Original Article

Integration of functional capacity to medically necessary, time-sensitive scoring system

A prospective observational study

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ABSTRACT

الأهداف: كان نظام التسجيل الأكثر شيوعًا لفرز العمليات الجراحية الاختيارية أثناء الجائحة هو نظام التسجيل الضروري طبيًا والمراعي للوقت (MeNTS). تم اقتراح العديد من التعديلات على MeNTS، ولم يدرس أي منها نتائج ما بعد الجراحة وتقييم قياس القدرة الوظيفية. كان هدفنا هو تقييم تعديلين جديدين على أنظمة تسجيل MeNTS حيث تم دمج تقييم القدرات الوظيفية، في تقدير متطلبات وحدة العناية المركزة (ICU).

المنهجية: أجريت هذه الدراسة الرصدية المستقبلية بين يوليو 2021م ويناير 2022م، وتم تضمين المرضى الذين خضعوا لعمليات جراحية اختيارية. تم حساب درجات MeNTS، اثنتين من درجاتنا المعدلة MeNTS-METs (مؤشر حالة نشاط Duke المتكامل (DASI) كمكافئات الأيض) و MeNTS-DASI-5Q المتكامل المعدل (M-DASI) كخمسة أسئلة). تم تسجيل متطلبات وحدة العناية المركزة (مثل وحدة العناية المركزة للمجموعة + ووحدة العناية المركزة للمجموعة -)، و DASI، وخصائص تخدير وجراحة المريض، ومدة الإقامة في المستشفى، وإعادة الاستشفاء، ومضاعفات ما بعد الجراحة والوفيات.

النتائج: تم تحليل 718 مريضًا. كانت درجات MeNTS و MeNTS-METs و MeNTS-DASI-5Q أعلى في وحدة العناية المركزة للمجموعة + مقارنة مع مجموعة Group ICU (p<0.001). كانت مدة العملية وطول الإقامة في المستشفى أطول (p<0.001)، وكانت درجات DASI أقل (p<0.001)، وإعادة الدخول إلى المستشفى، ومضاعفات ما بعد الجراحة والوفيات لوحظت أكثر (p<0.001) في وحدة العناية المركزة للمجموعة +. كان لدرجات MeNTS-METs و MeNTS-DASI-5Q تنبؤ أفضل بمتطلبات وحدة العناية المركزة مع منطقة تحت المنحنى AUC=0.806، و0.804، على التوالي من MeNTS الأصلي (AUC=0.782).

الخلاصة: من السهل حساب DASI المعدل المكون من خمسة استبيانات ويمكن الاعتماد عليه مثل DASI الأصلي للتنبؤ بمتطلبات وحدة العناية المركزة بعد الجراحة، عند إضافته إلى درجة الفرز.

Objectives: To evaluate 2 new modifications to medically necessary, time-sensitive (MeNTS) scoring systems integrating functional capacity assessment in estimating intensive care unit (ICU) requirements.

Methods: This prospective observational study included patients undergoing elective surgeries between July 2021 and January 2022. The MeNTS scores and our 2 modified scores: MeNTS-METs (integrated Duke activity status index [DASI] as metabolic equivalents [METs]) and MeNTS-DASI-5Q (integrated modified DASI [M-DASI] as 5 questions) were calculated. The patients' ICU requirements (group ICU+ and group ICU-), DASIs, patient-surgery-anesthesia characteristics, hospital stay lengths, rehospitalizations, postoperative complications, and mortality were recorded.

Results: This study analyzed 718 patients. The MeNTS, MeNTS-METs, and MeNTS-DASI-5Q scores were higher in group ICU+ than in group ICU- (p<0.001). Group ICU+ had longer operation durations and hospital stay lengths (p<0.001), lower DASI scores (p<0.001), and greater hospital readmissions, postoperative complications, and mortality (p<0.001). The MeNTS-METs and MeNTS-DASI-5Q scores better predicted ICU requirement with areas under the receiver operating characteristic curve (AUC) of 0.806 and 0.804, than the original MeNTS (AUC=0.782).

Conclusion: The 5-questionnaire M-DASI is easy to calculate and, when added to a triage score, is as reliable as the original DASI for predicting postoperative ICU requirements.

Keywords: intensive care units, metabolic equivalent, triage, elective surgical procedures

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Coronavirus disease 2019 (COVID-19) diagnoses in patients with comorbidities are associated with severe COVID-19 illness that requires intensive care unit (ICU) care.[1,2] Per global precautions, during the first surge of the COVID-19 pandemic, health authorities in several countries restricted elective surgeries to preserve resources for these critical patients and patients requiring urgent/emergent surgeries. Elective surgeries began to be scheduled after the first peak. The pandemic is now slowing, with fewer new COVID-19 diagnoses, after several surges in peak patient numbers.

Surgical prioritization is challenging under both surging and slowing pandemic conditions. During a pandemic, neither the possibility of overextending limited resources to cover elective cases, jeopardizing the care of infected patients, nor the possibility of disease advancement due to surgery postponement is desired. Furthermore, the post-pandemic era also requires a prioritization scoring system since a surgery backlog is created during the mandatory cancellation and restrictive capacity periods.

Several guidelines have been published for surgical decision and triage.[3,4] The medically necessary, time sensitive (MeNTS) scoring system (**Appendix 1**) comprising parameters evaluating procedure, disease, and patient factors, was proposed by Prachand et al[5] and promoted by the American College of Surgeons. Despite some improvements, patient characteristics relating to intensive care and hospital bed occupation and postoperative outcomes were not elucidated in these surgical studies.[6-10] As perioperative physicians, anesthesiologists, and intensive care specialists should be involved in resource planning.

We had previously published a significant relationship between high MeNTS scores and moderate to severe outcomes. We speculated that incorporating a cardiovascular functional capacity parameter could improve the scoring system.[11] Therefore, this observational, prospective study, carried out under the semi-restrictive status of our institution following the third surge of the pandemic, aimed to compare the original MeNTS scoring system with modified MeNTS scoring systems incorporating functional capacity for the primary outcome of ICU requirement. Our secondary outcomes were hospital stay length, hospital readmission, postoperative complications, and mortality.

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Methods. This study was approved by the Ethics Committee of Istanbul Medical Faculty, Istanbul, Turkey (protocol number: 2021/1117) and was carried out in accordance with the Declaration of Helsinki principles. Written informed consent was obtained from all patients prior to participation. This study followed the strengthening the reporting of observational studies in epidemiology (STROBE) reporting guideline.[12]

The study was carried out in a university hospital, a tertiary center with approximately 25.000 surgeries/year in the pre-pandemic era. Out of 8 ICUs, 4 with a total capacity of 38 beds are managed primarily by anesthesiologists who care for adult postoperative surgical and medical patients. The study period was from July 2021 to January 2022, between the third and fourth surges of the pandemic for our country. The total number of operating rooms were 30 and ICU beds were 25 allocated to surgery during this period. A pandemic ICU also operated with 13 beds employing 8 anesthesiologists/day during this period.

All patients undergoing operation were screened and enrolled if eligible after consenting. This study included elective cases, and case priority was classified according to the need to carry out surgery following admission as urgent-elective (>24 hours but <2 weeks), essential-elective (within 1-3 months), and discretionary elective (>3 months).[13] Emergent cases that had to be operated on within 24 hours of admission were excluded from this study. Patients aged <18 years or with whom communication was impossible were also excluded. All enrolled patients were screened for COVID-19 with a symptoms questionnaire, and the nasopharynx was sampled for a polymerase chain reaction (PCR) test.

We recorded the patients' demographic data, surgery characteristics (including case priority and surgery type), anesthesia characteristics, American Society of Anesthesiologists (ASA) physical status class, malignancy status, smoking history, PCR-test-based COVID-19 screening results, and, if present, the clinical symptoms and signs of COVID-19 (namely, fever, cough, and dyspnea).

The MeNTS scores were calculated for each patient. A senior surgeon on the surgical team carried out the surgical evaluation, which was confirmed by the study surgeon (AFKG).

We computed Duke activity status index (DASI) scores to incorporate functional capacity data into the patient domain in MeNTS scoring.[14] However, the 12-item DASI questionnaire is not a scoring system that could be divided into 5 or fewer parts and added easily to the patient domain of MeNTS because of the non-uniform weight of each item.

Therefore, the DASI was incorporated in 2 ways. In the first method, functional capacity computed by DASI was converted into metabolic equivalents (METs) using the formula: ([0.43×DASI]+9.6)/3.5.[15] In this MeNTS-METs scoring system, an additional row categorized according to METs values was inserted into patient factors (5 points= <4 METs; 4 points= ≥4 and <7 METs; 2 points= ≥7 and <9.89 METs; and one point= 9.89 METs, **Appendix 2**). In the second method, a simplified (modified) DASI comprising 5 questions (M-DASI-5Q) was calculated as suggested by Riedel et al.[16] In the MeNTS-DASI-5Q scoring system, the additional row was based on the number of questions answered positively: 5 points= none/one positive answer; 4 points= 2 positive answers; 3 points= 3 positive answers; 2 points= 4 positive answers; and one point= all questions answered positively (**Appendix 3**).

Anesthesia method (general, neuraxial, and peripheral nerve block), operation duration, ICU requirement (planned or unplanned), total hospital stay length, and rehospitalization were recorded. Planned ICU admissions were decided by the consultant anesthesiologist in charge of that operating theatre according to the patients' comorbidities and surgical characteristics. Unplanned admissions immediately after the operation due to intraoperative complications were decided by the same consultant. Unplanned ICU admissions from the ward due to postoperative complications were decided by the consultant anesthesiologist in charge of the ICU.

Postoperative complications were analyzed and classified in severity according to Clavien-Dindo (CLD) classification.[17] Postoperative pulmonary complications (PPCs), major adverse cardiac and cerebrovascular events (MACCEs), mortality within the first postoperative month, and postoperative COVID-19 infection within 14 days were recorded.[18,19]

Statistical analysis. In this exploratory study, we attempted to screen and approach all cases since the period between the third and fourth surges was unknown. Therefore, no sample size calculation was possible.

Patients were classified into 2 groups as group ICU+ and group ICU- according to their postoperative ICU requirements. Data are expressed as mean ± standard deviation (SD), median (interquartile range [IQR]), or number and precentages (%). The Shapiro-Wilk and Kolmogorov-Smirnov tests were used to assess the normality of quantitative data distributions. Student's t-test was used to compare normally distributed data, while the Mann-Whitney-U test was used to compare non-normally distributed data. Where applicable, the mean difference and its 95% confidence interval (CI) are also given. Chi-square tests were used to compare qualitative data. Receiver operating characteristic (ROC) curves were created. The area under the ROC curve (AUC) was calculated to assess the predictive accuracy of MeNTS, MeNTS-METs, and MeNTS-DASI-5Q scores for the ICU requirement. Receiver operating characteristic curves were interpreted according to their AUC: poor= 0.60-0.69; fair= 0.70-0.79, good= 0.80-0.89; and excellent= ≥0.90. Statistical analysis was carried out using the Statistical Package for the Social Sciences, version 21.0 (IBM Corp., Armonk, NY, USA).

Results. This prospective study screened 789 patients, of which 718 were included in the analysis (**Figure 1**). Case priority was listed as urgent-elective for 151 (21.0%), essential elective for 458 (63.8%), and discretionary elective for 109 (15.2%) patients. Patients' surgical characteristics are shown in **Table 1**. For 22 (3.1%) patients, COVID-19 PCR tests were negative preoperatively but positive postoperatively with repeated testing; 11 had a COVID-19 infection during their hospital stay, of which 5 needed ICU care, and 3 died. A total of 11 of 22 patients were infected within the first 14 days after discharge; and 2 were rehospitalized and discharged without complications.

The participants' median age was 48 (35-62) years, their mean body mass index (BMI) was 26.96±5.21 kg/m^2, and 287 (40%) were male. Their mean MeNTS score was 49.93±8.30, and their median DASI score was 44.70 (26.95-58.20). The mean MeNTS-METs score was 52.33±8.92 and the mean MeNTS-DASI-5Q score was 52.45±8.89. General anesthesia was carried out for 594 (82.7%) patients, while neuraxial anesthesia was used alone for 98 (13.6%) patients and peripheral nerve blocks was used for 26 (3.6%) patients. The median operation time was 110 (65-180) minutes.

The group ICU+ comprised 178 (24.8%) patients, of which 12 were unplanned; 6 were admitted due to intraoperative complications, while the other 6 were admitted from the ward due to postoperative complications. **Table 2** compares demographics, preoperative and intraoperative characteristics, DASI scores, the 3 different MeNTS scores with subdomains (procedure, disease, and patient factors), total hospital stay lengths, and rehospitalization rates in goup ICU+ and group ICU-.

When the subdomains of all 3 types of MeNTS scores were compared between groups ICU+ and ICU-, patients requiring an ICU stay had more complicated procedures with increased procedure domain scoring, operations requiring urgency with decreased disease domain scoring, and concomitant diseases with

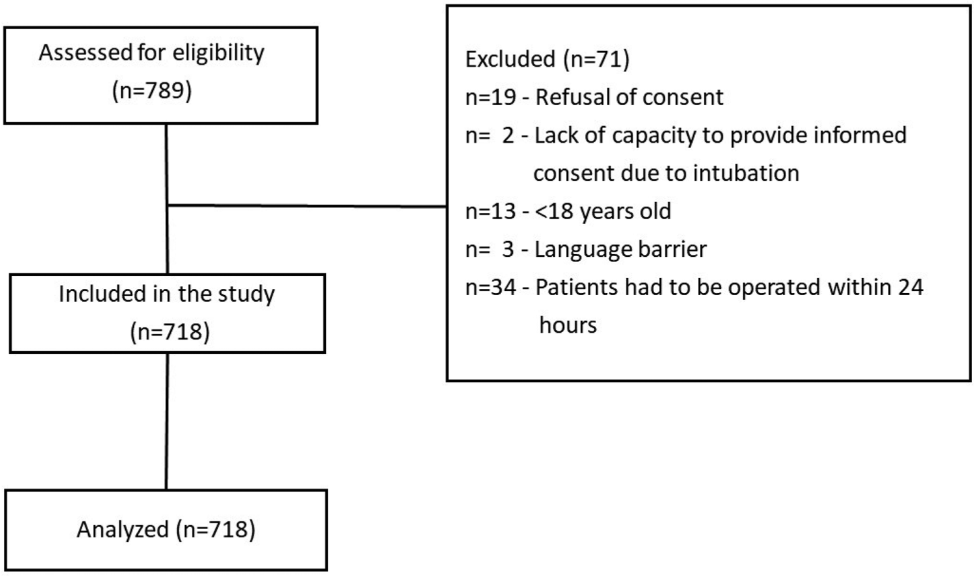

Figure 1 - Flow diagram.

Table 1 - Patients' surgical characteristics.

Type of surgery	n (%)
General surgery	235 (32.7)
Abdominal	167 (23.3)
Breast	29 (4.0)
Other	39 (5.4)
Orthopedic surgery	101 (14.1)
Gynecological and gynecologic oncological surgery	181 (25.2)
Neurosurgery	55 (7.7)
Ear-nose-throat surgery	54 (7.5)
Plastic surgery	16 (2.2)
Thoracic surgery	18 (2.5)
Cardiovascular surgery	10 (1.4)
Urology	48 (6.7)

Values are presented as numbers and precentages (%).

increased patient domain scoring (Table 2). Since the MeNTS-METs and MeNTS-DASI-5Q scores only change due to patient domain scoring, group ICU+ had higher patient domain scores for both MeNTS-METs and MeNTS-DASI-5Q (Table 2).

Figure 2 shows the ROC curves representing the carrying out of MeNTS, MeNTS-METs, and MeNTS-DASI-5Q scores for predicting ICU requirements. Area under the curves were good for the MeNTS-METs (AUC=0.806) and MeNTS-DASI-5Q (AUC=0.804) scores but fair for the original MeNTS score (AUC=0.782).

Postoperative complication severity, PCCs, MACCEs, and mortality in groups ICU+ and ICU- are shown in Table 3. Postoperative pulmonary complications were observed in 44 (6.1%) patients, of which 13 had 2 or more pulmonary complications, while postoperative MACCEs were observed in 22 (3.1%) patients. Three patients had pulmonary embolisms: 2 during their ICU stay and one on the ward on the ninth postoperative day, necessitating admittance to the ICU.

Median MeNTS scores were higher in patients with PPCs (58 [52.50-62] vs. 50 [44-55], $p<0.001$) and with MACCEs (57 [51-60] vs. 50 [44-56], $p<0.001$). The MeNTS, MeNTS-METs, and MeNTS-DASI-5Q subdomains were analysed according to the presence of PPCs and MACCEs (Table 4). According to Clavien-Dindo (CLD) classification, the total MeNTS scores were higher in patients with CLD ≥II than CLD <II (55 [48-61] vs. 49 [44-54], $p<0.001$). Mortality was observed in 9 (5.1%) patients and higher median MeNTS scores were calculated in these patients compared to survivors (58 [50.50-65] vs. 50 [44-56], $p=0.018$).

Discussion. In this study, we found that MeNTS scores were higher in patients requiring ICU care than in patients not requiring ICU care. Furthermore, the MeNTS scoring system incorporating functional capacity had better predictive accuracy for estimating ICU needs.

Determination of surgical patients requiring ICU admission is important. While underestimated admission might cause inadequate patient care on the ward, overestimation might misuse critical

Table 2 - Comparison of group intensive care unit (-) and group intensive care unit (+).

Parameters	Group ICU- (n=540)	Group ICU+ (n=178)	*P*-values	Mean (95% CI)
Age, years, median (IQR)	43 (32-56)	62.50 (51.75-70)	<0.001	
Gender, male	195 (36.1)	92 (51.7)	<0.001	
ASA physical status class			<0.001	
ASA 1	153 (28.3)	12 (6.7)		
ASA 2	358 (66.3)	89 (50.0)		
ASA 3	29 (5.4)	68 (38.2)		
ASA 4	0 (0.0)	9 (5.1)		
BMI (kg/m^2), mean±SD	26.81±4.89	27.39±6.08	0.196	
Presence of smoking	171 (31.7)	71 (39.9)	0.044	
Type of anesthesia			0.016	
General anesthesia	435 (80.6)	159 (89.3)		
Central nerve block-spinal	85 (15.7)	13 (7.3)		
Peripheral nerve block	20 (3.7)	6 (3.4)		
Duration of operation (min), median (IQR)	90 (60-138.75)	180 (120-300)	<0.001	
Malignancy	103 (19.1)	70 (39.3)	<0.001	
Type of operation			<0.001	
Urgent-elective	96 (17.8)	55 (30.9)		
Essential elective	341 (63.1)	117 (65.7)		
Discretionary elective	103 (19.1)	6 (3.4)		
DASI score, median (IQR)	50.70 (32.20-58.20)	26.95 (15.45-42.70)	<0.001	
Length of hospital stay (days), median (IQR)	2 (1-4)	8 (5-14.25)	<0.001	
Rehospitalization	11 (2.0%)	20 (11.2%)	<0.001	
MeNTS score, mean±SD	47.86±7.55	56.21±7.28	<0.001	8.35 (7.08-9.62)
Procedure factors	18.07±5.03	26.53±3.78	<0.001	8.45 (7.65-9.26)
Disease factors	18.47±5.24	15.37±5.54	<0.001	-3.10 (-4.00 - -2.20)
Patient factors*	11.23±2.84	14.37±3.69	<0.001	3.13 (2.61-3.66)
MeNTS-METs score, mean±SD	49.91±7.95	59.64±7.62	<0.001	9.72 (8.39-11.06)
Patient factors-METs*	13.34±3.69	17.67±4.66	<0.001	4.33 (3.66-5.00)
MeNTS-DASI-5Q score, mean±SD	50.07±7.94	59.69±7.61	<0.001	9.62 (8.28-10.95)
Patient factors-DASI-5Q*	13.44±3.77	17.84±4.64	<0.001	4.40 (3.72-5.08)

Values are presented as numbers and precentages (%), mean ± standard deviation (SD), or median interquartile range (IQR). *Only patient factors domain was modified in MeNTS-METs and MeNTS-DASI-5Q scoring systems. Procedure and disease domains were not changed. ICU: intensive care unit, CI: confidence interval, ASA: American Society of Anesthesiologists, BMI: body mass index, DASI: Duke activity status index, MeNTS: medically necessary, time-sensitive, METs: metabolic equivalents, 5Q: 5 questions

resources with increased stay length and costs.[20] The ongoing COVID-19 pandemic further exacerbates this conundrum. In acute surges, prioritizing essential surgeries and predicting postoperative outcomes, ICU requirements, and prolonged stays are crucial for resource allocation strategies. Prioritization is also crucial in the remission era since a surgery backlog exists due to deferred cases, which can cause logistical and clinical challenges in an overloaded healthcare system.[21,22] However, there are few tools to quantify prioritization.[2-4,23] One of the most well-known tools is the MeNTS scoring system proposed by Prachand et al.[5] It has been studied with several modifications to its surgical and patient domains in different surgery types and compared with other prioritization scales as detailed in **Appendix 4**.[6-10,24-28] However, these studies have not focused on patient outcomes and ICU resource utilization.

In this study, we observed higher MeNTS scores than the full restriction period during the early phase of the pandemic.[11] This finding is simply because increased operating room capacity and ICU beds result in more essential and discretionary elective surgeries. This dynamic change in prioritization due to resource availability and pandemic status had been predicted by Prachand et al.[5]

The MeNTS scoring can be discussed in terms of domains. The procedure domain mainly questions the severity and extensiveness of the operation. Procedure-related scores were higher in group ICU+ than in group ICU-. This finding is unsurprising since operation duration was longer in group ICU+, in which malignancy was also more prevalent, similar to other ICU admissions after non-cardiac major surgery.[29,30] Notably, since one parameter of procedure factors is ICU need anticipation, ICU need for planned

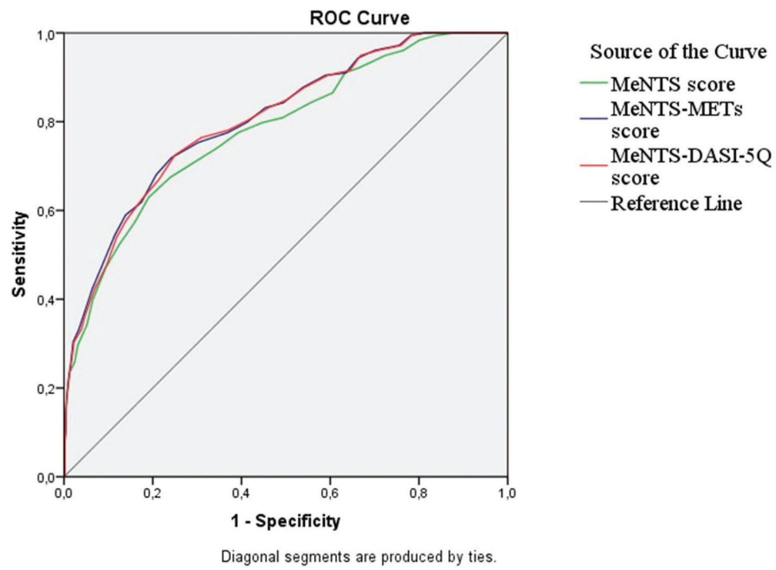

Figure 2 - Receiver operating characteristic (ROC) curve determining the carrying out of MeNTS, MeNTS-METs, and MeNTS-DASI-5Q score for predicting ICU requirement. Area under the curve (AUC)=0.782 (95% CI: [0.742-0.822]) for MeNTS score. Area under the curve=0.806 (95% CI: [0.769-0.843]) for MeNTS-METs, and AUC=0.804 (95% CI [0.766-0.841]) for MeNTS-DASI-5Q.

admissions may become a self-fulfilling prophecy. That is, high preoperative surgery anticipation may increase both the MeNTS score preoperatively and the frequency of our primary outcome postoperatively. Moreover, the anesthesia type may affect the procedure domain since general anesthesia and intubation increase procedure-related and total scores. We observed that patients with regional anesthesia had less ICU utilization, consistent with a meta-analysis that stated patients with regional anesthesia had decreased ICU admission odds.[31] However, when patients with and without pulmonary and cardiovascular complications are compared, there is a marked increase in procedure-related scores, showing that other factors than ICU need anticipation are involved.

For the disease domain, group ICU+ had lower scores than group ICU-, indicating more patients in group ICU+ had limited non-surgical treatment options, and surgery could not be delayed without aggravating surgical difficulty or worsening outcomes. Moreover, patients with PPCs and MACCEs also had lower disease domain scores than those without complications, further showing that urgent surgery is associated with higher complications. Urgent surgeries have higher complication and mortality rates than elective surgeries, which can also explain the increased use of ICU resources by these patients.[20,32]

Finally, for the patient domain, group ICU+ had higher scores than group ICU- since patients needing ICU care were older, had higher ASA classes, and were frequent smokers, possibly indicating more comorbidities. Indeed, advanced age, prehospital comorbidities, higher ASA class, and elevated BMI were associated with more frequent ICU requirements postoperatively.[29,30,33] In our study, the insignificant difference in BMI between group ICU+ and group ICU- is likely due to the relatively low number of obese or morbidly obese patients. We previously criticized the patient domain of MeNTS scoring since it is based on the presence of a limited number of comorbidities.[11] Furthermore, the severity of comorbidities is determined from drug consumption rather than functional capacity measurements. Functional capacity is crucial for predicting perioperative risks and complications in surgical patients and can be incorporated by ASA physical status classification or DASI scores.[34] While ASA classification had been incorporated into the MeNTS-OS scoring system in orthopedic surgery, all other patient domain items were excluded, which can be misleading since ASA classification is subject to substantial interobserver variability in score assignment.[9,20,35]

The DASI is a 12-item cardiopulmonary fitness index. Lower scores (<34) are associated with moderate-to-severe complications and new disability after elective non-cardiac operations.[36] Integrating the DASI score into the preoperative assessment of surgical patients was suggested for estimating moderate to severe

Table 3 - Comparison of group intensive care unit (-) and group intensive care unit (+).

Parameters	Group ICU- (n=540)	Group ICU+ (n=178)	*P*-values
Clavien-Dindo ≥II	52 (9.6)	97 (54.5)	<0.001
*PPCs**	6 (1.1)	38 (21.3)[†]	<0.001
Respiratory infection (n=19)	5 (0.9)	14 (7.9)	
Respiratory failure (n=5)	0 (0.0)	5 (2.8)	
Pleural effusion (n=9)	1 (0.2)	8 (4.5)	
Atelectasis (n=14)	2 (0.4)	12 (6.7)	
Pneumothorax (n=2)	0 (0.0)	2 (1.1)	
Bronchospasm (n=1)	0 (0.0)	1 (0.6)	
Aspiration pneumonitis (n=4)	0 (0.0)	4 (2.2)	
MACCEs	3 (0.6)	19 (10.7)[‡]	<0.001
Acute myocardial infarction (n=3, one mortal)	0 (0.0)	3 (1.7)	
Congestive heart failure (n=3)	0 (0.0)	3 (1.7)	
New cardiac arrhythmia (n=8)	2 (0.4)	6 (3.4)	
Angina (n=6)	1 (0.2)	5 (2.8)	
Stroke (n=2)	0 (0.0)	2 (1.1)	
Mortality	0 (0.0)	9 (5.1)	<0.001[§]

Values are presented as numbers and precentages (%). [*]Thirteen of 44 patients had two or more pulmonary complications. [†]Two of the patients with PCC in group ICU+ had unplanned admission. [‡]One of the patients with MACCE in group ICU+ had unplanned admission. [§]Fisher-exact test. ICU: intensive care unit, PCCs: postoperative pulmonary complications, MACCEs: major adverse cardiac and cerebrovascular events

Table 4 - Comparison according to the subdomains of medically necessary, time-sensitive, medically necessary, time-sensitive-metabolic equivalents, and medically necessary, time-sensitive-Duke activity status index-5 questions in patients with or without pulmonary and cardiovascular complications.

Scores	No PCCs (n=674)	PCCs (n=44)	*P*-values	Mean (95%CI)
Procedure domain (MeNTS)	19.75±5.8	26.7±4.5	<0.001	6.96 (5.19-8.72)
Disease domain (MeNTS)	17.88±5.4	15.05±5.8	0.001	-2.83 (-4.5 - -1.18)
Patient domain (MeNTS)	11.8±3.2	15.18±3.7	<0.001	3.37 (2.3-4.3)
Patient domain (MeNTS-METs)	14.13±4.2	18.81±4.54	<0.001	4.68 (3.39-5.97)
Patient domain (MeNTS-DASI-5Q)	14.24±4.28	18.93±4.48	<0.001	4.68 (3.37-5.99)
Scores	**No MACCEs (n=696)**	**MACCEs (n=22)**	***P*-values**	**Mean (95%CI)**
Procedure domain (MeNTS)	19.9±5.9	27.5±3.9	<0.001	7.55 (5.06-10.04)
Disease domain (MeNTS)	17.8±5.4	14.09±5.6	0.002	-3.73 (-6.05 - -1.4)
Patient domain (MeNTS)	11.9±3.33	14.5±3.39	<0.001	2.56 (1.14-3.98)
Patient domain (MeNTS-METs)	14.3±4.3	18.18±4.7	<0.001	3.88 (2.04-5.72)
Patient domain (MeNTS-DASI-5Q)	14.41±4.38	18.36±4.15	<0.001	3.94 (2.08-5.81)

Values are presented as mean ± standard deviation (SD) and mean difference (95% confidence interval [CI]). PCCs: postoperative pulmonary complications, MACCEs: major adverse cardiac and cerebrovascular events, MeNTS: medically necessary, time-sensitive, METs: metabolic equivalents, DASI: Duke activity status index, 5Q: 5 questions

perioperative risks.[36,37] In colorectal surgeries, patients with lower DASI scores had more overall and severe postoperative complications and more frequent hospital readmissions.[38] We also found lower DASI scores in group ICU+ than in group ICU-. Furthermore, patient subdomain scores of the MeNTS and our 2 modifications were higher in patients with than without PPCs and MACCEs since comorbidities are also known to be associated with postoperative complications.[39,40]

Our study proposed incorporating patients' functional status based on the DASI and tested its prognostic value for ICU resource planning. We added the original DASI as a METs value or the abbreviated 5-questionnaire DASI to the patient domain. We preferred not to exclude any item from the original MeNTS score. We did not incorporate ASA classification as proposed in MeNTS-OS.[9] Instead, we preferred DASI scoring since the presence of disease is part of the ASA classification, which may cause the same data to incorrectly increase its weight in patient factor component scoring.

The DASI is not an easy score to compute preoperatively, especially with time and personnel shortages in the perioperative period. While the abbreviated 5-question DASI (M-DASI-5Q) does not fully reflect the main aggregated score information, it was similar to the original 12-question DASI in predicting anaerobic threshold and peak oxygen consumption. The M-DASI-5Q was advocated as a basic screening instrument for preoperative assessment of cardiopulmonary exercise testing to guide perioperative patient management.[16] Our 2 modified MeNTS scores predicted the ICU requirement and ICU stay of ≥48 hours better than the original MeNTS score. Since both modified scores had similar predictive values, M-DASI-5Q integration can be preferred to the original scoring. Total MeNTS scores were higher in patients with moderate-to-severe postoperative complications than in patients with mild/no complications. As expected, hospital stays were prolonged and rehospitalization was more frequent in group ICU+, similar to other publications.[29,30]

While the COVID-19 pandemic is still ongoing, the number of patients diagnosed with COVID-19 is substantially lower than during its major surges. Elective surgery prioritization could be adapted to any situation with limited resources, not just pandemics. We showed that postoperative resource utilization could be predicted better when the functional capacity assessment was added to a triage score.

Study limitations. First, while all surgical specialties except ophthalmology were included, the surgical specialty distribution was not homogenous. Secondly, we included 718 patients who underwent elective operations, which might be low for analyzing ICU requirements. However, our study was limited to the period between the third and fourth surges of the pandemic which we had semi-restricted capacity; we stopped including patients at the beginning of the new surge. Prioritization which also assesses the functional capacity might be used in other resource-limited conditions. On the other hand, it is essential to note that this was a single-center exploratory study, and therefore, the findings might not be generalizable for other different settings and it could be accepted as a limitation. To validate the predictive accuracy of the modified MeNTS scores in various settings, prospective multicenter studies should be carried out. Finally, we did not carry out an actual cost analysis for ICU resource utilization expenses.

In conclusion, determining functional capacity during the perioperative process might help the clinician estimate postoperative patient outcomes. Additionally, incorporating functional capacity into a surgical triage scoring system might improve the prediction of resource utilization. The 5-questionnaire modified DASI is an easier score to compute. Its results were similar to the original DASI when added to an elective surgery triage scoring system to estimate ICU needs. Therefore, this easy adaptation could be applied in priority scoring.

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Appendix 1 - Medically necessary, time-sensitive scoring system.[5]

Variables	1	2	3	4	5
Procedure factors					
OR time (min)	<30	31-60	61-120	121-180	≥181
Estimated LOS	Outpatient	<23 h	24-48 h	2-3 d	≥4 d
Postoperative ICU need (%)	Very unlikely	<5	5-10	11-25	>25
Anticipated blood loss (cc)	<100	100-250	250-500	500-750	≥751
Surgical team size (n)	1	2	3	4	5
Intubation probability (%)	≤1	1-5	6-10	11-25	>25
Surgical site	None	Abdomino-pelvic MIS	Abdomino-pelvic open surgery, infraumbilical	Abdomino-pelvic open surgery, supraumbilical	OHNS/ upper GI/ thoracic
Disease factors					
Nonoperative treatment option effectiveness	None available	Available, <40% as effective as surgery	Available, 40-60% as effective as surgery	Available, 61-95% as effective as surgery	Available, equally effective
Nonoperative treatment option resource/exposure risk	Significantlyworse/ not applicable	Somewhat worse	Equivalent	Somewhat better	Significantly better
Impact of 2-wk delay in disease outcome	Significantly worse	Worse	Moderately worse	Slightly worse	No worse
Impact of 2-wk delay in surgical difficulty/risk	Significantly worse	Worse	Moderately worse	Slightly worse	No worse
Impact of 6-wk delay in disease outcome	Significantly worse	Worse	Moderately worse	Slightly worse	No worse
Impact of 6-wk delay in surgical difficulty/risk	Significantly worse	Worse	Moderately worse	Slightly worse	No worse
Patient factors					
Age, years	<20	21-40	41-50	51-65	>65
Lung disease (asthma, COPD, CF)	None	-	-	Minimal (rare inhaler)	>Minimal
Obstructive sleep apnea	Not present	-	-	Mild/moderate (no CPAP)	On CPAP
CV disease (HTN, CHF, and CAD)	None	Minimal (no meds)	Mild (one med)	Moderate (2 meds)	Severe (≥3 meds)
Diabetes	None	-	Mild (no meds)	Moderate (PO meds only)	>Moderate (insulin)
Immuno-compromised*	No	-	-	Moderate	Severe
ILI symptoms†	None (asymptomatic)	-	-	-	Yes
Exposure to a COVID-19 person in past 14 days	No	Probably not	Possibly	Probably	Yes

*Hematologic malignancy, stem cell transplant, solid organ transplant, active/recent cytotoxic chemotherapy, anti-TNFa or other immunosuppressants, >20 mg prednisone equivalent/day, congenital immunodeficiency, hypogammaglobulinemia on intravenous immunoglobulin, and AIDS. †Such as fever, cough, sore throat, body aches, and diarrhea. OR: operating room, min: minutes, LOS: length of stay, h: hours, d: days, ICU: intensive care unit, MIS: minimally invasive surgery, OHNS: otolaryngology, head & neck surgery, GI: gastrointestinal, wk: week, COPD: chronic obstructive pulmonary disease, CF: cystic fibrosis, CPAP: continuous positive airway pressure, CV: cardiovascular, HTN: hypertension, CHF: congestive heart failure, CAD: coronary artery disease, meds: medication, PO: by mouth, ILI: influenza-like illness, COVID-19: coronavirus disease-19

Appendix 2 - Patient factors domain of MeNTS-METs score.

Variables	1	2	3	4	5
Patient factors					
Age	<20	21-40	41-50	51-65	>65
Lung disease (asthma, COPD, and CF)	None	-	-	Minimal (rare inhaler)	>Minimal
Obstructive sleep apnea	Not present	-	-	Mild/moderate (no CPAP)	On CPAP
CV disease (HTN, CHF, and CAD)	None	Minimal (no meds)	Mild (one med)	Moderate (2 meds)	Severe (≥3 meds)
Diabetes	None	-	Mild (no meds)	Moderate (PO meds only)	>Moderate (insulin)
Immuno-compromised*	No	-	-	Moderate	Severe
ILI symptoms†	None (asymptomatic)	-	-	-	Yes
Exposure to a COVID-19 person in past 14 days	No	Probably not	Possibly	Probably	Yes
METs‡	=9.89	≥7 and <9.89	-	≥4 and <7	<4

*Hematologic malignancy, stem cell transplant, solid organ transplant, active/recent cytotoxic chemotherapy, anti-TNFa or other immunosuppressants, >20 mg prednisone equivalent/day, congenital immunodeficiency, hypogammaglobulinemia on intravenous immunoglobulin, AIDS. †Such as fever, cough, sore throat, body aches, and diarrhea.
‡ Maximum Duke activity status index: 58.2 [(0.43×DASI+9.6)/3.5] - [(0.43×58.2+9.6)/3.5]=9.89 (maximum METs value calculated according to the equation).
CAD: coronary artery disease, CF: cystic fibrosis, CHF: congestive heart failure, CPAP: continuous positive airway pressure, CV: cardiovascular, HTN: hypertension, ILI: influenza-like illness, med: medication, MeNTS: medically necessary, time-sensitive, METs: metabolic equivalents, PO: by mouth

Appendix 3 - Patient factors domain of MeNTS-DASI-5Q score.

Variables	1	2	3	4	5
Patient factors					
Age, years	<20	21-40	41-50	51-65	>65
Lung disease (asthma, COPD, and CF)	None	-	-	Minimal (rare inhaler)	> Minimal
Obstructive sleep apnea	Not present	-	-	Mild/moderate (no CPAP)	On CPAP
CV disease (HTN, CHF, and CAD)	None	Minimal (no meds)	Mild (one med)	Moderate (2 meds)	Severe (≥3 meds)
Diabetes	None	-	Mild (no meds)	Moderate (PO meds only)	> Moderate (insulin)
Immuno-compromised*	No	-	-	Moderate	Severe
ILI symptoms†	None (asymptomatic)	-	-	-	Yes
Exposure to a COVID-19 person in past 14 days	No	Probably not	Possibly	Probably	Yes
M-DASI-5Q					
1. Are you able to climb a flight of stairs or walk up a hill? 2. Are you able to do heavy work around the house? 3. Are you able to do yard work? 4. Are you able to have sexual relations? 5. Are you able to participate in strenuous sports?	5 positive answers	4 positive answers	3 positive answers	2 positive answers	None/one positive answer

*Hematologic malignancy, stem cell transplant, solid organ transplant, active/recent cytotoxic chemotherapy, anti-TNFa or other immunosuppressants, >20 mg prednisone equivalent/day, congenital immunodeficiency, hypogammaglobulinemia on intravenous immunoglobulin, AIDS. †Such as fever, cough, sore throat,body aches, diarrhea.
CAD: coronary artery disease, CF: cystic fibrosis, CHF: congestive heart failure, COVID-19: novel coronavirus, CPAP: continuous positive airway pressure, CV: cardiovascular, HTN: hypertension, ILI: influenza-like illness, med: medication, PO: by mouth, M-DASI-5Q: modified Duke activity status index-5 questions, MeNTS: medically necessary, time-sensitive

Appendix 4 - MeNTS scoring system and characteristics of related studies.

Authors	Score characteristics/modifications or comparisons of scales	Surgery type	Operation, disease, and patient factor characteristics and modifications	Main findings
Prachand et al[5]	Original described scoring system	Non-specified	Original operation, disease, and patient factors	It was proposed high scores were associated with poorer perioperative patient outcome, increased risk of COVID-19 transmission to the healthcare team, or increased hospital resource use.
Slidell et al[24]	Modified scoring system on pediatric patients (pMeNTS)	Paediatric surgery	Modified operation and patient factors Same disease factors	Adaptation of the adult MeNTS system into a pediatric-specific scoring system better reflected the needs of the pediatric patient population.
Dinçer et al[11]	Original described scoring system	General, orthopedic, gynecologic-obstetric, neurosurgery, ear-nose-throat surgery, plastic, cardiovascular, urology, and ophthalmology	Original operation, disease, and patient factors	MeNTS scores were calculated prospectively and postoperative complications were analyzed. High scores were related with postoperative complications/poorer patient outcome.
Cohn et al[28]	Comparison of questionnaire based (MeNTS), expert opinion based, and individual surgeon based approaches on patient triage	Urologic surgery	Original operation, disease, and patient factors	MeNTS did not meaningfully reflect the triage decision of urologic surgeries. MeNTS, consensus/expert opinion, and individual surgeon based surgical prioritizations disagreed.
Waxman et al[7]	Modified scoring system on CVS interventions (CV-MeNTS)	Cardiovascular procedures in the Catheterization Laboratory	Modified operation, disease, and patient factors	CV-MeNTS could be a useful tool for the prioritization of CV procedures in a period with limited capacity.
Marfori et al[6]	Assessment of interrater reliability and validity of modified elective surgery acuity scale (mESAS) and modified MeNTS scores (Gyn-MeNTS)	Benign gynecologic surgeries	Modified operation, disease, and patient factors	Gyn-MeNTS scoring system did not strongly discriminate the most urgent cases as determined by mESAS.
Saleeby et al[10]	Modified scoring system on gynecologic surgeries	General gynecologic, gynecologic oncologic, and female pelvic reconstructive surgery	Modified operation, disease, and patient factors	The modified-MeNTS could be purposed as a quantitative method for decision-making rather than subjective assessments.
Sharma et al[8]	Modified scoring system on otolaryngology surgeries (MeNTS-M)	Otolaryngology-Head and Neck Surgery (adults and pediatrics)	Mucosal score was incorporated into the original MeNTS	The mucosal score integrated MeNTS-M was interpreted as a valuable tool on triaging otolaryngology-head and neck surgeries.
Teja et al[25]	Modified scoring system on ophthalmic surgery	Ophthalmic surgery	Modified operation, disease, and patient factors	Modified MeNTS could provide guidance to ophthalmologists to facilitate decision making in triaging elective procedures.
Coello et al[26]	Comparison of modified MeNTS and subjective priority scale on operated, and deferred cases	Urologic surgery	Modified operation, disease, and patient factors	Modified MeNTS scores did not show statistically significant difference between operated and non-operated patients. The score was not considered as a useful tool.
Fernandez et al[27]	Modified scoring system on pediatric urology	Pediatric urologic surgery	Modified operation and patient factors Same disease factors	Pediatric urology specific modified scoring system was proposed and allowed to prioritize surgeries with cut-off values of 12 and 16.
Prabhakar et al[9]	Modified scoring system on orthopedic surgery (MeNTS-OS)	Orthopedic surgery	Modified operation, disease, and patient factors (consists of surgical and disease factors)	MeNTS-OS scoring system was proposed as a useful tool to triage orthopedic surgeries. Higher scores were correlate with postponed cases.