# Frailty and anaesthesia: what we need to know

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**Key points**

Frailty is a syndrome which overlaps with some other conditions that become more common as age increases.

Frailty has been recognized as an important risk factor for the development of postoperative complications and increased length of stay.

There are many tools for assessing frailty and there are some which can be done using smart phone and computer tablets.

In the emergency situation, there are a number of useful pointers to the frail patient, which include the ASA score and the number of prescribed medicines.

More work is required on the recognition of frailty in the elderly and methods that may be used before operation to modify the condition and improve outcome.

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We have an ageing population with approximately 1.25 million people in the UK aged 85 yr or more and about 20% of the total UK population classified as pensioners.[1] Estimates suggest that this patient characteristic change will continue with the older proportion of our society projected to double and treble in another 25 and 35 yr, respectively. Unsurprisingly, given this rate of population ageing, the number of older patients undergoing surgical procedures is also increasing. While surgery frequently has benefits for the older population, they also suffer from an excess of adverse postoperative outcomes when compared with younger patients. These adverse outcomes are due in part to age-related physiological change and multimorbidity but are increasingly attributed to the influence from geriatric syndromes. These syndromes can be thought of as clinical phenotypes commonly encountered in older people which do not neatly fit into a disease category or organ-specific condition, and the pathogenesis of which is often incompletely understood. Frailty, which can be thought of as decreased physiological reserve across multiple organ systems, leading to adverse outcomes in the frail individual, as a result of even seemingly minor external stressors, is a clear example of a geriatric syndrome.

## What is frailty?

A quick look at a dictionary gives a description of frail as weak and delicate, or easily broken. Although older people develop age-related changes such as long-term illnesses, muscle loss, and reduced strength, age is not the sole predictor of frailty and it may occur in younger surgical patients.[2] Various biomedical, psychological, and social factors can severely affect frail people's physiological state. This can greatly reduce the ability to function normally, making them increasingly vulnerable to minor environmental stresses which may then be sufficient to lead to dependency. It is accepted that, at present, there is no standardized method of measuring frailty, or physiological reserve, in older surgical patients. There are at least 20 frailty instruments to measure the condition,[3] only a couple of which will be mentioned in this article that refer specifically to studies that have been conducted in surgical patients. Many reading this article will recognize the syndromes that are described, either from personal experience of close friends or relatives or in patients whom they have encountered.

There are two main models of frailty; the frailty phenotype, which is based on aspects of physical decline, and the frailty index, which has multiple domains.

The frailty phenotype was initially described by Fried and colleagues[4] and was based on features observed in two populations comprising more than 5000 patients, who were all more than 65 yr of age. In this model, frailty was defined as a clinical syndrome in which three or more of the observed characteristics were present; unintentional weight loss [10 lb in the past year (~4 kg)], self-reported exhaustion, weakness (specifically grip strength), slow walking speed, and low physical activity (Table 1). The 'frailty phenotype' was predictive of progressive decline, resulting in falls, visits to hospitals, and eventually death.

In comparison, the frailty index,[5] also known as the deficit accumulation model, reflects the number of deficits an individual has accrued over a number of domains such as current illnesses, ability to manage activities of daily living, and various physical signs, which are used to calculate a numeric frailty index. There are 70 variables, including activities of daily living and physical issues such as stroke, diabetes, and cardiorespiratory disease, in the original Canadian Study of Health and Ageing (CSHA), which made up the original CSHA Frailty Index. This was an attempt to try and develop a widely acceptable tool for the definition and assessment of frail patients. In using these models, the overlap between frailty, comorbidity, and disability should be considered. There are also other syndromes, which anaesthetists may not be aware of, which also interplay

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**Table 1** Original description of the frailty phenotype

| Characteristics of frailty | Cardiovascular health study measure |
|---|---|
| Shrinking: weight loss (unintentional) | Baseline: >10 lb. Lost unintentionally in prior year |
| Sarcopenia (loss of muscle mass) | Grip strength: lowest 20% (by gender, body mass index) |
| Weakness | 'Exhaustion' (self-report) |
| Poor endurance; exhaustion | Walking time per 15 feet: slowest 20% (by gender, height) |
| Slowness | kcal per week: lowest 20% |
| Low activity | Males < 383 kcal per week |
| | Females < 270 kcal per week |
| | **Presence of frailty** |
| | Positive for frailty phenotype: >3 criteria present |
| | Intermediate or prefrail: 1 or 2 criteria present |

with the frailty models. Two of these are sarcopenia and cachexia and a short description will be given for completeness.

One characteristic of ageing is the progressive loss of muscle mass, which can be illustrated by the reduction in performance of masters' athletes in strength events such as the discus and shot put (Fig. 1). Examination of the graph shows a steep decline in distance thrown even in masters' athletes, with no concurrent long-term conditions. Sarcopenia is a clinical syndrome that now has a standard definition[6] and is associated with progressive loss of muscle mass and strength, which leads to poor quality of life and even to death. There are three criteria for the description of the syndrome; one constant feature is low muscle mass, which must be accompanied by either low muscle strength or low physical performance.

Similarly, after a consensus conference, there is now an accepted definition for cachexia. The condition is defined as a complex metabolic syndrome associated with an underlying illness.[7] It is beyond the scope of this article to expand on this topic further, but anaesthetists should be aware that many patients who present for surgery have experienced considerable weight loss and may have elements of the cachexia syndrome.

These models are useful as research constructs; however, their application in the clinical setting presents a challenge, especially when this challenge is an urgent operation on an older patient. Forty per cent of the cohort in the 2010 NECOPD report, *An Age Old Problem*,[8] had sustained a femoral neck fracture. The best practice tariff dictates surgery within 36 h; this does not leave much time for detailed frailty assessment. Should the diagnosis of frailty be made purely on clinical assessment approximating to one model or scale, or should we use tools or measurements for the accurate identification of the frail patient? There are going to be different approaches, depending on the urgency of the surgery and a realization that frail surgical patients are at increased risk during the perioperative period.

## The relevance of frailty to the anaesthetist

Frailty becomes more prevalent with age and up to 50% of those over the age of 85 may be frail.[9] Anaesthetists encounter the frail older patient frequently. For example, the National Joint Registry report from 2012[10] lists 166 000 primary hip and knee arthroplasty

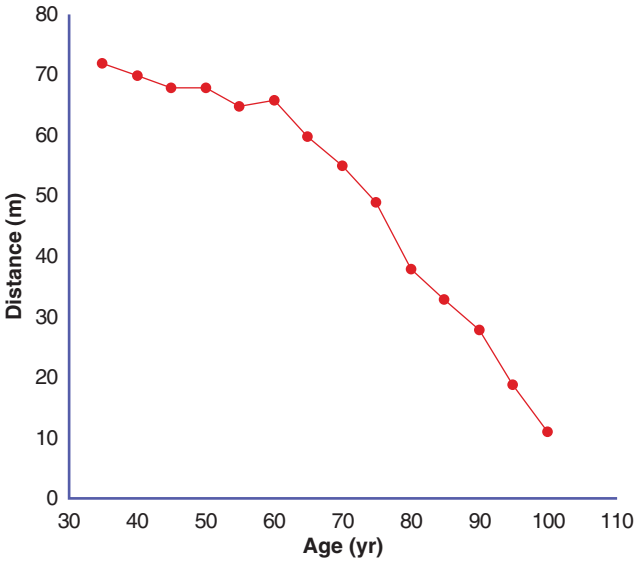


**Fig 1** World masters athletics discus records (male). Distance thrown in metres plotted against age range, which is in 5 yr gaps.

operations. For female patients, 51% of operations took place in individuals between 70 and 89 yr of age, and for males, this number was 43%. However, despite the frequency with which frailty is encountered, it is rarely formally assessed, diagnosed, or incorporated into discussion of the patient's risk profile. This is despite the independent association of frailty with increased postoperative morbidity, specifically the development of postoperative complications and length of acute hospital stay, both of which should be interesting to clinicians and healthcare managers.[11–13] Furthermore, the recognition of frailty and its use in addition to existing risk scores, such as ASA, improves the predictive power for postoperative complications.[12]

The 2010 NCEPOD report *An Age Old Problem* highlighted this gap in current services recommending that 'comorbidity, disability and frailty need to be clearly recognized as independent markers of risk in the elderly. This requires skill and multidisciplinary input including, early involvement of Medicine for the Care of Older People'. Three years on from this report, the authors are unaware of any frailty scoring tools in widespread use within the NHS for elective patients, let alone emergency ones.

Anaesthetists may have an important role in the proactive recognition of frailty, in risk stratifying older frail patients and in identifying and optimizing modifiable factors with a view to preventing postoperative complications and improving outcomes. Anaesthetists of all grades should be aware of the problems that frailty can pose to older surgical patients. By recognition of the problem, measures can be taken that may improve outcomes.

## Assessment tools for frailty and the surgical evidence

There is a comprehensive literature linking frailty to outcome in the medical literature.[9] The surgical and perioperative evidence is now

being gathered and a brief review of the frailty assessment tools reveals the different methods, where evidence of adverse outcomes in surgical patients has been collected.

Much of the work involving surgery and frailty has taken place in North America. Some of the evidence is taken from prospective studies and a proportion from examination of large databases of surgical patients. One Canadian group[11] prospectively examined more than 100 patients aged over 70 yr at the pre-surgery assessment clinic. They used an assessment tool called the Edmonton Frail Scale (EFS).[14] The EFS is a 17-point scale validated for use by non-geriatricians to assess frailty and can be applied to each patient within a matter of minutes. There is a smart phone app for the EFS, which is free to download, in English, French, and Dutch and takes about 5 min to perform in each patient (Fig. 2A and B). The first part of the score is to draw a clock face; this is much easier on an ipad, as the iphone is probably too small for most patients and those collecting the information. The clinical setting will dictate the utility of an assessment tool. For example, the time pressures in emergency surgery are an important factor in comparison with the elective setting. Certainly, this difference is reflected in the literature which mainly examines frailty in the context of planned surgery. However, in routine clinical care, the tools for identifying or measuring frailty must be applicable to both clinical scenarios. Ideally, the use of one tool across clinical settings, by all disciplines, specialities, and grades should be promoted. The EFS 17-point scale can be performed in <5 min. The 'get up and go' test, which is part of the EFS has recently been shown to predict morbidity and mortality across surgical specialities.[15] The test is not applicable to most emergency situations, but is valuable during anaesthesia assessment clinics, when this aspect of the scale can be observed when a patient either gets up and comes into the clinic or leaves at the end.

This prospective study[11] is relevant to UK anaesthesia, as the average age of the patients was 77 (range 70–92), and the majority of operations were orthopaedic, either primary or revision knee and hip arthroplasty. As frailty increased, postoperative complications increased, as did the length of hospital stay, and the inability to be discharged from hospital. This study also illustrated that 48% of the patients were on more than five oral medications, which could be a useful surrogate marker for frailty.

Another group from Johns Hopkins Hospital[12] used the tool described previously by Fried and colleagues.[4] This study was prospective and recruited almost 600 patients. The frailty scale (Table 1), comprising five core variables, was used and all patients were aged 65 yr or above. As frailty increased, postoperative complications got worse, as did the length of hospital stay and the discharge destination of the patient. What should be noted from this paper is the ability of the ASA score to predict postoperative complications. The predictive ability of the ASA score was 63%, which was improved up to 70% when the frailty measure was factored in.

When discharge to a convalescence unit was considered, ASA predicted this occurrence in 71%, increasing to 80% when the frailty measure was added in. ASA scoring is familiar to all anaesthetists and could easily be the starting point when deciding the frailty status of the patient. The specific tools improve accuracy but may not be readily available when an emergency assessment is being undertaken in an acute patient.

The data for emergency patients are retrospective and come from the analysis of the National Surgical Quality Improvement Programme (NSQUIP) from the USA.[13] The methodology that has been used takes data in the NSQUIP and matches it with aspects of the frailty index.[5] More than 35 000 patients, aged over 60, who underwent emergency inpatient general surgery were included in the study, for a 5 yr period, 2005–9. The Canadian Study of Health and Ageing has 70 variables, NSQUIP has 136, and the overlap between the two results in 11 data points for each patient, which the authors called the modified frailty index (MFI). A score of zero indicates no frailty, whereas a score of 11 indicates maximum frailty. The data were analysed for the occurrence of postoperative complications and 30 day mortality. As the frailty index increased, there were significantly more wound infections and mortality.

Similar methodology has been used, by the same research group, to analyse the elective surgical population using the NSQUIP data set.[2] These patients had undergone cardiac, general, gynaecological, neurosurgical, orthopaedic, ENT, thoracic, urological, and vascular surgical procedures. Data were collected from 971 434 patients and the same 11-point MFI was used. There was a stepwise increase in morbidity and mortality as the MFI increased for each surgical speciality. This study also highlighted that frailty is not confined to older individuals and perhaps with an increasingly inactive population, frailty may even become more prevalent in the younger age groups.

## Can frailty be modifed?

Prospective and retrospective data demonstrate that frailty, measured by different tools, impacts on morbidity and mortality from all types of surgery. Is there anything that can be done to modify the worsening outcomes as frailty increases?

For elective surgery, there may be some time to try and undertake some 'prehabilitation' for these patients. The evidence base is thin, but an exercise and strengthening programme before surgery may improve outcome. Other examples of interventions may include the review of current medication, cognitive screening, treatment of depression or mood disorders, improving nutrition, physiotherapy, and arranging social support. The use of even a simple tool as the EFS may be difficult in the emergency setting, but recognition is still important. Perhaps a simple tick box on the anaesthesia chart, recording that the clinician assessing the patient deemed the individual 'frail', would trigger a series of steps that would alert the nursing and medical staff who would be subsequently looking after the patient.

There is no clear or single intervention proven to modify the syndrome of frailty or to impact on postoperative outcomes in frail individuals. However, improving outcome in high-risk patients is likely to depend on earlier recognition of the high-risk frail individual, followed by risk stratification and optimization, with the aim of

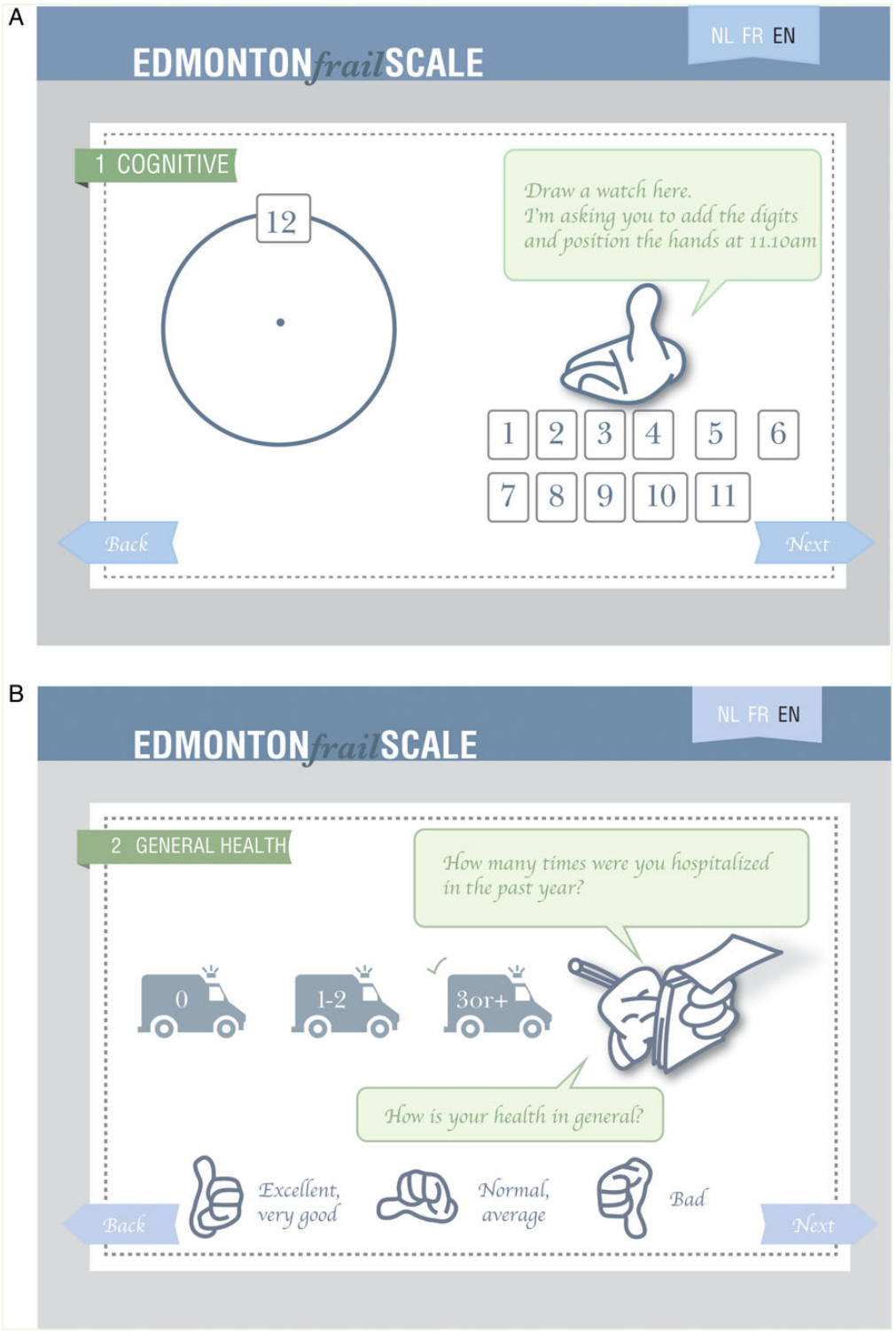


**Fig 2** (A) The Edmonton Frail Scale app screen shot. Available for smart phones and tablet devices (with permission from Create Multimedia, Belgium). The first task is to draw a clock face, and then put on the hands at 10 past 11. The numbers from the app can be dragged onto the clock face (http://www.createmultimedia.be/). (B) Edmonton Frail Scale screen shot with question asking about how many times the patient was in hospital in the last year. The whole process takes about 3 min and gives a final score out of 17 (http://www.createmultimedia.be/).

modifying the degree of frailty before surgery. Current interventional studies for modulation of frailty are focusing on approaches such as iron, folate, and vitamin $B_{12}$ replacement to correct anaemia; protein and vitamin D supplementation to correct sarcopenia; individual or group exercise programmes to improve mobility and functional ability; the use of anabolic steroids, growth hormone, or angiotensin-converting enzyme inhibitors. There is currently no outcome evidence to support these interventions.

Emergency surgery is more difficult, but early recognition can help anaesthetists identify the need to reduce drugs that may precipitate acute delirium, think about the postoperative destination of the patient, and pay attention to normothermia and hydration during the perioperative period.

Clinical management of frail older patients calls for close multidisciplinary working among various disciplines such as anaesthetists, intensive care team, surgeons, older persons physicians, old-age psychiatrists, nursing staff, pharmacists, physiotherapists, and dieticians. One such approach is that used in the 'POPS' model (Proactive care of Older People undergoing Surgery)[16] with early multidisciplinary team input, rather than a reactive approach, which may help to reduce postoperative complications and reduce the length of hospital stay. It may also allow early discharge planning with identification of those who may require additional support or rehabilitation post-surgery. Active input from geriatricians' may be required to advise on complex issues such as capacity, consent, and advance directives. The development of the speciality 'orthogeriatrics' as a medical subspeciality has helped the management of fractured femur patients. Perhaps, there will be more medical input into emergency general surgery patients, along the same model as orthogeriatrics. This was called for in the NCEPOD report,[8] together with the recognition of frailty. Three years down the line, progress has been limited.

## Summary

Frailty is an independent predictor of adverse surgical outcome. Anaesthetists are likely to encounter frail patients in the elective and emergency setting and should try to identify risk factors at preoperative assessment. A simple ASA score can highlight problems and the application of smart phone technology should help our speciality to understand and diagnose frailty more accurately. Work is urgently needed to try and address frailty and implement programmes that can reduce the impact of the condition on the outcomes of surgery.

## Declaration of interest

None declared.

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**Please see multiple choice questions 17–20.**