

**American Society for Metabolic and Bariatric Surgery:
Care Pathway Development for Laparoscopic Sleeve
Gastrectomy**

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Subcommittee Chairs and Members

A working product of the Quality Improvement and Patient Safety (QIPS) Committee

Project chair: Dana Telem MD, FASMBS

Subcommittee chairs and members:

Pre-operative:

Chair: Kinga Powers MD

Group members: Lionel Brounts MD, Henry Lin MD

Intra-operative:

Chair: Carl Pesta DO

Group members: Anthony Petrick MD, Andre Teixeira MD

Post-operative:

Chair: Jon Gould MD

Group members: Jake Greenberg MD, Saniea Majid MD

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Statement of Purpose

Clinical care maps are defined as tools that guide evidenced-based healthcare with the express goal of optimizing healthcare delivery and quality while minimizing health care expenditures. The goal of a clinical care map should be to accurately represent the care path for at least routine patient care and ideally to also provide structure for patient care when an individual patient develops an issue that requires deviation from the routine treatment path. Such care maps have important implications as we transition to value based healthcare.(1, 2)

The value of a care map is well recognized in bariatric surgery. Current literature, while limited, does support the use of clinical care pathways in bariatric surgery. Several single institutional studies of bariatric patients demonstrate reductions in cost, reduced hospital length of stays and decreased rate of perioperative complications following implementation of standardized patient clinical pathways.(3-7) Maintenance of and adherence to clinical care pathways are also mandated as a requirement for accreditation by The Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP).(8) Despite this recommendation a nationally accepted care map pertaining to bariatric surgery does not exist.

The Quality Improvement and Patient Safety (QIPS) Committee supports the mission and values of the American Society of Metabolic and Bariatric Surgeons (ASMBS) by promoting continuous improvement in patient safety and risk reduction. These goals are achieved by the integration and coordination of patient safety initiatives to reduce medical errors through process analysis and participation in quality improvement reporting. This committee recognized the importance of clinical care maps and that while mandated by MBSAQIP, little was known as to the content and variability of such pathways on a national level. We hypothesized that collecting and sharing established successful pathways could ultimately provide a valuable resource to support new programs as well as help existing programs improve patient safety. Additionally, analyzing these pathways would also demonstrate the variability in practice patterns across the country.

A study was then conducted which identified considerable national variations in clinical pathways are demonstrated among practicing bariatric surgeons. Only 6 variables that were assessed: preoperative nutritional evaluation, preoperative psychological evaluation, mention of intraoperative venous thromboembolism prophylaxis, mention of antiemetic utilization in the postoperative period, a dedicated perioperative pain and mention of obtainment of postoperative laboratory values were concordant between pathways. Further evaluation of these pathways also demonstrated the majority of metrics, even when mentioned, to be nonspecific without clear recommendation as to whether these metrics should be followed routinely versus selectively and in whom.(9)

This study highlighted a key opportunity for the ASMBS to develop and implement an evidence-based national care map for sleeve gastrectomy. As such, a task force was initiated to create this care map.

Methodology

Search Strategy and Literature Review

Systematic literature reviews were identified by principle literature searches conducted utilizing Embase or Pubmed to identify relevant contributions (Table 1). The Medical Subject Headings (MeSH) and text words were determined by the authors. Reference list of relevant manuscripts and gray materials were reviewed at the discretion of assigned work groups (i.e., preoperative, intraoperative, and postoperative) to identify other relevant titles. Article title and abstracts were reviewed by work groups for inclusion or exclusion to determine the relevance of the literature to the topic area. Irrelevant studies were excluded.

Study Selection and Characterization of Articles

Relevant manuscripts were selected by individual reviewers from manuscript titles and abstracts. Supporting evidence for each topic included randomized control studies, non-randomized control studies, meta-analysis, systemic reviews and reviews.

Articles were characterized on the following topics related to predetermined preoperative, intraoperative, and postoperative metrics. Metrics to be included were decided upon by expert consensus; common variables found in national pathways and MBSAQIP accreditation requirements and are listed in Table 2.

Quality Assessment and Data Analysis

The methodological quality of the studies was assessed utilizing the 2010 American Association of Clinical Endocrinologists Protocol for Production of Clinical Practice Guidelines: Evidence Rating (Table 3-5). Evidence quality and recommendation for clinical application were evaluated according to evidence level and grading recommendations. The committee utilized a consensus process when there was a lack of supporting evidence (Table 2 and 4). There are some recommendations based on consensus due to limited evidence. The recommendations are categorized as follows: “Routine” recommendation indicates the committee has confidence the evidence-based literature supports routine ordering of designated diagnostic studies, tests, and evaluations. “Selective” recommendation is indicated for patients with designated criteria to support additional practice, procedure, study, test or evaluation. “Not Recommended” are unnecessary practices, procedures, studies, tests, and/or evaluations and should not be routinely conducted.

Table 1. Literature Search Strategy

Data Base	Time Period	Topic	MeSH Headings	Results
Embase	1948 – October 2015	Laparoscopic Sleeve Gastrectomy: Enhanced Recovery Pathways	bariatric NEAR/2 surg* OR sleeve NEAR/2 bypass OR sleeve NEAR/2 gastrectomy OR gastric NEAR/2 bypass OR stomach NEAR/2 bypass enhanced NEAR/2 recover* NEAR/2 surg* OR eras	20
Embase	1948-November 2015	Laparoscopic Sleeve Gastrectomy: Preoperative Phase	'laparoscopic sleeve gastrectomy':ti OR 'laparoscopic sleeve gastrectomy':de AND 'preoperative period' (preoperat* OR 'pre operative' OR presurg* OR 'pre surgical') NEAR/5 (test OR tests OR testing OR evaluat* OR screen* OR diet OR preparation* OR 'x ray' OR 'x rays' OR 'mandatory weight loss' OR endoscop* OR assessment* OR 'helicobacter pylori' OR 'h pylori' OR nutrition) laparoscop* NEAR/3 sleeve NEAR/3 gastrectom*	239
Embase	1948-December 2015	Laparoscopic Sleeve Gastrectomy: Deep Vein Thrombosis and Assessment Tools	(dvt OR 'deep vein thrombosis' OR 'pulmonary embolism' OR vte OR 'venous thromboembolism') NEAR/5 risk* NEAR/5 (tool OR tools OR screen*	28

			OR score* OR scale* OR assessment* OR evaluat* OR predict* OR diagnos* OR preoperative* OR wells OR caprini OR 'university of michigan' OR 'north american') bariatric NEAR/2 surg*	
Pubmed	2006-2016	Laparoscopic Sleeve Gastrectomy: Bougie	"laparoscopy"[MeSH Terms] OR "laparoscopy"[All Fields] OR "laparoscopic"[All Fields]) AND sleeve[All Fields] AND ("gastrectomy"[MeSH Terms] OR "gastrectomy"[All Fields])) AND bougie[All Fields] AND (hasabstract[text] AND "2006/06/21"[PDAT] : "2016/06/17"[PDAT])	75
Embase	1948 – February 2016	Laparoscopic Sleeve Gastrectomy: Postoperative diet	16 #4 #2 OR #3 2 #3 #1 AND (postsurg* OR 'post surgery' OR 'post surgical') NEAR/5 diet* 14 #2 #1 AND postoperat* NEAR/5 diet* 3,135 #1 laparoscop* NEAR/5 sleeve NEAR/5 gastrectom*	16
Embase	1948-February 2016	Laparoscopic Sleeve Gastrectomy: Antiemetic agents	27 #7 #1 AND (#5 OR #6)	27

			87 #6 (antinausea* OR 'anti nausea') NEAR/2 (medicat* OR drug OR drugs) 168,676 #5 antiemetic* OR 'antiemetic agent'/exp 16 #4 #2 OR #3 2 #3 #1 AND (postsurg* OR 'post surgery' OR 'post surgical') NEAR/5 diet* 14 #2 #1 AND postoperat* NEAR/5 diet* 3,135 #1 laparoscop* NEAR/5 sleeve NEAR/5 gastrectom* Record 1	
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Table 2. Overview of perioperative metrics investigated for inclusion in clinical care map

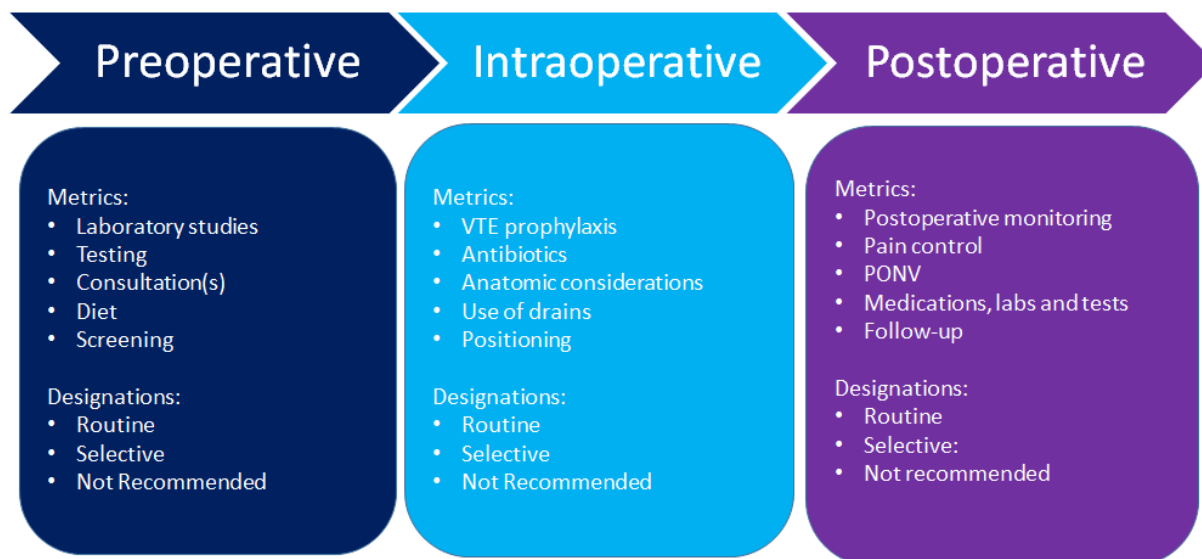


Table 3. 2010 American Association of Clinical Endocrinologists Protocol for Production of Clinical Practices Guidelines - Step I: Evidence Rating*

Numerical descriptor (evidence level)	Semantic descriptor (reference methodology)
1	Meta-analysis of randomized controlled trials (MRCT)
1	Randomized controlled trial (RCT)
2	Meta-analysis of nonrandomized prospective or case-controlled trials (MNRCT)
2	Nonrandomized controlled trial (NRCT)
2	Prospective cohort study (PCS)
2	Retrospective case-control study (RCCS)
3	Cross-sectional study (CSS)
3	Surveillance study (registries, surveys, epidemiologic study) (SS)
3	Consecutive case series (CCS)
3	Single case reports (SCR)
4	No evidence (theory, opinion, consensus, or review) (NE)

*1=strong evidence; 2=intermediate evidence; 3=weak evidence; 4=no evidence.

Table 4. American Association of Clinical Endocrinologists for Production of Clinical Practice Guidelines - Step II: Evidence Analysis and Subjective Factors

Study Design	Data analysis	Interpretation of results
Premise correctness	Intent-to- treat	Generalizability
Allocation concealment (randomization)	Appropriate statistics	Logical
Selection bias		Incompleteness
Appropriate blinding		Validity
Using surrogate endpoints (especially in “first-in-its class intervention)		
Sample size (beta error)		
Null hypothesis versus Bayesian statistics		

Table 5. 2010 American Association to Clinical Endocrinologists Protocol for Production of Clinical Practice Guidelines - Step III: Grading of Recommendations; How Different Evidence Levels can be Mapped to the Same Recommended Grade*

Best evidence	Subjective factor	Two-thirds	Mapping	Recommendation
1	None	Yes	Direct	A
2	Positive	Yes	Adjust up	A
2	None	Yes	Direct	B
1	Negative	Yes	Adjust down	B
3	Positive	Yes	Adjust up	B
3	None	Yes	Direct	C
2	Negative	Yes	Adjust down	C
4	Positive	Yes	Adjust up	C
4	None	Yes	Direct	D
3	Negative	Yes	Adjust down	D
1,2,3,4	NA	No	Adjust down	D

*Starting with the left column, best evidence levels (BEL), subjective factors, and consensus map to recommendation grades in the right column. When subjective factors have little or no impact (“none”), then the BEL is directly mapped to recommendation grades. When subjective factors have a strong impact, then recommendation grades may be adjusted up (“positive” impact) or down (“negative” impact). If a two-thirds consensus cannot be reached, then the recommendation grade is D. NA=not applicable (regardless of the presence or absence of strong subjective factors, the absence of a two-thirds consensus mandates a recommendation grade D).

PREOPERATIVE SLEEVE GASTRECTOMY

PREOPERATIVE: ROUTINE

Preadmission Patient Information and Education:

Patient information and education play an essential role in setting expectations and modifying individual response to surgical procedure. All patients should participate in a bariatric surgery information session prior to decision for bariatric surgery that includes information on formal preparation and counseling expectations.(10) The initial bariatric surgery informational session should include but is not limited to weight loss surgical options, surgery risks and complications, nutritional requirements, pathway information, support group participation, follow-up and monitoring requirements. Clinic practice guidelines exists describing detailed patient information and education.(11, 12)

Laboratory Studies:

Routine preoperative laboratory testing: Complete blood cell (CBC) count, basic metabolic panel (Chem 7), liver function tests, albumin, hemoglobin A1c (Hg A1c), international normalized ratio (INR), prothrombin time (PT), partial thromboplastin time(PTT), thyroid-stimulating hormone (TSH), vitamin B₁, vitamin B₁₂, vitamin D, micronutrients, urinalysis, urine human chorionic gonadotropin (HCg) for females.(11-14)

Screening:

- **Obstructive Sleep Apnea Screening:**

Routine screening for obstructive sleep apnea should be conducted. Patients with clinical symptoms or positive screening should be referred for polysomnography.(12, 15, 16)

- **Malignancy Screening:**

All patients should be encouraged to have routine cancer screening by a primary care provider based on age and risk factors. These screening tests should be done according to the current national guidelines. Although we recommend all patients be up to date with the screening recommendations, this does not preclude them from undergoing bariatric surgery unless patient are symptomatic or other factors indicate these test to be no longer screening in nature. (17)

- **Substance Use:**

Assess patient history or active substance use to include nicotine (cigarettes, cigars, pipe, snuff/chew, hookah, electronic nicotine delivery devices, and nicotine replacement therapy), alcohol, caffeine, and medications.(18) All patients should be advised to stop smoking. Smoking cessation and duration of cessation demonstrated prior to surgery should be at the discretion of the individual surgeon. (12, 19, 20) For patients identified with alcohol dependence a recommendation is made for mandatory abstinence of 1-2 years prior to surgery.(21) Patients with identified or suspected non-alcoholic substance

abuse should undergo a mental health evaluation, there is no clinical evidence to support the length of mandatory abstinence prior to surgery. (12)

- **Functional Status:**

Numerous studies demonstrate baseline functional status to correlate with and predict perioperative outcomes.(20, 22, 23) Functional health status is also an important data element captured by the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) registry to appropriately risk stratify patients preoperatively. As such all patient should be assessed at baseline.

Diet:

Recommendation to initiate patients on a liquid diet for 1-2 weeks preoperatively, body mass index (BMI) dependent.(24-30) This may also be decided on a case by case basis by the individual practitioner.

Testing:

- **Chest Radiography:**

Patients with new or unstable cardiopulmonary signs or symptoms should undergo preoperative chest radiography.(31-35)

- **Electrocardiogram:**

Patients should undergo routine preoperative electrocardiogram (ECG) and assessment of individual cardiovascular risk factors as well as cardiovascular physical exam.(36-38)

Consultants:

- **Nutrition Consult:**

All patients should receive a nutritional assessment by a dietitian with expertise to provide care for the bariatric surgical patient.(39-47) The preoperative evaluation and education should include a nutritional evaluation, micronutrient measurements, preoperative and postoperative meal guidance, life-time modifications, duration of nutritional counseling preoperatively and preoperative nutrition laboratory test as listed above and micronutrients.

- **Psychology Consult:**

All patients should receive a psychosocial-behavioral evaluation prior to surgery.(48, 49) Evaluation should include assessment for eating disorder, behavioral factors, alcohol abuse, substance abuse, or psychiatric illness.(18, 50-52) This will aid in identifying preoperative barriers and establishing continual postoperative care for those in whom it is required.

PREOPERATIVE: SELECTIVE

Laboratory Studies:

- **H-Pylori:**
Data demonstrates that H-pylori testing may not necessarily affect outcome or prevent complications. Testing should be at the discretion of the provider and based on patient factors.(53)
- **Urine Nicotine:**
A preoperative urine nicotine test may be required by insurance to ensure compliance with perioperative smoking cessation.(54, 55)
- **Urine Toxicology Screen:**
Urine toxicology screening should be selective and used as a supplement, not intended to replace patient self-reporting regarding substance abuse or abstinence.(56)

Testing:

- **Endoscopy/Upper Gastrointestinal (UGI) series:**
Selective preoperative EGD prior to laparoscopic sleeve gastrectomy is recommended. Patients with symptoms of GERD, such as heartburn, regurgitation, dysphagia, or any postprandial symptoms that suggest a foregut pathology and/or who chronically use antisecretory medications, should have an upper GI endoscopic evaluation before bariatric surgery. Routine EGD before surgery can identify a variety of conditions including hiatal hernia, esophagitis, ulcers, and tumors. Although the majority of patients with abnormalities in these studies were asymptomatic, endoscopic findings resulted in an alteration of the surgical approach or delay in surgery ranging from less than 1% to 9% of patients. Patients with morbid obesity might have a higher rate of endoscopic abnormalities, however the majority of abnormal endoscopic do not affect operative management. Performance of preoperative EGD is recommended in patients with upper gastrointestinal symptoms.(57-61)

Routine preoperative UGI studies prior to a laparoscopic bariatric procedure are not recommended. Radiographic UGI evaluation should be reserved for symptomatic patients or those with history of prior gastric surgery. A barium contrast study may be a useful alternative as it can provide information complementary to endoscopy. The presence of a hiatal hernia and endoscopic signs of reflux esophagitis represent a relative contraindication to sleeve gastrectomy because of an increased risk of the development of de novo GERD-type symptoms and esophageal mucosa injury after SG. Many surgeons advocate hiatal hernia reduction and crural closure in patients with hiatal hernia undergoing any weight loss operation. It is useful for surgeons planning weight loss interventions to know the measured size of any hiatal hernia, reported in centimeters, both as the length of the hernia and the gap between the diaphragmatic crura, with the

latter measurement obtained via intraoperative endoscopy. Non selective use of radiographic UGI series exposes patients to radiation and does not lead to changes on patients operative management.(57-69)

- **Ph/manometry:**

Manometry and pH study should be selective based on symptomatology to include esophageal motility disorder and severe acid reflux despite proton pump inhibitors in patients selecting relief.(65, 70-78)

- **Bone Density Test:**

Preoperative dual-energy X-ray absorptiometry (DXA) is selective can be performed in estrogen-deficient women and in premenopausal women and men who have conditions associated with bone loss or low bone mass to establish a baseline before bariatric surgery. There is, however, no compelling data to support routine DXA for all obese adolescents, men or premenopausal women undergoing bariatric surgery. If low bone mass is diagnosed preoperatively, a thorough evaluation should be undertaken to identify secondary causes. This laboratory testing can include thyroid stimulating hormone and testosterone levels in men.(79) A baseline DXA sir recommended for all women 65 years and older and for younger postmenopausal women, and men 70 years or older and men age 50–69 about whom you have concern based on their clinical risk factor profile patients such as those undergoing a malabsorptive procedure.(80)

- **Sleep Study:**

Obstructive sleep apnea (OSA) is highly prevalent in the bariatric patient population. Patients who screen positive on preoperative evaluation or demonstrate clinical symptoms consistent with apnea should be sent for further evaluation. The high prevalence demonstrated in some studies suggests that consideration be given to testing all patients, and especially those with any preoperative symptoms suggesting obstructive sleep apnea.(16)

- **Colonoscopy:**

Colonoscopy should be done for patients with unexplained abdominal symptoms, hematochezia/melena, iron deficiency of unknown cause or family/personal history of colonic pathology. Otherwise national screening guidelines should be followed.(17, 81)

- **Ultrasound:**

Indications for abdominal ultrasound include biliary disease symptomatology and abnormal liver function test.(12, 82, 83)

- **Venous Ultrasound:**

Venous ultrasound should be reserved for patients with a history of venous thromboembolism or deep venous thrombosis or who are at high risk based on evidence of venostasis, known or familial hypercoagulable state or increased right sided heart pressures.

- **Gastric Emptying Study:**

Gastric emptying study does not affect outcome. Consideration to this test may be given if patients present with clinical symptoms or studies concerning for delayed gastric emptying. (84)

Consultations: Selective

- **Anesthesia Consult:**

High risk patients ASA 3 or greater should have an anesthesia preoperative evaluation, preparation, and education visit scheduled prior to surgery. Evaluation should include assessment and management for intravenous access, monitoring, aspiration risk, postoperative nausea and vomiting, fluid management, needed analgesia, airway and ventilation management.

- **Cardiovascular Consult:**

Cardiovascular referral is indicated prior to surgery in patients with unstable coronary syndromes, history of recent myocardial infarction with ongoing ischemic risk factors, unstable or severe or mild angina, decompensated or compensated heart failure, significant arrhythmias, high-grade atrio-ventricular blocks, certain arrhythmias and severe valvular disease, diabetes mellitus and renal insufficiency, abnormal ECG, rhythm other than sinus, low functional capacity, uncontrolled systemic hypertension and previous stroke, obstructive sleep apnea with hypertension, exertional dyspnea, and evaluation for perioperative β -adrenergic blockade, significant family or personal cardiac disease or any other condition the clinician feels a consultation is warranted.(55, 85, 86)

- **Endocrinology Consult:**

For patient with Type I and Type 2 Diabetes preoperative glycemic control is recommended with goals for Hemoglobin A_{1c} of 6.5 to 7.0% or less, fasting blood glucose of less than or equal to 110 mg/dL; 2-hour postprandial blood glucose concentration of less than or equal to 140mg/dl. Endocrinology consultation should be considered for those patients with poorly controlled hyperglycemia.

- **Gastroenterology Consult:**

Consultation with a gastroenterologist may be considered for those patients with severe gastrointestinal (GI) symptoms not previously encountered elsewhere in this document.(87)

- **Hematology Consult:**

Patient with factors that place them at high-risk for venous thromboembolism (VTE) after bariatric surgery may include known hypercoagulable condition should be referred to hematologist for evaluation.(88)

- **Nephrology Consult:**

Patients with pre-existing kidney disease, end stage renal disease, those on hemodialysis and those with a renal transplant should be considered for preoperative evaluation.(89-91)

- **Pain Management Consult:**

Patients with chronic opioid use or dependence, opioid tolerance, suboxone use and those with anticipated needs for chronic pain management should be considered for preoperative consultation with a pain management specialist. (92)

- **Pharmacist Consult:**

Patients with polypharmacy, transplant recipient, extended release medications, and/or anticoagulation may receive a pharmacy referral to review medication transition to liquid or crushed forms of medication and rapid-release medications.

- **Pulmonary Specialist Consult:**

Pulmonary referral is indicated for abnormal chest radiography, positive polysomnography, or history of intrinsic lung disease.(12)

- **Sleep Medicine Consult:**

Patients with clinical symptoms or positive screening for OSA or obesity hypoventilation syndrome (OHS) should be referred to sleep medicine for further evaluation.(12, 15, 93)

PREOPERATIVE: NOT RECOMMENDED

- **Mandatory Preoperative Weight Loss:**

Mandatory preoperative weight loss in bariatric surgical patients is not required and at the discretion of the individual program. Weight gain and inability to lose weight prior to surgery should not preclude consideration for a bariatric procedure. (39-42, 94-99)

- **Inferior Vena Cava (IVC) Filter Placement:**

Routine use of IVC filter placement prior to bariatric surgery is not recommended. Filter placement may be considered for high-risk patients that may include high BMI, advanced age, immobility, prior history of VTE, venous stasis disease, hormonal therapy, expected operative time duration or open approach, and male gender.(100) Filter placement may be considered in combination with chemical and mechanical prophylaxis for selected high-risk patient in whom the risks of VTE are determined to be greater than the significant risks of filter-related complications for which there is not yet long-term safety data.(100)

- **Bowel Prep:**

Routine bowel prep is not recommended.

Table 6. Summary of Preoperative Recommendations: Routine

Metric	
Laboratory values <ul style="list-style-type: none"> • CBC • BMP • LFTs • Albumin • HGBA1C • INR/PT/PTT • TSH • Vitamin B1, B12, D • Micronutrients • Urinalysis/Urine HCG (females) 	Screening <ul style="list-style-type: none"> • OSA • Malignancy (age and gender) • Functional status • Smoking • Substance abuse Diet <ul style="list-style-type: none"> • Liquid diet 1- 2 weeks preop, BMI dependent
Consultations <ul style="list-style-type: none"> • Nutrition • Psychology 	Testing <ul style="list-style-type: none"> • CXR • EKG

Table 7. Summary of Preoperative Recommendations: Selective

Metric	
Laboratory studies	Consultations
<ul style="list-style-type: none"> • H.pylori • Urine nicotine • Urine tox screen • H. pylori 	<ul style="list-style-type: none"> • Anesthesia • Cardiology • Endocrine • Gastroenterology • Hematology
	<ul style="list-style-type: none"> • Infectious disease
Testing	<ul style="list-style-type: none"> • Nephrology
<ul style="list-style-type: none"> • Endoscopy • UGI series • pH/manometry • Dexa scan • Sleep study • Colonoscopy • Mammography • Ultrasound • Gastric emptying study 	<ul style="list-style-type: none"> • Neurology • Ob/gyn • Orthopedics • Pain medicine • Pulmonary • Pharmacy • Rheumatology • Sleep medicine • Urology

Table 8. Summary of Preoperative Recommendations: Not Recommended

Metric
• Mandatory preoperative weight loss
• Routine IVC filter placement
• Routine bowel prep

INTRAOPERATIVE: ROUTINE

Venous Thromboembolism (VTE) Prophylaxis

- **Sequential Compression Device:**

Mechanical prophylaxis is recommended for all bariatric surgery patients. There may be individual circumstances (severe lymphedema) when lower extremity compression devices are not practical and alternative strategies may be needed.(100)

- **Chemoprophylaxis:**

There are conflicting data in the literature regarding the type of chemoprophylaxis to use, but the highest-quality data currently available suggest that low molecular weight heparin (LMWH) offers better VTE prophylaxis than unfractionated heparin (UFH) without increasing the bleeding risk.(100)

Antibiotics

- **Antibiotics:**

A sleeve gastrectomy is classified as a clean contaminated case. At present, the recommendation is that patients should receive antibiotic therapy and follow institution guidelines. There are limited studies on the optimal antibiotic dose for the obese patient undergoing bariatric surgery. Standard dosages may result in decreased serum and tissues levels for the bariatric patient. Recommendations for prophylaxis includes administration of the highest prophylactic dose, adjusting for renal function.(101)

Numerous microbial species have been implicated as SSI pathogens. In bariatric surgical procedures, the predominant organisms include Gram-positive bacteria such as staphylococci, streptococci and enterococci, and Gram-negative pathogens such as Enterobacteriaceae including *Proteus mirabilis*, *Serratia marcescens*, *Enterobacter* and *Escherichia coli*, and anaerobes including *Bacteroides fragilis*. The most advocated prophylactic agent for gastroduodenal procedures is cefazolin. For bariatric surgeries above or including the duodenum, cefazolin is the drug of choice in nonallergic patients. For penicillin allergy Clindamycin may be a reasonable alternative.(102)

Patient Positioning

Assessment for positioning should occur before the patient is transferred to an operating room bed. The patient should be positioned with arms abducted and the legs split or together as per surgeon preference. Pressure points should be assessed and padded to minimize risk for potential neuropathies. A padded footboard and padding to the plantar surfaces and ankles should be applied so feet are aligned and flat against the footboard to avoid rotation when placed in reverse Trendelenburg.(103) The patient should be secured with safety straps.

Bougie Size

The optimal size of bougie in laparoscopic sleeve gastrectomy should be greater than 34-F. There is evidence to suggest an increased incidence of leak with tighter sleeves and smaller bougie sizes.(104-107)

Hiatal Inspection

- **Hiatus Inspection:**

The hiatus should be routinely inspected during a sleeve gastrectomy. This does not imply routine dissection. If a hiatal hernia is identified, a repair is recommended. Routine dissection of the hiatus should be at the discretion of the individual surgeon (59, 104)

INTRAOPERATIVE: SELECTIVE

Buttressing the Staple Line

- **Buttressing the staple line:**

The routine use of reinforcement materials may not be necessary during LSG, leaks may still occur, and these methods increase the cost of surgery and prolong the operation time. We could not prove any benefit of reinforcement over stapling with no reinforcement. The use of reinforcement increased the burst pressure and did not prevent leaks but did decrease bleeding. Leaving the staple line untouched appears to be safe, although the logic of reinforcement is understandable. However, improved results for reinforcement have not been supported by the statistics and are left to surgeon discretion.(108) There are new data to suggest; however, that while bleeding risks may decrease the risk of leak may increase with use of buttressing material.(109)

Leak Test

The use of intraoperative leak test should be selective at the surgeon's discretion. There is no correlation with methodology and outcome (endoscopic, air leak test, methylene blue). There is also no correlation with leak testing and postoperative complication of leak after sleeve gastrectomy. (110, 111)

Endoscopy

- **Endoscopy:**

Selective based on availability, surgeon comfort, skill level may help with anatomy and leak test. No data to support clinical improvement.

Protective Specimen Retrieval

- **Protective Specimen Retrieval:**

Although there are no studies specific for laparoscopic sleeve gastrectomy, laparoscopic gastric and biliary studies suggest protective effect of specimen retrieval with a wound protector. The utilization of wound protectors may reduce the incidence of surgical site infections following gastrointestinal and biliary tract surgery.(112)

INTRAOPERATIVE: NOT RECOMMENDED

Routine Drains

- **Nasogastric Tube/Closed Suction Abdominal Drain:**

While literature on sleeve gastrectomy is limited, studies demonstrate the routine use of closed suction abdominal drain and nasogastric tubes after roux-en-Y gastric bypass are not necessary and therefore are not recommended following sleeve gastrectomy.(113-115)

- **Urinary Catheter:**

There is insufficient evidence to recommend routine use of urinary catheter intraoperatively or following surgery. As placement is associated with risk of developing catheter associated urinary tract infection, use is reserved only in those requiring strict intake/output monitoring.(116)

Routine Invasive Monitoring

- **Central Venous Access:**

There is insufficient evidence to recommend routine use of central venous access.

- **Arterial Line:**

There is insufficient evidence to recommend routine placement of arterial line.

Table 9. Summary of Intraoperative Recommendations: Routine

Metric	
VTE prophylaxis <ul style="list-style-type: none"> • Sequential compression device • Chemoprophylaxis 	Hiatal inspection <ul style="list-style-type: none"> • Hernia repair if identified
Antibiotics <ul style="list-style-type: none"> • Non penicillin allergic • Penicillin allergic 	Preop Diet: Clears until 2hrs preop
Patient Positioning Guidelines	Goal Directed Fluid Therapy
Bougie > 34 French	

Table 10. Summary of Intraoperative Recommendations: Selective

Metric
Buttressing/over sewing staple line
Leak test <ul style="list-style-type: none">• Endoscopic• Air insufflation• Methylene blue
Protective specimen retrieval
Endoscopy
Hiatal dissection

Table 11. Summary of Intraoperative Recommendations: Not Recommended

Metric
Routine Drain(s) <ul style="list-style-type: none"> Nasogastric tube Closed suction abdominal drain Urinary catheter
Routine invasive monitoring <ul style="list-style-type: none"> Central venous access Arterial line

POSTOPERATIVE: ROUTINE

Prophylaxis

- **Prophylaxis Postoperative Nausea and Vomiting:**

All patients should receive empiric pre-treatment for anticipated postoperative nausea vomiting (PONV) prophylaxis.(117, 118)

Nausea is an expected outcome after this procedure. Effective management requires preventing nausea by prophylactically treating patients with anti-emetics as well as minimizing narcotic use as a postoperative analgesic due to its expected side effect of nausea. While there is no one specific regimen a variety of agents have been described in the literature. Combination of different medications that prevent or treat PONV is used. The concept is to address all four groups of nausea invoking receptors. Some options include:

- 1) Scopolamine patch placed preoperatively.
- 2) Combined use of dexamethasone, ondansetron and haloperidol has been described.
- 3) Minimizing narcotics such as morphine by using other analgesics such as ketorolac and intra-venous (IV) acetaminophen.
- 4) Metoclopramide.
- 5) Around the clock antiemetic use instead of just prn.

Modalities like intraoperative omentopexy have not proven to make any significant difference in postoperative GI symptoms such as nausea

- **Postoperative Venous Thromboembolism Prophylaxis:**

To prevent VTE postoperatively the VTE prophylaxis should be started in the preoperative phase and should continue intra operatively.(119-128) VTE prophylaxis is needed on all patients.

A multimodal approach is recommended as a combination of; Early ambulation, mechanical intervention such as Sequential Compression Devices (SCD's); Chemoprophylaxis such as LMWH, and UFH are acceptable, however some data suggest LMWH is preferred. Portal vein thrombosis (PVT) has become an emerging concern for patients undergoing sleeve gastrectomy. There is no literature to date recommending an ideal approach for prevention of PVT.

Monitoring

- **Routine Postoperative Monitoring:**

Admission to general care unit: Routine vitals, Intake/Output monitoring every 4 hours. Continuous pulse oximetry and capnography are both accurate in morbidly obese patients but capnography is not likely to be required for the majority of patients.(129) Continuous pulse oximetry and capnography are recommended postoperatively in patients with a history of OSA.(16) Continuous positive airway pressure (CPAP) may be started in the recovery room for patients with OSA.

Multimodal Pain Management

- **Postoperative Pain Management:**

Recommendation includes the use of intravenous Acetaminophen preoperatively and for first 24 hours, local analgesia to be administered to the port sites at time of surgery, and Ketorolac to be administered for first 24 hours at surgeon discretion, and narcotics via patient-controlled analgesia (PCA) for first 24 hours with prompt transition to oral narcotics.

Multimodal pain therapy beginning prior to surgery has been shown to be both clinically and cost effective in the postoperative care of bariatric surgery patients. Multimodal therapy includes the use of: Acetaminophen,(130, 131) Ketorolac(132) and narcotics. Ketorolac and Acetaminophen have both been shown to decrease postoperative narcotics requirements as well as postoperative nausea and vomiting (PONV).(132) There is no literature on the use of transversus abdominis plane block (TAPP) blocks in the setting of traditional laparoscopic surgery. One study assessing single port bariatric surgery showed that there were decreased pain scores in the TAPP plus narcotics group compared to narcotics alone, but similar doses of narcotics in both groups.(133) Dexmedetomidine has been shown to be associated with decreased narcotics use and earlier discharge in gastric bypass patients and gastric band patients, but not in sleeve gastrectomy.(134)

Length of Stay (1-2 nights)

- **Anticipated Length of Stay:**

All patients should be counseled prior to surgery with regards to the anticipated length of stay. The most common length of stay is 2 days. Patients should be discharged when criteria are met and may occur at POD#1 or after POD#2.(135, 136) Suggested discharge criteria include: tolerating diet with progression from clear liquids to pureed diet; good pain control, adequate ambulation, no concerns for ongoing or evolving complications (unexplained tachycardia, fevers and elevated white blood cell count, tachypnea, calf pain, or other signs of potential complication).

Although there is a growing movement for same day sleeve gastrectomy, data supporting the safety and outcomes of same day discharge are insufficient.(137) Programs who are performing same day sleeve surgery should have well-developed protocols for appropriate patient selection, and should track outcomes closely as well as have transfer agreements with nearby hospitals. Further studies are needed to determine appropriateness for same day sleeve procedures.

Diet

- **Diet:**

Diet on postoperative day 0 – clear liquids post nausea as tolerated

Day 1 – full liquid bariatric diet

Puree 2-4 weeks postop

Early initiation of oral intake has been demonstrated to be safe. Some evidence even supports earlier return of bowel function in gastrointestinal surgery with early intake.(138) Clear liquids on the day of surgery has been implemented as a safe and successful component of Enhanced Recovery after Bariatric Surgery care bundles with a decreased duration of hospital stay. Diet includes water to sugar-free clear liquids with in-hospital progression to pureed/soft to solids including vitamins, proteins and supplements.

During a 6 to 8 week period, the patient progresses through four diet phases: liquid (up to 1 week), purred (2 to 4 weeks), soft solid (progress as tolerated) and firmer, regular foods (maintenance). The surgeon or registered dietician (RD) may decide to progress the diet sooner based on the individual's needs and tolerances.

There are no standard recommendations for protein intake after bariatric surgery, but many centers use either 60 to 80 g/day protein or 1 to 1.5 g/kg ideal body weight per day to estimate protein needs.(12) Many programs use liquid protein supplements until the patient is able to take in enough food sources of protein to meet daily needs.(44)

Postoperative Visits

- **Time to Postoperative Visit:**

Patients should be called by a healthcare provider at home on the day of discharge. Recommendations to schedule follow up evaluations at 2-3-week (wound check, general postoperative recovery, dietary progression and monitoring), 6-9-weeks (general wellbeing, dietary progression, dietary progression and monitoring), 6-month, and annual intervals with surgeon or advanced practice practitioner for routine progression and monitoring.

Patients should schedule routine follow-up appointments with a RD following surgery. These appointments typically occur 1 to 2 weeks after surgery, at months 1, 2, 3, 6, and 9 after surgery, and then yearly.(11)

Postoperative Medications

- **Postoperative Medications:**

Recommendations for post-operative routine medications as above for multimodal pain management, nausea and vomiting, and VTE prophylaxis. Multivitamins or nutritional supplements are typically not needed in the immediate postoperative period.

Laparoscopic sleeve gastrectomy patients are potentially at high risk for nutrient deficiencies long term for several reasons: their substantially reduced dietary intake, decreased hydrochloric acid and intrinsic factor, potential nausea and vomiting soon after surgery, poor food choices, and food avoidance because of intolerance.(44) It is necessary for sleeve gastrectomy patients to take daily micronutrient supplements to prevent any deficiencies.(139, 140)

Recommended supplements include:(44)

- Chewable multi vitamin concentrate (containing iron, copper, zinc)
- Chewable or liquid Calcium Citrate with Vitamin D
- Vitamin B-12
- Elemental Iron (Do not take with calcium to improve iron absorption. Separate calcium and iron by 2-4 hours)

Early Ambulation

- **Early Ambulation**

Early Ambulation has been employed in fast track surgery protocols as part of a bundled intervention. As a part of these fast track bundles, early ambulation has been associated with early discharge(141) and fewer postoperative complications.(142) When

appropriate, early ambulation (within 3-4 hours of surgery) may be beneficial and is recommended.

POSTOPERATIVE: SELECTIVE

Monitoring

- **Finger Stick Testing:**

Postoperative blood glucose monitoring is necessary in diabetic patients.

A protocol driven perioperative diabetes management algorithm has been demonstrated in a small pilot study to result in greater improvement in glycemic control 1 year following gastric bypass surgery than patients not on a protocol.(143) Another pilot study suggests that neither intensive management of glycemia in the 3 months pre- roux-en-Y gastric bypass (RYGB), nor the first 2 weeks post-RYGB resulted in better glycemic control one year after surgery.(144) A large study in patients undergoing abdominal, vascular, and spine surgery suggests that perioperative hyperglycemia in diabetics is not associated with an increased risk of adverse events.(145) The main risk of intensive management of diabetic patients after bariatric surgery is hypoglycemia. In patients without severe b-cell failure (fasting C-peptide <0.3 nmol/l), it has been suggested that a 75% reduction in insulin dose is safe in Type 2 diabetic patients and prevents hypoglycemia in the early postoperative period following gastric bypass surgery in most cases.(146) Rates and timing of diabetes and improvement and remission vary widely by procedure and patient.

- **Continuous Pulse Oximetry:**

Admission to general care unit: Routine vitals, Intake/Output monitoring every 4 hours. Continuous pulse oximetry and capnography are both accurate in morbidly obese patients but capnography is not likely to be required for the majority of patients.(129) Continuous pulse oximetry and capnography are recommended postoperatively in patients with a history of OSA.(16)

Medications

- **Extended VTE Prophylaxis:**

Most VTE events occur post discharge, hence extended chemoprophylaxis for high-risk patients defined as(119-127)*:

- Previous history of VTE event
- High BMI > 55
- Male gender
- Surgery duration >3 hours
- Thrombophilia- identified preoperatively
- Non ambulatory patient

Duration of chemoprophylaxis for deep venous thrombosis (DVT) is extended beyond hospital stay for 2-4 weeks for high-risk patients. Assessment tool are available that define the indications for extended VTE prophylaxis and risk assess patients.(147)

- **GERD**

Gastroesophageal reflux disease (GERD) is a common condition in patients following sleeve gastrectomy, with an estimated prevalence of 2.1-34%.(136, 148) Empiric treatment with a proton pump inhibitor in patients without GERD or GERD symptoms following sleeve gastrectomy is not recommended. GERD should be treated as in patients who have not had a sleeve gastrectomy and in accordance with clinical and society guidelines.(149)

Consultants

- **Nutrition:**

Routine nutritional consultation is a part of the decreasing readmissions through opportunities provided (DROP) project. The premise of the nutrition consult is that many readmissions are secondary to dehydration and malnutrition. By providing these services postoperatively this may improve postoperative outcomes.

- **Acute Pain Management:**

- **Cardiology: Selective**

- **Endocrine:**

A health care provider with experience and knowledge about medical management of diabetes should manage patient's diabetic medication requirements in the perioperative and postoperative period.

- **Postoperative Upper GI:**

Routine UGI for the detection of staple line leak following sleeve gastrectomy has limited sensitivity that varies between institutions. Clinical signs of potential leak likely more sensitive (unexplained tachycardia, abdominal pain and peritonitis, fever and elevated WBC#). In these patients – UGI or CT may be helpful in diagnosis. Surgical exploration via laparoscopy or laparotomy may be indicated in patients in whom a leak cannot be ruled out entirely based on a combination of diagnostic tests and clinical suspicion. The routine use of UGI following sleeve gastrectomy adds cost with limited benefit. Recommend UGI or CT in patients with clinical suspicion of leak or obstruction and not as a matter of routine.(150)

Table 12. Summary of Postoperative Recommendations: Routine

Metric	Level of Evidence
Prophylaxis <ul style="list-style-type: none"> • Postop nausea and vomiting • VTE 	Diet <ul style="list-style-type: none"> • NPO or clears POD#0 • Bariatric fulls diet POD#1
Multimodal pain management <ul style="list-style-type: none"> • PCA • IV acetaminophen 	Postoperative visits <ul style="list-style-type: none"> • 2-3 weeks • 6-9 weeks • 6-months • Annual
Monitoring <ul style="list-style-type: none"> • Routine vitals +/- tele • Strict ins and outs 	Postoperative medications <ul style="list-style-type: none"> • Proton pump inhibitor (DURATION) • Multivitamin and supplements
Length of stay (1-2 nights)	Early Ambulation

Table 13. Summary of Postoperative Recommendations: Selective

Metric	
Monitoring <ul style="list-style-type: none"> • Finger Sticks • Continuous pulse oximetry 	Consultations <ul style="list-style-type: none"> • Nutrition • Physical therapy • Acute pain management • Cardiology • Endocrine
Medications	Radiographic Studies
<ul style="list-style-type: none"> • Extended VTE prophylaxis 	<ul style="list-style-type: none"> • UGI/CT

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