l'administration de glucides complexes à l'Hôpital général de Montréal (HGM) et à l'Institut de cardiologie de Montréal (ICM).

Analyse d'impact budgétaire

Nous avons estimé le coût supplémentaire de l'administration préopératoire de glucides complexes pour tous les patients opérés au CUSM. Nous avons obtenu les volumes annuels d'interventions chirurgicales et les coûts des soins infirmiers auprès du Service des finances du CUSM, ainsi que le coût de la boisson glucidique commerciale utilisée à l'HGM pour l'exercice financier 2023-2024.

RÉSULTATS

Impact clinique : Données issues d'une revue exploratoire et d'une méta-analyse

Nous avons recensé neuf essais cliniques randomisés (ECR) depuis leur création jusqu'en 2025, mais seulement trois répondaient à nos critères PICO. Un ECR a été mené au CUSM et portait sur 30 patients non diabétiques devant subir une résection colique laparoscopique programmée. Un autre ECR a inclus des patients atteints de cancer et devant subir une pancréatoduodénectomie, tandis que le dernier recrutait des patients pour tous types de chirurgie programmée.

Volume gastrique résiduel (VGR) :

- La mesure du VGR, qui correspond à la quantité de liquide résiduel dans l'estomac, vise principalement à prévenir l'inhalation pulmonaire, un phénomène où le contenu de l'estomac pénètre dans les poumons et peut entraîner des complications graves telles qu'une pneumonie. Une valeur inférieure à 100 mL est considérée comme normale.
- Les estimations combinées de trois ECR (165 participants) ont montré que la différence moyenne du volume gastrique résiduel était de 1,05 mL (IC à 95 % : -3,61 à 5,71) (données de faible certitude).
- Ceci indique que la consommation préopératoire de glucides complexes pourrait **avoir peu ou pas d'effet** sur le volume gastrique résiduel comparativement à la consommation de glucides simples.

Sensibilité à l'insuline

- La chirurgie induit souvent une insulinorésistance, associée à des complications, un ralentissement de la convalescence et une durée d'hospitalisation plus longue. La sensibilité à l'insuline est mesurée par clamp euglycémique hyperinsulinémique, qui produit une valeur M : des valeurs élevées indiquent une meilleure sensibilité à l'insuline ; des valeurs inférieures à 5,5 mg/kg/min indiquent une insulinorésistance.
- Selon un essai contrôlé randomisé (29 participants) réalisé au CUSM, la différence moyenne de l'indice de sensibilité à l'insuline était de 0,5 (-2,1 à 3,1) mg/kg/min (niveau de preuve modéré).
- Ceci indique que la consommation préopératoire de glucides complexes a **probablement peu ou pas d'effet** sur l'indice de sensibilité à l'insuline comparativement aux glucides simples.

Autres résultats

Les complications postopératoires et le bien-être ont été rapportés comme critères d'évaluation secondaires dans deux ECR. Aucun n'a montré de différence significative entre les groupes glucides simples et glucides complexes.

Données expérientielles

CUSM

- Des boissons à base de glucides complexes disponibles dans le commerce sont utilisées au MGH depuis 2019. Cependant, les données sur la sécurité des patients (p. ex., risque d'aspiration), les résultats cliniques tels que la durée du séjour ou les mesures de confort des patients (p. ex., soif, faim, nausées et vomissements postopératoires) n'ont pas été recueillies de façon formelle.

Institut Cardiologie de Montréal (ICM)

- Depuis 2019, l'Institut de cardiologie de Montréal (ICM) a intégré l'administration préopératoire de boissons glucidiques complexes au programme de récupération améliorée après chirurgie cardiaque (Enhanced Recovery After Cardiac Surgery ou ERACS), en remplacement du jeûne à partir de minuit. Les patients éligibles (hémoglobine A1c < 7 %) reçoivent une dose unique de 400 ml deux heures avant l'intervention, sous réserve de critères d'exclusion définis.
- Une étude rétrospective menée en 2022 auprès de 400 patients n'a révélé aucun cas d'aspiration et a suggéré un meilleur contrôle glycémique peropératoire ainsi qu'une diminution des besoins en insuline chez les patients diabétiques ayant reçu des glucides complexes en préopératoire, comparativement au jeûne.
- Bien qu'aucune analyse statistique formelle n'ait été réalisée, ces observations ont rassuré les cliniciens et ont justifié la poursuite de l'utilisation de cette pratique au sein du programme ERACS de l'ICM.

Impact budgétaire

Au MGH, les patients achètent actuellement les boissons à base de glucides complexes directement à la boutique de l'hôpital au prix de 2 $ l'unité. Dans l'ensemble des sites du CUSM, 6 252 interventions chirurgicales chez l'adulte ont été pratiquées au RVH et 8 565 au MGH au cours de l'exercice financier 2023-2034. Si l'hôpital prenait en charge le coût des boissons glucidiques complexes pour tous les patients adultes opérés, le coût annuel de ce produit s'élèverait à environ 29 634 $. Le coût estimé des soins infirmiers, calculé sur la base d'environ quatre minutes supplémentaires par patient pour l'éducation, porte le coût annuel total à 76 100 $ pour le CUSM.

CONCLUSIONS

- **Bénéfice clinique** : Des données probantes de faible à modérée certitude, issues de trois essais contrôlés randomisés, indiquent que la consommation préopératoire de glucides complexes pourrait n'avoir que peu ou pas de bénéfice clinique sur le volume gastrique résiduel et la sensibilité à l'insuline comparativement à la consommation de glucides simples. Ces résultats concordent avec les lignes directrices ERAS plus récentes qui concluent que la consommation préopératoire de glucides n'offre pas d'avantage clinique clair en termes de confort ou de résultats cliniques comparativement aux protocoles de jeûne court standard (c.-à-d. des aliments solides pendant 6 heures, des liquides clairs pendant 2 heures avant l'anesthésie).
- **Impact budgétaire** : L'administration de glucides complexes en préopératoire au CUSM aux patients adultes subissant une chirurgie pourrait entraîner une légère augmentation annuelle des coûts (76 100 $) en raison du coût du produit et des soins infirmiers.

RECOMMANDATION

Le Comité des politiques de l'Université McGill, composé d'intervenants de l'ensemble du Centre universitaire de santé McGill, a examiné les données probantes et a émis la recommandation suivante : Non approuvé.
Cette recommandation est motivée par les éléments suivants :

- D'après les meilleures données probantes disponibles sur la sensibilité à l'insuline et le volume gastrique résiduel, **les données sont insuffisantes** pour justifier la standardisation des boissons à base de glucides complexes à l'échelle du CUSM à l'heure actuelle.
- Toute incertitude restante ne peut être levée de façon significative que par des études de recherche bien conçues, suffisamment puissantes et contrôlées, axées sur des populations chirurgicales spécifiques et des résultats centrés sur le patient. Les projets pilotes de petite envergure, non contrôlés ou insuffisamment puissants seraient peu susceptibles d'établir des relations causales ou de répondre aux principales questions cliniques et risqueraient donc d'entraîner une utilisation inefficace des ressources cliniques et organisationnelles. Par conséquent, aucune étude de recherche ne devrait être financée par le budget de fonctionnement du CUSM.

PRE-OPERATIVE COMPLEX CARBOHYDRATE LOADING FOR ENHANCING RECOVERY AFTER SURGERY

1. BACKGROUND

1.1 Evolution in Pre-operative Fasting and Carbohydrate Loading Guidelines

- Traditionally, patients scheduled for surgery were instructed to fast ("nothing by mouth" or NPO) after midnight to minimize the risk of pulmonary aspiration. However, this practice lacked strong evidence and led to negative outcomes, such as dehydration and discomfort. Moreover, pre-operative fasting practices could impair metabolic homeostasis through increased insulin resistance and glycogen depletion.(1)
- Since the introduction of the Enhanced Recovery After Surgery (ERAS) programs in the 1990s, perioperative management has been evolving with the goal to reduce complications and hospital stay, improve cardiopulmonary function, and facilitate earlier return of bowel function and earlier resumption of normal activities.(1) The evolution of preoperative fasting and carbohydrate (CHO) loading guidelines is illustrated in Figure 1.
- The ERAS consensus review in 2005 recommended that patients should only be fasted for liquids for 2 hours and for solids for 6 hours pre-operatively (2). Patients should receive oral pre-operative fluids and carbohydrate loading. The work by researchers in Sweden laid the ground for recommending a clear carbohydrate-rich beverage (12.6%) at a dose of 800ml before midnight and 400ml 2–3h before surgery, as this approach reduced pre-operative thirst, hunger and anxiety as well as postoperative insulin resistance (3, 4).
- Beginning in 2012, ERAS guidelines graded the strength of recommendations and quality of evidence (5). A summary of the ERAS guidelines and consensus statements published between 2012 and 2023 showed that:
    - Fasting for liquids for two hours before surgery was strongly recommended across different types of surgeries (6).
    - Giving oral carbohydrate drinks in non-diabetic patients 2–3 hours before surgery was strongly recommended for colorectal, breast, cystectomy, gynecologic/oncology, head and neck, lung, pancreatic, lumbar, abdominal/pelvic surgeries, and weakly recommended for cardiac, vascular, caesarean,

cytoreductive, and liver surgeries. No specific recommendations were identified for bariatric, emergency laparoscopic, esophagectomy, hip, and knee surgeries.

- Although the guidelines did not specify carbohydrate type (i.e. simple vs. complex), most supporting randomized clinical trials (RCTs) used complex carbohydrate drinks containing maltodextrin.

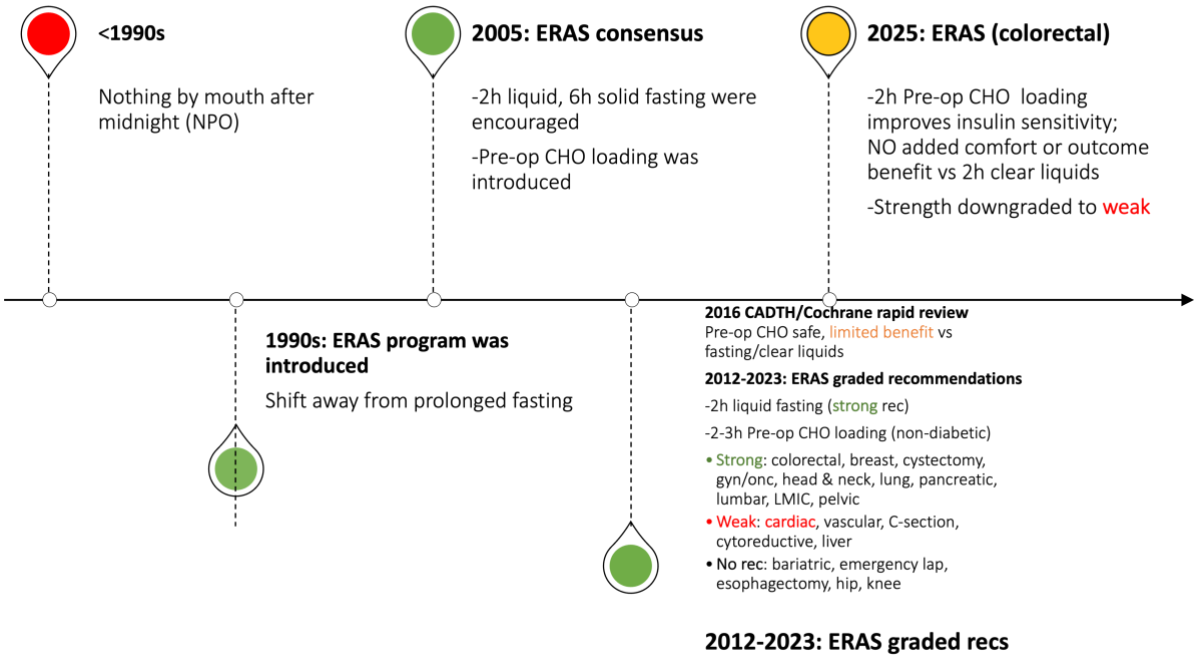


Figure 1. Evolution of preoperative fasting and carbohydrate (CHO) loading guidelines

- In 2016, the Canadian Agency for Drugs and Technologies in Health (now the Canadian Drug Agency) conducted a rapid review(7) of five systematic reviews, including a Cochrane review by Smith et al(8). These reviews compared 2 hours pre-operative carbohydrate loading (most commonly using maltodextrin) with fasting or placebo (defined as equivalent volume of non-caloric flavoured water, clear liquids, or drinks containing less than 45 grams of carbohydrates). They found that:
  - Complex carbohydrate loading did not reduce the overall hospital length of stay or the intensive care unit (ICU) length of stay compared to placebo.
  - The Cochrane review found that it improved insulin sensitivity, though postoperative insulin resistance did not differ significantly between groups.
  - Despite inconclusive evidence regarding clinical outcomes, there was no increase in aspiration or postoperative complications, supporting that it is a safe strategy to shorten the pre-operative fasting period.

- The latest ERAS guideline for colorectal surgery, released in 2025, incorporated findings from three systematic reviews, all of which compared preoperative carbohydrate loading (most commonly using maltodextrin) with fasting or placebo (defined as non-caloric flavored water or clear liquids). The reviews concluded that preoperative carbohydrate loading may improve insulin sensitivity but provides no clear clinical advantage over standard short fasting protocols. Hence, the ERAS recommendation for pre-operative carbohydrate loading changed from strong to weak with moderate quality of evidence in this population (9).

1.2 Context of the current report

- Following the 2018 ERAS guidelines, adult elective surgery patients at the MUHC were directed to consume unrestricted clear fluids after midnight and up to 2 hours before scheduled surgery. Since 2019, patients at the Montreal General Hospital (MGH) have been instructed to drink one package of preoperative complex carbohydrate drinks two hours before surgery, available for purchase at the hospital's hospitality shop. At the Royal Victoria Hospital (RVH), patients continue to follow previous ERAS guidelines to drink clear (no-pulp) juice.
- The MUHC is now considering standardizing the type of preoperative carbohydrate drink used; however, current evidence does not directly compare simple vs. complex carbohydrates, and has been restricted to carbohydrate loading vs. fasting.
- Loïca Ducheine, nursing advisor in the Products Procurement division of the nursing directorate of the MUHC, requested the Technology Assessment Unit (TAU) to conduct an evaluation of complex versus simple carbohydrate loading on post-surgical outcomes to inform the policy change.

2. POLICY AND EVALUATION QUESTIONS

2.1 Policy Question

Should the MUHC standardize the administration of pre-operative complex carbohydrate loading for adult patients undergoing elective surgery under general anesthesia?

2.2 Evaluation Questions (Objectives of this report)

The objectives of this report were:

1. To evaluate the clinical benefit of preoperative complex carbohydrate loading compared to simple carbohydrate loading (e.g. fruit juice without pulp) on patient outcomes.
2. To estimate the budget impact of administering preoperative complex carbohydrate loading at the MUHC.

3. METHODS

3.1 Scoping Review and Meta-analysis

3.1.1 Literature search and data sources

We conducted a scoping review by searching PubMed, Medline and Embase using the following search terms: (“apple juice” OR "simple carbohydrate*”) AND ("complex carbohydrate*” OR maltodextrin) AND pre-operative*. The literature search was done by ES from inception and our last search was done on August 28th, 2025. We limited the search to clinical trials in humans and adults. We also manually searched relevant studies from the references. In addition, we searched for unpublished reports via the grey literature on Google Scholar, and for published reports and guidelines on the international network of agencies for health technology assessment (INAHTA), Canada’s Drug Agency (previously Canadian Agency for Drugs and Technologies in Health [CADTH]) and the National Institute for Health and Care Excellence (NICE) of the UK databases.

3.1.2 Study eligibility criteria

Our inclusion criteria for the targeted population, intervention, control, and outcomes (PICO) are shown in Table 1 below.

Table 1. Population, intervention, control and outcomes

	Inclusion Criteria
Population	Adult patients ≥18 years requiring any type of surgery under general anesthesia
Intervention	Any pre-operative complex carbohydrate (e.g. maltodextrin) loading
Comparator	Any pre-operative simple carbohydrate (e.g. clear juice) loading
Outcomes	Safety: residual gastric volume (RGV) Clinical effectiveness: insulin sensitivity and postoperative complications Patient reported outcomes: Patient health status or wellbeing

3.1.3 Study selection and data extraction

Study selection and data extraction were done independently by ES and TO and any discrepancies were resolved by consensus. Studies were included in the report if they met the inclusion criteria as defined in Table 1. Systematic review and meta-analyses as well as any primary studies (RCT, observational study) were considered. Only studies in English or French were included due to language restriction.

The following variables were collected:

- Study characteristics: first author, year of publication, country
- Study population (colorectal surgery etc.)
- Complex carbohydrate (type, concentration, preparation)
- Simple carbohydrate (type, concentration, preparation)
- Total number of patients per group
- Outcomes: Data for only the following outcomes were available:
    - Residual gastric volume (RGV): the amount of residual liquid in the stomach can be measured by inserting an orogastric tube immediately after induction of anesthesia. A value <100 mL is considered normal.
    - Insulin sensitivity can be measured using the ‘‘gold standard’’ technique called the hyperinsulinemic euglycemic glucose clamp (HEC). From the HEC technique, we obtained the M-value, which represents the glucose infusion rate (mg/kg/min) required to maintain euglycemia under hyperinsulinemia. A higher M-value indicates greater insulin sensitivity, while M-value <5.5 mg/kg/min reflects insulin resistance.

3.1.4 Assessment of Risk of Bias

Two reviewers (ES and TO) independently assessed the risk of bias (RoB) and any discrepancies were resolved by consensus. For RCTs, we used the Cochrane Risk of Bias Tool for Randomized Trials (RoB 2.0) (10). RoB was done for each outcome result of each study. RoB 2.0 tool covers five domains: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in the measurement of the outcome, and bias in the selection of the reported result. Each domain was graded as high, moderate (some concerns or unclear) or low risk of bias. A study is considered as having a low overall risk of bias when all domains have a low risk. We considered a high overall risk of bias when at least one domain had a high risk of bias. Other situations are considered as a moderate risk of bias.

3.1.5 Assessment of Certainty of the Evidence

Two reviewers (ES and TO) independently assessed the certainty of evidence and any discrepancies were resolved by consensus. We rated the overall certainty of evidence as high, moderate or low for each outcome using an in-house decision tree, which was based on Grading of Recommendations Assessment, Development and Evaluation (GRADE) quality assessment (11). Our tool has six domains: the overall risk of bias of the included studies; the presence of a comparator group; imprecision (i.e. wide confidence intervals and small sample size for continuous outcomes); inconsistency (only applicable if there are at least two RCTs); indirectness; and others (e.g. improper statistical analytical tests).

Low-certainty evidence indicates that our confidence in the overall effect estimate is limited. Conversely, high-certainty evidence indicates we are very confident in the overall effect estimate, which results from studies with a low overall risk of bias and without downgrading from the above domains. Elements of the domains and the decision tree are detailed in Appendix A:.

3.1.6 Meta-analysis

We conducted our own meta-analysis to estimate the pooled effect size for residual gastric volume from three RCTs and for insulin sensitivity from one RCT. The meta-analysis was performed by one reviewer (TO) and data consistency was verified by another reviewer (ES).

- A random-effects model (restricted maximum likelihood) was used since the preliminary literature review showed that the populations and interventions were not sufficiently similar across the trials.
- Mean difference (MD) with their 95% confidence interval (CI) were calculated based on the means and standard deviations of complex and simple drinks obtained from the RCTs.
- We assessed the statistical heterogeneity in the effect estimates and between-study by calculating I^2 and τ^2 statistics and inspecting the Forest plots. Substantial heterogeneity was defined as $I^2 > 60$.
- Sensitivity analysis was done by including only studies with low risk of bias
- Forest plots were constructed for both outcomes.
- Bilateral p-values of 0.05 and confidence intervals were used to assess statistical significance. All analyses were performed with software R v4.4.2.

3.2 Experiential Data

We gathered information about preoperative carbohydrate loading (protocol, administration, and any data collection) at the MUHC and the Institut Cardiologie de Montréal (ICM). We also identified a survey about the use, type, and timing of preoperative carbohydrate drinks in colorectal ERAS programs across the U.S.(12).

3.3 Budget Impact Analysis

We estimated the additional cost of administering preoperative complex carbohydrate for all surgical patients at the MUHC. We obtained annual surgical volumes and nursing costs from the Finance Department of the MUHC, and the cost of the commercial carbohydrate drink used at the MGH and estimated time for preoperative nursing activities from Sonia Sandberg (the Surgical Care Pathway Coordinator at MGH), Debbie Watson (ERAS Program Nurse Coordinator at MGH), and Claudiane Poisson (ERAS Program Nurse Coordinator at RVH).

4. RESULTS

4.1 Scoping Review and Meta-analysis

We identified nine studies from inception until 2025 (Figure 2), but only three met our PICO (Braga et al. (13), Karimian et al. (14), and Shetty et al. (15)). The characteristics of these RCTs are summarized in Table 2. The study by Karimian et al. was conducted at the MUHC involving 30 non-diabetic patients scheduled for elective laparoscopic colon resection. Braga et al. enrolled cancer patients undergoing pancreaticoduodenectomy, while Shetty et al. recruited all types of elective surgery patients.

4.1.1 Residual Gastric Volume

- Based on three RCTs (165 participants), the mean difference in residual gastric volume was 1.05 mL (95% CI -3.61 to 5.71) (low certainty evidence) (Table 3). The Forest plot is shown in Figure 3.
- The certainty of the evidence was low: it was downgraded due to a moderate risk of bias, and imprecision due to wide confidence intervals and small sample size.
- Results from a sensitivity analysis with only studies with low risk of bias showed similar results to pooled effect: the mean difference in the residual gastric volume was 1.80 mL (95% CI -5.52 to 9.12) Figure 4).

- Taken together, this indicates that pre-operative complex carbohydrate loading **may have little or no effect** on the residual gastric volume compared to simple carbohydrate.

4.1.2 Insulin Sensitivity

- Based on one RCT (29 participants), the mean difference in the insulin sensitivity index was 0.5 (95% CI -2.1 to 3.1) mg/kg/min (moderate certainty evidence) (Table 3). The Forest plot is shown in Figure 5.
- The certainty of the evidence was moderate: it was downgraded for imprecision due to wide confidence intervals and small sample size.
- Taken together, this indicates that pre-operative complex carbohydrate loading probably has little or no effect on the insulin sensitivity index compared to simple carbohydrate.

4.1.3 Postoperative complications and other clinical outcomes

Karimian et al. (14) reported postoperative complications in five (33%) patients in the simple carbohydrate and three (21%) patients in the complex carbohydrate groups (p=0.68). They also reported no difference between the two groups in terms of time for readiness to be discharged, length of stay, readmission, and death.

4.1.4 Patient-reported outcomes

- Karimian et al. (14) evaluated patient self-reported health status. Health status was self-assessed on the second postoperative day using a vertical visual analogue scale (VAS) ranging from 0 to 100, where 0 represented the worst and 100 the best imaginable health state (adapted from the EuroQol Group, www.euroqol.org). No significant difference was observed in the VAS scores reported on the complex carbohydrate drink group (median (interquartile range [IQR]) 70 (67.5–85) vs. the simple carbohydrate drink group (median (IQR) 80 (70–87.5); *P* = 0.3).
- Braga et al. (13) used VAS to evaluate pre- and postoperative well-being including questions about feeling hungry, thirsty, anxious, weak, or nausea and found no difference between the two groups.

4.2 HTA Reports

To date, no health technology assessment (HTA) report has directly compared pre-operative complex versus simple carbohydrate loading.

4.3 Experiential Data

4.3.1 At the MUHC

- Commercially available complex carbohydrate drinks have been used at the MGH since 2019. The MUHC protocol describing contraindications for preoperative carbohydrate loading is available in Appendix B:. Data on patient safety (e.g., aspiration risk), clinical outcomes such as length of stay, or patient comfort measures (e.g., thirst, hunger, postoperative nausea and vomiting) have not been formally collected.
- At RVH, patients receive an education booklet at the pre-operative clinic, which is reviewed with a nurse. Together, the patient and nurse decide which juice to drink on the morning of surgery.

4.3.2 The Institut de Cardiologie de Montréal

The Institut de Cardiologie de Montréal (ICM) has been administering preoperative complex carbohydrate drinks since 2019, aligning with the first Enhanced Recovery After Cardiac Surgery (ERACS) guidelines. Prior to this adoption, ICM did not have an established ERAS protocol for cardiac surgery, and patients were generally instructed to fast from midnight for solid foods. The following information was obtained through personal communication with Mohamed El Qachchach, Program Coordinator at ICM.

Eligibility and Administration:

- Preoperative complex carbohydrate drinks are provided to all surgical patients with HbA1c <7% (i.e. including patients with controlled type 2 diabetes), excluding patients with insulin-dependent diabetes, with gastric emptying disorders, those already intubated or ventilated before surgery, and patients scheduled for the earliest blocks of surgery due to lack of time to administer the drink.
- Nurses prepare and administer a single dose of 400mL liquid containing 50g maltodextrin two hours before surgery.
- Although manufacturers recommend dosing on both the day before and day of surgery, ICM limits use to a single dose on the day of surgery.

Safety and Clinical Outcomes:

- A retrospective audit conducted in 2022 of 400 patients (four groups of 100: diabetic patients with preoperative complex carbohydrate loading (CHO) vs. fasting; non-diabetic patients with preoperative CHO vs. fasting) reviewed local experience following adoption.

- No aspiration events were reported.
- Among diabetic patients, those who received CHO appeared to have lower intraoperative glucose values (7.6 vs. 9.3 mmol/L) and needed insulin less frequently (44% vs. 68%) compared with those who did not receive CHO.
- While no formal statistical testing was conducted, these observations provided reassurance to clinicians and supported continued use of preoperative complex carbohydrate drinks within the ERACS program at ICM.

4.3.3 Colorectal ERAS programs across the U.S.

A national survey (Sept–Nov 2018) of 78 adult colorectal ERAS programs to understand preoperative loading practices across the U.S. (12) found that:

- The majority (87.2%) of hospitals reported administering carbohydrate drinks before colorectal surgery: 98.5% for non-diabetic patients, 79.7% for diabetics not on insulin, and 60.9% for diabetics on insulin.
- Both simple and complex carbohydrates drinks were used in similar proportions regardless patient diabetic status. Two-third of the institutions administered complex carbohydrates drinks, while one-third administered simple carbohydrates drinks before colorectal surgery: 37.7% for non-diabetic patients, 33.3% for diabetics not on insulin, and 34.2% for diabetics on insulin.

4.4 Budget Impact Analysis

At the MGH, patients currently purchase the complex carbohydrate drink packages directly from the hospital hospitality shop at a cost of $2 per unit. Across MUHC sites, there were 6,252 adult surgeries at RVH and 8,565 at MGH in the 2023/2034 fiscal year (Table 4). Assuming the hospital were to cover the cost of the preoperative complex carbohydrate drinks for all adult surgical patients, the annual product cost would be $29,634 for the MUHC. The estimated nursing cost, based on roughly four additional minutes per patient for education, brings the total annual cost to $76,100 for the MUHC.

5. DISCUSSION

This health technology assessment evaluated the clinical benefits and potential cost of homogenizing the administration of pre-operative complex carbohydrate compared to simple carbohydrate loading in adult elective surgery patients. It was undertaken given the recent change in ERAS guidelines indicating that, although carbohydrate loading can

improve metabolic parameters, it offers no clear clinical advantage over standard short fasting protocols.

5.1 Clinical Benefit

- Results from our meta-analysis indicate that pre-operative complex carbohydrate drinks have no clinically meaningful impact on residual gastric volume or insulin sensitivity compared to simple carbohydrate loading. However, these findings were based on low to moderate certainty evidence, downgraded due to risk of bias and imprecision.
- Other patient-important outcomes such as post-operative complications, time for readiness to be discharged, length of stay, readmission, and death showed no difference between the two groups**,** but a very small sample size preclude firm conclusions.

5.2 Limitations of the evidence

- Small number of studies: We identified only three small RCTs comparing preoperative complex versus simple carbohydrate loading. The study population was heterogeneous as two of the RCTs were done in elective gastrointestinal surgeries (colon resection and pancreaticoduodenectomy), and one RCT included all types of elective surgery. These limitations contributed to the overall low to moderate certainty of evidence across outcomes.
- Lack of data on key patient-important outcomes and high-risk populations: Data for only two outcomes, residual gastric volume and insulin sensitivity, were available for inclusion in this analysis. Therefore, evidence on other clinical outcomes that matter to patients (comfort, nausea, time to recovery) and benefit for high-risk patient groups remain inconclusive.

5.3 Compliance

A potential benefit of standardizing the use of a commercially available preoperative carbohydrate drink is that it may be more convenient for patients and therefore improve compliance with preoperative food/drink intake protocols. However, we currently do not have data to confirm this hypothesis.

5.4 Budget Impact

- From a cost perspective, the estimated impact of standardizing preoperative use of complex carbohydrate drinks is relatively small in the context of the roughly 15,000 adult surgery patients treated at the MUHC.
- The potential for cost savings in terms of complications, length of stay and readmissions remains inconclusive given the available evidence.

6. CONCLUSIONS

- **Clinical benefit**: Low to moderate certainty evidence, derived from three RCTs, indicates that pre-operative complex carbohydrate loading may have little or no clinical benefit on residual gastric volume and insulin sensitivity compared to simple carbohydrate loading. These results align with the more recent ERAS guidelines that conclude that preoperative carbohydrate loading does not offer a clear clinical advantage in comfort or clinical outcome over standard short fasting protocols (i.e. solids for 6 hours, clear liquids for 2 hours before anesthesia).
- **Budget impact:** Administering pre-operative complex carbohydrate at the MUHC could yield modest annual cost increase ($76,100) from the product and nursing costs.

7. RECOMMENDATIONS

The TAU Policy Committee, made up of stakeholders from across the McGill University Health Centre, reviewed the evidence and issued the following recommendation: Not approved.

This recommendation was driven by the following:

- Based on the best available evidence on insulin sensitivity and residual gastric volume, there is **insufficient evidence** to justify standardizing complex carbohydrate drinks MUHC-wide at this time.
- Any remaining uncertainty can only be meaningfully addressed through well-designed, adequately powered, and controlled **research studies** focused on specific surgical populations and patient-centred outcomes. Small, uncontrolled, or underpowered pilot projects would be unlikely to establish causal relationships or answer the key clinical questions, and therefore risk inefficient use of clinical and organizational resources. As such, any research studies should not be funded through the MUHC's operating budget.

FIGURES

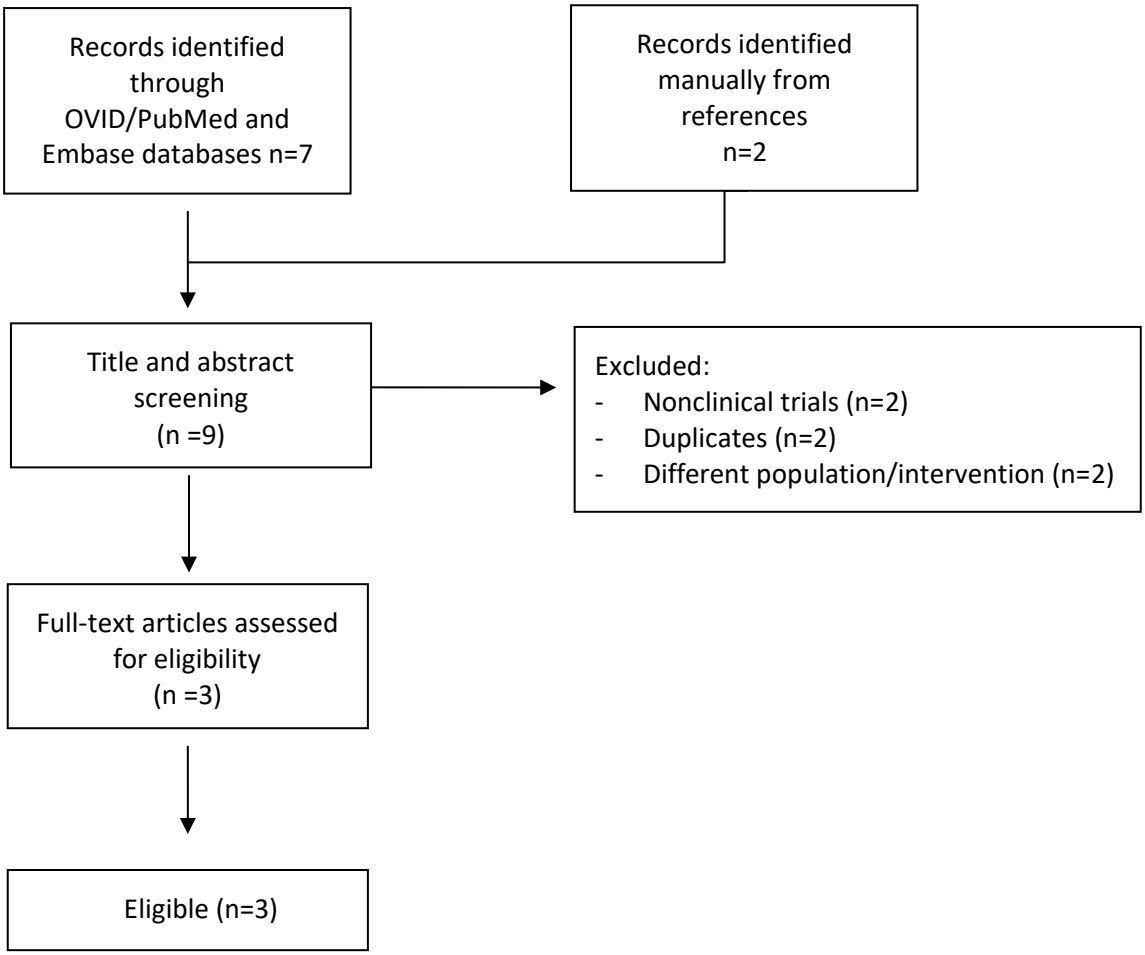


Figure 2. PRISMA Flowchart of the RCTs comparing preoperative simple and complex carbohydrate loading

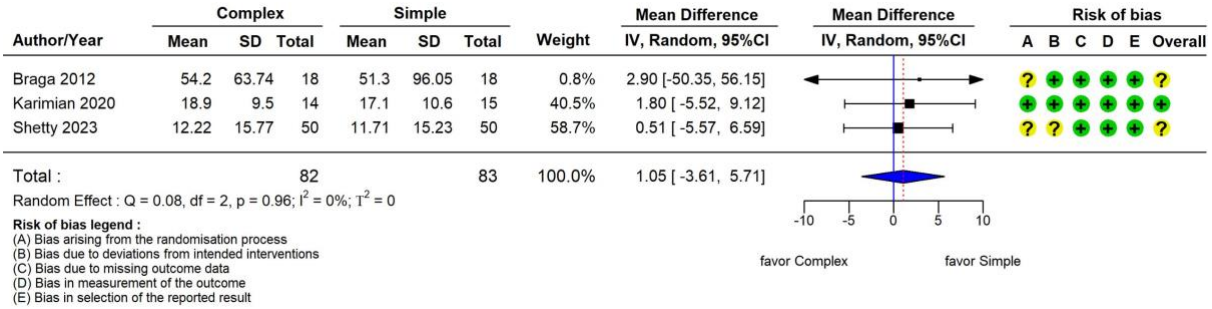


Figure 3. Forest plot of studies assessing the impact of pre-operative carbohydrate loading on the residual gastric volume.

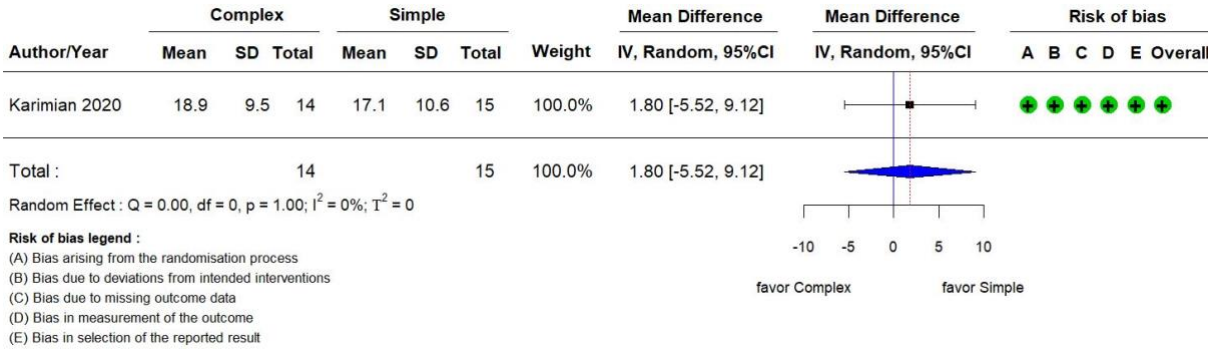


Figure 4. Forest plot of studies assessing the impact of pre-operative carbohydrate loading on the residual gastric volume for only study with low risk if bias

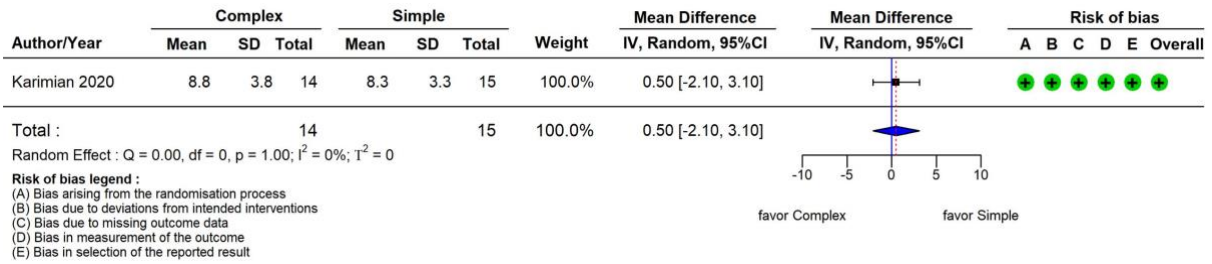


Figure 5. Forest plot of studies assessing the impact of pre-operative carbohydrate loading on insulin sensitivity.

TABLES

Table 2. Characteristics of the RCTs comparing pre-operative complex versus simple carbohydrate drink

Study	Population	Intervention	Comparator	Primary Outcomes	Secondary Outcomes	Risk of Bias
Karimian et al., 2020 (Canada)	30 non-diabetic patients scheduled for elective laparoscopic colon resection without a stoma, aged >18 years	Complex CHO (n=14): maltodextrin + fructose (40 g of complex CHO (maltodextrin) and 10 g simple CHO (207mOsm/kg, PH 4.5)), 400 mL, 2 h preop	Simple CHO (n=15): fructose drink (Minute Maid Without Pulp) containing 50 g of fructose/galactose (648mOsm/kg, PH 3.7)), 400 mL, 2 h preop	(1) Intraoperative insulin sensitivity (measured using the hyperinsulinemic euglycemic glucose clamp (HEC), the ''gold standard'' technique). M values <5.5 mg/ kg/min represent a state of IR. Insulin sensitivity with HEC method: M values 8.3 (3.3) in SC vs 8.8 (3.8) mg/kg/min in CC, P = 0.7 (2) Residual Gastric Volume (normal value considered to be <100 mL). The mean (SD) RGV was 17.1(10.6) mL in SC vs. 18.9(9.5) mL in CC.	Serum C-reactive protein (CRP), grip strength, self-reported health status on POD2 with VAS, Time to readiness for discharge, and postoperative complications and infections to 30 days. There were no differences between the simple and complex CHO groups in overall complications and self-reported health status	Low Despite lack of description about concealment, the patients, the surgeons, and the researchers were all blinded to the randomization order. To ensure blinding, the drinks were prepared in identical opaque containers with the same shape and appearance. There was no deviation from the protocol and all outcomes were complete
Braga, 2012 (Italy)	Cancer patients undergoing pancreaticoduodenectomy, aged 18-80 years	Complex CHO (N=18): Maltodext/ saccarose 50 g enriched with glutamine, antioxidants, and green tea extract	Simple CHO (N=18): Orange juice concentrate	C-reactive protein and F-2 Isoprostanes variations	The mean (SD) Residual Gastric Volume was 54.2 (63.74) mL in the complex CHO group versus 51.3 (96.05) mL in the simple CHO group. Pre- and postoperative well-being including questions about feeling	Moderate No description on concealment or blinding, and there was lack of supervision with multiple fluid administration before the surgery

					hungry, thirsty, anxious, weak, or nausea (assessed by means of VAS), overall morbidity, and length of hospital stay were not different between the two groups	
Shetty, 2023 (India)	Patients scheduled for elective surgeries, aged 19-65 years	Complex CHO (n=50): Carbohydrate drink (300 mL) containing a total carbohydrate content of 50 gm and 6 gm of sugar)+100 mL water.	Simple CHO (n=50): Apple juice (300 mL) +100 mL water.	The mean (SD) Residual Gastric Volume was 12.22 (15.77) mL in the complex CHO group versus 11.71 (15.23) mL in the simple CHO group.		Moderate No description on concealment or blinding, but the drink was supervised. Patients and anesthesiologists were not blinded, but the radiologist was. There was no deviation from the protocol, and all outcomes were complete.

CHO: carbohydrate, CC: complex carbohydrate, POD: postoperative day, SC: simple carbohydrate, SD: standard deviation; VAS: vascular analogue scale

Table 3. Level of Certainty of the Impact of pre-operative carbohydrate loading on the residual gastric volume

№ of studies	Certainty assessment						Effect			Certainty of Evidence
	Risk of bias *	Controlled study	Imprecision	Inconsistency	Indirectness	Others	№ of samples in the Complex group	№ of individuals in the Simple group	Mean Difference (MD) (95% CI)	
Outcome: Residual Gastric Volume										
3	Moderate (one low, two moderate)	RCTs, no downgrading	Small sample size, wide CI	No downgrading (all in favour of simple)	No downgrading	No downgrading	82	83	Pooled MD 1.05 (-3.61, 5.71) mL	Low
Outcome: Insulin Sensitivity										
1	Low	RCTs, no downgrading	Small sample size, wide CI	Not applicable	No downgrading	No downgrading (no publication bias, proper analysis)	14	15	MD 0.5 (-2.1 to 3.1) mg/kg/min	Moderate

MD: mean difference. *Assessed according to the Cochrane risk of bias Tool

Table 4. Cost for administering preoperative complex carbohydrate loading in adult surgery patients

Center	Annual patient volume	Product cost		Nursing cost			Annual Total Costs
		Unit cost ($)	Total	Annual labour hours (4 min per patient)	Unit cost/hour ($)	Total	
MGH							$41,797
	8,565	2	$17,130	571	43.2	$24,667	
RVH							
	6,252	2	$12,504	417	52.3	$21,799	$34,303
						Grand Total	$76,100

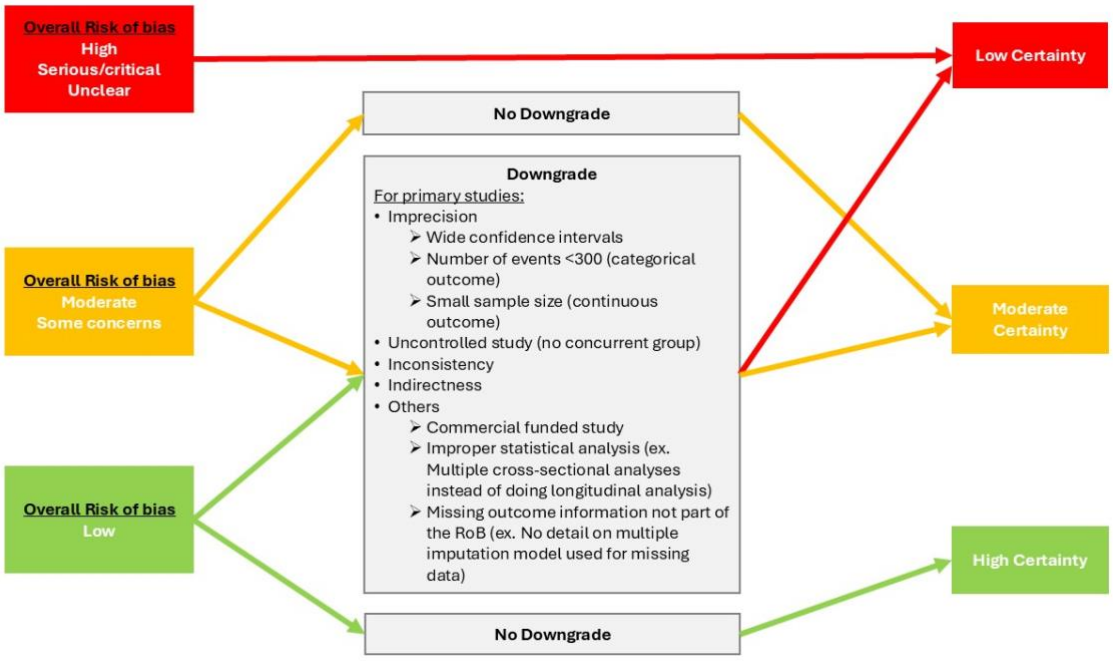
MGH: Montreal General Hospital; RVH: Royal Victoria Hospital

APPENDICES

APPENDIX A: QUALITY ASSESSMENT ALGORITHM

Our in-house tool incorporated the following dimensions to evaluate the evidence quality:

i. Overall risk of bias of the included studies (based on controlling bias due to confounding, selection, misclassification, reporting and analytic concerns)
ii. Uncontrolled study (no comparator group)
iii. Imprecision (bias arising from small sample size)
   - Wide confidence intervals
   - Low number of events (<300 for categorical outcomes)
   - Small sample size (for continuous outcomes)
iv. Inconsistency (results vary widely between studies)
v. Indirectness (extrapolating results from indirect comparisons)
vi. Others
   - commercially funded study
   - improper statistical analytical tests (e.g., multiple cross-sectional analyses for a longitudinal data)
   - missing outcome information that is not part of RoB (e.g. no details on multiple imputation models used for missing data)



Low certainty evidence:

- This indicates that our confidence in the overall effect estimate is limited.

- Studies with a high overall risk of bias were, by default, considered low certainty evidence.

Moderate certainty evidence:

- Moderate certainty evidence suggests that we are moderately confident in the effect estimate; the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
- Included studies with a low or moderate overall risk of bias could be downgraded and considered a lower certainty of evidence if one of these domains were met
    - Imprecision (i.e. confidence intervals, low number of events (<300 for categorical outcomes), or small sample size (for continuous outcomes))
    - Uncontrolled study (no comparator group)
    - Inconsistency (i.e. studies have inconsistent effects, or are too heterogenous to compare)
    - Indirectness (i.e. studies reporting outcomes that indirectly answer our research question)
    - Others
        - commercially funded study
        - improper statistical analytical tests (e.g., multiple cross-sectional analyses for a longitudinal data)
        - missing outcome information that is not part of RoB (e.g. no details on multiple imputation models used for missing data)

High certainty evidence:

- High certainty evidence indicates that we are very confident that the true effect lies close to that of the estimate of the effect.
- When studies are not downgraded for any of the elements considered above and overall risk of bias is low, this would indicate an overall high certainty evidence.

APPENDIX B: CONTRAINDICATIONS FOR PRE-OP CARBOHYDRATE BEVERAGE AT THE MUHC

There are three categories of contraindications for pre-op carbohydrate beverages at the MUHC (source: Collective Order PREOP-20240418 CPRC FINAL 11 July 2025).

Contraindications	**Medical conditions**
1) Fluid restrictions needed	• Pulmonary edema • Congestive heart failure • On dialysis • Other conditions requiring fluid restriction
Instructions for patients with fluid restrictions: Fasting after midnight the night before surgery	
2) Risk of aspiration	• Documented gastroparesis • Patient on metoclopramide and/or domperidone use to treat gastroparesis • patient taking GLP-1 (Glucagon-like peptide-1) agonists • Documented gastric outlet or bowel obstruction • Achalasia • Dysphagia (any difficulty with swallowing) • Patients with movement disorders undergoing deep brain stimulation, focused ultrasound surgery or battery change
Instructions for patients at risk of aspiration: Fasting after midnight the night before surgery	
3) Risk of hyperglycemia	• Diabetic type 1 patients • Uncontrolled diabetic type 2 patients (HbA1c more than 7 %). If there is no HbA1c, nurses will consult the pre-operative anesthesiologist or physician to advise.
Instructions for patients at risk of hyperglycemia: In the absence of any risk factors for aspiration or for fluid restrictions, patients who are at risk of hyperglycemia may drink water up to 2 hours before surgery but should not have juice or complex carbohydrate beverage.	

APPENDIX C: POSTOPERATIVE OUTCOMES COMPARISON BY KARIMIAN ET AL.(11)

TABLE 3. Postoperative Outcomes

Variables	Simple CHO (n = 15)	Complex CHO (n = 14)	*P*
Any complication	5 (33)	3 (21)	0.68
Infectious complications	2 (13)	1 (7)	1
Any SSI	2 (13)	1 (7)	1
Incisional	0	1 (7)	0.48
Organ space	2 (13)	0	0.48
Urinary tract infection	0	0	—
Sepsis	1 (6)	0	1
Pneumonia	1 (6)	0	1
Other infections	1 (6)	0	1
Surgical complications	2 (13)	1 (7)	1
Anastomotic leak	2 (13)	0	0.48
Ileus	0	1 (7)	0.48
Other surgical complications	0	0	—
Respiratory complications	2 (13)	0	0.48
Cardiac complications	0	0	—
Deep vein thrombosis	0	0	—
Acute renal insufficiency	0	0	—
Complication severity (highest grade)			
Clavien I–II	2 (13)	3 (21)	0.65
Clavien III–IV	3 (20)	0	0.22
Death	0	0	—
Time to readiness for discharge, d, median (IQR)	2 (2–3)	2 (2–3)	0.62
Primary length of stay, d, median (IQR)	2 (2–3)	2.5 (2–4)	0.61
Readmissions	2 (13)	0	0.48
Total length of stay, d, median (IQR)	3.5 (3–7)	2.5 (2–4)	0.1

Data expressed as number of patients (%) unless specified.
SSI indicates surgical site infection.

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