Mini-Review

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International landscape of guidelines for perioperative frailty assessment and barriers to clinical translation

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SUMMARY: Frailty significantly influences perioperative outcomes and healthcare resource utilization among older adults. Although the importance of intervention has been recognized, guidelines vary significantly across regions. This review synthesizes geriatric, perioperative, and specialty guidelines from the UK, the US, Europe, and the Asia-Pacific region. We found that, although they widely share core principles such as the use of validated tools and comprehensive geriatric assessment (CGA), guidance specific to the perioperative setting remains limited. Existing recommendations are often restricted to the preoperative phase and lack standardization of risk thresholds. However, high-quality evidence on the clinical and economic impact of frailty-based pathway redesigns is limited. Future research should focus on multicenter pragmatic trials that evaluate integrated care pathways extending from preoperative optimization through postoperative care. In parallel, further development of automated screening using electronic health records and electronic frailty indices is warranted. Such initiatives will require careful evaluation of feasibility and equity to support successful implementation in routine clinical practice. We recommend that clinicians routinely incorporate validated frailty screening into preoperative evaluation for all patients age 65 and older and that healthcare systems prioritize the development of an interoperable data infrastructure to enable the seamless transfer of community-derived frailty information into surgical decision-making workflows.

Keywords: perioperative management, comprehensive geriatric assessment (CGA), Clinical Frailty Scale (CFS), algorithmic fairness, electronic frailty index (eFI), clinical translation

1. Introduction

As the global population ages, frailty has evolved from a theoretical research concept into a central target for healthcare management (*1,2*). Defined as a state of reduced physiological reserve and diminished resistance to stressors, frailty affects approximately 10% of community-dwelling older adults, rising to 25–50% in those age 85 and older (*3,4*). It is a clinically important predictor of adverse outcomes, including falls, hospitalization, and mortality (*5*). Consequently, key organizations dealing with elderly patients, such as the British Geriatrics Society (BGS), and key guidelines for clinical practice, such as the Asia-Pacific Clinical Practice Guidelines, have established a consensus: frailty is a manageable condition rather than an inevitable consequence of aging (*6*). General guidelines universally advocate for a two-step approach involving rapid screening using validated tools followed by a comprehensive geriatric assessment (CGA) to guide multicomponent interventions.

However, translating this consensus into the high-stakes environment of perioperative care remains a significant challenge. Surgery constitutes a substantial physiological stressor, and yet the integration of frailty assessment into surgical pathways is inconsistent. While general guidelines provide a foundational framework, they often lack the specificity required for the complex logistical and clinical demands of the perioperative period.

Recent systematic evaluations highlight substantial gaps in the current guideline landscape. A review by Mehta *et al.* utilizing the AGREE II instrument revealed that while existing guidelines are strong on scope, they frequently exhibit low scores in rigor of development and applicability (*7*). Crucially, recommendations are often fragmented, with only a minority of guidelines providing actionable, consensus-based strategies that can feasibly

be implemented across diverse healthcare systems. This implementation gap is particularly acute in surgery. Engel *et al.* found that among thousands of guidelines, only a small fraction specifically addressed perioperative frailty (*8*). Moreover, these recommendations are predominantly limited to the preoperative period, largely neglecting intraoperative management and postoperative continuity of care.

Despite the overarching agreement on the importance of recognizing frailty, clinicians currently face a fragmented landscape of guidelines with marked heterogeneity in assessment tools, risk thresholds, and pathway designs. This lack of standardization acts as a critical barrier to clinical translation, hindering the widespread provision of frailty-informed perioperative care. Therefore, this review aims to map the international landscape of perioperative frailty guidelines, comparing recommendations across the UK, US, Europe, and Asia-Pacific regions. By examining differences in target populations, timing of assessment, and management pathways, this review highlights key barriers to clinical translation, including issues related to data quality and economic feasibility. Priorities for future research are also proposed to help bridge the gap between evidence and practice.

2. Similarities and differences in perioperative frailty assessment guidance across countries/regions

2.1. The UK model

From the perspective of the overall guideline architecture, the UK frailty-related guidance exhibits a clear functional division of labor and continuity across stages of care. In particular, the BGS Fit for Frailty consensus emphasizes the systematic identification of frailty in community and outpatient settings. In addition, the joint guidance on perioperative care, issued by the Center for Perioperative Care (CPOC) and the BGS, translates frailty identification into stage-specific perioperative care strategies. In this manner, the management of frailty is longitudinally integrated throughout the perioperative pathway.

In terms of target populations and clinical contexts, the Fit for Frailty program is primarily intended for older adults living in the community and receiving outpatient services, including general practice, community hospitals, memory clinics, and specialty outpatient clinics (*9,10*). The program emphasizes that any health professional who encounters older people in these settings should proactively identify frailty (*3*). Conversely, the CPOC-BGS perioperative guideline focuses exclusively on adults with frailty who are undergoing elective or emergency surgery, encompassing the entire perioperative trajectory from referral and preoperative assessment to admission and postoperative recovery (*11*).

With regard to the selection of screening tools, Fit for Frailty proposes a combined approach that prioritizes simplicity and repeatability. Gait speed, defined as a walking time of four meters greater than five seconds or a speed of less than 0.8 meters per second, is regarded as a highly sensitive initial screening indicator. Although it has moderate specificity, it is considered particularly suitable for the early identification of potential frailty in older populations. The timed up-and-go (TUG) test, employing a threshold of > 10 seconds as an indicator of abnormality, is also regarded as a highly sensitive method of functional screening. The PRISMA-7 questionnaire utilizes a set of seven yes-no questions, enabling expeditious risk stratification. A score of ≥ 3 on this scale is typically indicative of a high risk of frailty. Despite the existence of several multidimensional tools (*e.g.*, the Groningen Frailty Indicator), the prevailing consensus places greater emphasis on the combined use of gait speed, the TUG test, and the PRISMA-7 to enhance the feasibility and efficiency of frailty screening in primary care and perioperative contexts.

Conversely, the CPOC-BGS perioperative guideline advocates for the utilization of the Clinical Frailty Scale (CFS) as the instrument for pathway entry (*11*). The guideline suggests that the CFS be documented at three pivotal moments: referral, preoperative evaluation, and admission. This recommendation is applicable to patients age ≥ 65 years undergoing elective or emergency surgery, as well as to younger patients deemed to be at risk of frailty (evidence level B, strong recommendation). The guideline provides an explicit definition of a CFS score ≥ 5 as frailty (living with frailty). Moreover, it strongly advises that all patients with a CFS score ≥ 5 undergo a CGA and preoperative optimization, with assessment domains including multimorbidity, function, nutrition, and medication use. Furthermore, all patients found to have a CFS score ≥ 5 should undergo a preoperative cognitive assessment utilizing validated tools. In addition, hospitals need to establish standards for the prevention and management of delirium.

With regard to the temporal aspect of the UK perioperative frailty framework, a salient feature is early engagement and recurrent assessment at several pivotal points. The Fit for Frailty document, put out by the BGS, advocates for the implementation of opportunistic case-finding methodologies across various healthcare, social care, and related professional contexts. The document recommends the utilization of straightforward, readily implementable tools such as gait speed, TUG, and PRISMA-7 for initial screening purposes. However, it explicitly advises against the incorporation of routine population screening within the general population. The CPOC guidance also recommends repeating CFS assessments at key points in the perioperative pathway, including referral, the preoperative clinic, and ward admission, to ascertain changes in frailty over time. At the community level, when the PRISMA-7 score is ≥ 3,

gait speed is slow, or performance on the TUG is > 10 s, further referral to geriatric teams or relevant specialties for assessment and intervention is recommended. An important point to note is that Fit for Frailty considers the CFS to be more appropriate as a tool to stratify frailty severity on the basis of an adequate clinical assessment. The CFS should not be used as a stand-alone screening measure in the absence of a formal clinical evaluation. At the perioperative level, when the CFS score is ≥ 5, the protocol stipulates a comprehensive management strategy be initiated, encompassing a CGA, cognitive assessment, and delirium prevention measures. This is to be accompanied by continuous follow-up and coordination throughout hospitalization by a perioperative frailty management team.

2.2. The US model

The UK approach is characterized by the utilization of a single, standardized scale (*e.g.*, the CFS) for the assessment of frailty. In contrast, the US has not mandated a specific frailty assessment instrument at the national level. Instead, frailty assessment is systematically embedded within a broader best-practice framework for older surgical patients, gradually forming a multidisciplinary consensus system centered on the American College of Surgeons (ACS)/American Geriatrics Society (AGS) best-practice guidelines and the 2025 American Society of Anesthesiologists (ASA) Practice Advisory.

The ACS and AGS jointly established the *Optimal Preoperative Assessment of the Geriatric Surgical Patient* in 2012 (*12*) and updated it in 2016 to the *Optimal Perioperative Management of the Geriatric Patient* (*13*). These guidelines explicitly incorporate frailty assessment into the standard framework for geriatric surgical care. These guidelines provide a comprehensive framework for evaluation, encompassing nine core domains: cognition and behavior, cardiac function, pulmonary function, functional status and mobility, frailty, nutritional status, perioperative medication management, patient education, and preoperative testing and risk assessment. This structure provides an organized framework to support perioperative risk stratification, individualized decision-making, and multidisciplinary interventions.

Building upon this foundation, the 2025 ASA Practice Advisory for Perioperative Care of Older Adults Scheduled for Inpatient Surgery (*14*) further emphasized the critical role of frailty in risk assessment for elderly patients undergoing inpatient surgery, from the perspective of anesthesia and perioperative medicine. This practice advisory is applicable to all older adults (typically defined as ≥ age 65) scheduled for inpatient surgery. The increasing number of elderly surgical patients means that they will be exposed to increased risks of adverse postoperative outcomes, including delirium, cognitive impairment, and delayed functional recovery. Core risk factors include age-related decline in physiological reserves, increased vulnerability due to frailty, and the presence of multiple comorbid factors.

The ASA 2025 does not stipulate the utilization of a particular frailty scale; however, it advocates for the use of validated assessment tools. Optional methods include gait speed measurement, stand-up-and-walk tests (*e.g.* the TUG test), and relevant components within the CGA. Drawing upon established US clinical practices, the Fried frailty phenotype, the CFS, and the Frailty Index derived from the CGA are tools commonly used to assess frailty. The ACS/AGS guidelines similarly emphasize, within the section on functional/mobility status and frailty, the identification of high-risk elderly patients through objective physical testing (*e.g.* gait speed and strength testing) in combination with questionnaires. The guidelines further posit that frailty should be considered as an interconnected component of a geriatric syndrome spectrum, alongside functional limitations and malnutrition, rather than as an isolated issue.

With regard to the temporal aspect of assessment, the aforementioned ASA advisory emphasizes the completion of an initial systematic assessment at the preoperative clinic and recommends dynamic reassessment of cognition and function during hospitalization in response to changes in clinical course, particularly for patients in the ICU or those with prolonged immobility. The ACS/AGS guidelines conceptualize frailty assessment as spanning the full perioperative period, including preoperative optimization, intraoperative management (*e.g.* adjustments in anesthesia and dosing), and postoperative rounds and follow-up, with the goal of preventing functional decline and postoperative delirium. Once frailty or substantial functional impairment has been identified, both sets of guidance recommend activation of multidisciplinary team interventions (including surgery, anesthesia, geriatrics, rehabilitation, and nursing). Key measures include perioperative optimization of medication, prevention of delirium, encouragement of early mobilization, nutritional support, and individualized anesthesia plans. For patients exhibiting significant frailty, the guidance further recommends an early discussion of goals of care and prognosis, including the consideration of non-operative options and a required reconsideration of advance directives.

2.3. The European model

In Europe, the most recent guidance is provided by the European Society of Anaesthesiology and Intensive Care (ESAIC). In 2024, the ESAIC released an updated guideline on preoperative evaluation for adult patients undergoing elective non-cardiac surgery (*15*). The 2024 update to the 2018 framework issued by the ESAIC (*16*) further emphasizes the importance of frailty assessment as a component of multidimensional preoperative risk

assessment, rather than considering it as a standalone screening or decision-making tool. The guideline notes that frailty is highly correlated with advanced age, comorbidity, functional impairment, and cognitive dysfunction and that it acts as an important risk modifier for predicting perioperative complications, delayed functional recovery, and mortality. Consequently, the guideline advocates a systematic evaluation of functional status and frailty-related characteristics in older patients and those at risk due to functional limitations or multimorbidity. The results of this evaluation are to be incorporated into broader anesthesia and perioperative decision-making processes, rather than relying solely on any single frailty scale.

With regard to the assessment approach, ESAIC 2024 does not stipulate the utilization of a particular frailty screening instrument. Instead, it emphasizes that facilities may adopt an approach tailored to local resources and clinical context, integrating information on functional capacity, gait or exercise tolerance, nutritional status, and cognitive function to reach a comprehensive judgement. The guideline clarifies that the central aim of frailty assessment is to identify high-risk patients and guide personalized perioperative management strategies, including preoperative optimization, choice of anesthesia, level of postoperative monitoring, and rehabilitation planning. Concurrently, ESAIC 2024 acknowledges the paucity of evidence pertaining to the efficacy of perioperative pathways that are modified on the basis of a frailty assessment in enhancing patient outcomes. Consequently, it does not advocate for the utilization of a frailty score in isolation to determine surgical eligibility or decisions on limiting treatment. It recommends that future research concentrate on the prospective validation of frailty-guided interventions and their impact on outcomes that are of significance to patients.

2.4. The Asia-Pacific model

Unlike the UK's centralized pathway involving the National Health Service (NHS) or the US's guideline-embedded approach, the Asia-Pacific region has a public health-first model (Table 1). Frailty assessment is deeply integrated into community health screening and primary care to address rapid population aging. However, specific guidelines on perioperative frailty are still evolving, often appearing as adaptations of a general geriatric consensus or expert opinions rather than mandated national surgical standards.

2.4.1. Regional consensus framework

The Asia-Pacific Clinical Practice Guidelines for the Management of Frailty (*6*) serve as the foundational document for the region. Developed using a modified GRADE methodology, these guidelines explicitly advocate for the identification of frailty using validated measurement tools. While not exclusively designed for surgical populations, the guidelines categorize tools into functional groups:

(i) Rapid screening: The FRAIL scale and PRISMA-7 are recommended for quick identification in outpatient settings.

(ii) Global judgment: The CFS is recognized for its utility in clinical stratification.

(iii) Intervention: The guidelines provide strong recommendations for prescribing individualized physical activity programs (resistance training) and addressing polypharmacy. This framework shifts frailty assessment upstream, identifying patients before clinic presentation and maximizing the lead time for prehabilitation and physiological optimization.

2.4.2. National adaptations and perioperative integration

(1) China: Rapid translation of a consensus into perioperative pathways

In response to a rapidly aging surgical population, China has accelerated the development of expert consensus frameworks. The Chinese Expert Consensus on Frailty Assessment and Intervention underscores the marked heterogeneity in the prevalence of frailty (ranging from 4.0% to > 50% by setting) and it codifies the use of the Fried phenotype, Frailty Index (FI), FRAIL scale, and CFS (*17*). Clinical integration in the perioperative period is advancing based on authoritative guidelines:

(i) CGA-integrated models: Leading facilities, notably Peking Union Medical College Hospital, have embedded frailty screening into routine preoperative workflows, positioning it alongside cognitive and nutritional assessments (*18*).

(ii) Closed-loop management: The 2023 Expert Opinion on Perioperative Management of Older Patients Living with Frailty, spearheaded by the Chinese Society of Anesthesiology, represents the most definitive guidance to date. It advocates a "Screening-CGA-Intervention" closed-loop paradigm, wherein detection of frailty or pre-frailty *via* validated tools (*e.g.*, the Fried phenotype and Edmonton Frailty Scale) triggers an immediate CGA and multidisciplinary optimization, encompassing malnutrition, sarcopenia, and prophylaxis of DVT (*19*).

(2) Japan: Checklist-based screening and specialty integration

Japan's approach is distinguished by the widespread use of government-developed checklists embedded in the national long-term care insurance system.

(i) The Kihon Checklist (KCL): A 25-item self-administered questionnaire covering physical, nutritional, and social domains (*20*). Originally for a community screening, the KCL is increasingly being validated as a predictor of postoperative outcomes.

(ii) Questionnaire for Medical Checkup of Old-

Table 1. Anti-HBV response of TCM and related active compounds in clinical trials

Region/Country/*Ref*	Key authorities	Target population	Preferred tools	Pathway & timing	Primary characteristic
United Kingdom *(11)*	CPOC, BGS	Community-dwelling older adults, surgical patients age ≥65; or <age 65 with multimorbidity	Gait speed, TUG, PRISMA-7, CFS	Longitudinal: Community → Referral → Pre-op → Admission	Comprehensive, multi-stage pathway integration with CFS thresholds
United States *(12)*	ACS, AGS, ASA	≥age 65 surgical patients	Fried phenotype, CFS, FI, Gait speed, TUG	Full-cycle: Pre-op optimization → Intra-op → Post-op follow-up	Multidisciplinary team approach; flexible tool selection
Europe *(15)*	ESAIC	Older adults with multimorbidity or functional decline	multidimensional (gait speed, nutrition, cognition)	Pre-operative risk stratification	Flexible, regionally adaptable framework for frailty integration
Asia-Pacific (General) (*6*)	Asia-Pacific Clinical Practice Guidelines for Frailty	Community & outpatient elderly	FRAIL scale, PRISMA-7, CFS, FI	Upstream identification & prehabilitation	Focus on upstream frailty screening in primary care settings
China *(17, 19)*	CSA & Geriatrics Branch	≥age 70 or weight loss / high-risk patients	Fried Phenotype, CFS, FI, FRAIL scale	Tertiary hospital "Closed-loop": Screening → CGA → Intervention	Integration of frailty within CGA; emphasis on optimizing preoperative care
Japan *(17-20)*	JCS/JHFS, Gov. Policy	Community-dwelling older adults (≥75y for QMCOO) & disease-specific groups	KCL, QMCOO, CFS-J, Fried Phenotype	National health check-ups & disease-specific guidelines	Government-backed tools embedded in long-term care and specialty care
South Korea *(31)*	Korean Academy of Family Medicine	≥age 70 community-dwelling	K-FRAIL, FPQ	Primary care screening → Specialist CGA referral	Systematic screening in primary care to ensure continuity of geriatric data

Abbreviations: CFS, Clinical Frailty Scale; FI, Frailty Index; FPQ, Frailty Phenotype Questionnaire; KCL, Kihon Checklist; K-FRAIL, the Korean version of the FRAIL scale; PRISMA-7, Pictorial Indicators of Frailty and the Risk of Sarcopenia in the Elderly; QMCOO, Questionnaire for Medical Checkup of Old-Old; RAI, Risk Analysis Index; TUG, timed up-and-go test.

Old (QMCOO): A 15-item simplified tool adopted for nationwide health check-ups for adults ≥ age 75 (*21*).

Instead of using a single standalone perioperative guideline, Japan integrates frailty into disease-specific guidelines. For instance, the 2025 JCS/JHFS Guideline on the Diagnosis and Treatment of Heart Failure explicitly categorizes frailty into physical (Fried phenotype), multidimensional (KCL), and social domains, mandating assessment as part of comorbidity management (*22*). In addition, the validation of the Japanese version of the CFS (CFS-J) in inpatient settings suggests a growing convergence with international standards regarding acute care assessment (*23*).

A distinctive infrastructure feature is the national effort to link administrative databases across care settings. In October 2020, the Ministry of Health, Labour and Welfare began accepting applications for third-party provision and linkage analysis of the NDB-Long-Term Care Insurance (LTCI) database under a newly launched data linkage framework (*24-26*). This infrastructure supports the use of the claims-based frailty index (CFI), which was originally developed in the US. The CFI has been validated in a large Japanese cohort of 519,941 older adults. It has shown good predictive ability for LTCI certification and mortality (*27*). Similarly, coding-based algorithms such as the Electronic Frailty Index (eFI) and Hospital Frailty Risk Score (HFRS) have been validated using regional administrative claims databases (*28*).

The policy framework for this integration is the Community-based Integrated Care System, intended for full implementation by 2025. Under this model, care managers coordinate the information flow among primary care physicians, community health nurses, and hospital specialists. Despite the availability of linked claims databases for research purposes, routine clinical interoperability between LTCI screening records (*e.g.*, KCL or QMCOO results) and hospital electronic medical records remains limited. Frailty data collected during municipal health checkups are maintained in separate administrative databases, and information exchanges often still rely on traditional methods such as telephone calls and fax, accompanied by interoperability burdens including redundant forms and duplicate documentation (*29,30*). National initiatives encourage shifting away from paper-based exchanges and enabling multiple stakeholders to view care-related information electronically. However, current care-plan data exchange systems were not designed to routinely connect to medical facilities. This creates ongoing structural barriers to seamless sharing of data between medical and long-term care services in routine perioperative practice.

(3) South Korea: Primary care as the gatekeeper

The Korean Primary Care Guideline (2021) establishes a unique gatekeeper model by mandating frailty screening for all community-dwelling adults age ≥ 70 (*31*). It prioritizes the Frailty Phenotype Questionnaire (FPQ) and the Korean version of the FRAIL scale (K-FRAIL). For perioperative care, this implies that surgical patients referred by primary care facilities increasingly arrive with pre-established frailty data, necessitating improved information continuity between community clinics and surgical centers.

The Korean Frailty Index for Primary Care (KFI-PC) has been validated for comprehensive diagnostic assessment. It is a 54-item tool based on a CGA and covers 10 domains, including cognition, mood, mobility, and nutrition. An optimal cut-off value of 0.23 has been reported (*32*). However, its extensive nature limits practical application in busy clinical environments, underscoring the need for efficient screening instruments in both community and perioperative settings.

South Korea's healthcare system draws on administrative claims data from the National Health Insurance Service (NHIS) database. A Korean Hospital Frailty Risk Score (K-HFRS) has been developed using ICD-10 codes derived from healthcare encounters and linked with NHIS cohort data (*33*), representing an initial step toward claims-based frailty assessment in hospital settings. Digital innovation is advancing through initiatives such as the "SUPERAGING" study, which explores mobile app-based multidomain frailty interventions integrating disease management, cognitive training, and nutrition (*34*). Such digital platforms could theoretically facilitate the seamless transfer of information between community screening and hospital-based perioperative teams.

However, South Korea has, like Japan, not systematically established formal protocols for transferring community-derived frailty assessments to hospital perioperative teams. Linkage between NHIS claims data and individual hospital electronic medical records faces legal and privacy constraints, representing a key barrier to realizing the perioperative potential of South Korea's robust primary care-based screening infrastructure.

In summary, the Asia-Pacific model differs significantly from the Western trajectory. While the UK and Europe emphasize point-of-care assessment using tools like the CFS at the time of surgical admission, the Asia-Pacific region relies heavily on upstream community screening (*e.g.*, the KCL in Japan and K-FRAIL in South Korea). In this setting, the main barrier to translation is not a lack of tools but an interoperability gap. The challenge lies in integrating a host of community-level frailty data into acute perioperative workflows so that those data can meaningfully inform surgical decisions and resource allocation (Figure 1).

3. Translational challenges and future directions

3.1. The evidence-practice gap

A profound discrepancy persists between the proliferation of frailty research and its translation into routine perioperative practice. This translational gap and the overarching framework from evidence to practice are shown in Figure 2. A survey of the literature underscores the rapid growth of this field, with approximately 75% of relevant studies having been published within the past five years. However, the use of this research remains highly skewed. Strikingly, 99.6% of studies have employed frailty measurement exclusively for risk description or prognostic validation, while only 0.4% have utilized assessment results to prospectively modify or redesign care processes (*35*). Consequently, observational data have consistently linked frailty to adverse outcomes, but high-quality causal evidence supporting specific, guideline-recommended intervention pathways remains scarce.

3.2. Heterogeneity in measurement

This translational gap is exacerbated by substantial heterogeneity in assessment tools. Hothi *et al.* reported that while the deficit-accumulation-based Frailty Index (41.0%), the CFS (23.3%), and the Fried phenotype (9.3%) are predominant, over 11.2% of studies employ multiple or non-standard instruments (*35*). Methodological diversity allows for the exploration of the frailty construct, but it severely limits the comparability of findings across trials. More critically, it hinders the establishment of consistent, operational threshold values required to trigger clinical pathways.

3.3. Barriers at the implementation level

Even when validated assessment tools are selected, successful translation from research to practice is frequently impeded by barriers at the human and organizational levels. Successful implementation depends largely on organizational readiness, including adequate funding, infrastructure, and workforce capacity, as well as a strong interdisciplinary culture.

Challenges in workflow integration and cognitive load are particularly prominent. Qualitative evidence from acute care settings in Singapore has revealed a dissonance between tool availability and clinical utility. While participants identified over ten different screening tools, they expressed a lack of familiarity with specific scoring metrics. Consequently, clinicians frequently defaulted to clinical gestalt (or subjective eyeball screening) rather than utilizing standardized instruments to mitigate the perceived administrative burden (*36*).

This lack of standardization is often compounded by ambiguous process ownership. The same study highlighted a critical phenomenon of diffusion of responsibility: while frailty was universally recognized as a significant clinical priority, the ambiguity surrounding specific roles led to a scenario where everyone agreed that it mattered, but no one assumed responsibility for it. Without a clear delineation of who performs the screening and who acts on the results, the pathway collapses.

Moreover, structural resource constraints present a formidable barrier to sustainability. Implementation

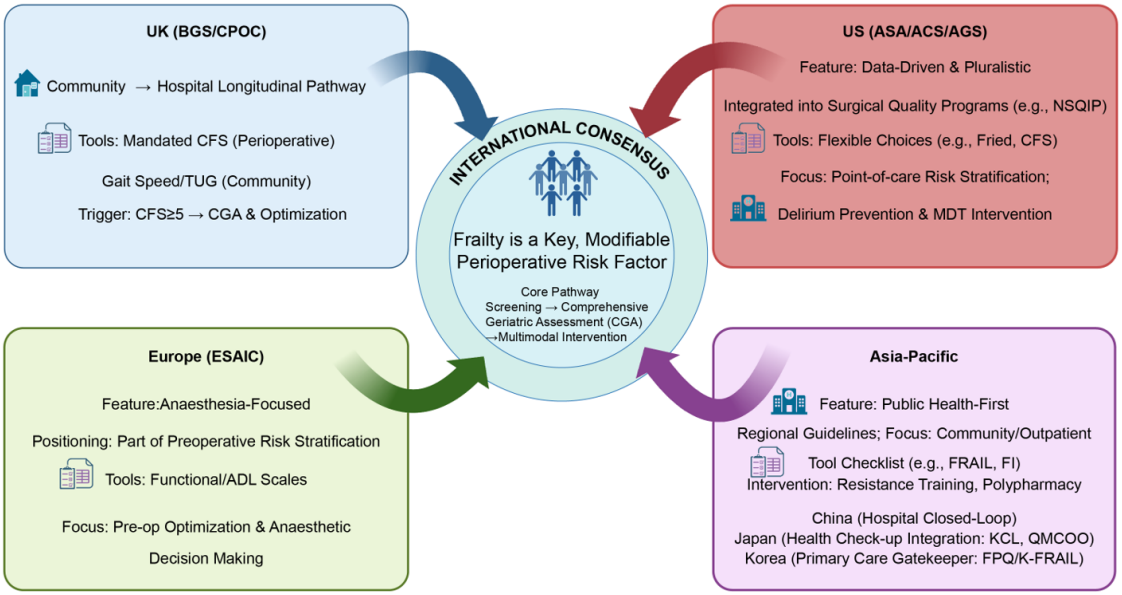

Figure 1. Global landscape & translational pathway of perioperative frailty assessment. *Abbreviations*: ADL, Activities of Daily Living scales; CFS, Clinical Frailty Scale; CGA, comprehensive geriatric assessment; FI, Frailty Index; FPQ, Frailty Phenotype Questionnaire; KCL, Kihon Checklist; K-FRAIL, the Korean version of the FRAIL scale; MDT, multidisciplinary team; NSQIP, National Surgical Quality Improvement Program; QMCOO, Questionnaire for Medical Checkup of Old-Old; RAI, Risk Analysis Index; TUG, timed up-and-go test.

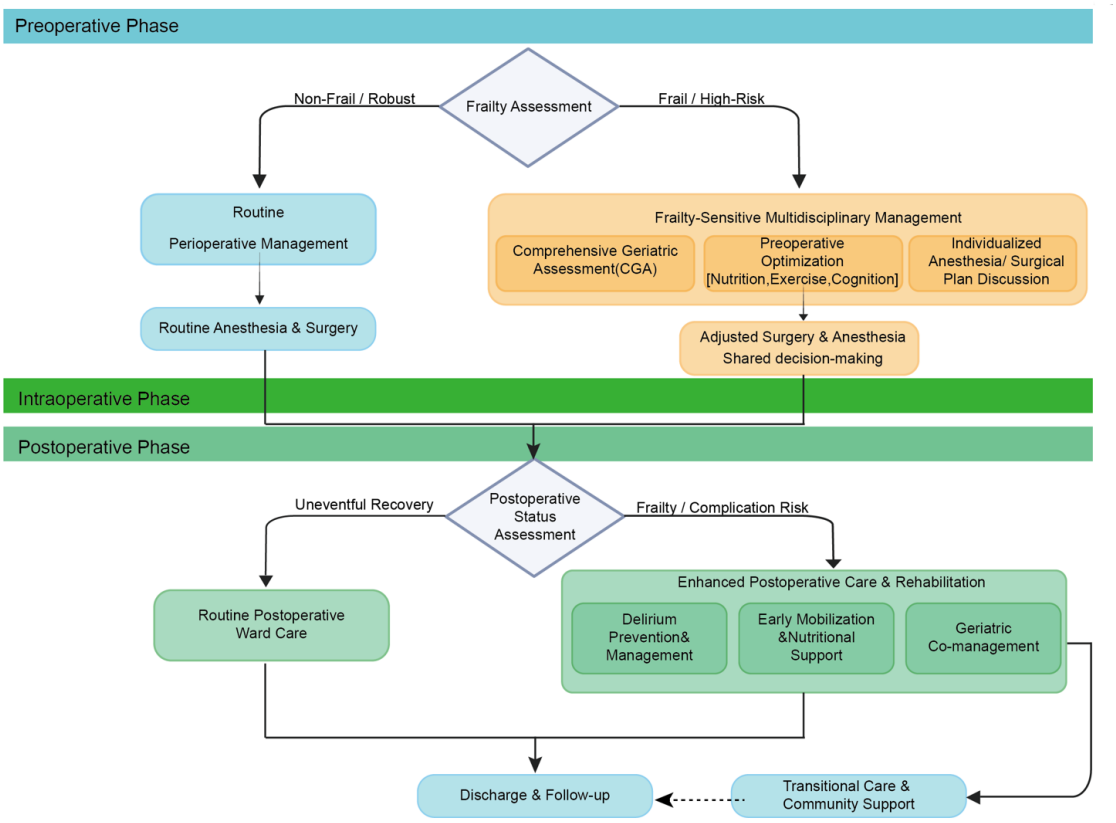

Figure 2. Schematic diagram of perioperative management pathways based on frailty assessment.

research from Germany examining multimodal prehabilitation has indicated that workforce capacity and the complexity of redesigning workflows (*e.g.*, integrating assessments in existing anesthesia clinics) are primary concerns for healthcare providers. The findings suggest that the absence of designated coordination teams and mechanisms of secured financing often stall the critical transition from assessment to actionable intervention (*37*).

Beyond resource and workflow barriers, a critical gap exists in translating frailty identification into patient-centered care: the systematic incorporation of shared decision-making (SDM). In perioperative frailty management, assessment should serve not merely as a risk-prediction exercise but as a trigger for goal-oriented discussions. In line with the ACS/AGS Best Practices, surgical teams should prioritize preoperative discussions on personal goals, explicitly addressing outcomes that matter most to older patients: functional decline, loss of independence, and the potential need for skilled care (*13*).

For patients identified as high-risk (*e.g.*, a CFS score ≥ 5 per UK guidelines), clinical pathways should mandate multidisciplinary SDM conferences involving surgeons, anesthesiologists, geriatricians, and patients' families. For frail patients, who face profound risks of complications and disability, the clinical question must evolve from technical feasibility ("Can we operate?") to goal alignment ("Should we operate?"). This requires prioritizing the patient's values, independence, and risk tolerance over surgical intervention alone (*38*).

However, current guidelines, while acknowledging the importance of goal-oriented discussions, lack standardized SDM tools and decision aids tailored to the perioperative context (*39*). Future pathway design should integrate frailty assessment results with prognostic prediction models to provide quantified risk evidence for SDM, ensuring that care plans authentically reflect the life goals and preferences of frail older adults. Such integration may help reduce both overtreatment and undertreatment, ultimately improving patient welfare and resource allocation.

3.4. Digital opportunities and data challenges

To mitigate the frontline workload, digital approaches such as the eFI, derived from routine electronic health records (EHR), offer a promising solution for automated screening (*40,41*). In the perioperative context, leveraging preoperative diagnostic codes, laboratory results, and medication records could facilitate the pre-screening of high-risk patients without adding to the clinical burden. However, the scalability of eFI-based pathways faces its own challenges, primarily concerning the completeness of data, algorithmic bias, and equity across different healthcare settings. The promise of algorithmic frailty assessment must be tempered by a

critical examination of equity implications. Obermeyer *et al.*'s landmark study revealed substantial racial bias in a widely used commercial algorithm for care management. Crucially, the study found that at equivalent risk scores, black patients were significantly sicker than their white counterparts.(*42*). This bias arose because the algorithm used healthcare costs as a proxy for health needs; however, due to systemic barriers to care access, less money was historically spent on black patients compared to white patients with an equivalent illness burden. A similar concern applies to frailty algorithms. An eFI trained mainly on data from well-resourced tertiary care centers may embed comparable biases. For example, lower healthcare use among underserved populations may be misread as better health rather than reflecting barriers to accessing care.

Three specific equity challenges warrant attention in the perioperative context:

(i) Bias in the representativeness of data. The predictive performance of eFI-type algorithms is highly dependent on the completeness and uniformity of underlying clinical documentation. In resource-constrained settings or regions with higher proportions of minority populations, EHR documentation may be less structured or complete, leading to "missingness bias" that systematically underestimates frailty prevalence in precisely those populations who may benefit the most from perioperative optimization (*43*).

(ii) Amplification of structural inequities. If training datasets are drawn disproportionately from well-resourced academic medical centers, the resulting algorithms may embed socioeconomic assumptions that are not generalizable. Cultural or linguistic barriers that result in incomplete assessment documentation may be misinterpreted as "low risk", potentially leading to inequitable allocation of perioperative resources such as prehabilitation programs or enhanced recovery pathways.

(iii) Equity-conscious validation standards. Future work on automated frailty screening should consider fairness alongside performance. This includes using measures such as equalized odds, calibration across demographic groups, and stratified positive predictive values, in addition to standard discrimination metrics like the C-statistic. Before deploying eFI-triggered perioperative pathways, implementation studies should evaluate whether algorithmic performance is consistent across levels of education, levels of income, and racial/ethnic groups through stratified subgroup analyses.

In conclusion, digital frailty assessment should not be viewed merely as a tool for greater technical efficiency but as a sociotechnical system requiring ongoing audits to ensure that automation does not inadvertently exacerbate existing health inequities. Governance frameworks that mandate transparency, periodic audits for bias, and community engagement will be essential to the ethical scaling of these technologies in perioperative care.

3.5. Priorities for future research

In view of these challenges, the research agenda must pivot decisively from prognostic association studies towards pragmatic implementation studies. First, there is an urgent need for well-designed multicenter cluster-randomized controlled trials or stepped-wedge studies to generate high-quality causal evidence. Unlike traditional individual randomization, these designs are better suited to evaluating complex, system-level interventions. They allow comparison between routine care and integrated frailty pathways that include systematic screening, a CGA, individualized preoperative optimization, and continuity of care after surgery.

Second, the evaluation framework must evolve. Outcome measures should extend beyond traditional surgical metrics (*e.g.*, 30-day mortality or readmission) to prioritize outcomes that are important to patients, such as functional recovery trajectories, disability-free survival, and quality of life. Concurrently, health economic analyses (cost-effectiveness and cost-utility) must be embedded within these trials to evaluate the feasibility and scalability of frailty-guided pathways in resource-constrained real-world settings.

Finally, as digital tools gain prominence, future studies must rigorously validate automated screening approaches. Research utilizing quasi-experimental designs needs to assess the predictive performance and real-world impact of eFI-triggered pathways. Crucially, this validation must explicitly address algorithmic fairness, ensuring that data-driven approaches do not exacerbate health inequities across diverse patient populations.

4. Conclusion

Frailty profoundly influences perioperative outcomes, and yet guideline formulation has not kept pace with scientific understanding. This review highlights marked regional differences. The UK tends to emphasize standardized pathways, the US favors more pluralistic approaches, and the Asia-Pacific region faces challenges in linking community screening to acute care workflows. Across all settings, however, a common issue remains: frailty is increasingly detected but not consistently acted upon.

Moving forward, care must transition from viewing frailty as a static risk label to considering it as a dynamic signal for intervention. This requires consensus risk thresholds that trigger the activation of prehabilitation and surveillance protocols, the integration of automated screening into clinical decision-making support systems, and interoperable infrastructure enabling seamless data transfer across care settings. Only by bridging detection and intervention can frailty-guided care achieve its potential to improve surgical outcomes and healthcare equity for older adults.

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