1. **Cardiac--- Gupta Cardiac Risk**
2. **Pulmonary— STOP BANG//Gupta Risk Index/ ARISCAT**
3. **Venous Thromboembolism: Caprini Score**

## Cardiac:

1. **Gupta Risk Model: Use Qx Med to Calculate.** (App from App store or website)

**Gupta MICA NSQIP database risk model** — The NSQIP database was used to determine risk factors associated with intraoperative/postoperative myocardial infarction or cardiac arrest (MICA) \[29\]. Among over 200,000 patients who underwent surgery in 2007, 0.65 percent developed perioperative MICA. On multivariate logistic regression analysis, five factors were identified as predictors of MICA:

- Type of surgery;
- Dependent functional status;
- Abnormal creatinine;
- American Society of Anesthesiologists’ class (table 4);
- Increased age.

A risk model was developed using these five factors and subsequently validated on a 2008 data set (n = 257,385). The risk model had a relatively high predictive accuracy (C statistic of 0.874) and outperformed the RCRI (C statistic of 0.747). An easy-to-use [calculator](#) was developed from this model

**Calculator** Determine peri-operative risk for a wide array of surgeries.

**Age?**

<table>
<thead>
<tr>
<th>Years</th>
</tr>
</thead>
</table>

**Creatinine?**

- ≥1.5 mg/dL
- <1.5 mg/dL
- Unknown
ASA Class?

Normal healthy patient  ASA 1
Patients with mild systemic disease  ASA 2
Patients with severe systemic disease  ASA 3
Patients with severe systemic disease that is a constant threat to life  ASA 4
Moribund patients who are not expected to survive without the operation  ASA 5

Preoperative Functional Status?

Total independent
Partially dependent
Totally dependent

Procedure Site?

Anorectal
Aortic
Bariatric
Brain
1.3969
Breast
Cardiac
ENT (EXCEPT thyroid/parathyroid)
Foregut/Hepatopancreatobiliary
Gallbladder, Appendix, Adrenal and Spleen
Hernia (ventral, inguinal, femoral)
Intestinal
Neck (thyroid/parathyroid)
Obstetric/Gynecologic
Orthopedic and non-vascular Extremity
Other abdominal
Peripheral Vascular
Skin
Spine
Non-esophageal Thoracic
Vein
Urology

About this tool

This risk calculator provides an estimate of perioperative cardiac risk for individual patients based on a model derived from a large sample (>400 000) of patients. This is intended to supplement the clinician's own judgment and should not be taken as absolute. Certain limitations
exist such as absence of information on preoperative stress test, echocardiography, arrhythmia, and aortic valve disease. Unfortunately, known/remote coronary artery disease (except prior PCI and cardiac surgery) was also not controlled for in the multivariate analysis. In spite of the absence of these variables, the predictive ability of the calculator as measured by c-statistic was 0.88 (88%), much higher than previous models such as Revised Cardiac Risk Index.

The details of the methodology are provided in the published paper:


2. Revised cardiac risk index — The RCRI, sometimes referred to as the Lee index, was published in 1999 and has been used worldwide since then [10]. In the derivation of the index, 2893 patients (mean age 66) undergoing elective major noncardiac procedures were monitored for major cardiac complications (cardiac death, acute MI, pulmonary edema, ventricular fibrillation/cardiac arrest, and complete heart block) (table 1). The index was validated in a cohort of 1422 similar individuals. The predictive value was significant in all types of elective major noncardiac surgery except for abdominal aortic aneurysm surgery (figure 1).

The risk of major cardiac complications (cardiac death, nonfatal MI, nonfatal cardiac arrest, postoperative cardiogenic pulmonary edema, complete heart block) varied according to the number of risk factors. The following rates of adverse outcomes were seen in various studies [31]:

- No risk factors – 0.4 percent
- One risk factor – 1.0 percent
- Two risk factors – 2.4 percent
- Three or more risk factors – 5.4 percent

In a large retrospective analysis on mortality, the perioperative risk was evaluated in 663,665 adults with no contraindications to beta blockers who underwent major noncardiac surgery in 2000 and 2001 at 329 hospitals in the United States [2]. In-hospital mortality in patients not treated with beta blockers increased progressively from 1.4 percent at a score of 0, to 7.4 percent at a score ≥4. The rate of mortality in this study was higher at the same RCRI than the combined end point of cardiac death, nonfatal MI, and nonfatal cardiac arrest in the earlier RCRI (Goldman) population [31].

Pre-Op Pulmonary:

Stop-Bang Questionnaire: For Diagnosis of Obstructive Sleep Apnea

1.) Do you SNORE loudly (Loud enough to be heard through closed doors)?
   - Yes (1)  No (0)

2.) Do you often feel TIRED, fatigued, sleep during daytime?
   - Yes (1)  No (0)

3.) Has anyone OBSERVED you stop breathing during your sleep?
   - Yes (1)  No (0)

4.) Do you have or are you being treated for high blood pressure?
   - Yes (1)  No (0)

5.) BMI more than 35 kg/m2?
   - Yes (1)  No (0)

6.) AGE more than 50 yrs old?
   - Yes (1)  No (0)

7.) NECK circumference greater than 40cm?
   - Yes (1)  No (0)

8.) Gender: Male
   - Yes (1)  No (0)

Total score possible: 8

Total score achieved: __

Patient Score:

(High Risk = Answering Yes to 5 or more questions; Low risk = Answering Yes to less than 5 questions)

- High risk for Obstructive Sleep Apnea
- Low risk for Obstructive Sleep Apnea

High STOP-Bang score indicates a high probability of obstructive sleep apnoea


2. Gupta calculator for postoperative respiratory failure — This Gupta pulmonary risk calculator provides a risk estimate of postoperative respiratory failure (PRF) for individual patients based on a model derived from a large sample of patients. This is intended to supplement the clinician’s own judgment and should not be taken as absolute. Postoperative respiratory failure (PRF) is considered as failure to wean from mechanical ventilation within 48 hours of surgery or unplanned intubation/reintubation postoperatively. The validated risk
calculator provides a risk estimate of PRF and is anticipated to aid in surgical decision-making and informed patient consent.


3. ARISCAT (Canet) — The ARISCAT Risk Index (calculator 1) predicts the overall incidence of postoperative pulmonary complications (of any severity), by assigning a weighted point score to seven independent risk factors (table 2) [49]:

- Advanced age
- Low preoperative oxygen saturation
- Respiratory infection within the past month
- Preoperative anemia
- Upper abdominal or thoracic surgery
- Surgery lasting more than two hours
- Emergency surgery

The incidence of pulmonary complications in patients with scores stratified as low-, intermediate-, and high-risk is 1.6, 13.3, and 42.2 percent, respectively.

This index has the advantage of being simple to calculate manually at the bedside with readily available clinical information, but the disadvantage of inclusion of minor complications of little clinical significance (eg, new wheezing treated with bronchodilators). It was derived from a prospective evaluation of 2464 surgical patients and validated in a cohort of 5099 patients in Europe [60]


Calculator: ARISCAT (Canet) preoperative pulmonary risk index

<table>
<thead>
<tr>
<th>Age</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>≤50 years old (0 points)</td>
<td></td>
</tr>
<tr>
<td>51 to 80 years old (3 points)</td>
<td></td>
</tr>
<tr>
<td>&gt;80 years old (16 points)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preoperative oxygen saturation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>≥96% (0 points)</td>
<td></td>
</tr>
<tr>
<td>91 to 95% (8 points)</td>
<td></td>
</tr>
<tr>
<td>≤90% (24 points)</td>
<td></td>
</tr>
</tbody>
</table>
Other clinical risk factors

☐ Respiratory infection in the last month (17 points)
☐ Preoperative anemia with hemoglobin ≤10 g/dL (11 points)
☐ Emergency surgery (8 points)

Surgical incision

☐ Upper abdominal (15 points)
☐ Intrathoracic (24 points)

Duration of surgery

☐ ≤2 hours (0 points)
☐ 2 to 3 hours (16 points)
☐ >3 hours (23 points)

Total criteria point count: _____

ARISCAT risk index interpretation

<table>
<thead>
<tr>
<th>Points Range</th>
<th>Risk Level</th>
<th>Pulmonary Complication Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 25 points</td>
<td>Low risk</td>
<td>1.6%</td>
</tr>
<tr>
<td>26 to 44 points</td>
<td>Intermediate risk</td>
<td>13.3%</td>
</tr>
<tr>
<td>45 to 123 points</td>
<td>High risk</td>
<td>42.1%</td>
</tr>
</tbody>
</table>

Risk Factors for Peri-operative Venous Thrombo-Embolism-Caprini Risk Model
## Caprini Risk Score

### Modified Caprini risk assessment model for VTE in general surgical patients

<table>
<thead>
<tr>
<th>Risk score</th>
<th>1 point</th>
<th>2 points</th>
<th>3 points</th>
<th>5 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 41 to 60 years</td>
<td>Age 61 to 74 years</td>
<td>Age ≥75 years</td>
<td>Stroke (&lt;1 month)</td>
<td></td>
</tr>
<tr>
<td>Minor surgery</td>
<td>Arthroscopic surgery</td>
<td>History of VTE</td>
<td>Elective arthroplasty</td>
<td></td>
</tr>
<tr>
<td>BMI &gt;25 kg/m²</td>
<td>Major open surgery (&gt;45 minutes)</td>
<td>Family history of VTE</td>
<td>Hip, pelvis, or leg fracture</td>
<td></td>
</tr>
<tr>
<td>Swollen legs</td>
<td>Laparoscopic surgery (&gt;45 minutes)</td>
<td>Factor V Leiden</td>
<td>Acute spinal cord injury (&lt;1 month)</td>
<td></td>
</tr>
<tr>
<td>Varicose veins</td>
<td>Malignancy</td>
<td>Prothrombin 20210A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnancy or postpartum</td>
<td>Confined to bed (&gt;72 hours)</td>
<td>Lupus anticoagulant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of unexplained or recurrent spontaneous abortion</td>
<td>Immobilizing plaster cast</td>
<td>Anticardiolipin antibodies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral contraceptives or hormone replacement</td>
<td>Central venous access</td>
<td>Elevated serum homocysteine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sepsis (&lt;1 month)</td>
<td></td>
<td></td>
<td>Heparin-induced thrombocytopenia</td>
<td></td>
</tr>
<tr>
<td>Serious lung disease, including pneumonia (&lt;1 month)</td>
<td></td>
<td></td>
<td>Other congenital or acquired thrombophilia</td>
<td></td>
</tr>
<tr>
<td>Abnormal pulmonary function</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute myocardial infarction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congestive heart failure (&lt;1 month)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of inflammatory bowel disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical patient at bed rest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Interpretation

<table>
<thead>
<tr>
<th>Surgical risk category*</th>
<th>Score</th>
<th>Estimated VTE risk in the absence of pharmacologic or mechanical prophylaxis (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low (see text for definition)</td>
<td>0</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Low</td>
<td>1 to 2</td>
<td>1.5</td>
</tr>
<tr>
<td>Moderate</td>
<td>3 to 4</td>
<td>3.0</td>
</tr>
<tr>
<td>High</td>
<td>≥5</td>
<td>6.0</td>
</tr>
</tbody>
</table>

VTE: venous thromboembolism; BMI: body mass index.

* This table is applicable only to general, abdominal-pelvic, bariatric, vascular, and plastic and reconstructive surgery. See text for other types of surgery (e.g., cancer surgery).

**VTE risk and suggested prophylaxis for surgical patients**

<table>
<thead>
<tr>
<th>Total Risk Factor Score</th>
<th>Incidence of DVT</th>
<th>30-day Proven DVT Incidence*</th>
<th>Risk Level</th>
<th>Prophylaxis Regimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>&lt;10%</td>
<td>0%</td>
<td>Low Risk</td>
<td>No specific measures; early ambulation</td>
</tr>
<tr>
<td>2</td>
<td>10-20%</td>
<td>0.7%</td>
<td>Moderate Risk</td>
<td>IPC, LDUH (5000U BID), or LWMH (&lt;3400 U)</td>
</tr>
<tr>
<td>3-4</td>
<td>20-40%</td>
<td>0.97%</td>
<td>High Risk</td>
<td>IPC, LDUH (5000U TID), or LMWH (&gt;3400U) or FXa I</td>
</tr>
<tr>
<td>5 or more</td>
<td>40-80%</td>
<td>1.94%</td>
<td>Highest Risk</td>
<td>Pharmacological: LDUH, LMWH (&gt;3400 U), Warfarin, or FXa I alone or in combination with IPC</td>
</tr>
</tbody>
</table>

*30-day post-discharge clinically evident imaging proven DVT
IPC - Intermittent Pneumatic Compression; LDUH - Low Dose Unfractionated Heparin; LWMH - Low Molecular Weight Heparin; FXa I - Factor X Inhibitor

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**Prophylaxis Safety Considerations: Check box if answer is ‘YES’**

### Anticoagulants: Factors Associated with Increased Bleeding

- Is patient experiencing any active bleeding?
- Does patient have (or has had history of) heparin-induced thrombocytopenia?
- Is patient’s platelet count <100,000/mm³?
- Is patient taking oral anticoagulants, platelet inhibitors (e.g., NSAIDS, Clopidogrel, Salicylates)?
- Is patient’s creatinine clearance abnormal? If yes, please indicate value ____________

If any of the above boxes are checked, the patient may not be a candidate for anticoagulant therapy and you should consider alternative prophylactic measures such as IPC or FP.

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### Intermittent Pneumatic Compression (IPC)

- Does patient have severe peripheral arterial disease?
- Does patient have congestive heart failure?
- Does patient have an acute superficial/deep vein thrombosis?

If any of the above boxes are checked, then patient may not be a candidate for intermittent compression therapy and you should consider alternative prophylactic measures. (IVC filter?)