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Original Contribution

Recommendations for Preoperative Management of Frailty from the Society for Perioperative Assessment and Quality Improvement (SPAQI)☆

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ABSTRACT

Frailty is an age-related, multi-dimensional state of decreased physiologic reserve that results in diminished resiliency and increased vulnerability to stressors. It has proven to be an excellent predictor of unfavorable health outcomes in the older surgical population. There is agreement in recommending that a frailty evaluation should be part of the preoperative assessment in the elderly. However, the consensus is still building with regards to how it should affect perioperative care. The Society for Perioperative Assessment and Quality Improvement (SPAQI) convened experts in the fields of gerontology, anesthesiology and preoperative assessment to outline practical steps for clinicians to assess and address frailty in elderly patients who require elective intermediate or high risk surgery. These recommendations summarize evidence-based principles of measuring and screening for frailty, as well as basic interventions that can help improve patient outcomes.

1. Introduction

With the changing demographics, operative teams are caring for a greater number of older patients [1]. Traditionally aging has been measured with chronological age alone. Elderly patients are generally defined as patients 65 and older. However, as we are able to care for and study a larger number of older people, the field of gerontology has discovered that biologic age in those 65 and older is not best measured by chronological age alone but rather with multiple variables beyond chronological time or disease accumulation [2]. Out of this endeavor gerontologists have defined the concept of frailty.

Frailty applied to the perioperative setting, as expected, also performs better than chronological age in terms of prediction for mortality and morbidity [3]. A joint statement from the American College of Surgeons and the American Geriatrics Society recommends frailty assessment as part of the preoperative assessment for older surgical patients [4]. The added benefit from frailty assessment is that it is not just a prediction tool, but may highlight the need for tailored perioperative interventions to improve outcomes as well as appropriate time-intensive resources for shared decision making.

Given the increasing importance of assessing and diagnosing frailty in the preoperative setting, the Society for Perioperative Assessment and Quality Improvement (SPAQI) convened experts in the fields of geriatric medicine, anesthesiology and preoperative assessment to outline practical steps for clinicians to assess and address frailty in elderly patients who require elective intermediate or high risk surgery.

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These recommendations summarize evidence-based principles of measuring and screening for frailty, as well as basic interventions that can help improve patient outcomes.

2. Defining frailty

Frailty is an age-related, multi-dimensional state of decreased physiologic reserve that results in diminished resiliency, loss of adaptive capacity, and increased vulnerability to stressors [3]. Therefore, it is not surprising that frailty has been associated with adverse postoperative outcomes [3].

There is a lack of consensus on the best way to measure it, and subsequently how to screen for it. With regards to measurement, at this point it is fair to say that there is diagnostic consensus around two methods: frailty index (Rockwood et al.) and frailty phenotype (Fried et al.) [5–8]. With regards to screening, this is still quite variable, but all are based on subsections of these two measurement methods [5].

3. Measuring frailty

The two methods that are the most accepted forms of diagnosing and measuring frailty are the frailty index (Rockwood et al.) and frailty phenotype (Fried et al.) [5–8].

The frailty index (FI) is based on a comprehensive geriatric assessment where the number of accumulated deficits is across multiple domains: cognitive status, emotional, motivation, communication, strength, mobility, balance, elimination, nutrition, activities of daily living (ADLs), instrumental activities of daily living (IADLs), sleep, social, and comorbidities (Fig. 1) [2]. The index is then derived as a ratio of number of deficits divided by the total number of variables measured. The frailty index can be compared to the frailty phenotype classification where FI $\leq$ 0.10 is considered "non-frail", 0.1 $<$ FI $\leq$ 0.2 is "vulnerable", 0.21 $<$ FI $\leq$ 0.45 is "frail" and FI $>$ 0.45 is "most frail" [9]. It is worth highlighting that the majority of the FI variables are self- or proxy-reported and do not require any sophisticated measurement instruments. The greatest benefit of the frailty index is that upon completion, a geriatric specialist can quickly identify the domains where interventions can be directed perioperatively. The limitation of the frailty index is that it can be time-consuming and requires geriatric skills for collecting the information, especially in patients with cognitive impairment.

The frailty phenotype, originally developed as a research tool, focuses on frailty as a syndrome that can be measured across five domains. The five domains and method of measurement are: unintentional weight loss (measured $>$ 10 pounds loss in past year), self-reported exhaustion, weakness (measured by grip strength with a Jamar hand dynamometer), slow walking speed (measured in seconds across 15 ft), and low physical activity (measured by Minnesota Leisure Time Activity Questionnaire) (Table 1) [6]. A patient with the presence of three or more of the measured domains was considered "frail", while a person with one or two measured domains was considered "prefrail". Performing the measurements for the frailty phenotype requires less geriatric expertise but utilizes specialized equipment. The phenotype also does not provide the geriatric assessment needed for identifying where interventions should be directed once a frail patient is identified, but it may allow a multicomponent general intervention on high-risk patients.

Both measurement modalities are considered time- and resource-intensive which is consistent with frailty itself. Thus, in the process of implementing frailty for the perioperative setting a shorter screening test would be ideal to identify which patients require the extra resources.

4. Screening for frailty

The proliferation of multiple screening tools, which are in some form limited versions of the frailty phenotype or frailty index, can make the initial reading of the frailty literature seem chaotic. Many specialties are currently exploring the role of frailty screening in their respective specialties, the bulk of which demonstrates risk predictive value beyond current tools used in each specialty [10].

The prevalence of frailty will depend on the screening instrument used and the target population selected. For instance, the prevalence of frailty in a sample of elderly patients living in the community will be lower using the FRAIL scale than what is found using the Edmonton score [11].

The FRAIL scale and the single variable assessments are among the screening tools based on the frailty phenotype model. The Geriatric Advisory Panel of the International Academy of Nutrition and Aging proposed the FRAIL scale as a simple screen for frailty [3,12]. It consists of 5 self-reported questions (Table 2). The single variable assessments include the measurement of gait speed alone or the timed "get up and go" test [3].

On the other hand, the frailty index has been modified into tools such as the Risk Analysis Index (RAI), the Edmonton Frail Scale (Table 3), modified frailty index, and the Clinical Frail Scale [10,13–15].

At this stage, specific recommendations about which screening tests should be considered first cannot be made. Rather, several requirements should be met before embarking on frailty screening, after considering the demands and limitations of the institution, health care setting, composition of the multidisciplinary team, patient population, and goal of the intervention:

- Define a care pathway with appropriate interventions to address the perioperative needs of frail patients.
- Pilot your screening test first to see how well it performs in your population before committing to it.

5. Operationalizing frailty in the elective perioperative setting

A possible work flow diagram using the evidence explained above is presented in Fig. 2.

The narrative below describes the reasoning behind the proposed work flow.

I. Overview

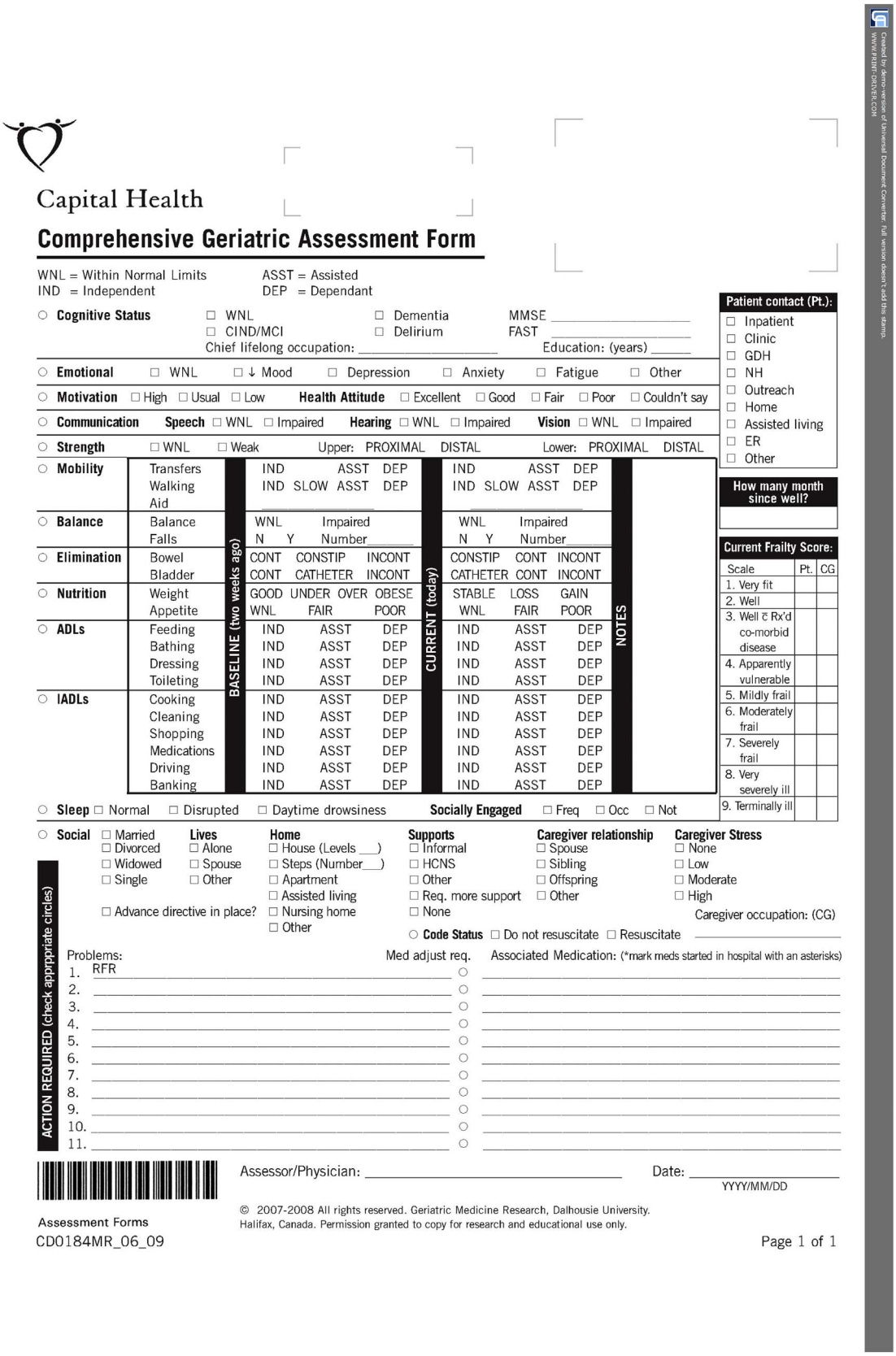
How to implement frailty in the elective perioperative setting very much depends on the working environment of the surgical and anesthesia team and the resources available to them. As with any preoperative intervention, frailty screening should only be implemented if it will influence the management of the patient.

The best way to organize the care of the elderly surgical population is to create a multidisciplinary team, coordinated to deliver patient-centered care. The joint efforts of the surgical, anesthesia, medical, and geriatric care teams, along with other crucial collaborators working in the field of rehabilitation and nutrition, provide the individualized care that the elderly surgical patient requires.

This care pathway is proposed for intermediate or high risk surgical procedures, which are those with a cardiac risk higher than 1%. Examples of high risk procedures are aortic and other major vascular surgeries or peripheral vascular surgeries, while intermediate procedures involve intraperitoneal and intrathoracic surgeries, carotid endarterectomies, and head and neck, orthopedic or prostate surgeries [16].

It is also important to note that the elective preoperative time frame is different depending on the diagnosis, ranging from days to months, and this may alter the effectiveness of some interventions proposed to improve the prognosis of the elderly surgical patient.

Finally, to maximize the cost-effectiveness of any intervention in geriatrics, a careful selection of a practical screening method will save



Capital Health

Comprehensive Geriatric Assessment Form

WNL = Within Normal Limits ASST = Assisted
IND = Independent DEP = Dependant

○ **Cognitive Status** ☐ WNL ☐ Dementia MMSE _____
☐ CIND/MCI ☐ Delirium FAST _____
Chief lifelong occupation: _____ Education: (years) _____

○ **Emotional** ☐ WNL ☐ ↓ Mood ☐ Depression ☐ Anxiety ☐ Fatigue ☐ Other

○ **Motivation** ☐ High ☐ Usual ☐ Low **Health Attitude** ☐ Excellent ☐ Good ☐ Fair ☐ Poor ☐ Couldn't say

○ **Communication** **Speech** ☐ WNL ☐ Impaired **Hearing** ☐ WNL ☐ Impaired **Vision** ☐ WNL ☐ Impaired

○ **Strength** ☐ WNL ☐ Weak Upper: PROXIMAL DISTAL Lower: PROXIMAL DISTAL

		BASELINE (two weeks ago)	CURRENT (today)	NOTES
○ **Mobility**	Transfers	IND ASST DEP	IND ASST DEP	
	Walking	IND SLOW ASST DEP	IND SLOW ASST DEP	
	Aid	_____	_____	
○ **Balance**	Balance	WNL Impaired	WNL Impaired	
	Falls	N Y Number_____	N Y Number_____	
○ **Elimination**	Bowel	CONT CONSTIP INCONT	CONSTIP CONT INCONT	
	Bladder	CONT CATHETER INCONT	CATHETER CONT INCONT	
○ **Nutrition**	Weight	GOOD UNDER OVER OBESE	STABLE LOSS GAIN	
	Appetite	WNL FAIR POOR	WNL FAIR POOR	
○ **ADLs**	Feeding	IND ASST DEP	IND ASST DEP	
	Bathing	IND ASST DEP	IND ASST DEP	
	Dressing	IND ASST DEP	IND ASST DEP	
	Toileting	IND ASST DEP	IND ASST DEP	
○ **IADLs**	Cooking	IND ASST DEP	IND ASST DEP	
	Cleaning	IND ASST DEP	IND ASST DEP	
	Shopping	IND ASST DEP	IND ASST DEP	
	Medications	IND ASST DEP	IND ASST DEP	
	Driving	IND ASST DEP	IND ASST DEP	
	Banking	IND ASST DEP	IND ASST DEP	

○ **Sleep** ☐ Normal ☐ Disrupted ☐ Daytime drowsiness **Socially Engaged** ☐ Freq ☐ Occ ☐ Not

Patient contact (Pt.):
☐ Inpatient
☐ Clinic
☐ GDH
☐ NH
☐ Outreach
☐ Home
☐ Assisted living
☐ ER
☐ Other

How many month since well?

Current Frailty Score:

Scale	Pt.	CG
1. Very fit		
2. Well		
3. Well c Rx'd co-morbid disease		
4. Apparently vulnerable		
5. Mildly frail		
6. Moderately frail		
7. Severely frail		
8. Very severely ill		
9. Terminally ill		

○ **Social** ☐ Married ☐ Divorced ☐ Widowed ☐ Single
Lives ☐ Alone ☐ Spouse ☐ Other
Home ☐ House (Levels ___) ☐ Steps (Number___) ☐ Apartment ☐ Assisted living ☐ Nursing home ☐ Other
Supports ☐ Informal ☐ HCNS ☐ Other ☐ Req. more support ☐ None
Caregiver relationship ☐ Spouse ☐ Sibling ☐ Offspring ☐ Other
Caregiver Stress ☐ None ☐ Low ☐ Moderate ☐ High

☐ Advance directive in place?
Caregiver occupation: (CG) _____

○ **Code Status** ☐ Do not resuscitate ☐ Resuscitate

ACTION REQUIRED (check apprppriate circles)

Problems:	Med adjust req.	Associated Medication: (*mark meds started in hospital with an asterisks)
1. RFR	○	_____
2. _____	○	_____
3. _____	○	_____
4. _____	○	_____
5. _____	○	_____
6. _____	○	_____
7. _____	○	_____
8. _____	○	_____
9. _____	○	_____
10. _____	○	_____
11. _____	○	_____

Assessor/Physician: _____ Date: _____ YYYY/MM/DD

Assessment Forms
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Fig. 1. Frailty Index-Comprehensive Geriatric Assessment form.
(Courtesy of Geriatric Medicine Research Unit, Dalhousie University, Halifax, Nova Scotia.)

Table 1
Frailty measurement according to the Cardiovascular Health Study-derived criteria ("Fried" criteria).
(Adapted from Fried et al. [6].)

Characteristic of frailty	Measurement
Shrinking	> 10 pounds unintentional weight loss in last year
Weakness	Grip strength: lowest 20% By gender/BMI, using a hand dynamometer
Exhaustion	Self-report exhaustion during last week Identified by two questions from the CES-D scale
Slowness	Walking time for 15 ft: slowest 20% By gender/height
Low activity	kcal/week: lowest 20% By gender: men < 383 kcal/week; women < 270 kcal/week, using the Minnesota Leisure Time Activity Questionnaire

BMI: Body Mass Index.
CES-D: Center for Epidemiological Studies-Depression scale.
Scoring: ≥3 criteria = **positive for frailty** phenotype; 1–2 criteria = **intermediate or prefrail**.

Table 2
FRAIL Questionnaire Screening Tool.
(Adapted from Morley et al. [5].)

Fatigue	Are you fatigued? (yes = 1 point)
Resistance	Can you walk up one flight of stairs? (no = 1 point)
Aerobic	Can you walk more than a block? (no = 1 point)
Illnesses	Do you have more than five illnesses? (yes = 1 point)
Loss of weight	Have you lost more than 5% of your weight in the past 6 months? (yes = 1 point)

Scoring: ≥3 points = **frail**; 1–2 points = **prefrail**; 0 points = **robust**.

time and energy downstream by better quantifying the need at your institution.

II. Implementing frailty screening

The perioperative evaluation of elderly patients who require elective major surgery should include a frailty screen.

The combination of short screening tools, such as the FRAIL or Edmonton scale, is proposed here to stratify patients by their risk of developing perioperative complications. A cognitive screen may also be included if that domain is not already part of the selected screening tool or protocol. Given the high rate of perioperative delirium in the elderly surgical population [17] and its association with unfavorable outcomes after surgery, addition of a cognitive impairment screen is important from a prognostic perspective [18]. Any patient who screens positive in frailty screening (prefrail or frail patients) or fails the cognitive screening would be considered a "high risk" patient. The surgical team should be informed and a confirmation of the frailty diagnosis should be pursued, depending on the specific surgical procedure, the time from diagnosis to surgery, and the resources and structure of the perioperative team.

III. Implementing frailty diagnosis: role of the comprehensive geriatric assessment (CGA) and the tailored intervention

A positive frailty screen is best followed up with a diagnostic assessment of frailty and when feasible a comprehensive geriatric assessment with a tailored intervention, ideally by a geriatric specialist.

For older adults who screen positive for frailty more formal assessment can confirm the diagnosis. The gold standard is the comprehensive geriatric assessment (CGA), performed by a geriatric specialist to confirm and assess the severity of the frailty diagnosis. The frailty index (FI) [2] can be calculated to quantify the severity of frailty and

Table 3
Edmonton Frail Scale.
(Adapted from Rolfson et al. [14].)

Frailty domain	Item	0 points	1 point	2 points
Cognition	Please imagine that this pre-drawn circle is a clock. I would like you to place the numbers in the correct positions then place the hands to indicate a time of "ten after eleven"	No errors	Minor spacing errors	Other errors
General health status	In the past year, how many times have you been admitted to a hospital?	0	1–2	Greater than or equal to 2
	In general, how would you describe your health?	"Excellent", "very good", "good"	"Fair"	"Poor"
Functional independence	With how many of the following activities do you require help? (meal preparation, shopping, transportation, telephone, housekeeping, laundry, managing money, taking medications)	0–1	2–4	5–8
Social support	When you need help, can you count on someone who is willing and able to meet your needs?	Always	Sometimes	Never
Medication use	Do you use five or more different prescription medications on a regular basis?	No	Yes	
	At times, do you forget to take your prescription medications?	No	Yes	
Nutrition	Have you recently lost weight such that your clothing has become looser?	No	Yes	
Mood	Do you often feel sad or depressed?	No	Yes	
Continence	Do you have a problem with losing control of urine when you don't want to?	No	Yes	
Functional performance	I would like you to sit in this chair with your back and arms resting. Then, when I say GO, please stand up and walk at a safe and comfortable pace to the mark on the floor (approximately 3 m away), return to the chair and sit down.	0–10 s	11–20 s	> 20 s, patient unwilling, or patient requires assistance
Total				Final score is the sum of the column totals

Scoring: not frail [0–4], vulnerable [5–6], mild frailty [7–8], moderate frailty [9–10], and severe frailty (> 11).

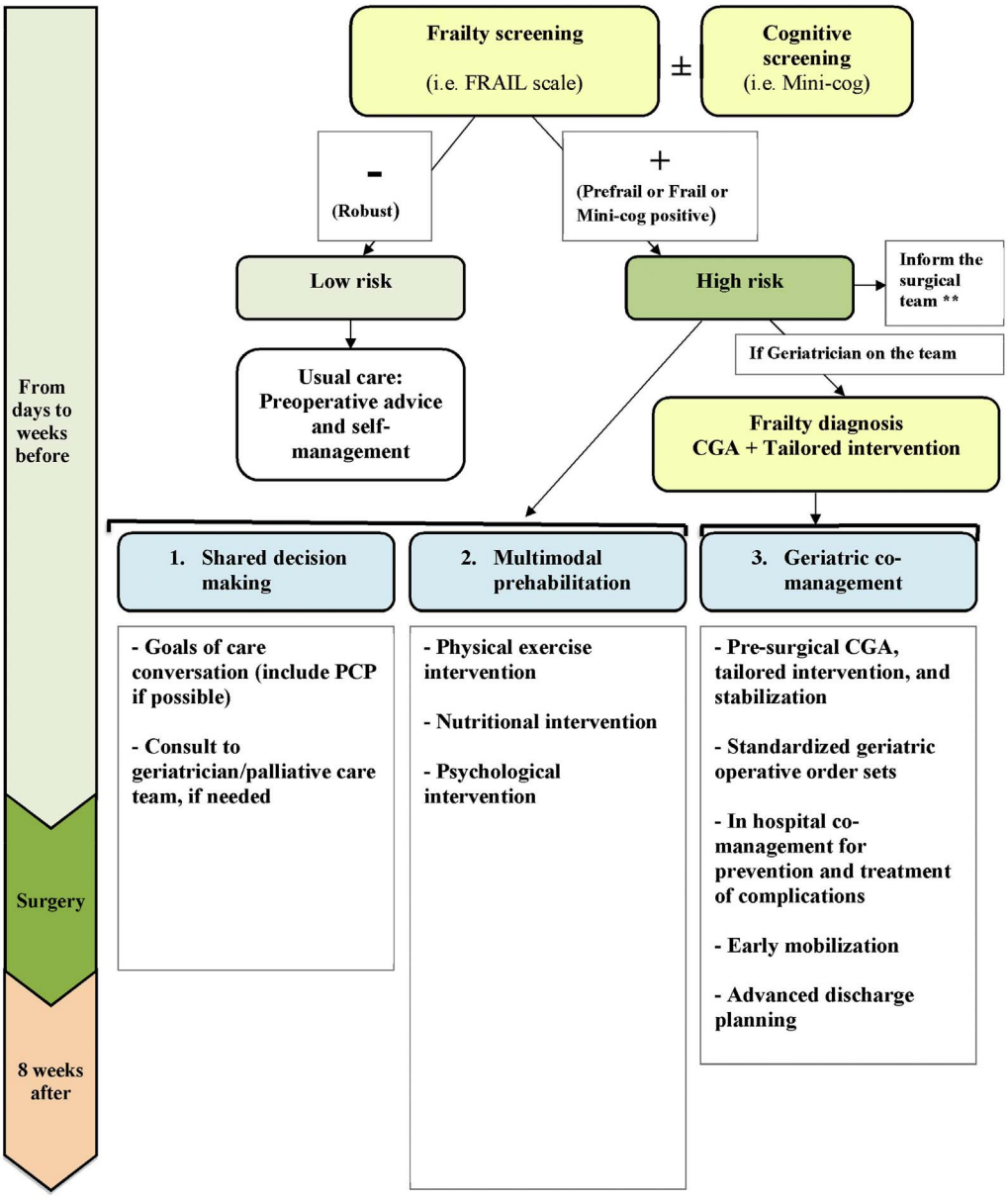

Fig. 2. Operationalizing frailty in the perioperative setting: work-flow diagram (CGA: comprehensive geriatric assessment) (**surgical team may include surgery, anesthesia, geriatric medicine, family medicine, internal medicine, physical therapy, occupational therapy, or social work depending on setting).

identify possible areas of intervention.

The perioperative care of elderly patients is delivered according to the local resources of each hospital, and some perioperative teams are composed by hospitalists, internists or other geriatrics-trained health care providers. Perioperative teams at institutions lacking a geriatrician to confirm a frailty diagnosis may use comprehensive screening tools like the Edmonton Frail Scale [14] (Table 3) to identify basic areas of intervention.

Definition: Comprehensive geriatric assessment is defined as a "multidimensional interdisciplinary diagnostic process focused on

determining a frail elderly person's medical, psychological and functional capability in order to develop a coordinated and integrated plan for treatment and long-term follow up" [19].

Intervention: Comprehensive geriatric assessment involves a rigorous evaluation of different areas, including physical, cognitive, emotional, social, environmental, and spiritual aspects that may have a great impact in an older adult's life. The goal of the assessment is:

- to characterize the presence of geriatric syndromes [20], such as functional decline, falls, delirium or polypharmacy; and
- to implement a tailored intervention, for instance an exercise and nutrition program, prevention of falls or delirium, and perioperative medication changes.

The goal of the intervention is to improve specific outcomes, which could be different depending on the setting (functional recovery, institutionalization, mortality, readmission rate, etc.) [21].

Evidence: The use of the CGA in community dwelling older adults' guides management, that in turn results in a decrease in mortality and a reduction in functional decline [22,23]. The effectiveness of geriatric health care based on the CGA/tailored intervention approach has been demonstrated in acute geriatric units [21,25], geriatric rehabilitation units [26], and geriatric day hospitals [27].

Several recent studies have tried to determine the effectiveness of an outpatient preoperative multidisciplinary intervention including CGA on surgical outcomes.

A recent randomized controlled trial aiming to investigate the effect of a preoperative geriatric assessment and tailored intervention in frail older patients with colorectal cancer concluded that the intervention did not reduce the rate of severe complications, readmissions or mortality. However, the study was underpowered to detect differences, the intervention occurred only seven days before the surgery, there was no measurement of the compliance of the patients to the recommendations, and the selection of the outcome measures may not have been the most appropriate according to the intervention [28].

Another randomized controlled study testing an outpatient CGA and optimization program in elderly patients scheduled for elective vascular surgery did not utilize frailty screening but concluded that the intervention was associated with shorter length of stay, lower incidence of complications, and lower rate of patients discharged to a higher level of care dependency [29].

The preliminary results of the Duke Perioperative Optimization of Senior Health (POSH) program are promising. Their goal is to screen and intervene on patients older than 65 years of age who are choosing elective surgery and who present with cognitive concerns, significant weight loss, multimorbidity, polypharmacy, or sensory impairment. Results thus far have shown a 1.95-day reduction in length of hospital stay, a 7.08% decrease in hospital readmissions at 7 days, a 10.53% hospital readmission decrease at 30 days, and 11.25% higher percentage of patients returning to self-care at home [30].

IV. Implementing frailty management

Once the frailty diagnosis is confirmed, three perioperative domains of intervention could potentially improve the prognosis of frail patients: shared decision making, prehabilitation, and interdisciplinary geriatric co-management. Future studies should test the impact of these frailty interventions on system-centered outcomes (length of stay, complications, mortality, readmissions) and on patient-centered outcomes (functional recovery, cognitive stability, health-related quality of life).

The general management of frailty is currently being extensively studied. A network meta-analysis of randomized controlled trials will soon determine the comparative effect of interventions for the prevention and treatment of frailty. The interventions tested are physical activity, physical activity with protein or other nutritional supplementation, psychosocial interventions, medication management, pharmacotherapy, and multifaceted interventions [31].

In the perioperative setting, the answer to how to better treat frailty in elderly patients waiting for elective surgery is even more complex, given that the goal of the initiative is to offer them the best preventive and therapeutic intervention to improve their outcomes in a very short period of time (days to months).

After the frailty screening and the confirmation of the frailty diagnosis by the CGA, three perioperative interventions could potentially improve the prognosis of the frail patient. First, interventions that use the frailty assessment in the preoperative shared decision-making process. Second, prehabilitation strategies, which should be studied further before including them as standard recommendations. Third, during admission and follow-up, the effectiveness of geriatric medicine co-management mainly in non-elective surgical patients has recently been studied in with promising results, although the quality of the published evidence is still low [32].

a. Shared decision making

During the shared decision making process, a careful discussion with frail patients about goals of care, with the advice of other specialists if needed, could help patients have realistic expectations and make better informed decisions before the surgery, which in turn could decrease their morbidity and mortality.

Given the higher risk of morbidity and mortality associated with surgery in the frail older population, carefully executed shared decision making is essential once frailty is identified. For older adults, particularly those who are frail, it is essential to clarify their goals for care and expectations and ensure these are in line with the anticipated surgical outcomes [33]. The surgical intervention is only the beginning of a long course of recovery for many frail older adults. Here the concept of lag time to benefit (when will this help) is as important as other more typical surgical outcomes discussed in the informed consent process [34]. Some surgical interventions may have an immediate benefit. However, others require extensive rehabilitation before the primary goal is achieved (e.g. improved function), potentially making surgery less acceptable in the eyes of the patient. Furthermore, clinicians must consider the effects of frailty on postoperative patient-centered outcomes, such as quality of life, function, and cognition [33].

Definition: Shared decision making (SDM) has been defined as: "an approach where clinicians and patients share the best available evidence when faced with the task of making decisions, and where patients are supported to consider options, to achieve informed preferences" [35].

Intervention: A reasonable approach to shared decision making in the context of frailty includes: 1) identifying frailty and obtaining a comprehensive geriatric assessment, 2) performing the Advance Care Planning (ACP) to discuss and record patient preferences concerning goals for end-of-life care and to elucidate patient's goals, and 3) discussing how surgery may or may not get them to their goals in the context of their frailty. For many patients, avoiding chronic debility, morbidity, and diminished independence and quality of life may be more important than longevity. For this reason, careful discussion of goals of care is a key component of shared decision making. To find out a patient's preferences, one can start by asking the patient the following question: "Is one of the following goals more important to you than anything else: 1) living as long as possible, 2) keeping your ability to take care of yourself and live independently, or 3) keeping comfortable with minimal symptoms." If the discussion is not straightforward, consultation with geriatric medicine, palliative care, and/or others with a strong patient rapport and comfort with goals of care discussions is the next step [36].

Evidence: One study of 310 pre-operative older adults from 2006 to 2013 found that initiating a frailty screening program increased palliative medicine consultation and these consultations were associated

with a 33% reduction of mortality compared to those without such consultation [37].

Another recent prospective cohort study of 9153 patients who required an elective noncardiac surgery examined the effect of a Frailty Screening Initiative on mortality and complications. The intervention consisted of two parts: a preoperative screening for frailty and, in those identified as frail, a multidisciplinary review of surgical decision making and optimization of perioperative care. Its implementation decreased postoperative mortality at 30, 180 and 365 days, and multivariate analysis revealed a 3-fold survival benefit after controlling for age, frailty, and predicted mortality [38].

b. Prehabilitation

Multimodal prehabilitation programs, including exercise, nutrition and psychological interventions, could potentially improve the perioperative prognosis of frail patients but they should be studied further before including them as standard recommendations. In the meantime, the preoperative approach for frail older adults should be individualized with interventions tailored to the patient's baseline functional status, comorbidities, and cognitive/psychological function.

The term prehabilitation describes the process of improving the functional capacity of the patients to enable them to withstand an upcoming stressor. Previous studies have shown that the preoperative functional reserve, assessed by the VO_{2peak}, the 6 minute walk test (6MWT) and the anaerobic threshold (AT), can predict postoperative morbidity and mortality [39,40]. The subsequent questions would be:

- Can the preoperative functional reserve of frail elderly patients be improved through a multimodal program specifically designed for that goal?
- Does improving the preoperative functional reserve of frail patients translate into better perioperative outcomes?

In non-surgical frail older patients, team-based multimodal care which emphasizes physical exercise and treatment of protein-calorie malnutrition has shown improved health outcomes [41]. Ongoing studies are evaluating the efficacy of physical activity and nutritional counseling interventions to prevent disability in frail sarcopenic patients [42].

However, direct evidence showing improved postoperative outcomes utilizing preoperative physical exercise and nutrition explicitly among frail patients waiting for elective surgery, is still absent to date.

Definition: Prehabilitation encompasses pre-operative physical exercise, nutritional intervention and psychological support as preventive strategies that may improve postoperative outcomes and patients' health-related quality of life (HRQOL) [43].

Intervention: The standardization of the three main proposed modalities of prehabilitation (exercise, nutrition and psychological care) is still lacking, but multimodal programs appear to be more effective [44,45].

General recommendations about exercise, nutrition and relaxation prehabilitation components can be found in a recent review written by Carli and Scheede-Bergdahl [46]. The authors recommend that other potential components of the prehabilitation intervention such as medication optimization or cognitive enhancement should be considered. Both are included in the comprehensive geriatric assessment and plan of care.

The optimal duration of prehabilitation should be at least 4 weeks before surgery [46], but programs lasting up to 6–8 weeks, if allowed by the underlying disease, reach a better balance between compliance and effectiveness [44]. Some of the interventions may be beneficial if extended after discharge [46].

The outcome measures selected to determine the impact of the prehabilitation intervention should be relevant in the context of the time point evaluated. For instance, complications and length of stay could serve as outcome measures during admission, functional recovery and pain control at 3 weeks, and quality of life and reintegration in the community at 6–8 weeks [46,47].

Evidence: Compared with usual care, most studies have found that prehabilitation improves postoperative pain and physical function and reduces hospital length of stay, but data are inconsistent for improving patients' health-related quality of life or aerobic capacity. However, the heterogeneity of the studies, including trials design, interventions, and outcome measures, limits generalization. The studies available are focused primarily on orthopedic surgeries with few gastro-intestinal, cardiac and pulmonary surgeries, and often not adequately powered. Moreover, only 7% of all randomized controlled trials published worldwide specifically feature older patients [48].

Evidence is emerging that prehabilitation improves outcomes compared to usual care in older adults undergoing major elective surgery. However, the potential of prehabilitation in improving post-surgical outcomes in the specific group of frail individuals remains to be defined. Features of frailty such as low physical activity, endurance and weight loss are amenable to improvement with multimodal targeted interventions.

More robust research is needed before prehabilitation can be recommended as standard practice. In absence of evidence-based strategies, the approach for frail older adults should be individualized with any physical intervention tailored to the patient's baseline functional status, co-morbidities, cognitive function and fall/injury risk.

1. Physical activity intervention

Preoperative functional status correlates with postoperative complications, hospital length of stay, need for skilled nursing placement, and mortality [43,44].

Studies support three 20–30 minute sessions per week of personalized cardiovascular/aerobic and strength/resistance training, stretching and upper and lower extremities range of motion exercises as part of a prehabilitation strategy [46]. The studies available focus on specific surgical populations.

Evidence shows prehabilitation may improve early postoperative pain and function among patients who undergo hip or knee joint replacement surgery. The effect is modest and current data have not examined outcomes such as length of stay, quality of life, and cost-benefit analyses [49].

For surgical oncology patients, exercise training in the neoadjuvant or adjuvant setting with surgery is safe, feasible and improves measures of physical fitness and health-related quality of life. Aerobic exercise may also improve prognosis in patients with solid tumors, with effects on tumor progression and chemotherapy efficacy [50].

For patients undergoing colorectal surgery, no studies have shown a significant reduction in postoperative complications or hospital length of stay. A few studies have shown improvement in physical measures, such as walking distance and respiratory endurance [51]. However, clinical heterogeneity in these studies precludes a meta-analysis [52].

For patients undergoing intra-abdominal surgery, exercise therapy including inspiratory muscle training and aerobic and/or resistance exercises is superior to usual care in reducing all-cause and pulmonary complications [53].

Finally, for patients undergoing thoracic surgery, a moderate to vigorous intensity aerobic exercise program improved aerobic fitness [54,55].

2. Nutritional intervention

Nutritional status correlates with postoperative morbidity and mortality. The focus of the 2012 North American Surgical Nutrition Summit was on nutrition therapy of the adult patient anticipating major elective surgery. The expert panel proposed the use of a screening tool,

such as the Nutrition Risk Screening 2002 (NSR 2002) to identify those with or at risk for malnutrition [56].

Proactive nutritional intervention is recommended for older patients who are undernourished or at risk for undernutrition. The use of oral nutritional supplementation for frail elderly patients has been proposed in several guidelines [57,58]. Surgical delay would be reasonable only for patients with severe nutritional risk [59].

To be effective, any nutritional intervention requires a timeline, that extends from the preoperative period into the postoperative one [46]. When feasible, enteral nutrition is always the first choice [56].

Nutritional supplementation may be beneficial as surgical stress induces a catabolic state, which leads to protein breakdown primarily from muscle. Thus, adequate protein intake (approximately 1.5 g/kg/day) is necessary to prevent muscle loss or sarcopenia [51,58]. In addition, adequate protein intake reduces major postoperative morbidity, including infection.

Although Enhanced Recovery After Surgery (ERAS) protocols support the use of preoperative carbohydrate loading, a 2014 Cochrane systematic review concluded that it was associated with only a small reduction in length of hospital stay when compared to placebo or fasting and did not decrease complication rates [60].

3. Psychological intervention

The most recent Cochrane review studying the effect of psychological preparation on postoperative outcomes suggested that psychological preparation may be beneficial for postoperative pain, behavioral recovery, negative affect, and length of stay, but the current evidence quality is still low or very low [61]. Although there is no standard recommendation, non-pharmacologic strategies such as deep breathing, meditation, visual imagery, and music therapy should be first-line interventions for anxiety reduction.

c. Geriatric co-management

The degree of frailty will help select the target population for highly-specialized geriatric co-management programs (involving anesthesiology, surgery, and geriatric medicine) that have already been demonstrated to improve the outcomes of elderly patients in non-elective surgeries.

The best outcomes so far for older surgical patients come from co-management programs between geriatricians, surgical specialists, and anesthesiologists. These programs have up to now focused on patients selected by age or on those with a "geriatric profile" (old, comorbid, functionally or cognitively impaired patients with any geriatric syndrome). The utility of frailty to characterize a high-risk population facilitates the selection of patients most likely to benefit from geriatric intervention. Currently the literature available evaluating the effectiveness of geriatric co-management specifically in elective frail surgical patients is limited. The existing evidence describes the positive effect of co-management in geriatric surgical patients selected mostly by age alone.

Definition: Geriatric co-management is defined as a shared responsibility and decision-making between at least a treating physician (e.g. surgeon) and a geriatrician who provides complementary medical care in the prevention and management of geriatric-oriented problems [32].

Intervention: The principles of the geriatric co-management intervention in surgical patients could be summarized as: early evaluation and optimization of the patient; short time to surgery; interdisciplinary co-management with shared responsibility and frequent communication to prevent medical and functional complications; standardized preventive protocols; early mobilization; and advance discharge planning [62].

Evidence: The main evidence has emerged from geriatric co-management in orthopedic fracture surgery, in which the shared model of care significantly decreased length of stay, postoperative complications, in-hospital mortality, and one year mortality [63].

The Geriatric Fracture Center, a co-management model, resulted in shorter time to surgery and length of stay, and lower complication rates, mortality, cost, and readmission rates [62,18,63].

Another model of care, more in line with a geriatric liaison service than with a co-management model of care, is the Proactive care of Older People undergoing Surgery (POPS) program developed in the UK for high-risk elective orthopedic patients. It consisted of a preoperative and in-hospital intervention, and it showed a reduction in postoperative complications and length of stay, and improvement in pain control and the rate of early mobilization [64]. The model has been reproduced in vascular surgery in the US with markedly improved outcomes in frail elderly patients [65]. It has also been exported to elective and emergency urological surgery with preliminary results indicating reductions of length of stay and complications [66].

In summary, as operative teams are starting to care for the aging population, frailty assessment and management is providing an effective way to meet the demands of this population. Future studies and innovative models of care will identify how best to implement these changing needs.

6. Key points and recommendations

- The perioperative evaluation of elderly patients who require elective major surgery should include a frailty screen.
- A positive frailty screen is best followed up with a diagnostic assessment of frailty and when feasible a comprehensive geriatric assessment with a tailored intervention, ideally by a geriatric specialist.
- Once the frailty diagnosis is confirmed, three perioperative domains of intervention could potentially improve the prognosis of frail patients: shared decision making, prehabilitation, and interdisciplinary geriatric co-management.
- During the shared decision making process, a careful discussion with frail patients about goals of care, with the advice of other specialists if needed, could help patients have realistic expectations and make better informed decisions before the surgery, which in turn could decrease their morbidity and mortality.
- Multimodal prehabilitation programs, including exercise, nutrition and psychological interventions, could potentially improve the perioperative prognosis of frail patients but they should be studied further before including them as standard recommendations. In the meantime, the preoperative approach for frail older adults should be individualized with interventions tailored to the patient's baseline functional status, comorbidities, and cognitive/psychological function.
- The degree of frailty will help select the target population for highly-specialized geriatric co-management programs (involving anesthesiology, surgery, and geriatric medicine) that have already been demonstrated to improve the outcomes of elderly patients in non-elective surgeries.
- Future studies should test the impact of these frailty interventions on system-centered outcomes (length of stay, complications, mortality, readmissions) and on patient-centered outcomes (functional recovery, cognitive stability, health-related quality of life).

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