CLIP: Checklist for Lung Injury Prevention


U.S. Critical Illness and Injury Trials Group (USCIITG)
USCIITG-Lung Injury Prevention Group

• A collaborative research network of 20 institutions for mechanistic studies and Acute Lung Injury prevention trials:
  – Treatment options limited in
  – Little research on Acute Lung Injury prevention
  – Early (ED, OR) identification of patients at risk
  – Multidisciplinary USCIIT group facilitates research in early stages of critical illness
Lung Injury Prevention Study 1:

- Develop and validate clinical prediction model to identify patients at high risk of developing Acute Lung Injury during their first 6 hours of hospital admission.
Acute Lung Injury Pathophysiology

Initial Injury

- Acid aspiration
  - Chemical
- Mechanical
  - High tidal volume

Membrane Injury

Inflammation

Acute Lung Injury

Permeability, Pulmonary Edema and Its Consequences

- 30 - 40% Mortality
- $ QALY
Pathophysiology of Acute Lung Injury- “Multiple Hit Hypothesis”

**Risk modifiers that may ↑ risk of ALI (2\textsuperscript{nd} hit):**
- High tidal volume, transfusion, delayed resuscitation, inappropriate antibiotics, aspiration, high FiO\textsubscript{2},

**Risk modifiers that may ↓ risk of ALI:**
- PEEP

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**Patient at risk (1\textsuperscript{st} hit):**
- Pneumonia
- Toxic inhalation
- Pancreatitis
- Aspiration
- Trauma
- Sepsis
- Shock
- Age
- SNPs
- Alcohol
- Tobacco
- Thoracic and vascular surgery
- Preexisting lung disease
- Vasculitis
- Radiation
- Chemotherapy

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**HOSPITAL ADMISSION**

**ICU ADMISSION**
<table>
<thead>
<tr>
<th>Predisposing conditions</th>
<th>Estimate</th>
<th>(95% CI)</th>
<th>p-value</th>
<th>LIPS points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock</td>
<td>0.77</td>
<td>0.19</td>
<td>1.32</td>
<td>0.008</td>
</tr>
<tr>
<td>Aspiration</td>
<td>0.79</td>
<td>0.07</td>
<td>1.45</td>
<td>0.024</td>
</tr>
<tr>
<td>Sepsis</td>
<td>0.37</td>
<td>-0.13</td>
<td>0.87</td>
<td>0.139</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>-1.07</td>
<td>-3.96</td>
<td>0.51</td>
<td>0.299</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0.83</td>
<td>0.33</td>
<td>1.34</td>
<td>0.001</td>
</tr>
<tr>
<td>High risk surgery*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thoracic (noncardiac)</td>
<td>-0.14</td>
<td>-2.00</td>
<td>1.15</td>
<td>0.896</td>
</tr>
<tr>
<td>Orthopedic spine</td>
<td>0.75</td>
<td>-0.11</td>
<td>1.53</td>
<td>0.071</td>
</tr>
<tr>
<td>Acute abdomen</td>
<td>0.93</td>
<td>0.06</td>
<td>1.72</td>
<td>0.028</td>
</tr>
<tr>
<td>Cardiac</td>
<td>1.32</td>
<td>0.67</td>
<td>1.96</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Aortic vascular</td>
<td>1.78</td>
<td>0.93</td>
<td>2.56</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>High risk trauma</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traumatic brain injury</td>
<td>1.29</td>
<td>0.67</td>
<td>1.91</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Smoke inhalation</td>
<td>0.93</td>
<td>-0.21</td>
<td>1.41</td>
<td>0.438</td>
</tr>
<tr>
<td>Near drowning</td>
<td>1.68</td>
<td>-2.74</td>
<td>6.00</td>
<td>0.498</td>
</tr>
<tr>
<td>Lung contusion</td>
<td>0.40</td>
<td>-0.48</td>
<td>1.21</td>
<td>0.355</td>
</tr>
<tr>
<td>Multiple fractures</td>
<td>0.64</td>
<td>-0.21</td>
<td>1.41</td>
<td>0.117</td>
</tr>
<tr>
<td>Risk modifiers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male gender</td>
<td>0.02</td>
<td>-0.34</td>
<td>0.39</td>
<td>0.905</td>
</tr>
<tr>
<td>Alcohol abuse</td>
<td>0.51</td>
<td>-0.08</td>
<td>1.07</td>
<td>0.080</td>
</tr>
<tr>
<td>Obesity (BMI&gt;30)</td>
<td>0.56</td>
<td>0.18</td>
<td>0.93</td>
<td>0.004</td>
</tr>
<tr>
<td>Hypoalbuminemia</td>
<td>0.46</td>
<td>0.04</td>
<td>0.87</td>
<td>0.029</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>0.46</td>
<td>-0.54</td>
<td>1.29</td>
<td>0.314</td>
</tr>
<tr>
<td>FiO2 &gt;0.35 (&gt;4L/min)</td>
<td>1.02</td>
<td>0.62</td>
<td>1.41</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Tachypnea (RR&gt;30)</td>
<td>0.69</td>
<td>0.11</td>
<td>1.25</td>
<td>0.017</td>
</tr>
<tr>
<td>SpO2&lt;95%</td>
<td>0.35</td>
<td>-0.04</td>
<td>0.73</td>
<td>0.078</td>
</tr>
<tr>
<td>Acidosis (pH&lt;7.35)</td>
<td>0.55</td>
<td>0.09</td>
<td>1.00</td>
<td>0.017</td>
</tr>
<tr>
<td>Diabetes mellitus**</td>
<td>-0.59</td>
<td>-1.40</td>
<td>0.15</td>
<td>0.135</td>
</tr>
</tbody>
</table>

*Add 1.5 point if emergency surgery

**Only if sepsis
LIPS Score

% ALI/ARDS

LIPS Points

N = 1063 1154 1092 852 548 394 225 253
Many proven therapies are underutilized

Lower tidal volume in ALI/ARDS

Transfusion in ICU

Practice Variation Between Institutions and Within Institutions

- Restrictive transfusion policies
  - 50% of ICU, 12.5% of ED, 6% of OR
- Sepsis protocol
  - 69% of ICU, 6% of ED, 13% of OR
- Structured handoffs on transfer
  - 35% between ED and ICU
  - 24% between ED and anesthesia
  - 36% between ED and surgical staff
<table>
<thead>
<tr>
<th>CLIP Element</th>
<th>Clinically Supported practices</th>
<th>AHA grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate empiric antimicrobial treatment and source control</td>
<td>According to suspected site of infection, health care exposure, and immune suppression</td>
<td>Class I</td>
</tr>
<tr>
<td>Lung protective mechanical ventilation</td>
<td>Tidal volume &lt;6-8 mL/kg predicted body weight and plateau pressure &lt;25 cm H2O; PEEP ≥ 5 cm H2O, minimize FIO2 (target O2sat 88-92% after early shock)</td>
<td>Class IIa</td>
</tr>
<tr>
<td>Aspiration precautions</td>
<td>Rapid sequence intubation supervised by experienced providers, elevated head of the bed, oral care with chlorhexidine, gastric acid neutralization</td>
<td>Class IIA-IIb</td>
</tr>
<tr>
<td>Early reassessment of noninvasive ventilation (to prevent delayed intubation)</td>
<td>Early reassessment of the work of breathing 30 minutes into the onset of noninvasive ventilation</td>
<td>Class IIb</td>
</tr>
<tr>
<td>Fluid management:</td>
<td>- Early fluid administration in septic shock</td>
<td>-Class IIa</td>
</tr>
<tr>
<td></td>
<td>- Limiting fluid overload after resuscitation</td>
<td>-Class IIa</td>
</tr>
<tr>
<td>Restrictive transfusion</td>
<td>Hemoglobin target &gt;7 g/dL in the absence of acute bleeding and/or ischemia</td>
<td>Class IIa</td>
</tr>
<tr>
<td>Appropriate handoff of patients at risk</td>
<td>Structured handoff such as SBAR</td>
<td>Class IIa</td>
</tr>
</tbody>
</table>
Sample Patient

72 yo man with diabetes and CAD presents to the ED from acute rehab hospital at 4 AM with SOB.

Initial work-up:
Temperature 102  Heart rate 119  Respiratory Rate 32  Blood Pressure 85/65  Oxygen saturation 92% on RA
WBC 18  ABG 66/36/7.36  CXR with LLL infiltrate
Sample Patient

By 9 AM, the patient was awake, responsive:

BP 92/69 on levophed at 3 mcg/min after only 3 liters of NS
O2 sat 95% on 40% face mask
Questions to be asked on the application to determine LIPS score

<table>
<thead>
<tr>
<th>Study ID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Predisposing Conditions * **

- [x] Shock
- [ ] Aspiration
- [x] Sepsis
- [x] Pneumonia
- [ ] Orthopedic spine surgery
- [ ] Acute abdomen
- [ ] Cardiac surgery
- [ ] Aortic vascular surgery
- [ ] Traumatic brain injury
- [ ] Smoke inhalation
- [ ] Near drowning
- [ ] Lung contusion
- [ ] Multiple fractures
- [ ] None of the above

*(Check all that is present in the patient)*

**Risk Modifiers within first 6 hours of hospital admission * **

- [x] Alcohol abuse
- [ ] Obesity (BMI > 30)
- [x] Chemotherapy
- [x] Diabetes Mellitus
- [x] Emergency surgery
- [x] Highest Respiratory rate > 30 breaths/min
- [ ] Lowest Oxygen saturation < 95%
- [x] FiO2 > 0.35 or more than 4 litres/min of oxygen required
- [ ] Albumin < 3.5 g/dl
- [ ] At least one Arterial pH < 7.35
- [ ] None of the above

*(Check all that is present in the patient)*

[OK] [Cancel]
Lung Injury Prediction Score (LIPS) = 7

> 20% of pts with LIPS = 7 develop ALI
<table>
<thead>
<tr>
<th>Questions to be answered by clinician</th>
<th></th>
</tr>
</thead>
</table>
| 1. Does the patient have a suspected infection? | Yes  
No |
| - If YES, is there a potentially removable or drainable source? (Such as abscess, line, hardware/implant, renal or gallstones, empyema, perforated viscus, acute abdomen, etc.) | No |
| 2. Is the patient CURRENTLY in shock? | Yes  
No |
| - If NO, was patient in shock at any time in the last 12 hours? |  |
| 3. Does the patient CURRENTLY have acute bleeding? | Yes  
No |
| 4. Does the patient CURRENTLY have acute ischemia? (acute coronary syndrome, acute stroke, acute bowel ischemia) | Yes  
No |
| 5. CURRENT respiratory status | Currently on non-invasive ventilation  
Spontaneously breathing and NOT on invasive or non-invasive ventilation  
Currently intubated/trached on mechanical ventilation |
| 6. Is admission/transfer to intensive care unit likely in the next 24 hours? | Yes  
No  
Already in the ICU |
| 7. Will patient possibly need surgery in the next 24 - 48 hours? | Yes  
No |
### Infection Control:
#### Antibiotics:
- □ Rapid administration of appropriate antibiotics

<table>
<thead>
<tr>
<th>Presumed Source</th>
<th>Suggested Empiric Antibiotics</th>
<th>If Previous Healthcare Contact</th>
<th>If Immune Suppressed</th>
</tr>
</thead>
</table>
| Lung            | (Vancomycin / macrolide / 3rd gen cephalosporin) OR (Vancomycin / fluoroquinolone) | (Vancomycin / anti-pseudomonal PCN) OR (Vancomycin / fluoroquinolone / Aminoglycoside) *Consider treatment for influenza | (Vancomycin / anti-pseudomonal PCN / macrolide) *Consider treatment for PCP, fungals, Tb *
|                 | *Consider treatment for influenza |                              | *Consider treatment for influenza |
| Abdomen         | (Vancomycin / amino-PCN) OR (Vancomycin / fluoroquinolone / metronidazole) | (Vancomycin / anti-pseudomonal PCN) OR (Vancomycin / fluoroquinolone / metronidazole) *Consider broader C. Diff coverage with PO vancomycin | (Vancomycin / anti-pseudomonal PCN) OR (Vancomycin / fluoroquinolone / metronidazole / aminoglycoside) *Consider treatment for fungals, Tb *
|                 | *Consider broader C. Diff coverage with PO vancomycin |                              | *Consider broader C. Diff coverage with PO vancomycin |
| Urine           | (3rd Generation cephalosporin) OR (fluoroquinolone) | (Vancomycin / anti-pseudomonal PCN) OR (Vancomycin / fluoroquinolone) | (Vancomycin / anti-pseudomonal PCN) OR (Vancomycin / fluoroquinolone / Aminoglycoside) *Consider treatment for fungals, Tb |
|                 | *Consider treatment for viral *Consider ampicillin for Listeria |                              | *Consider treatment for viral *Consider ampicillin for Listeria |
| CNS             | (Vancomycin / ceftriaxone) | (Vancomycin / cefepime) | (Vancomycin / cefepime / acyclovir / ampicillin) *Consider treatment for fungals, Tb |
|                 | *Consider treatment for viral |                              | *Consider treatment for fungals, Tb |
| IV Catheter     | N/A                           | (Vancomycin / anti-pseudomonal PCN) | (Vancomycin / anti-pseudomonal PCN) |
|                 |                               |                              | |
| Skin / Tissue   | (Vancomycin) *Consider anti-pseudomonal PCN if diabetic or vascular disease *Consider clindamycin for suspected toxic shock syndrome | (Vancomycin / anti-pseudomonal PCN) *Consider clindamycin for suspected toxic shock syndrome | (Vancomycin / anti-pseudomonal PCN) *Consider clindamycin for suspected toxic shock syndrome |
| Unknown         | (Vancomycin / anti-pseudomonal PCN) |                              | (Vancomycin / anti-pseudomonal PCN / fluoroquinolone) |

### Fluids and Transfusion:
- □ Resuscitate as needed
If intubation needed:

**Aspiration Precautions:**
- Consider rapid sequence intubation by experienced clinicians
- Administer IV H2 antagonist to neutralize gastric acid

**Minimize ventilator induced lung injury:**
- Low pressure ventilation with 6-8 cc/kg IBW (below table) and plateau pressures < 25 cm H2O

- Increase respiratory rate as needed to maintain ventilation (up to 35 bpm)
- PEEP of at least 5 cm H2O

**Communication:**
- Contact ICU fellow or attending with structured handoff as per SBAR table below

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**SBAR : Structured communication during patient transfer to ICU or OR**

**SITUATION**
- Introduce yourself and the patient
- Briefly describe the patient's situation and reason for ICU transfer

**BACKGROUND**
- Briefly state the pertinent history
- What got us to this point

**ASSESSMENT**
- Summarize the facts and give your best current assessment of the situation
- Identify patient as high risk for ALI/ARDS
- What is going on? Use your best judgment.
- What intervention/treatment did you start and how did the patient respond?
- What is the patient's current state?
- Is the patient improving, deteriorating, not changed?

**RECOMMENDATION / REQUEST**
- Indicate CLIP elements to be implemented and continued for duration of ICU stay or during OR
- What laboratory or radiologic tests are pending that will require follow-up?
- Who have been consulted and what recommendations have to be followed up?
- What therapies need to be continued or followed up?

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Return to CLIP website for updated recommendations daily and whenever the clinical situation of the patient has changed.
### Questions to be answered by clinician

1. **Does the patient have a suspected infection?**
   - Yes
   - No

   - If YES, is there a potentially removable or drainable source? (Such as abscess, line, hardware/implant, renal or gallstones, empyema, perforated viscus, acute abdomen, etc.)
     - No

2. **Is the patient CURRENTLY in shock?**
   - Yes
   - No

   - If NO, was patient in shock at any time in the last 12 hours?
     - No

3. **Does the patient CURRENTLY have acute bleeding?**
   - Yes
   - No

4. **Does the patient CURRENTLY have acute ischemia? (acute coronary syndrome, acute stroke, acute bowel ischemia)**
   - Yes
   - No

5. **CURRENT respiratory status**
   - Currently on non-invasive ventilation
   - Spontaneously breathing and NOT on invasive or non-invasive ventilation
   - Currently intubated/trached on mechanical ventilation

6. **Is admission/transfer to intensive care unit likely in the next 24 hours?**
   - Yes
   - No
   - Already in the ICU

7. **Will patient possibly need surgery in the next 24 - 48 hours?**
   - Yes
   - No
Fluids and Transfusion:
□ Avoid fluid overload targeting CVP and urine output as in below table

<table>
<thead>
<tr>
<th>Estimated CVP</th>
<th>MAP ≥ 60 mm Hg AND off vasopressors for ≥ 12 hours</th>
<th>Average urine output &lt; 0.5 ml/kg/hr</th>
<th>Average urine output ≥ 0.5 ml/kg/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 8</td>
<td>Furosemide* Reassess in 1 hour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-8</td>
<td>Furosemide* Reassess in 4 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 4</td>
<td>Give fluid bolus as fast as possible</td>
<td>No intervention</td>
<td>Reassess in 4 hours</td>
</tr>
</tbody>
</table>

□ RBC transfusion should be avoid unless Hb < 7 g/dL
□ Plasma and platelet transfusion should be avoided prior to minimally invasive procedures unless there is active bleeding

Respiratory Support:
□ Minimize ventilator induced lung injury:
□ Low pressure ventilation with 6-8 cc/kg IBW (below table) and plateau pressure < 25 cm H2O

□ Increase respiratory rate as needed to maintain ventilation (up to 35 bpm)
□ PEEP of at least 5 cm H2O

Aspiration Precautions:
□ Elevate head of bed > 30 degree
□ Oral care with chlorhexidine
□ Gastric acid neutralization

Return to CLIP website for updated recommendations daily and whenever the clinical situation of the patient has changed.
### Checklist Elements:

**Infection Control:**

**Antibiotics:**
- Rapid administration of appropriate antibiotics

<table>
<thead>
<tr>
<th>Presumed source</th>
<th>Suggested empiric antibiotics</th>
<th>If previous health care contact</th>
<th>If immune suppressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung</td>
<td>(Vancomycin / macrolide / 3rd gen cephalosporin) OR (Vancomycin / fluoroquinolone) *Consider treatment for influenza</td>
<td>(Vancomycin / anti-pseudomonal PCN) OR (Vancomycin / fluoroquinolone / Aminoglycoside) *Consider treatment for influenza</td>
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<td>Abdomen</td>
<td>(Vancomycin / amino-PCN) OR (Vancomycin / fluoroquinolone / metronidazole) *Consider broader C.Diff coverage with PO vancomycin</td>
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<td>(Vancomycin / anti-pseudomonal PCN) OR (Vancomycin / fluoroquinolone / metronidazole / aminoglycoside) *Consider treatment for fungals, Tb *Consider broader C.Diff coverage with PO vancomycin</td>
</tr>
<tr>
<td>Urine</td>
<td>(3rd generation cephalosporin) OR (fluoroquinolone)</td>
<td>(Vancomycin / anti-pseudomonal PCN) OR (Vancomycin / fluoroquinolone)</td>
<td>(Vancomycin / anti-pseudomonal PCN) OR (Vancomycin / fluoroquinolone / Aminoglycoside) *Consider treatment for fungals, Tb</td>
</tr>
<tr>
<td>CNS</td>
<td>(Vancomycin / ceftriaxone) *Consider treatment for viral *Consider ampicillin for Listeria</td>
<td>(Vancomycin / cefepime) *Consider treatment for viral *Consider ampicillin for Listeria</td>
<td>(Vancomycin / cefepime / acyclovir / ampicillin) *Consider treatment for fungals, Tb</td>
</tr>
<tr>
<td>IV Catheter</td>
<td>N/A</td>
<td>(Vancomycin / anti-pseudomonal PCN)</td>
<td>(Vancomycin / anti-pseudomonal PCN)</td>
</tr>
<tr>
<td>Skin / Tissue</td>
<td>(Vancomycin) *Consider anti-pseudomonal PCN if diabetic or vascular disease *Consider clindamycin for suspected toxic shock syndrome</td>
<td>(Vancomycin / anti-pseudomonal PCN) *Consider clindamycin for suspected toxic shock syndrome</td>
<td>(Vancomycin / anti-pseudomonal PCN) *Consider clindamycin for suspected toxic shock syndrome</td>
</tr>
<tr>
<td>Unknown</td>
<td>(Vancomycin / anti-pseudomonal PCN)</td>
<td>(Vancomycin / anti-pseudomonal PCN)</td>
<td>(Vanco / carbapenem / fluoroquinolone)</td>
</tr>
</tbody>
</table>
The Project

• IPad/Iphone app to calculate the Lung Injury Prevention Score
• Checklist of items for lung injury prevention
• Usability Testing: Multicenter Group
Questions?

- Raquel Bartz
- Dept. of Anesthesiology
- Email: raquel.bartz@duke.edu