# Frailty assessment in older urological patients prior to surgery: a systematic review and narrative synthesis

Andrea Haren, Rajni Lal, David Walker, Rajesh Nair, Judith Partridge and Jugdeep Dhesi


## Abstract

**Background:** Radical cystectomy (RC) and urinary diversion are the recommended treatment for patients with muscle invasive bladder cancer. This is complex surgery, associated with significant patient morbidity and mortality. Frailty has been shown to be an independent risk factor for adverse outcomes in several surgical populations. Preoperative assessment of frailty is advocated in current guidelines but is not yet standard clinical practice.

**Aims:** This systematic review and narrative synthesis aims to examine whether patients undergoing RC are assessed for frailty, what tools are used, and whether an association is found between frailty and adverse outcomes in this population.

**Results:** Nine studies, published within the last 4 years, describe the use of tools reporting to measure frailty in the RC population. All demonstrate increased risk of adverse postoperative outcomes with higher frailty levels. Only one study used a validated frailty tool. The majority of studies measure frailty using variations on a tool derived from a large database (ACS-NSQIP) effectively counting co-morbidities, rather than assessing the multidomain nature of the frailty syndrome.

**Conclusion:** The recognition of frailty as an important consideration in the perioperative period is welcome. This systematic review and narrative synthesis demonstrates the need for collaboration in research and delivery of clinical care for older surgical patients. Such collaboration may provide clarity regarding terms such as frailty and multimorbidity, preventing the development of assessment tools inaccurately measuring these discreet syndromes interchangeably. More accurate assessment of patients in terms of frailty, multimorbidity and functional status may allow better modification and shared decision making leading to improved postoperative outcomes in older patients undergoing RC.


***Keywords:*** frailty, cystectomy, perioperative medicine, comprehensive geriatric assessment, surgery, age, older

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Correspondence to:
**Jugdeep Dhesi**
Perioperative Care of Older People undergoing Surgery (POPS), Department of Ageing and Health, Guy's and St Thomas' NHS Foundation Trust, London, SE1 9RT, UK

Reader, Division of Primary Care and Public Health Sciences, Faculty of Life Sciences and Medicine, King's College London

Division of Surgery and Interventional Science, University College London, UK
**jugdeep.dhesi@gstt.nhs.uk**

**Andrea Haren**
Perioperative Medicine Fellow, Department of Anaesthesia and Perioperative Medicine, University College London Hospitals, London, UK

**Rajni Lal**
Perioperative Care of Older People undergoing Surgery (POPS) Fellow, Department of Ageing and Health, Guy's and St Thomas' NHS Foundation Trust, London, UK

**David Walker**
Department of Anaesthesia and Perioperative Medicine, University College London Hospitals, London, UK

Centre for Anaesthesia and Perioperative Medicine, University College London, London, UK

**Rajesh Nair**
Consultant Urological Surgeon, Department of Urology, Guy's and St. Thomas' NHS Foundation Trust, London, UK

**Judith Partridge**
Perioperative Care of Older People undergoing Surgery (POPS), Department of Ageing and Health, Guy's and St Thomas' NHS Foundation Trust, London, UK

Division of Primary Care and Public Health Sciences, Faculty of Life Sciences and Medicine, King's College London

## Background

Bladder cancer is the tenth most common cancer in the UK, accounting for 10,300 new cancer cases annually.[1] It is estimated that over half of these cases occur in those aged over 75 years of age. Radical cystectomy (RC) with bilateral pelvic lymph node dissection is standard treatment for muscle invasive, as well as high risk non-muscle-invasive disease,[2] with up to a quarter of patients presenting with muscle invasive bladder cancer at the time of diagnosis.[3] RC is complex surgery, with reported 90-day mortality rates of between 1.7% and 9%,[4–6] and perioperative morbidity rates of up to 70%.[7]

Despite higher prevalence of bladder cancer in the older population, and evidence and consensus that RC provides clear survival benefit for suitably selected older patients,[8] curative treatment with RC remains disproportionately low in this age group. A US study, of the National Cancer Database, indicated that, although cystectomy

use increased from 14% in 2003 to 24% in 2012 in those over 75 years of age, only 21% of those over 80 years received RC, as opposed to 55% of those under 70 years.[9] Age was also found to be a negative predictor of access to curative treatment in a UK study of practice from 1994–2009, where 52% of those under 60 underwent RC, *versus* 12% of those over 80.[10] Reasons for reduced access to curative treatment in older people include a potentially unfavourable risk profile with higher rates of physiological decline, multimorbidity and geriatric syndromes, together with concern regarding burdens related to surgery including stoma management and functional recovery. Careful patient selection is therefore key, but no standardised approach to defining such risks exists. Chronological age alone is an unreliable indicator of perioperative risk. Whilst multimorbidity is associated with adverse postoperative outcomes, risk assessment using comorbidity scores has limited clinical utility and fails to evaluate the complex interplay of multiple diseases common in older people.

Similarly, frailty is an independent risk factor for morbidity, mortality, protracted length of stay and institutional discharge in several surgical populations.[11–14] Frailty assessment may enhance preoperative risk assessment through combining the impact of chronological age, multimorbidity and the accumulation of multidomain deficits in order to better predict adverse outcomes.

Whilst current guidelines recommend preoperative assessment of comorbidity, functional status, activity levels, and frailty,[2,15–17] routine assessment of frailty is not yet standard clinical practice.

Frailty is defined as a distinctive health state related to the ageing process in which multiple body systems gradually lose their in-built reserves, rendering the frail individual vulnerable to even minor external stressors.[18] Well described in the geriatric medicine literature for many years, frailty has been conceptualised through two main models; the frailty phenotype and the deficit accumulation model or frailty index score.[19,20] The phenotype model defines frailty based on at least three of five physical characteristics: slow walking speed, impaired grip strength, low activity, unintended weight loss, and exhaustion. The cumulative deficit model defines frailty through calculation of a frailty index score based on deficits across several domains including signs, symptoms, diseases, disabilities and impairments. Both models emphasise the multidimensional, multidomain nature of frailty, as opposed to a simple count of comorbidities. More than 50 screening and diagnostic tools for frailty are available in clinical and research settings.[11,12,21,22]

In the surgical setting, numerous tools have been used for screening and diagnosis of frailty but to date there is no standardised approach used routinely in clinical care. This systematic review and narrative synthesis aims to examine whether patients undergoing RC for bladder cancer are preoperatively assessed for frailty. The following questions will be considered:

1. Which frailty tools are used preoperatively in patients undergoing RC?
2. What is the prevalence of frailty in patients undergoing RC?
3. Is there an association between frailty and adverse postoperative outcomes in patients following RC?

## Methods

### *Ethics*

Our study did not require an ethical board approval as it did not contain human or animal trials.

### *Identification of studies/data sources*

MEDLINE and EMBASE electronic databases *via* the Ovid Interface were searched using a prespecified search strategy (see Appendix 1). Additional eligible studies were retrieved by hand searching bibliographies of relevant articles. The search was restricted to English language articles only but no date restrictions were applied. The last electronic search was performed on 1 June 2019.

### *Study selection*

Article abstracts and subsequently the full text articles were independently assessed for eligibility by two researchers (AH and RL). Discrepancies were resolved through a third reviewer (JP).

The criteria for inclusion were: (1) randomised controlled trials, quasi-experimental and prospective or retrospective observational studies; (2) adults (over 18 years) undergoing RC for bladder

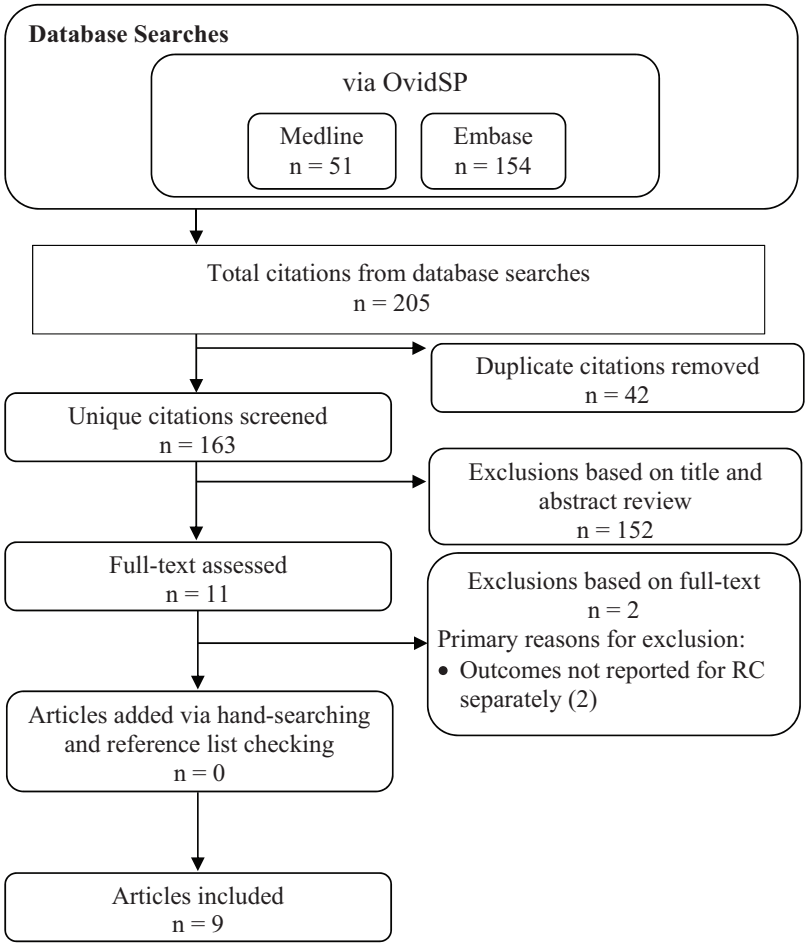


**Figure 1.** PRISMA diagram.
Study characteristics: Of the nine studies included, all were observational cohort studies. Eight studies were retrospective and one prospective. All studies were conducted in the USA. Three of the nine were undertaken in a mixed urological surgical population, with outcomes for RC reported separately. Seven of the eight retrospective studies used the American College of Surgeons-National Surgical Quality Improvement database.
PRISMA, preferred reporting items for systematic reviews and meta-analyses; RC, radical cystectomy; USA, United States of America.

cancer; (3) preoperative frailty assessment conducted using an explicitly defined frailty tool.

Exclusion criteria were; (1) case reports, case studies, editorials, review articles and conference abstracts; (2) studies reporting frailty and postoperative outcomes in a mixed urological surgical population if patients undergoing RC were not analysed and reported separately.

### *Data extraction*

Two reviewers (AH and RL) extracted data from eligible full text articles to collate information on study characteristics, outcome measures and risk of bias.

### *Data synthesis*

Anticipated heterogeneity between studies precluded meta-analysis, and therefore, the *a priori* decision to conduct narrative synthesis was taken and recorded on PROSPERO registration number CRD42019145874.

All identified papers were first read and re-read several times with the key points recorded in order to ensure familiarity with the literature. In particular, important similarities and differences in trial design, patient populations, the frailty tool being studied and outcome measures were noted. All included studies were tabulated and translated using content analysis. Relationships in the data were explored using grouping and textual

**Table 1.** Frailty tools and their components.

| Tool | Components | | Scoring system |
|---|---|---|---|
| FFC | Grip strength, gait speed, exhaustion, physical activity and unintended weight loss | | Robust (0–1)<br>Intermediate frail (2–3)<br>Frail (4–5) |
| FFI (max score 6) | Diabetes (1 if on oral agents, 2 if on insulin)<br>Impaired functional status (1)<br>Congestive heart failure within 30 days before surgery (1) | Chronic obstructive pulmonary disease (1)<br>Hypertension requiring medication (1) | FFI 0<br>FFI 1<br>FFI 2<br>FFI ⩾3 |
| FI-15 | Consists of NSQIP-FI 11 items (see below) with additional 4 variable related to oncology patients<br>History of metastases, history of weight loss (>10%) within 6 months, chemotherapy or radiation before surgery, severe renal failure or currently on dialysis | | FI-15 0–0.05<br>FI-15 0.05–0.10<br>FI 15 0.10–0.15<br>FI 15 0.15–0.20<br>FI 15 >0.20 |
| mFI<br>NSQIP-FI<br>(11 items) | Scores are summed and divided by total number of items (11) to give index<br>Diabetes, impaired functional status, chronic obstructive pulmonary disease or pneumonia, congestive cardiac failure or myocardial infarction within 6 months of surgery, history of percutaneous coronary intervention, cardiac surgery or angina, on hypertensive medications, peripheral vascular disease or rest pain, impaired sensorium, transient ischaemic attack without neurological deficit, cerebrovascular accident with neurological deficit | | (Pearl) Pre-frail 0.09–0.18, frail > 0.27,<br>(Woldu) mFI 0/1/2/⩾3<br>(Suskind, Chappidi, Woldu, Meng)<br>Frail > 0.18 *versus* not frail |
| s-FI | Diabetes mellitus, functional status, chronic pulmonary disease, congestive cardiac failure, hypertension requiring treatment | | sFI 0<br>sFI 1<br>sFI 2<br>sFI 3+ |

FFC, Fried Frailty Criteria; FFI, Five-item Frailty Index; FI-15, frailty Index with 15 variables; mFI, Modified Frailty Index; NSQIP-FI, National Surgical Quality Improvement PROGRAM – Frailty Index; s-FI Simplified-FI.

descriptions. The robustness of the synthesis was evaluated and presented using critical reflection on the synthesis process.

### *Quality assessment*

Full text articles were assessed for risk of bias and given a quality score using an adaptation of the Critical Appraisal Skills Programme (CASP) checklist for cohort studies.[23] This tool consists of three sections to assess internal validity, the results and the relevance to practice (see Appendix 2). The maximum score achievable was 12, with a higher score indicating lower risk of bias.

## Results

After removing duplicates, 163 articles were reviewed for eligibility based on title and abstract screening. Of the 11 full text articles included and assessed against eligibility criteria, 2 were eliminated at this stage because RC outcomes were not reported separately, thus 9 studies were included for analysis in the narrative synthesis (Figure 1).

### *Frailty tools*

Across the nine studies, 11 preoperative assessment tools were reported, 6 of which were specifically described as frailty assessment tools (Table 1). Of the six frailty assessment tools, four (Suskind *et al.*,[24] Chappidi *et al.*,[25] Woldu *et al.*,[26] Meng *et al.*[27]) described frailty as a binary outcome and three (Lascano *et al.*,[30] Sathianathen *et al.*,[31] Taylor *et al.*[32]) as a continuous variable; two studies (Pearl *et al.*,[28] Burg *et al.*[29]) used an ordinal scale. Differences were observed in the cut off values for defining frailty, with four studies using the 11 point mFI and describing frailty as the presence of two or more deficits (Woldu *et al.*,[26] Meng *et al.*,[27] Suskind *et al.*,[24] Chappidi *et al.*[25]), whereas one study applied a threshold of three or more deficits, with one or more deficits indicating a pre-frail state (Pearl *et al.*[28]).

**Table 2A.** Studies comparing frailty tool to alternative risk indices.

| Author, country | Study design | Tool | Comparison | Number of patients | Prevalence of frailty | Primary outcome | Results | | | *p*-value | CASP score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Woldu *et al.*[26] USA | Retrospective | mFI | ASA<br>CCI | 346 | 40.8%<br>(mFI ⩾ 2) | CD > 3 within 30 days<br>Secondary outcome: readmissions within 90 days | AUC | mFI<br>ASA<br>CCI | 0.55 (95% CI 0.47–0.63)<br>0.56 (95% CI 0.46–0.61)<br>0.57 (95% CI 0.47–0.63) | 0.194<br>0.367<br>0.100 | 9 |
| Meng *et al.*[27] USA | Retrospective | mFI | ASA<br>CCI | 1516 | 27.7%<br>(mFI ⩾ 2) | Any adverse event within 30 days after surgery | AUC | mFI<br>ASA<br>CCI | 0.51 (95% CI 0.47–0.53)<br>0.51 (95% CI 0.49–0.55)<br>0.51 (95% CI 0.49–0.54) | N/S | 7 |
| Sathianathen *et al.*[31] USA | Retrospective | sFI | ASA<br>m-FI<br>NSQIP calculator | 5516 | 2.2%<br>(sFI ⩾ 3) | CD > 3 within 30 days<br>Discharge destination | OR<br>AUC<br>OR<br>AUC | sFI 3+<br>sFI 3+ | 3.22 (95% CI 2.01–5.17)<br>0.52 (95% CI 0.47–0.57)<br>2.31 (95% CI 1.40–3.82)<br>0.60 (95% CI 0.58-0.62) | N/S | 7 |
| Burg *et al.*,[29] USA | Prospective | FFC | ASA<br>CCI<br>CESD<br>ECOG<br>Karnofsky<br>Katz | 123 (109 full FFC) | 44.9%<br>Frail 5.5% (FFC 4-5)<br>Intermediate frail 39.4% (FFC 2-3) | CD 4/5 30 days<br>CD 4/5 90 days | OR | IF/F<br>IF/F | 4.87 (95% CI 1.39 to 22.77)<br>3.01 (95% CI 1.05 to 9.37) | 0.022<br>0.045 | 10 |
| Lascano *et al.*[30] | Retrospective | 15 – FI | 11 mFI<br>ASA<br>CCI | 3388 | 5.2%<br>(15 item FI > 0.20) | CD 4 30 days<br>30 day mortality | AUC<br>OR<br>AUC<br>OR | 0–0.05<br>0.05–0.10<br>0.10–0.15<br>0.15–0.20<br>>0.20<br>0–0.05<br>0.05–0.10<br>0.10–0.15<br>0.15–0.20<br>>0.20 | 0.585<br>Reference Group<br>1.55 (95% CI 1.31–1.85)<br>2.08 (95% CI 1.66–2.60)<br>2.76 (95% CI 2.20–3.47)<br>3.70 (95% CI 2.87–4.79)<br>0.574<br>Reference Group<br>1.45 (95% CI 0.98–2.16)<br>1.94 (95% CI 1.18–3.18)<br>3.40 (95% CI 2.13–5.41)<br>5.95 (95% CI 3.71–9.51) | <0.0005<br>-<br><0.0005<br><0.0005<br><0.0005<br><0.0005<br><0.0005<br>-<br>0.066<br>0.009<br><0.0005<br><0.0005 | 7 |

ASA, American Society Anaesthesiology; AUC, area under curve; CASP, critical appraisal skills programme; CCI, Charlson Co-morbidity Index; CD, Clavien-Dindo complication; CESD, Centre for Epidemologic Studies Depression Scale; ECOG, Eastern Cooperative Oncology Group; FFC, Fried Frailty Criteria; FFI, Five-item Frailty Index; FI-15, Frailty Index with 15 Variables; mFI, Modified Frailty Index; OR, odds ratio; NS, not stated; NSQIP-FI, National Surgical Quality Improvement Program – Frailty Index; s-FI Simplified-FI.

**Table 2B.** Association between frailty tool and postoperative outcome.

| Author, country | Study design | Tool | Comparison | Number of patients | Prevalence of frailty | Primary outcome | Results | | | *p*-value | CASP score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Taylor *et al.*[32] USA | Retrospective | FFI | Not applicable | 9466 | 6.7% (FFI ⩾3) | Health care Resource Utilization (HRU) 30 days | OR | FFI 1<br>FFI 2<br>FFI 3 | 1.2 (95% CI 1.2–1.3)<br>1.5 (95% CI 1.4–1.6)<br>2.0 (95% CI 1.8–2.1) | <0.001<br><0.001<br><0.001 | 9 |
| Pearl *et al.*[28] USA | Retrospective | mFI | Not applicable | 4330 | 67.3% Frail 2.2% (mFI ⩾0.27) Prefrail 65.1% (mFI 0.09–0.18) | Discharge destination (non-home based care) 30 days<br>- robust: mFI 0<br>- pre-frail: mFI 0.09-0.18<br>- frail: mFI ⩾ 0.27 | OR | mFI pre-frail<br>mFI frail | 1.37 (95% CI 1.07–1.74)<br>2.33 (95% CI 1.34–4.03) | 0.011<br>0.003 | 7 |
| Suskind *et al.*[24] | Retrospective | mFI | Not applicable | 1638 | 25%: in mixed urological surgical cohort: NS for RC separately (NSQIP-FI ⩾0.18) | Discharge destination 30 days<br>- NSQIP-FI 0<br>- NSQIP-FI 0.09<br>- Frail: NSQIP-FI 0.18 | OR | FI 0<br>FI 0.09<br>FI 0.18 | 1.0<br>1.5 (95% CI 1.2–1.9)<br>3.1 (95% CI 2.5–3.8) | <0.01 | 8 |
| Chappidi *et al.*[25] USA | Retrospective | mFI | Not applicable | 2679 | 25% (mFI ⩾2) | CD 4 or 5 complications within 30 days of surgery<br>- mFI 0<br>- mFI 1<br>- mFI 2<br>- mFI ⩾ 3 | OR | mFI 0<br>mFI 1<br>mFI 2<br>mFI ⩾ 3 | Reference Group<br>1.16 (95% CI 0.83–1.62)<br>1.84 (95% CI 1.28–2.64)<br>2.58 (95% CI 1.47–4.55) | -<br>0.4<br>0.001<br>0.001 | 8 |

ASA, American Society Anaesthesiology; AUC, area under curve; CASP, critical appraisal skills programme; CCI, Charlson Co-morbidity Index; CD, Clavien-Dindo complication; CESD, Centre for Epidemologic studies depression scale; ECOG, Eastern Cooperative Oncology Group; FFI, Five Item Frailty Index; 15 FI, Frailty Index with 15 variable; FFC, Fried Frailty Criteria; mCCI, Modified Charlson Co-morbidity Index; mFI, Modified Frailty Index; OR, odds ratio; NS, not stated; NSQIP- calculator, National Surgical Quality Improvement Programme Calculator; RC, radical cystectomy; sFI, Simplified Frailty Index.

The prevalence of frailty described in this population varies widely from 22.2% to 67.3%.[28,31] Using the same definition (mFI $\geqslant$ 2), frailty is almost twice as prevalent in the Woldu cohort (40.8%) compared with the Chappidi cohort (24.6%),[25,26] despite a lower percentage of patients being American Society of Anaesthesiology (ASA) grade 3 or more (58.3% *versus* 74.4%, respectively).[25,26] The prevalence of the frailest cohort [defined as Fried score $>$ 3, simplified frailty index (sFI) 3+, five item frailty index (FFI) 3+, or modified frailty index (mFI) $\geqslant$ 0.27] varies from 2.2% to 16.8%.[26,28,31]

As part of the narrative synthesis, the studies were divided into two groups. In the first group (Table 2A), the tool reporting to assess frailty was compared with an established risk prediction tool or morbidity count to predict postoperative outcome. In the second group (Table 2B), associations between results of a tool reporting to assess frailty and postoperative outcomes were described.

### *Frailty and morbidity*

An association is demonstrated between increased frailty (variably defined) and high-grade postoperative complications (Clavien-Dindo 3+). However, the discriminative ability of derived frailty indices to predict adverse outcomes is poor, with an area under the curve between 0.51 (Meng *et al.*) and 0.585 (Lascano *et al.*).[27,30]

### *Frailty and mortality*

One study reported a progressive increase in 30-day mortality rates with increasing frailty index.[30] However, when tested against existing tools used to predict adverse outcomes (including Charlson Co-morbidity Index, age, ASA, 11-point mFI) the 15-point Frailty Index had poor sensitivity and specificity for predicting 30-day mortality in patients undergoing RC (AUC 0.574).

### *Frailty and discharge destination*

Overall, between 7.8% and 16.3% of the RC cohort were discharged to a destination other than home.[24,26] In one study, 16.3% were discharged to a skilled facility after RC, as opposed to 5.5% after all urological surgeries.[24] Similarly, 29% of those with sFI score greater than 3 were not able to return home at discharge.[31]

### *Healthcare resource utilisation*

There is an association between greater healthcare resource utilisation (as reflected by length of stay and readmissions) and increased frailty scores [higher Fried Frailty Criteria (FFC), higher sFI,[31] higher mFI].[26,29]

## Discussion

This systematic review and narrative synthesis examined nine papers, published in the last 4 years, describing the use of tools reporting to measure frailty and the association with postoperative outcomes in patients undergoing RC. Six tools reporting to measure frailty were used in the included studies. All studies demonstrated an association between the result of the instrument reporting to measure frailty and adverse postoperative outcomes, with the strongest association observed using the FFC. Notably, the frailty tools did not add predictive value to other predictive risk scores such as ASA with respect to postoperative morbidity, discharge destination or healthcare resource utilisation.

Eight of the nine studies measured frailty using variations on a tool derived from a large national database (American College of Surgeons-National Surgical Quality Improvement Project). These tools measured the number of comorbidities (between 4 and 10), and a binary description of functional status. Although ostensibly modelled on the deficit accumulation model of frailty,[33] these scores simply provide a count of comorbidities as opposed to offering a method for measuring the multidomain frailty syndrome. In comparison, the literature on frailty and its measurement advocates the construction of frailty indices using at least 30 items across multiple domains, with a risk of 'unstable estimation' when the number of deficits evaluated is $<$10.[34] Specifically, 'if a measure considers only a few items, to define broad risks those items need to integrate across several systems (e.g. mobility or function).'[35] The tools evaluated in eight of the nine papers included in this narrative synthesis do not adhere to this recommendation and have not been validated or tested against the original 70-item frailty index. It is therefore unsurprising that these tools do not add predictive value to preoperative risk assessment tools such as ASA as shown by receiver operating characteristic (ROC) curves of no greater than 0.6. Given this, eight of the nine papers presented in Table 2 are actually examining multimorbidity rather than frailty.

Preserving this distinction is more than merely semantics. Although the two syndromes overlap to some extent, and the terms are incorrectly used interchangeably, a recent meta-analysis showed that, while 7 out of 10 frail adults present with multimorbidity, only a fifth of adults with multimorbidity present with frailty.[36] Furthermore, frail older people with the same count of comorbidities counts can experience differing levels of disability.[37]

It is estimated that 10.7% of community dwelling adults over 65 years of age are frail, and 41.6% pre-frail.[38] In general surgical settings, the prevalence of pre-frailty is 31.3–45.8% and frailty 10.4–37.0%.[39] Differences in operationalization of frailty definitions may account for some of this variation. Comparing the phenotype with the index model of frailty in a large US cohort (the National Health and Nutrition Examination Survey) revealed a 10-fold difference in estimated prevalence (3.6% with modified phenotype *versus* 34% in frailty index).[40] There is a similarly wide range of prevalence in vascular surgery depending on the tool used, the prevalence ranges from 16% to 70%.[41]

Only one paper in our review (Burg) describes frailty using a validated frailty tool.[29] Pre-frailty was present in 39.5%, and frailty in 5.5%, which is lower than in other major surgical populations. Whilst limited conclusions can be drawn from this small sample, the low prevalence of frailty may reflect reduced access to RC for older patients with bladder cancer. Such access to RC for older people is likely limited for various reasons, but may reflect an awareness by clinicians of the higher rates of adverse postoperative outcomes associated with surgery in a frail population.[11–13,42] Certainly, the association between frailty and adverse postoperative outcome is well established in other surgical populations.[11] However, in the RC population, this finding has been less clearly illustrated, although the one paper in this review that used a validated frailty score (Burg *et al.*), did report an association between frailty and higher grade (Clavien-Dindo 3+) 30 and 90-day complications.[29]

The importance of accurately defining frailty is not simply to assess perioperative risk but instead to modify the risk profile, with the aim of improving postoperative outcomes.[43] The dynamic nature of frailty offers potential for preventative and rehabilitative interventions. Potential modifiers include exercise, nutritional, pharmacological or multicomponent interventions. Of these, Comprehensive Geriatric Assessment has established efficacy in improving outcomes in older community and medical inpatients, many of whom are frail. More recently, Comprehensive Geriatric Assessment has been shown to impact positively on the postoperative outcomes of older patients undergoing surgery.[44–47] Translating this literature into routine clinical care is problematic due to challenges related to an inadequately trained workforce and has been explored in a recent study aiming to deliver Comprehensive Geriatric Assessment, with limited success, by non-geriatricians.[48] Prehabilitation refers to multidimensional interventions aimed at increasing functional reserve prior to surgery, the central tenets being structured exercise programme and nutritional optimisation. Patients with lower preoperative fitness levels have been shown to derive most benefit,[49] but a recent systematic review has concluded that there is a lack of evidence for clinical outcomes in this population, limited by a low number and quality of studies.[50] As understanding of the pathophysiology of frailty and the importance of biomarkers increases, potential pharmacological modulators of frailty have been proposed, but with limited evidence of efficacy to date.[12,51]

Despite the ongoing discussions regarding the assessment and potential modification of frailty, accurate measurement of this syndrome in the surgical setting remains key in informing the process of perioperative shared decision making. This will be best achieved through collaboration to develop the evidence base regarding perioperative assessment and modification of frailty in surgical patients, such as those being considered for RC. Successful collaboration requires interspecialty and multidisciplinary working to share expertise, thus avoiding pitfalls such as the development of tools which measure multimorbidity as opposed to mapping to the multidomain frailty paradigm. Given the availability of validated frailty tools, the focus should now shift to ensuring an interprofessional and disciplinary consensus on which frailty tool should be employed in the clinical perioperative setting.

Interprofessional and patient collaboration should also contribute to the development and delivery of clinical services and pathways, such that frailty experts work alongside patients, surgeons, and anaesthetists to deliver optimal care underpinned by shared decision making.[52]

## Conclusion

This systematic review and narrative synthesis demonstrates the need for collaboration in research and delivery of clinical care for older surgical patients. Such collaboration may provide clarity regarding terms such as frailty and multimorbidity, preventing the development of assessment tools inaccurately measuring these discreet syndromes interchangeably. More accurate assessment of patients in terms of frailty, multimorbidity and functional status may allow better modification and shared decision making leading to improved postoperative outcome in older patients undergoing RC.

## Conflict of interest statement

The authors declare that there is no conflict of interest.

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## ORCID iD

Jugdeep Dhesi https://orcid.org/0000-0003-0815-0233

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## Appendix 1

### *Search Strategy*

Database: Embase < 1980 to 2019 Week 22>
Search Strategy:

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1. Cystectomy/ (26492)
2. Urinary Diversion/ (9183)
3. Cystectom*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word] (30151)
4. ((urinary or bladder*) adj3 (diversion* or resect*)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word] (16855)
5. Frailty/ (7056)
6. frail*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word] (33132)
7. fragil*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word] (69013)
8. 1 or 2 or 3 or 4 (40230)
9. 5 or 6 or 7 (101000)
10. 8 and 9 (154)

## Appendix 2 - Quality Scoring Methodology

*Adapted from the CASP Cohort Study Checklist*

| CASP Cohort Study Checklist | Score |
|---|---|
| **Question 1**<br>Did the study address a clearly focussed issue? | 1 point |
| **Question 2**<br>Was the cohort recruited in an acceptable way | 1 point |
| **Question 3**<br>Was the exposure accurately measured to minimise bias? | 1 point |
| **Question 4**<br>Was the outcome accurately measured to minimise bias? | 1 point |
| **Question 5**<br>Were all the important confounding factors identified, were these taken account of in the design and/or analysis? | 1 point |
| **Question 6**<br>Was the follow up of subjects complete enough, was it long enough? | 1 point |
| **Question 7**<br>What are the results of the study? | 1 point |
| **Question 8**<br>How precise are the results? | 1 point if good precision or adjustment for confounders |
| **Question 9**<br>Do you believe the results? | 1 point |
| **Question 10**<br>Can the results be applied to the local population? | 1 point |
| **Question 11**<br>Do the results of this study fit with other available evidence? | 1 point |
| **Question 12**<br>What are the implications of this study for practice? | 1 point if sufficiently robust evidence to inform practice change |
| **Maximum score*** | 12 points |

*A higher score = less risk of bias.
CASP, critical appraisal skills programme.