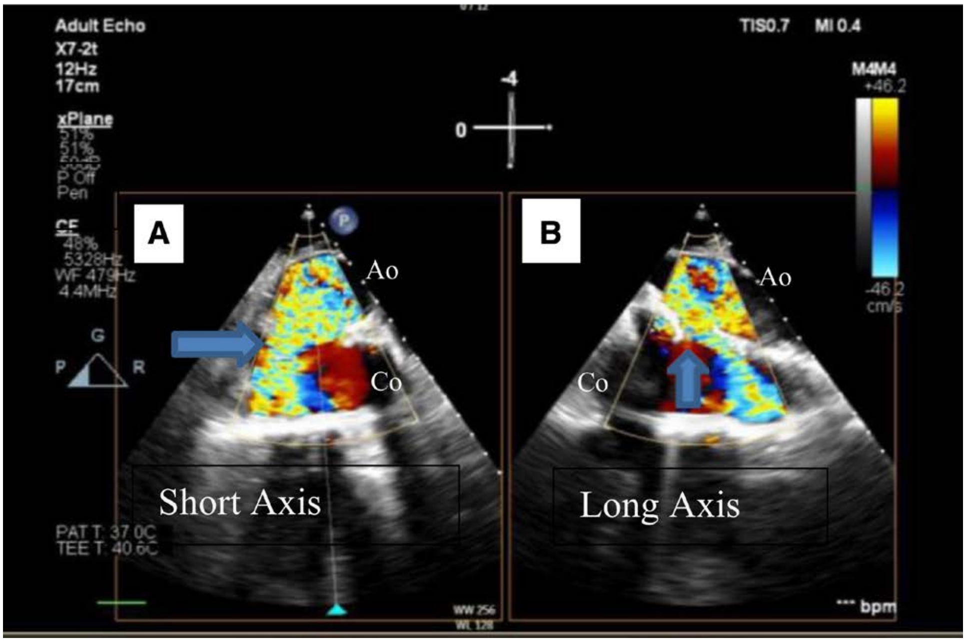

Fig. 1. Midesophageal ascending aorta short axis (*A*) and long axis (*B*). Co, pseudoaneurysm collection; Ao, aorta.

opening of the pseudoaneurysm, a larger box size was used to image the area of flow from the aorta to the pseudoaneurysm. Our Nyquist limit was lower than recommended range, but turbulence flow entering the pseudoaneurysm can be expected as a result of the narrow opening of the pseudoaneurysm.[6]

Competing Interests

The author declares no competing interests.

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Preoperative Frailty Assessment: Comment

To the Editor:

We read with interest the article by Sonny *et al.*[1] comparing two methods for frailty measurement in the ability to predict hospital length of stay after noncardiac surgery.

Assessments of frailty have been relevant in surgical outcomes research since milestone work by Makary *et al.*[2] With more than 60 instruments to measure frailty currently available and no consensus on how to integrate frailty measures into perioperative management, we agree with the authors that assessing comparative predictive accuracy between different frailty instruments is timely and clinically relevant.

It is not surprising, however, that the two measures selected (the phenotypic Hopkins Frailty Score and a modified deficit accumulation score [*i.e.*, frailty index]) in the study of Sonny *et al.*[1] demonstrated large error in the prediction of prolonged hospitalization across a heterogeneous group of patients undergoing noncardiac surgery. Many studies evaluating perioperative prediction models have consistently shown substantial challenges in accurately estimating prolonged hospitalization. Indeed, of routinely collected outcomes, hospital length of stay has arguably the highest variation and most substantial contribution from indirect patient predictors (*e.g.*, social status, home supports, availability of allied health services). Neither of the frailty instruments tested by Sonny *et al.*[1] capture these factors and are therefore unlikely to accurately predict or explain a substantial degree of variance in prolongation of stay.

Despite the clear importance of the authors' efforts to compare frailty instruments, the choice of these two frailty tools, each of which lacks multidimensionality, likely contributes to the low predictive accuracy reported. As the authors rightly point out, frailty instruments differ in their estimation of a frailty score based on the use of a phenotypic model (requiring prospective ascertainment and direct patient evaluation) or an accumulation of deficits model of frailty (amenable to medical record evaluation, which can be conducted retrospectively or in real time). The phenotype model, developed by Fried *et al.*[3] and adapted in various operationalizations, including the Hopkins Frailty Score (used by Sonny *et al.*[1]), provides an objective assessment of biologic manifestations of frailty. In the phenotype model, changes and dysregulation present at the cellular and subcellular level are expressed through means that are primarily physical in nature (*i.e.*, decreased energy, strength, gait speed, body mass, and activity levels); this means that the phenotype model does not directly include cognitive or social deficits, both of which are agreed upon by experts to be essential components of the frailty syndrome[4] and both of which are likely to substantively influence a patient's length of hospital stay.

The deficit accumulations model, originally developed by Mitnitski *et al.*,[5] has also been adapted in many forms yet comes with clear guidelines for robust derivation of a frailty index. This guidance includes the need to measure 30 or more deficits that exist across multiple domains (*e.g.*, cognitive, medical, psychosocial, physiologic).[6] The Rockwood frailty index is robust, likely reflecting redundancy and strong interrelationships between the different elements that make up the model. Unfortunately, the modified frailty index (initially derived for use with the National Surgical Quality Improvement Program administrative database) contains only 11 deficits, 10 of which are specifically medical diagnoses. Although the reduced number of variables increases measurement ease and broad implementation, the additional variables that are missing within the modified frailty index compared to a more traditional Rockwood frailty index likely contribute to risk for perioperative adverse outcomes, particularly in surgical populations with relatively low levels of frailty (~20% in the study by Sonny *et al.*[1]) This makes the modified frailty index more closely aligned to a condensed comorbidity index (*e.g.*, Charlson index) than a true multidimensional measure of frailty.

Additionally, frailty status assigned by both tools was applied in a dichotomous manner (with a cutoff of either 3 or higher [in the text] or 4 or higher [in Table 3] for the Hopkins Frailty Score and 4 or higher for the modified frailty index). While we agree that a dichotomized frailty assignment is often used for risk stratification, if the objective of a study is to determine the predictive accuracy of a given scale, it is well demonstrated that dichotomization of a predictor variable can lead to decreased predictive performance compared to continuous representations such as regression splines or polynomials.[7]

Last, and perhaps most salient to the study by Sonny *et al.*,[1] type of surgery is likely the most important predictor of complications and length of stay. While the study's primary outcome, prolonged length of stay, was determined based on the difference between actual length of stay and hospital- and surgery-specific expected length of stay (which provides some degree of procedural adjustment), this approach may also downwardly bias measures of accuracy. The study was performed in the period from 2015 to 2016, whereas expected length of stay data were based on historical trends from 2010 to 2015. Poor temporal transportability of prediction models is well documented. It would be interesting in future studies to better understand whether actual *versus* predicted total length of stay, adjusted for procedure as a covariate in a temporally contemporaneous cohort, might yield better performance when assessing the accuracy of prediction tools. Especially if, as in the current study, procedures with typically shorter lengths of stay like orthopedic surgeries are found more than two times more common in the group with frailty (introducing confounding bias).

We commend the authors for highlighting the need to identify a best method for perioperative frailty estimation to aid implementation of frailty measurement more effectively into clinical practice. More importantly, however, we believe that the failure of the two frailty instruments studied in predicting prolonged hospitals stays, readmissions, and 30-day complications, should be interpreted with caution. We appreciate this recent feature article for highlighting the need to advance research on the risk prediction ability of frailty by type of surgery in anesthesiology. The gold standard for risk prediction in anesthesiology is yet to be determined, and tools will likely need to be more granular and stratified by type of surgery.

Competing Interests

The authors declare no competing interests.

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Preoperative Frailty Assessment: Comment

To the Editor:

We read with interest the study by Sonny *et al.*[1] assessing frailty using the Hopkins phenotypic scale and of the health deficit–based modified frailty index in 1,042 patients undergoing noncardiac surgery. We are particularly interested in the finding that neither approach to diagnosing frailty was a clinically useful predictor of unexpected prolonged hospital stay, readmission, and serious complications. We agree that many previous studies of frailty have not adequately examined both odds ratios and predictive value of frailty assessments. However, we are concerned about the validity of the modified frailty index as a tool to measure frailty. Sonny *et al.* found only a weak correlation between the modified frailty index and Hopkins frailty scales: r = 0.28.

The modified frailty index was derived by identifying National Surgical Quality Improvement Program variables that aligned with the 70-item Canadian Study of Health and Aging Frailty Index.[2] The resulting scale involves only 11 variables: 9 are medical comorbidities, and only 2 are alternative health deficits: "functional status–not independent" and "impaired sensorium." This contrasts with the 2012 Frailty Consensus Conference, which defined six health domains affected by frailty that should be included in a frailty scale: physical performance, gait speed, mobility, nutritional status, mental health, and cognition.[3] Few of these attributes are contained within the modified frailty index. Sonny *et al.* also reference the work of Searle *et al.*[4] in describing the 10-variable threshold below which frailty estimates are unstable; this article, however, clearly states that at least 30 age-related deficits must be included across the spectrum of health when constructing an accurate cumulative deficit frailty index. It is also instructive that the majority of health deficits contained in the original Rockwood frailty index are nonmedical comorbidities (42 of 70 variables).[5] We thus question whether the modified frailty index can be truly regarded as a measure of frailty or whether it is more an index of comorbidity. If this were the case, it is still unsurprising that the modified frailty index has been associated with adverse postoperative outcomes given the link between perioperative comorbidity and postoperative complications and mortality. In support of this proposition—that the modified frailty index is predominantly a comorbidity index—Sonny *et al.* reported higher Charlson comorbidity index values in patients diagnosed with frailty with the modified frailty index (median, 6; interquartile range, 4 to 8) compared with those diagnosed as frail with the Hopkins scale (median, 3; interquartile range, 2 to 6).

Although the modified frailty index is an understandably attractive measure to derive from the National Surgical Quality Improvement Program data sets with 11-point simplicity, we question its validity as a frailty tool because of the small number of items, the overrepresentation of comorbidity, and the under representation of other health domains. Caution must be exercised in its application as a proxy for frailty without validation research.

Competing Interests

The authors declare no competing interests.

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Preoperative Frailty Assessment: Reply

In Reply:

We compared the Modified Frailty Index and Hopkins Frailty Score for predicting duration of hospitalization.[1] Johnson *et al.*[2] and Darvall *et al.*[3] note that the scores we used differ from those recommended by the 2012 frailty operative definition consensus conference.[4] The consensus conference used a modified Delphi process to consolidate expert opinion and generate a consensus definition for frailty. Although participating experts agreed that frailty is multidimensional, they could not agree on an operational definition, possibly because supportive data for individual frailty components are lacking. The assessment tools we used assess single—but different—frailty dimensions. In this respect, they were similar to most perioperative frailty assessment tools that are also unidimensional. For example, a recent systematic review of reported frailty instruments describes 51 tools, of which only two are multidimensional.[5]

Johnson *et al.*[2] comment that the Hopkins Frailty Score only measures the physical aspects of frailty. However, our study was not to develop or test a specific multidimensional frailty score; instead it was designed to compare the clinical performance of the two most commonly used measures. Hopkins Frailty Score closely mimics the commonly used Fried Index and is validated for noncardiac surgical patients. A recent systematic review and meta-analysis identified the Fried Index and related modifications to be the most prevalent preoperative frailty measure among the 35 tools they evaluated.[6] Despite its lack of multidimensionality, the Fried Index is recommended by the American College of Surgeons as a tool for assessment of frailty among geriatric surgical patients.[7]

The other frailty tool we used, the Modified Frailty Index, was developed by selecting 11 of the variables collected by the National Surgical Quality Improvement Program. The selected variables closely match those in the Canadian Study of Health and the Aging-Frailty Index, a well regarded deficit accumulation model of frailty.[8] Among the 11 variables constituting the Modified Frailty Index, nine are comorbidities. The other two are impaired sensorium and functional status, which measures cognitive domain and physical performance. We do acknowledge the observations of Johnson *et al.*[2] and Darvall *et al.*[3] that the Modified Frailty Index is largely a measure of comorbidity rather than a multidimensional measure of frailty. We nonetheless considered the index because it is among the most commonly reported frailty scores within the deficit accumulation paradigm. In fact, a recent meta-analysis assessing frailty in noncardiac surgical population evaluated the Modified Frailty Index because it was the most commonly used perioperative measure.[9] Specifically, the authors identified 32 studies that used the Modified Frailty Index, most published after 2015.

Referring to the work of Searle *et al.*,[10] Darvall *et al.*[3] state that at least 30 deficits must be included to construct an accurate deficit accumulation frailty index. We agree that more information increases precision of frailty measures, but measures that assess 30 or more deficits are relatively impractical and seem unlikely to be broadly adopted. Furthermore, such elaborate measures may not be necessary. Although Searle *et al.*[10] stated that 30 to 40 deficits is optimal, they also conclude that models with at least 10 deficits are stable.

We agree with Johnson *et al.*[2] that duration of hospitalization is influenced by various variables including social factors. Nevertheless, it is primarily driven by various disease-related factors and to some extent by hospital-related factors. Hospital duration is therefore a widely reported outcome in frailty studies, including ones that used the Modified Frailty Index and the Fried Index. Johnson *et al.*[2] comment that using historic trends to calculate length of stay downwardly biases accuracy. However, our length-of-stay data were obtained from 2010 to 2015, which is well within the accepted time frame of temporal transposability. Johnson *et al.*[2] suggested that an alternative study design adjusting for procedure as a covariate in a contemporaneous cohort might have better performance. However, choosing a contemporaneous cohort for calculating expected length-of-stay from a different hospital setting would not be preferable because hospital-related factors play an important role in determining length of stay. Even if our estimates of expected length-of-stay were consistently high, it would not influence the *relative* ability of each measure to predict hospital duration. In any case, we compared the two frailty measures within each patient, thereby avoiding bias.

We agree with Johnson *et al.*[2] that dichotomizing continuous variables diminishes statistical power—and therefore did not. As specified in the text, "Patients with a Hopkins Frailty Score of 3 or more are classified as frail. Among various cutoffs used to designate frailty based on the Modified Frailty Index, the score of 4 or higher out of 11 is most commonly reported. However, both scores were considered as continuous variables for our analyses." As specified, dichotomized cohorts were therefore presented in the tables only to facilitate interpretation.

In summary, our results support the 2012 frailty consensus statement by showing that the Hopkins Frailty Score and the Modified Frailty Index, both of which lack multidimensionality, poorly predict the duration of hospitalization and complications after noncardiac surgery. It will be interesting to see whether multidimensional measures predict better.

Competing Interests

The authors declare no competing interests.

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Protective Device during Airway Management in Patients with Coronavirus Disease 2019 (COVID-19)

To the Editor:

Healthcare workers are exposed to a higher than average risk of infection by the contagious coronavirus disease 2019 (COVID-19), which requires special attention to their protection.[1] Anesthesiologists and nurse anesthetists are particularly confronted by a high-risk situation when managing the airway of infected patients: oxygenation by bag-mask, cough during laryngoscopy, and tracheal intubation and extubation. Careful planning is required, and guidelines have been published for anesthesiology teams[2,3] to follow in such cases. Thus, airway management must be realized in an airborne isolation room (negative pressure).

Fig 1. Neonatal plexiglass incubator hood (after removing one side and strengthening the base).

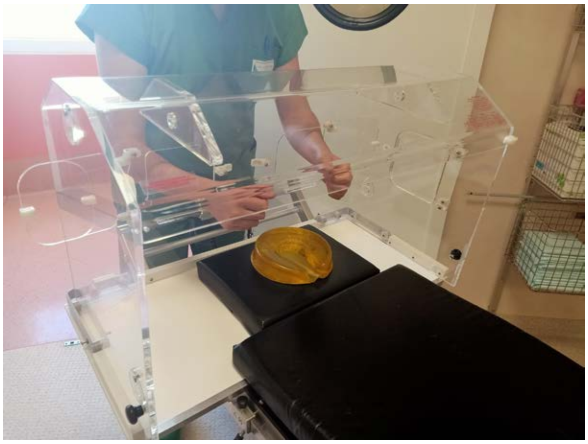

Fig 2. Installation on operating table and access by the two portholes.

Airborne precautions, hand hygiene, and donning of personnel protective equipment including reinforced overshirt, double gloves, glasses, and filtering facepiece particles class 2 mask must be respected. It is also recommended that tracheal intubation is carried out under rapid sequence induction by an expert anesthesiologist using video laryngoscopy.[2,4]

To reduce the risk of contamination during airway management, several devices are described (transparent field over the patient, protective helmet, plexiglass box).[2,5] We hereby describe a novel device by recycling and reusing existing hospital equipment; it is based on a neonatal incubator hood, which has been modified by reinforcing the base and removing one side (fig. 1).

On the model available in our hospital, it can simply be unscrewed and the four sides are removable. After testing two models with different sizes of portholes (12 and 15 cm), we opted for the larger one, providing adequate ability to perform intubation (using MacGrath in our institution) without movement difficulties (figs. 2 and 3). The space around the arms is minimal and offers the best benefit–risk ratio, reducing the diffusion of aerosolized particles as much as possible compared with the absence of a protective device. In addition, the side porthole offers the possibility for a second operator to perform additional maneuvers, such as suction or the Sellick maneuverer (fig. 4). To harden the entire device, we used a rigid plastic board cut to the dimensions of the hood and fixed directly with screws on the existing screw holes. The manufacturing process was carried out with the help of a technical agent, in particular for the manufacture of the new base, with compatible equipment for hospital use (especially for hygiene). The entire process took less than an hour. The hood used was part of a defective incubator that was intended to be destroyed (obsolete equipment).

Because of the importance of the risk of projections of contaminated aerosols during the various maneuvers on the