Improving safety during endotracheal intubation of critically ill patients

Canadian Critical Care Conference 2011

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Clinical Assistant Professor
Anesthesiology & Critical Care Medicine
University of British Columbia
Disclosure
Disclosure

“And this is Dr. Og, your anesthesiologist.”
Complications of intubating critically ill patients

Intubation checklists
- Personnel
- Airway adjuncts (videolaryngoscopy)
- Patient preparation: preoxygenation and avoiding hypotension
- Induction medications
Patient

Provider
Clinical practice and risk factors for immediate complications of endotracheal intubation in the intensive care unit: A prospective, multiple-center study*

Samir Jaber, MD, PhD; Jibba Amraoui, MD; Jean-Yves Lefrant, MD, PhD; Charles Arich, MD; Robert Cohendy, MD, PhD; Liliane Landreau, MD; Yves Calvet, MD; Xavier Capdevila, MD, PhD; Aba Mahamat, MD; Jean-Jacques Eledjam, MD, PhD

![Graph showing overall complications 28%]

- Severe hypoxemia
- Severe collapse
- Cardiac arrest
- Death
- Difficult intubation
- Cardiac arrhythmia
- Esophageal intubation
- Agitation
- Aspiration
- Dental injury

Crit Care Med 2006 Vol. 34, No. 9
Complications of endotracheal intubation in the critically ill

<table>
<thead>
<tr>
<th>All Patients (n=136)</th>
</tr>
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<tbody>
<tr>
<td>Age, mean (SD)</td>
</tr>
<tr>
<td>Female sex, n(%)</td>
</tr>
<tr>
<td>Apache II, mean (SD)</td>
</tr>
<tr>
<td>Body Mass Index, mean (SD)</td>
</tr>
<tr>
<td>Indication for Intubation, n(%)</td>
</tr>
<tr>
<td>Respiratory Failure</td>
</tr>
<tr>
<td>Decreased LOCe</td>
</tr>
<tr>
<td>Shock</td>
</tr>
<tr>
<td>Procedure</td>
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<td>Night Intubation, n(%)</td>
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<tr>
<td>Location outside ICU, n(%)</td>
</tr>
<tr>
<td>SBP &lt; 90 mmHg, n(%)</td>
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<td>Vasopressor, n(%)</td>
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<td>SaO2&lt;90%, n(%)</td>
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**Donald E. G. Griesdale**
T. Laine Bosma
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CLINICAL PRACTICE

Out-of-theatre tracheal intubation: prospective multicentre study of clinical practice and adverse events

T. M. Bowles¹, D. A. Freshwater-Turner², D. J. Janssen³ and C. J. Peden⁴, on behalf of the RTIC Severn Group

<table>
<thead>
<tr>
<th></th>
<th>ICU (n=87)</th>
<th>ED (n=52)</th>
<th>Ward (n=20)</th>
<th>Total (n=164)</th>
</tr>
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<tbody>
<tr>
<td>Death</td>
<td>1 (1)</td>
<td>3 (6)</td>
<td>0</td>
<td>4 (2)</td>
</tr>
<tr>
<td>Non-fatal cardiac arrest</td>
<td>0</td>
<td>2 (4)</td>
<td>1 (5)</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Significant hypoxaemia</td>
<td>12 (14)</td>
<td>3 (6)</td>
<td>5 (25)</td>
<td>21 (13)</td>
</tr>
<tr>
<td>Significant hypotension</td>
<td>23 (26)</td>
<td>6 (12)</td>
<td>5 (25)</td>
<td>35 (21)</td>
</tr>
<tr>
<td>Dysrhythmia requiring treatment</td>
<td>2 (2)</td>
<td>3 (6)</td>
<td>2 (10)</td>
<td>7 (4)</td>
</tr>
<tr>
<td>Challenging intubation</td>
<td>8 (9)</td>
<td>2 (4)</td>
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<td>12 (7)</td>
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Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 2: intensive care and emergency departments†

T. M. Cook¹, N. Woodall², J. Harper³ and J. Benger⁴, on behalf of the Fourth National Audit Project

Table 5  Airway management and degree of harm number of cases: n (includes all reported cases—anaesthesia, ICU, and ED)

<table>
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<tr>
<th>Clinical area</th>
<th>Airway management</th>
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<tbody>
<tr>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>ICU</td>
<td>4</td>
</tr>
<tr>
<td>ICU death</td>
<td>0</td>
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<td>ICU death and brain damage</td>
<td>0</td>
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Intubation

- An intubation checklist should be developed and used for all intubations of critically ill patients. A checklist might usefully identify preparation of patent, equipment, drugs, and team. A checklist should include identification of back-up plans.
An intervention to decrease complications related to endotracheal intubation in the intensive care unit: a prospective, multiple-center study

Pre-intubation
1. Presence of two operators
2. Fluid loading (isotonic saline 500 ml or starch 250 ml) in absence of cardiogenic pulmonary edema
3. Preparation of long-term sedation
4. Preoxygenation for 3 min with NIPPV in case of acute respiratory failure (FiO₂ 100%, pressure support ventilation level between 5 and 15 cmH₂O to obtain an expiratory tidal volume between 6 and 8 ml/kg and PEEP of 5 cmH₂O)

During intubation
5. Rapid sequence induction: etomidate 0.2–0.3 mg/kg or ketamine 1.5–3 mg/kg combined with succinylcholine 1–1.5 mg/kg in absence of allergy, hyperkaliemia, severe acidosis, acute or chronic neuromuscular disease, burn patient for more than 48 h and medullar trauma
6. Sellick maneuver

Post-intubation
7. Immediate confirmation of tube placement by capnography
8. Norepinephrine if diastolic blood pressure remains <35 mmHg
9. Initiate long-term sedation
10. Initial “protective ventilation”: tidal volume 6–8 ml/kg of ideal body weight, PEEP <5 cmH₂O and respiratory rate between 10 and 20 cycles/min, FiO₂ 100% for a plateau pressure <30 cmH₂O
An intervention to decrease complications related to endotracheal intubation in the intensive care unit: a prospective, multiple-center study

Problem
ETI Checklist
Expert providers
Videolaryngoscopy
Metaanalysis
Communication
Airway Evaluation
Positioning
Preoxygenation
Critically Ill
Non-invasive
Hypotension
Intubation drugs
Hypotension
Adrenal insufficiency
Ketamine
Capnography
Conclusion

Samir Jaber
Boris Jung
Philippe Corne
Mustapha Sebbane
Laurent Muller
Gerald Chanques
Daniel Verzilli
Olivier Jonquet
Jean-Jacques Eledjam
Jean-Yves Lefrant

![Graph showing intervention effectiveness](attachment:image.png)

- Control (n=121)
- Intervention (n=123)

- Severe hypoxemia
- Severe collapse
- Cardiac arrest or death

- NS

* Represents statistically significant difference.
Please practice
SAFE SEX
and use the Condom stapled to this card
## Problem

### ETI Checklist

- Expert providers
- Videolaryngoscopy
- Metaanalysis
- Communication
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- Positioning
- Preoxygenation
- Critically Ill
- Non-invasive
- Hypotension
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- Ketamine
- Capnography
- Conclusion

### Patient Preparation

1. **Airway assessment & positioning**
   - Potential for difficult airway assessed and communicated to team
   - Shifting position (e.g., Troop pillow, funnel s/p pillows)

2. **Breathing / Pre-oxygenation**

### Personnel & Equipment

- Suction IV
- OR
- Bag mask ventilation with PEEP valve at 5 cm H2O
- Present: expert MD (airway pager 87 04524), RT, RN

### Circulation

- Airway equipment & adjuncts available (Bougie, Glidescope)
- Bolus 500 mL normal saline prior to intubation
- IV access established
- Norepinephrine infusion to keep MAP > 70 mmHg
- Monitoring applied (NIBP q1min or art line, EKG, SaO2)
- Phenytoin 50 - 100 mg IV bolus prn available
- Plan verbally communicated to all team members

### Drugs: Consideration for standardized medications:

a. **Rapid sequence intubation (RSI):**
   - Ketamine 1.5 mg/kg
   - Succinylcholine 1 mg/kg

b. **Sedated, spontaneously breathing intubation:**
   - Topical anesthesia with lidocaine
   - Midazolam 0.5 mg IV prn
   - Ketamine 0.25 mg/kg IV prn

### Intubation

- **Consider** cricoid pressure if RSI
- **Confirmation** with in-line CO2 monitoring & auscultation
**Problem**

**ETI Checklist**

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**Personnel & Equipment**

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Influence of residency training on multiple attempts at endotracheal intubation

Influence de la formation sur les tentatives multiples d’intubation endotrachéale par les résidents

A. J. Hirsch-Allen, BASc · Najib Ayas, MD · Scot Mountain, MD · Peter Dodek, MD · Adam Peets, MD · Donald E. G. Griesdale, MD
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<td>0.43</td>
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- Airway equipment & adjuncts available (Bougie, Glidescope)
- IV access established
- Monitoring applied (NIBP q1min or art line, EKG, SaO2)
- Plan verbally communicated to all team members
Glidescope®

Problem
ETI Checklist
Expert providers

Videolaryngoscope
Metaanalysis
Communication
Airway Evaluation
Positioning
Preoxygenation
Critically Ill
Non-invasive
Hypotension
Intubation drugs
Hypotension
Adrenal insufficiency
Ketamine
Capnography
Conclusion
Glidescope®

Problem
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Intubation drugs
Hypotension
Adrenal insufficiency
Ketamine
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LEDs (blue and red)

Video camera
Glidescope® vs. Direct

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Conclusion
Glidescope® vs. Direct

Superior laryngeal views that appear to be independent of operator expertise

CJA 2005;52:191
Glidescope®

Problem
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Glidescope® systematic

Metaanalysis

Problem
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Expert providers
Videolaryngoscopy
**Glidescope® systematic**

**Questions**

- Glottic View
- Successful 1st attempt
- Time-to-intubate

**Problem ETI Checklist**
- Expert providers
- Videolaryngoscope
- Metaanalysis

**Communication**
- Airway Evaluation
- Positioning
- Preoxygenation
- Critically Ill
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Adrenal insufficiency
Ketamine
Capnography
Conclusion

Novice vs. expert providers

Difficulty of intubation

Class I
Class II
Class III
Class IV
Glidescope® video-laryngoscopy versus direct laryngoscopy for endotracheal intubation: a systematic review and meta-analysis

Donald E. G. Griesdale, MD · David Liu, MD · James McKinney, MD · Peter T. Choi, MD

Citations identified in literature search (n=297)
- MEDLINE (n=76)
- EMBASE (n=150)
- CENTRAL (n=71)

Excluded (n=264)
- Duplicate citations (n=178)
- Abstract screening (n=86)

Published conference abstracts (n=3)
Identified from reference lists (n=5)

Full-text review (n=41)

Excluded (n=24)
- No outcomes of interest (n=5)
- Not randomised trials (n=7)
- Wrong intervention (n=7)
- Pediatric studies (n=3)
- Mannequin studies (n=2)

Articles included in meta-analysis (n=17)
Glottic View

- Problem
- ETI Checklist
- Expert providers
- Videolaryngoscopy
- Metaanalysis
- Communication
- Airway Evaluation
- Positioning
- Preoxygenation
- Critically Ill
- Non-invasive Hypotension
- Intubation drugs
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- Adrenal insufficiency
- Ketamine
- Capnography
- Conclusion

<table>
<thead>
<tr>
<th>Author Year</th>
<th>Glidescope®</th>
<th>Direct Laryngoscope</th>
<th>RR (95% CI)</th>
<th>Weight (%)</th>
<th>Favours DL</th>
<th>Favours GS</th>
</tr>
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<tbody>
<tr>
<td>Non-difficult intubations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun 2005</td>
<td>75 / 100</td>
<td>59 / 100</td>
<td>1.27 (1.04, 1.55)</td>
<td>17.28</td>
<td></td>
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</tr>
<tr>
<td>Jones 2008</td>
<td>32 / 34</td>
<td>23 / 35</td>
<td>1.43 (1.11, 1.85)</td>
<td>15.54</td>
<td></td>
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<tr>
<td>Bilehjani 2009</td>
<td>36 / 40</td>
<td>30 / 38</td>
<td>1.14 (0.94, 1.38)</td>
<td>17.43</td>
<td></td>
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<tr>
<td>Morello 2009</td>
<td>239 / 300</td>
<td>128 / 300</td>
<td>1.87 (1.62, 2.15)</td>
<td>18.90</td>
<td></td>
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<tr>
<td>Nouruzi-Sedeh 2009</td>
<td>66 / 100</td>
<td>32 / 100</td>
<td>2.06 (1.50, 2.84)</td>
<td>13.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tech 2010</td>
<td>78 / 100</td>
<td>58 / 100</td>
<td>1.34 (1.10, 1.64)</td>
<td>17.35</td>
<td></td>
<td></td>
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<tr>
<td>All non-difficult intubations (P² = 81.5%, p &lt; 0.001)</td>
<td>526 / 674</td>
<td>330 / 673</td>
<td>1.47 (1.15, 1.89)</td>
<td>100.00</td>
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</tr>
<tr>
<td>Difficult intubations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lim 2005</td>
<td>20 / 30</td>
<td>4 / 30</td>
<td>5.00 (1.94, 12.89)</td>
<td>16.40</td>
<td></td>
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<tr>
<td>Malik 2008</td>
<td>21 / 30</td>
<td>6 / 30</td>
<td>3.50 (1.65, 7.43)</td>
<td>19.76</td>
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<tr>
<td>Robitaille 2008</td>
<td>10 / 20</td>
<td>0 / 20</td>
<td>21.00 (1.31, 335.74)</td>
<td>3.64</td>
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<tr>
<td>Serocki 2010</td>
<td>43 / 120</td>
<td>10 / 120</td>
<td>4.30 (2.27, 8.15)</td>
<td>21.90</td>
<td></td>
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<tr>
<td>Malik 2009</td>
<td>22 / 25</td>
<td>2 / 25</td>
<td>11.00 (2.89, 41.89)</td>
<td>11.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venick 2009</td>
<td>37 / 39</td>
<td>17 / 39</td>
<td>2.18 (1.51, 3.13)</td>
<td>27.07</td>
<td></td>
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<tr>
<td>All difficult intubations (P² = 64.1%, p = 0.016)</td>
<td>153 / 264</td>
<td>39 / 264</td>
<td>3.52 (2.26, 5.48)</td>
<td>100.00</td>
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<tr>
<td>All patients (P² = 85.3%, p &lt; 0.001)</td>
<td>679 / 938</td>
<td>369 / 937</td>
<td>1.97 (1.54, 2.52)</td>
<td></td>
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</tbody>
</table>
Successful 1st Attempt

<table>
<thead>
<tr>
<th>Problem</th>
<th>ETI Checklist</th>
<th>Expert providers</th>
<th>Videolaryngoscopy</th>
<th>Metaanalysis</th>
<th>Communication</th>
<th>Airway</th>
<th>Evaluation</th>
<th>Positioning</th>
<th>Preoxygenation</th>
<th>Critically Ill</th>
<th>Non-invasive Hypotension</th>
<th>Intubation drugs</th>
<th>Hypotension</th>
<th>Adrenal insufficiency</th>
<th>Ketamine</th>
<th>Capnography</th>
<th>Conclusion</th>
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<tr>
<th>Author, Year</th>
<th>Glidescoper</th>
<th>Direct Laryngoscope</th>
<th>RR (95% CI)</th>
<th>Weight (% Random-Effects)</th>
<th>Favours DL</th>
<th>Favours GS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lim 2005^23</td>
<td>28 / 30</td>
<td>26 / 30</td>
<td>1.08 (0.91, 1.28)</td>
<td>7.72</td>
<td></td>
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</tr>
<tr>
<td>Sun 2005^15</td>
<td>94 / 100</td>
<td>97 / 100</td>
<td>0.97 (0.91, 1.03)</td>
<td>11.11</td>
<td></td>
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<tr>
<td>Xue 2007^30</td>
<td>28 / 30</td>
<td>27 / 27</td>
<td>0.94 (0.83, 1.05)</td>
<td>9.50</td>
<td></td>
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</tr>
<tr>
<td>Jones 2008^16</td>
<td>33 / 34</td>
<td>32 / 35</td>
<td>1.06 (0.94, 1.19)</td>
<td>9.45</td>
<td></td>
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<td>Malik 2008^26</td>
<td>28 / 30</td>
<td>26 / 30</td>
<td>1.08 (0.91, 1.28)</td>
<td>7.72</td>
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</tr>
<tr>
<td>Serocki 2010^24</td>
<td>38 / 40</td>
<td>35 / 40</td>
<td>1.11 (0.98, 1.27)</td>
<td>9.10</td>
<td></td>
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<tr>
<td>Bilehjani 2009^22</td>
<td>29 / 40</td>
<td>35 / 38</td>
<td>0.79 (0.64, 0.97)</td>
<td>6.45</td>
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<tr>
<td>Malik 2009^26</td>
<td>22 / 25</td>
<td>17 / 25</td>
<td>1.29 (0.95, 1.76)</td>
<td>4.33</td>
<td></td>
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</tr>
<tr>
<td>Morello 2003^27</td>
<td>134 / 150</td>
<td>95 / 150</td>
<td>1.41 (1.23, 1.61)</td>
<td>8.90</td>
<td></td>
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<tr>
<td>Siddiqui 2009^25</td>
<td>16 / 20</td>
<td>18 / 20</td>
<td>0.89 (0.68, 1.16)</td>
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<td>Yeatts 2010^26</td>
<td>150 / 200</td>
<td>154 / 205</td>
<td>1.00 (0.89, 1.12)</td>
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<tr>
<td>Tech 2010^27</td>
<td>91 / 100</td>
<td>98 / 100</td>
<td>0.93 (0.87, 0.99)</td>
<td>10.93</td>
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<tr>
<td><strong>All expert intubators</strong> (P = 0.01, p &lt; 0.001)</td>
<td>691 / 799</td>
<td>660 / 800</td>
<td>1.03 (0.95, 1.12)</td>
<td>100.00</td>
<td></td>
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</table>

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<tr>
<td>Nouruzi-Sedeh 2009^14</td>
<td>93 / 100</td>
<td>51 / 100</td>
<td>1.82 (1.49, 2.23)</td>
<td>79.63</td>
<td></td>
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</tr>
<tr>
<td>Shimada 2010^36</td>
<td>20 / 20</td>
<td>11 / 20</td>
<td>1.78 (1.20, 2.64)</td>
<td>20.37</td>
<td></td>
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</tr>
<tr>
<td><strong>All non-expert intubators</strong> (P = 0.02, p = 0.92)</td>
<td>113 / 120</td>
<td>62 / 120</td>
<td>1.82 (1.52, 2.17)</td>
<td>100.00</td>
<td></td>
<td></td>
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<tr>
<td>All patients (P = 0.001, p &lt; 0.001)</td>
<td>804 / 919</td>
<td>722 / 920</td>
<td>1.10 (0.99, 1.22)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph: Box plot showing distribution of outcomes.
Time-to-intubation

- Problem
- ETI Checklist
- Expert providers
- Videolaryngoscopy
- Metaanalysis
- Communication
- Airway Evaluation
- Positioning
- Preoxygenation
- Critically Ill
- Non-invasive Hypotension
- Intubation drugs
- Hypotension
- Adrenal insufficiency
- Ketamine
- Capnography
- Conclusion
Videolaryngoscopy

- Consistently better glottic view
- Possibly increased 1\textsuperscript{st} attempt success and reduced time-to-intubation in novice providers
- Consistently better glottic view
- Possibly increased 1\textsuperscript{st} attempt success and reduced time-to-intubation in novice providers

\textbf{Risk of Difficult intubation}
Videolaryngoscopy

- Consistently better glottic view
- Possibly increased 1st attempt success and reduced time-to-intubation in novice providers

Risk of Difficult intubation

Risk of Severe complications

Problem
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Intubation drugs
Hypotension
Adrenal insufficiency
Ketamine
Capnography
Conclusion
### Personnel & Equipment

- Present: expert MD (airway pager 87-04524), RT, RN
- Airway equipment & adjuncts available (Bougie, Glidescope)
- IV access established
- Monitoring applied (NIBP q1min or art line, EKG, SaO2)
- Plan verbally communicated to all team members

### Patient Preparation

1) Airway assessment & positioning
   - Potential for difficult airway assessed and communicated to team
   - Sniffing position (e.g. Troop pillow, flannel s/ p/ I lows)

2) Breathing / Pre-oxygenation
   - Start NIV unless contraindicated
   - Bag-mask ventilation with PEEP valve at 5 cmH₂O

2) Circulation:
   - Bolus 500 mL normal saline prior to intubation
   - Norepinephrine infusion to keep MAP >70 mmHg
   - Phenylephrine 50 - 100 mcg IV bolus prn available

3) Drugs: *consideration* for standardized medications:
   - a. Rapid sequence intubation (RS):
     - Ketamine 1.5 mg/kg
     - Succinylcholine 1mg/kg
   - b. Sedated, spontaneously breathing intubation:
     - Topical anesthesia with lidocaine
     - Midazolam 0.5mg IV prn
     - Ketamine 0.25mg/kg IV prn

### Intubation

- Consider cricoid pressure if RSI
- Confirmation with in-line ETCO₂ monitoring & auscultation
## Patient Preparation

1) Airway assessment & positioning
   - Potential for difficult airway assessed and communicated to team
   - Sniffing position (e.g., Troop pillow, flannel s/p I lows)

2) Breathing / Pre-oxygenation
   - Start NIV
   - Bag-mask ventilation with PEEP valve at 5 cmH₂O

3) Drugs: consideration for standardized medications:
   a. Rapid sequence intubation (RS):
      - Ketamine 1.5 mg/kg
      - Succinylcholine 1 mg/kg
   b. Sedated, spontaneously breathing intubation:
      - Topical anesthesia with lidocaine
      - Midazolam 0.5 mg IV prn
      - Ketamine 0.25 mg/kg IV prn

---

**Problem**
- Expert providers
- Videolaryngoscope
- Communication
- Airway
- Evaluation

**ETI Checklist**
- Preoxygenation
- Critically Ill
- Non-invasive
- Hypotension
- Intubation drugs

**Metaanalysis**
- Adrenal insufficiency
- Ketamine
- Capnography

**Conclusion**
<table>
<thead>
<tr>
<th>Patient Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Airway assessment &amp; positioning^b</td>
</tr>
<tr>
<td>- Potential for difficult airway assessed and communicated to team</td>
</tr>
<tr>
<td>- Sniffing position ^c (e.g. Troop pillow, flannel s/pillow)</td>
</tr>
<tr>
<td>2) Breathing / Pre-oxygenation</td>
</tr>
<tr>
<td>- Start NIV \text{--OR--}</td>
</tr>
<tr>
<td>- Bag-mask ventilation with PEEP valve at 5 cmH$_2$O $}^{\text{unless contraindicated}^d}$</td>
</tr>
<tr>
<td>2) Circulation:</td>
</tr>
<tr>
<td>- Bolus 500 mL normal saline prior to intubation</td>
</tr>
<tr>
<td>- Norepinephrine infusion to keep MAP &gt; 70 mmHg $^f$</td>
</tr>
<tr>
<td>- Phentylephrine 50 - 100 mcg IV bolus prn available</td>
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<td>3) Drugs: consideration for standardized medications:</td>
</tr>
<tr>
<td>a. □ Rapid sequence intubation (RS):</td>
</tr>
<tr>
<td>• Ketamine 1.5 mg/kg</td>
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<td>• Succinylcholine 1 mg/kg $^g$</td>
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<td>b. □ Sedated, spontaneously breathing intubation:</td>
</tr>
<tr>
<td>• Topical anesthesia with lidocaine</td>
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<td>• Midazolam 0.5 mg IV prn \text{--OR--}</td>
</tr>
<tr>
<td>• Ketamine 0.25 mg/kg IV prn</td>
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**Problem**

ETI Checklist

Expert providers

Videolaryngoscopy

Metaanalysis

**Communication**

**Airway**

**Evaluation**

Positioning

Preoxygenation

Critically Ill

Non-invasive

Hypotension

Intubation drugs

Hypotension

Adrenal insufficiency

Ketamine

Capnography

Conclusion
Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 2: intensive care and emergency departments†

T. M. Cook¹*, N. Woodall², J. Harper³ and J. Benger⁴, on behalf of the Fourth National Audit Project

<table>
<thead>
<tr>
<th>Factors</th>
<th>ICU (n=36)</th>
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<tbody>
<tr>
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<tr>
<td>Communication</td>
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<tr>
<td>Education and training</td>
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<tr>
<td>Equipment and resources</td>
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<tr>
<td>Medicines</td>
<td>0</td>
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<tr>
<td>Organization and strategic</td>
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<tr>
<td>Patient</td>
<td>6</td>
</tr>
</tbody>
</table>
Airway management necessary
Ensure airway management expertise available

- No
  - Consider single attempt at laryngoscopy

- Yes
  - Time for patient assessment & optimization?
    - No
      - Potential for DMV and or DI?
        - No
          - RSII
            - Ketamine 1mg/kg
            - Succinylcholine 1mg/kg OR Rocuronium 1mg/kg
        - Yes
          - Primary awake technique
            - Topicalization with lidocaine
            - Judicious sedation
  
  - Potential for DMV and or DI?
    - No
      - RSII
        - Ketamine 1mg/kg
        - Succinylcholine 1mg/kg OR Rocuronium 1mg/kg
    - Yes
      - Primary awake technique
        - Topicalization with lidocaine
        - Judicious sedation

  - Fail
    - CALL FOR HELP!

  - Adequate MV
    - Alteration of primary technique
      - Improve positioning
      - Fiberoptic bronchoscope
      - Gum elastic bougie
      - Videolaryngoscope
      - Lightwand
      - LMA®
    - Adequate MV
  
  - Inadequate MV
    - Surgical or needle cricothyroidotomy
Airway management necessary
Ensure airway management expertise available

Time for patient assessment & optimization?

Yes
Potential for DMV and or DI?

No
Consider single attempt at laryngoscopy

Ketamine 1mg/kg
Succinylcholine 1mg/kg
OR Rocuronium 1mg/kg

Primary awake technique
Topicalization with lidocaine
Judicious sedation
Poor sensitivity
Fair specificity
Poor sensitivity
Fair specificity
Poor PPV
Fair NPV
Poor sensitivity
Fair specificity
Poor PPV
Fair NPV

Must always be prepared for unanticipated difficulty
<table>
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</tr>
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<td>- Ketamine 0.25mg/kg IV prn</td>
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</table>

---

**Positioning**

Preoxygenation

Critically Ill Non-invasive Hypotension

Intubation drugs

Hypotension Adrenal insufficiency

Ketamine Capnography Conclusion
### Patient Preparation

1) Airway assessment & positioning

- [ ] Potential for difficult airway assessed and communicated to team
- [ ] Sniffing position (e.g., Troop pillow, funnel s/ p/ I lows)

2) Breathing / Pre-oxygenation

- [ ] Start NIV
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- [ ] Bolus 500 mL normal saline prior to intubation
- [ ] Norepinephrine infusion to keep MAP > 70 mmHg
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Metaanalysis
Communication
Airway
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Preoxygenation in critically ill patients requiring emergency tracheal intubation*

Thomas C. Mort, MD

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<td>T-0</td>
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- 36% had change of +/- 5% from baseline
- Only 19% had > 50mmHg change in PaO2

*ETI Checklist
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Noninvasive Ventilation Improves Preoxygenation before Intubation of Hypoxic Patients

Christophe Baillard, Jean-Philippe Fosse, Mustapha Sebbane, Gérald Chanques, François Vincent, Patricia Courouble, Yves Cohen, Jean-Jacques Eledjam, Frédéric Adnet, and Samir Jaber

Department of Anesthesiology and Intensive Care, and SAMU 93, Avicenne Hospital, Paris 13 University–AP-HP, Bobigny; Intensive Care Unit, Department of Anesthesiology, DAR B University Hospital of Montpellier, and Saint Eloi Hospital, Montpellier University, Montpellier, France

![Graph showing the protocol for preoxygenation and intubation with non-invasive ventilation.](image)
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- Conclusion

**Graph:**
- SpO2 (%)
- Baseline, Before ETI, During ETI, ETI+5', ETI+30'
- C, NIV

*Am J Respir Crit Care Med Vol 174. pp 171–177, 2006*
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<tbody>
<tr>
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</tr>
<tr>
<td>$P_{O_2}$, mm Hg</td>
<td>97 (66–163)</td>
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<td>BE, mmol/L</td>
<td>24 (22–28)</td>
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Determination of Cardiac Output By Equating Venous Return Curves With Cardiac Response Curves

ARTHUR C. GUYTON

From the Department of Physiology and Biophysics, School of Medicine, University of Mississippi, University, Mississippi

fig. 2

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<tr>
<th>MCFP</th>
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<tr>
<td>10.6</td>
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<td>8.4</td>
<td>5</td>
</tr>
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RIGHT ATRIAL PRESSURE (mm Hg)
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C. E. Harris, A. M. Murray, J. M. Anderson, R. M. Grounds and M. Morgan

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C. E. Harris, A. M. Murray, J. M. Anderson, R. M. Grounds and M. Morgan

Arterial blood pressure (mmHg)

Fentanyl/saline
Induction
Suxamethonium
Intubation
After intubation (minutes)

Etomidate
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**Ketamine**

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C. E. HARRIS, A. M. MURRAY, J. M. ANDERSON, R. M. GROUNDS AND M. MORGAN

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Arterial blood pressure (mmHg)

Fentanyl/saline

Induction

Suxamethonium

Etomidate

Propofol

1 2 3

After intubation (minutes)
Hydrocortisone Therapy for Patients with Septic Shock

Charles L. Sprung, M.D., Djillali Annane, M.D., Ph.D., Didier Keh, M.D., Rui Moreno, M.D., Ph.D., Mervyn Singer, M.D., F.R.C.P., Klaus Freivogel, Ph.D., Yoram G. Weiss, M.D., Julie Benbenishty, R.N., Armin Kalenka, M.D., Helmuth Forst, M.D., Ph.D., Pierre-Francois Laterre, M.D., Konrad Reinhart, M.D., Brian H. Cuthbertson, M.D., Didier Payen, M.D., Ph.D., and Josef Briegel, M.D., Ph.D., for the CORTICUS Study Group*
Post-hoc analysis of patients who received etomidate
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• Decreased response to corticotropin (p=0.004)
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  • No etomidate: 175/403 (43%)
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• Increased 28-day mortality (p=0.03)
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  • No etomidate: 123/403 (31%)
Etomidate versus ketamine for rapid sequence intubation in acutely ill patients: a multicentre randomised controlled trial

Patricia Jabre, Xavier Combes, Frederic Lapostolle, Mohamed Dhaouadi, Agnes Ricard-Hibon, Benoit Vivien, Lionel Bertrand, Alexandra Beltrami, Pascale Gamand, Stephane Albizzati, Deborah Perdrizet, Gaelle Lebail, Charlotte Chollet-Xemard, Virginie Maxime, Christian Brun-Buisson, Jean-Yves Lefrant, Pierre-Edouard Bollaert, Bruno Megarbene, Jean-Damien Ricard, Nadia Anguel, Eric Vicaut, Frederic Adnet, on behalf of the KETASED Collaborative Study Group

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<th>p value</th>
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<tr>
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<td>441 (304-717)</td>
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<tr>
<td>30 min after ACTH test</td>
<td>497 (331-800)</td>
<td>911 (690-1131)</td>
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<td>100 (86%, 82-90)</td>
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<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

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Etomidate versus ketamine for rapid sequence intubation in acutely ill patients: a multicentre randomised controlled trial

Patricia Jabre, Xavier Combes, Frederic Lapostolle, Mohamed Dhaouadi, Agnes Ricard-Hibon, Benoit Vivien, Lionel Bertrand, Alexandra Beltramini, Pascale Gamand, Stephane Albizzati, Deborah Perdrizet, Gaelle Lebail, Charlotte Chollet-Xenard, Virginie Maxime, Christian Brun-Buisson, Jean-Yves Lefrant, Pierre-Edouard Bollaert, Bruno Megarbane, Jean-Damien Ricard, Nadia Anguel, Eric Vicaut, Frederic Adnet, on behalf of the KETASED Collaborative Study Group

<table>
<thead>
<tr>
<th>Intubation condition</th>
<th>Etomidate (n=234)</th>
<th>Ketamine (n=235)</th>
<th>Difference (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDS value (median [IQR])</td>
<td>1 (0 to 3)</td>
<td>1 (0 to 3)</td>
<td>0 (0 to 0)†</td>
<td>0.70</td>
</tr>
<tr>
<td>Difficult intubation (n [%], 95% CI)†</td>
<td>24 (10%, 6 to 14)</td>
<td>20 (9%, 5 to 13)</td>
<td>2 (4 to 7)</td>
<td>0.52</td>
</tr>
<tr>
<td>Change in arterial systolic blood pressure (mm Hg; median [IQR])‡</td>
<td>5 (11 to 30)</td>
<td>10 (10 to 33)</td>
<td>-5 (13 to 2)†</td>
<td>0.24</td>
</tr>
<tr>
<td>Change in arterial diastolic blood pressure (mm Hg; median [IQR])¶</td>
<td>1 (8 to 13)</td>
<td>5 (7 to 18)</td>
<td>-4 (8 to 1)†</td>
<td>0.18</td>
</tr>
<tr>
<td>Change in SpO₂ (%) (median [IQR])¶¶</td>
<td>1% (0 to 6)</td>
<td>2% (0 to 7)</td>
<td>-1 (2 to 1)†</td>
<td>0.98</td>
</tr>
<tr>
<td>Cardiac arrest during intubation (n [%])</td>
<td>7 (3%)</td>
<td>4 (2%)</td>
<td>1.3 (1.5 to 4.0)</td>
<td>0.36</td>
</tr>
</tbody>
</table>
## Personnel & Equipment

- Present: expert MD (airway pager 87-04524), RT, RN
- Airway equipment & adjuncts available (Bougie, Glidescope)
- IV access established
- Monitoring applied (NIBP q1min or art line, EKG, SaO2)
- Plan verbally communicated to all team members

## Patient Preparation

1) Airway assessment & positioning
   - Potential for difficult airway assessed and communicated to team
   - Sniffing position (e.g., Troop pillow, flannel s/phil lows)

2) Breathing / Pre-oxygenation
   - Start NIV^\text{a}\text{b}\text{c}\text{d} --OR--
   - unless contraindicated

## Intubation

2) Cricoid
   - Consider cricoid pressure if RS^\text{e}
   - Bolus 500 ml normal saline prior to intubation
   - Confirmation with in-line ETCO₂ monitoring & auscultation
   - Norepinephrine infusion to keep MAP >90 mmHg

- Phenylephrine 50 - 100 mcg IV bolus prn available

3) Drugs: consideration for standardized medications:
   - Rapid sequence intubation (RS):
     - Ketamine 1.5 mg/kg
     - Succinylcholine 1mg/kg^\text{f}
   - Sedated, spontaneously breathing intubation:
     - Topical anesthesia with lidocaine
     - Midazolam 0.5mg IV prn --OR--
     - Ketamine 0.25mg/kg IV prn
### Intubation

- Consider cricoid pressure if PSI
- Confirmation with in-line EtCO₂ monitoring & auscultation

**Problem**
- ETI Checklist
- Expert providers
- Videolaryngoscope
- Metaanalysis
- Communication
- Airway
  - Evaluation
- Positioning
- Preoxygenation
- Critically Ill
- Non-invasive
- Hypotension
- Intubation drugs
  - Hypotension
  - Adrenal insufficiency
- Ketamine

**Capnography**

**Conclusion**
Out-of-theatre tracheal intubation: prospective multicentre study of clinical practice and adverse events

T. M. Bowles*, D. A. Freshwater-Turner², D. J. Janssen³ and C. J. Peden⁴, on behalf of the RTIC Severn Group

<table>
<thead>
<tr>
<th></th>
<th>ICU (n=87)</th>
<th>ED (n=52)</th>
<th>Ward (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cricoid pressure not applied</td>
<td>23 (26)</td>
<td>5 (10)</td>
<td>7 (35)</td>
</tr>
<tr>
<td>Suction not available</td>
<td>1 (1)</td>
<td>0</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Bougie not available</td>
<td>3 (3)</td>
<td>3 (6)</td>
<td>0</td>
</tr>
<tr>
<td>Alternative airway not available</td>
<td>14 (16)</td>
<td>6 (12)</td>
<td>4 (20)</td>
</tr>
<tr>
<td>Capnography not used</td>
<td>24 (28)</td>
<td>10 (19)</td>
<td>16 (80)</td>
</tr>
</tbody>
</table>
Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 2: intensive care and emergency departments†

T. M. Cook¹, N. Woodall², J. Harper³ and J. Benger⁴, on behalf of the Fourth National Audit Project

Capnography

- Capnography should be used for intubation of all critically ill patients irrespective of location.
- Continuous capnography should be used in all ICU patients with tracheal tubes (including tracheostomy) who are intubated and ventilator-dependent. Cost and technical difficulties may be practical impediments to the rapid introduction of routine capnography. However, these need not prevent its implementation.
## Personnel & Equipment

- Present: expert MD (airway pager 87-04524), RT, RN
- Airway equipment & adjuncts available (Bougie, Glidescope)
- IV access established
- Monitoring applied (NIBP q1min or art line, EKG, SaO2)
- Plan verbally communicated to all team members

## Patient Preparation

1. **Airway assessment & positioning**
   - Potential for difficult airway assessed and communicated to team
   - Shifting position (e.g. Troop pillow, funnel s/p pillows)

2. **Breathing / Pre-oxygenation**
   - Start NIV\(^b\) --OR--
   - Bag-mask ventilation with PEEP valve at 5 cmH\(_2\)O \(\) unless contraindicated\(^d\)

3. **Circulation:**
   - Bolus 500 mL normal saline prior to intubation
   - Norepinephrine infusion to keep MAP \(>70\) mmHg
   - Phenylephrine 50 - 100 mcg IV bolus prn available

3. **Drugs: consideration for standardized medications:**
   a. **Rapid sequence intubation (RSI):**
      - Ketamine 1.5 mg/kg
      - Succinylcholine 1mg/kg
   b. **Sedated, spontaneously breathing intubation:**
      - Topical anesthesia with lidocaine
      - Midazolam 0.5mg IV prn --OR--
      - Ketamine 0.25mg/kg IV prn

## Intubation

- Consider cricoid pressure if RSI\(^g\)
- Confirmation with in-line ECO\(_2\) monitoring & auscultation
Conclusions

- Intubation in critically ill patients is associated with a high risk of severe complications
- Many are preventable
- ETI checklists may help reduce complications by ensuring:
  - Appropriate personnel
  - Adjuvant equipment
  - Patient preparation
Contact me!!
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Thank you

Dr. Najib Ayas
Dr. Peter Choi
Dr. Anton Chau
Dr. George Isac
Dr. Adam Peets
Dr. Peter Dodek
Dr. Noemi Chessex

Ms. Denise Foster
Ms. Corrie Irwin
Mrs. Maureen Gardner
Mrs. Susan Logie
Thank You!!