Cognitive Aids to Improve Crisis Management

Alexander A. Hannenberg, M.D.
Council on Surgical & Perioperative Safety
Emergency Manual Implementation Collaborative
Past President
American Society of Anesthesiologists
Tufts University School of Medicine
Newton-Wellesley Hospital
Newton, MA

Pamela Windle, MS, RN, NE-BC, CPAN, CAPA, FAAN
Council on Surgical & Perioperative Safety
Chair 2013-2014
American Society of PeriAnesthesia Nurses (ASPN)
Past President
Baylor St. Luke’s Medical Center Houston, TX
Nurse Manager, Post Anesthesia Care Unit (PACU)
Council on Surgical & Perioperative Safety

Checklist Use

- Aviation
- Nuclear Power
- Naval Aircraft Carriers
- .....Health Care
B17: Miracle of Aviation Engineering

B-17 Aircraft Loss: Birth of Aviation Checklists 1935
W. Wayne Babcock, M.D (1872-1963)  
Chair, Department of Surgery (1903)  
Temple University
“If a response is not instantly obtained by simple measures, a fixed emergency routine, posted on the walls of every operating room and drilled into every member of the staff, should be enforced.”

Anesthesia and Analgesia—December 1924

Resuscitation During Anesthesia


Anesthesia Apparatus Checkout Recommendations, 1993

This checklist, or a reasonable equivalent, should be conducted before administration of anesthesia. These recommendations are only valid for an anesthesia system that conforms to current and relevant standards and includes an operating floor ventilator and at least the following components: capnometer, pulse oximeter, oxygen analyzer, respiratory volume monitor, and a filling system. The system shall include a common gas outlet, arterial pressure monitoring, end-tidal CO₂ monitoring, and an end-tidal ventilating valve. The system shall be designed and maintained according to the manufacturer’s specifications and to local clinical practice. Local modifications should have appropriate peer review. Users should refer to the operators manual for the manufacturer’s specific procedures and precautions, especially the manufacturer’s low pressure limit test (step 9).

1. Verify Backup Ventilation Equipment is Available & Functioning
   - High Pressure System
     a. Open cylinder and verify at least half full (about 1000 psi).
     b. Close cylinder.
   - Low Pressure System
     a. Close low pressure valve and verify.
     b. Check III level and tightness of valve caps.

2. Check Clearance Tissues, if present
   - Remove all trailing plastic, tape and ties.

3. Check Central Line Supplies
   - Verify that lines are connected and the proper gauge is used.

4. Check Initial Status of Low Pressure System
   - Open low pressure valve and verify.
   - Verify that all IIICs are closed.

5. Perform Leak Check of Machine Low Pressure System
   - Verify that the machine master switch and flow control valves are OFF.
   - Attach “snubber bulb” to common gas outlet.
   - Squeeze bulb repeatedly until fully collapsed.
   - Verify that flow rate is not collapsed for at least 10 seconds.
   - Open the gas valve and verify that the pressure drops are noted.

6. Turn On Machine Master Switch
   and all other necessary electrical equipment.

7. Test Flowmeters
   - Adjust flow of all gases through their full range, checking for smooth operation of flows and unabraded flowmeters.
   - Adjust for a hyperoxic N₂O mixture and verify correct changes in flow meter units.

8. Adjust and Check Scavenging System
   - Ensure proper connections between the scavenging system and both ASAP (pop-off) valve and scavenging relief valve.
   - Ensure all ASAP are flush with Y-piece.
   - Verify that all ASAP are flush with Y-piece and that Y-piece is not leaking.
   - Open the flowmeter to the scavenging system bag to simulate the exhaust bag collapse and verify that the scavenging flowmeters read zero.
   - Open the flowmeter to the scavenging system bag to simulate the exhaust bag collapse, and then verify that the scavenging flowmeter reads no significant flow.

9. Calibrate O₂ Monitor
   - Ensure monitor reads 21% ± 2%.
   - Verify the flow alarm is audible and functioning.
   - Verify that the monitor alarm system is functional in circuit and flush breathing circuit with 0%.
   - Verify that the monitor alarm system is functional in circuit and flush breathing circuit with 0%.

10. Check Initial Status of Breathing System
    a. Select switch to “Bag” mode.
    b. Check that breathing circuit is complete, unobstructed, and unobstructed.
    c. Verify that E, exhalation valve is adequate.
    d. Ensure that breathing circuit accessory equipment (e.g., humidifier, PEEP valve) is to be used.

11. Perform Leak Check of the Breathing System
    a. Set all gas flows to zero (or minimum).
    b. Close ASAP (pop-off) valve and exclude Y-piece.
    c. Expose Y-piece to the scavenging system bag with O₂, back.
    d. Ensure that pressure remains fixed for at least 10 seconds.
    e. Open ASAP (pop-off) valve and measure that pressure decreases.

Manual and Automatic Ventilating System

12. Test Ventilation System and Unidirectional Valves
    a. Place a second breathing bag on Y-piece.
    b. Set appropriate ventilator parameters for next patient.
    c. Switch to automatic ventilator (ventilator mode).
    d. Verify that ventilator is set to the desired ventilator ON.
    e. Set I, flow to minimum, other gas flows to zero.
    f. Verify that during inspiration follows 10–15 cm H₂O pressure during expiration just before complete.
    g. Verify that the ventilator is set to the desired ventilator ON.
    h. Verify that the ventilator is set to the desired ventilator ON.
    i. Verify that the ventilator is set to the desired ventilator ON.
    j. Verify that the ventilator is set to the desired ventilator ON.
    k. Verify that the ventilator is set to the desired ventilator ON.
    l. Verify that the ventilator is set to the desired ventilator ON.
    m. Verify that the ventilator is set to the desired ventilator ON.
    n. Verify that the ventilator is set to the desired ventilator ON.
    o. Verify that the ventilator is set to the desired ventilator ON.
    p. Verify that the ventilator is set to the desired ventilator ON.
    q. Verify that the ventilator is set to the desired ventilator ON.
    r. Verify that the ventilator is set to the desired ventilator ON.
    s. Verify that the ventilator is set to the desired ventilator ON.
    t. Verify that the ventilator is set to the desired ventilator ON.
    u. Verify that the ventilator is set to the desired ventilator ON.
    v. Verify that the ventilator is set to the desired ventilator ON.
    w. Verify that the ventilator is set to the desired ventilator ON.
    x. Verify that the ventilator is set to the desired ventilator ON.
    y. Verify that the ventilator is set to the desired ventilator ON.
    z. Verify that the ventilator is set to the desired ventilator ON.

Monitors

13. Check, Calibrate and Set Alert Limits of all Monitors
    - Capnometer
    - Pulse Oximeter
    - Oxygen Analyzer
    - Respiration Volume Monitor (Spironeter)
    - Pressure Monitor with High and Low Alarm Alarms
    - Monitor

14. Check final status of Monitors
    a. Verify that all breathing systems are functional.
    b. Verify that all alarms are audible and functioning.
    c. Verify that all ventilators are functional.
    d. Verify that all ventilators are functional.
    e. Verify that all ventilators are functional.
    f. Verify that all ventilators are functional.
    g. Verify that all ventilators are functional.
    h. Verify that all ventilators are functional.
    i. Verify that all ventilators are functional.
    j. Verify that all ventilators are functional.
    k. Verify that all ventilators are functional.
    l. Verify that all ventilators are functional.
    m. Verify that all ventilators are functional.
    n. Verify that all ventilators are functional.
    o. Verify that all ventilators are functional.
    p. Verify that all ventilators are functional.
    q. Verify that all ventilators are functional.
    r. Verify that all ventilators are functional.
    s. Verify that all ventilators are functional.
    t. Verify that all ventilators are functional.
    u. Verify that all ventilators are functional.
    v. Verify that all ventilators are functional.
    w. Verify that all ventilators are functional.
    x. Verify that all ventilators are functional.
    y. Verify that all ventilators are functional.
    z. Verify that all ventilators are functional.

* If an anesthesia provider uses the same machine in consecutive cases, those steps need not be repeated if they are able to be abbreviated after the initial checkout.
Speed of Checklist Adoption

Wright Brothers
ca 1905

Hippocrates
ca 400 BC

The NEW ENGLAND JOURNAL of MEDICINE

An Intervention to Decrease Catheter-Related Bloodstream Infections in the ICU

Peter Pronovost, M.D., Ph.D., Dale Needham, M.D., Ph.D., Sean Berenholtz, M.D., David Sinopoli, M.P.H., M.B.A., Halton Chu, M.D., Ph.D., Sara Cosgrove, M.D., Bryan Sexton, Ph.D., Robert Hyzy, M.D., Robert Welsh, M.D., Gary Roth, M.D., Joseph Bandier, M.D., John Kepros, M.D., and Christine Goeschel, R.N., M.P.A.
Impact of Catheter Related Bloodstream Infections

- Frequency: 250,000/yr (US hospitals)
- Mortality: 12-25%
- Cost: $25,000 per episode

50,000 Lives, $6.2 Billion

Kluger DM, Maki DG. The relative risk of intravascular device related bloodstream infections. American Society for Microbiology, 1999


- 103 ICUs in Michigan (2004-2005)
- 18 month study period
- MD and RN Team leaders in each ICU
- Checklist:
  - Hand washing
  - Full barrier precautions
  - Chlorhexidine
  - Avoid femoral insertions
  - Remove unneeded catheters

### Rates of Catheter-Related Bloodstream Infection from Baseline (before Implementation of the Study Intervention) to 18 Months of Follow-up

<table>
<thead>
<tr>
<th>Study Period</th>
<th>No. of ICUs</th>
<th>No. of Bloodstream Infections per 1000 Catheter-Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overall</td>
<td>Teaching Hospital</td>
</tr>
<tr>
<td>Baseline</td>
<td>15</td>
<td>2.7 (0.5–4.8)</td>
</tr>
<tr>
<td>During implementation</td>
<td>96</td>
<td>1.6 (0.4–4.6)†</td>
</tr>
<tr>
<td>After implementation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 0–3 mo       | 96          | 0 (0–3.0)†       | 1.3 (0–3.1)†           | 0 (0–1.6)† | 0 (0–2.7) | 1.1 (0–3.1)† |
| 4–6 mo       | 96          | 0 (0–2.7)†       | 1.1 (0–3.6)†           | 0 (0–0)†   | 0 (0–0)†  | 0 (0–3.2)†   |
| 7–9 mo       | 95          | 0 (0–2.1)†       | 0.8 (0–2.4)†           | 0 (0–0)†   | 0 (0–0)†  | 0 (0–2.2)†   |
| 10–12 mo     | 90          | 0 (0–1.9)†       | 0 (0–2.3)†             | 0 (0–1.5)† | 0 (0–0)†  | 0.2 (0–2.3)† |
| 13–15 mo     | 85          | 0 (0–1.9)†       | 0 (0–2.2)†             | 0 (0–0)†   | 0 (0–0)†  | 0 (0–2.0)†   |
| 16–18 mo     | 70          | 0 (0–2.6)†       | 0 (0–2.7)†             | 0 (0–1.2)† | 0 (0–0)†  | 0.6 (0–3.6)† |

*Because the ICUs implemented the study intervention at different times, the total number of ICUs contributing data for each period varies. Of the 103 participating ICUs, 48 did not contribute baseline data. P values were calculated by the two-sample Wilcoxon rank-sum test.
† P<0.05 for the comparison with the baseline (preimplementation) period.
‡ P=0.002 for the comparison with the baseline (preimplementation) period.
TOGO
Anesthesia AMR 1:133

ZIMBABWE
Avoidable mortality rate 1:482

MALAWI
Avoidable mortality rate 1:275
Anesthesia AMR 1:504

NIGERIA
Overall Emergency Surgery Mortality 10.3%

Surgical Safety Checklist

Before induction of anaesthesia
(with at least nurse and anaesthetist)
- Has the patient confirmed his/her identity, site, procedure, and consent?
  - Yes
  - No
- Is the site marked?
  - Yes
  - No
- Is the anesthesia machine and medication check complete?
  - Yes
  - No
- Is the pulse oximeter on the patient and functioning?
  - Yes
  - No
- Does the patient have a:
  - Known allergy?
    - Yes
    - No
  - Difficult airway or aspiration risk?
    - Yes
    - No
- Risk of >500mbl blood loss (bleeding in child?)
  - Yes
  - No
- Has two central access and fluids planned?
  - Yes
  - No
  - Not applicable
- Has antibiotic prophylaxis been given within the last 60 minutes?
  - Yes
  - No
  - Not applicable

Before skin incision
(with nurse, anaesthetist and surgeon)
- Confirm all team members have introduced themselves by name and role.
- Confirm the patient’s name, procedure, and where the incision will be made.
- Has antibiotic prophylaxis been given within the last 60 minutes?
  - Yes
  - No
  - Not applicable

Before patient leaves operating room
(with nurse, anaesthetist and surgeon)
- Anticipated Critical Events
  - To Surgeon:
    - What are the critical or non-routine steps?
    - How long will the case take?
    - What is the anticipated blood loss?
  - To Anaesthetist:
    - Are there any patient-specific concerns?
  - To Nursing Team:
    - Has sterile (including indicator results) been confirmed?
    - Are there equipment issues or any concerns?
    - Is essential imaging displayed?
      - Yes
      - No
      - Not applicable

Nurse Verbally Confirms:
- The name of the procedure
- Completion of instrument, sponge and needle count
- Specimen labelling (check specimen labels aloud, including patient name)
- Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:
- What are the key concerns for recovery and management of this patient?

- 8 hospitals, 2007-2008
  - Geographically, economically diverse

- Complications & death within 30 d postop

- WHO Surgical Safety Checklist
  - Modified as needed
  - 7-30 day implementation program

- n=3733 pre, 3955 post-intervention

Characteristics of Participating Hospitals

<table>
<thead>
<tr>
<th>Site</th>
<th>Location</th>
<th>No. of Beds</th>
<th>No. of Operating Rooms</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prince Hamzah Hospital</td>
<td>Amman, Jordan</td>
<td>500</td>
<td>13</td>
<td>Public, urban</td>
</tr>
<tr>
<td>St. Stephen's Hospital</td>
<td>New Delhi, India</td>
<td>733</td>
<td>15</td>
<td>Charity, urban</td>
</tr>
<tr>
<td>University of Washington Medical Center</td>
<td>Seattle, Washington</td>
<td>410</td>
<td>24</td>
<td>Public, urban</td>
</tr>
<tr>
<td>St. Francis Designated District Hospital</td>
<td>Ifakara, Tanzania</td>
<td>371</td>
<td>3</td>
<td>District, rural</td>
</tr>
<tr>
<td>Philippine General Hospital</td>
<td>Manila, Philippines</td>
<td>1800</td>
<td>39</td>
<td>Public, urban</td>
</tr>
<tr>
<td>Toronto General Hospital</td>
<td>Toronto, Canada</td>
<td>744</td>
<td>19</td>
<td>Public, urban</td>
</tr>
<tr>
<td>St. Mary's Hospital</td>
<td>London, England</td>
<td>541</td>
<td>16</td>
<td>Public, urban</td>
</tr>
<tr>
<td>Auckland City Hospital</td>
<td>Auckland, New Zealand</td>
<td>710</td>
<td>31</td>
<td>Public, urban</td>
</tr>
</tbody>
</table>

* St. Mary's Hospital has since been renamed St. Mary's Hospital–Imperial College National Health Service Trust.
## Outcomes Before and After Checklist Implementation

### Table 5: Outcomes before and after Checklist Implementation, According to Site.\(^a\)

<table>
<thead>
<tr>
<th>Site No.</th>
<th>No. of Patients Enrolled</th>
<th>Surgical-Site Infection</th>
<th>Unplanned Return to the Operating Room</th>
<th>Pneumonia</th>
<th>Death</th>
<th>Any Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>Before</td>
<td>After</td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>1</td>
<td>524</td>
<td>598</td>
<td>4.0</td>
<td>2.0</td>
<td>4.6</td>
<td>1.8</td>
</tr>
<tr>
<td>2</td>
<td>357</td>
<td>351</td>
<td>2.0</td>
<td>1.7</td>
<td>0.6</td>
<td>1.1</td>
</tr>
<tr>
<td>3</td>
<td>497</td>
<td>486</td>
<td>3.8</td>
<td>4.3</td>
<td>4.6</td>
<td>2.7</td>
</tr>
<tr>
<td>4</td>
<td>520</td>
<td>545</td>
<td>3.1</td>
<td>2.6</td>
<td>2.5</td>
<td>2.2</td>
</tr>
<tr>
<td>5</td>
<td>310</td>
<td>310</td>
<td>20.5</td>
<td>3.6</td>
<td>1.4</td>
<td>1.8</td>
</tr>
<tr>
<td>6</td>
<td>496</td>
<td>476</td>
<td>4.0</td>
<td>4.0</td>
<td>3.0</td>
<td>3.2</td>
</tr>
<tr>
<td>7</td>
<td>525</td>
<td>585</td>
<td>9.5</td>
<td>5.8</td>
<td>1.3</td>
<td>0.2</td>
</tr>
<tr>
<td>8</td>
<td>444</td>
<td>584</td>
<td>4.1</td>
<td>2.4</td>
<td>0.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Total</td>
<td>3713</td>
<td>3955</td>
<td>6.2</td>
<td>3.4</td>
<td>2.4</td>
<td>1.8</td>
</tr>
</tbody>
</table>

\(^a\) The most common complications occurring during the first 30 days of hospitalization after the operation are listed. Bold type indicates values that were significantly different (at P<0.05) before and after checklist implementation, on the basis of P-values calculated by means of the chi-square test or Fisher’s exact test. P-values are shown for the comparison of the total value after checklist implementation as compared with the total value before implementation.
Modern Medical Checklist Pioneers
Why *Crisis* Checklists?

- Rare events
- Complex management
  - Team Resources
  - Clinical Management
- Rapid response essential
- High potential for morbidity, mortality
- Established use in other industries

Knowledge Becomes Inaccessible
Science of Checklist Design

Daniel Boorman
Test Pilot
Engineering Fellow

A CHECKLIST FOR CHECKLISTS

<table>
<thead>
<tr>
<th>Development</th>
<th>Drafting</th>
<th>Validation</th>
</tr>
</thead>
</table>

- **Does the Checklist:**
  - Utilize natural breaks in workflow (pause points)?
  - Use simple sentence structure and basic language?
  - Have a title that reflects its objectives?
  - Have a simple, uncluttered, and logical format?
  - Fit on one page?
  - Minimize the use of color?

- **Is the checklist:**
  - Sans serif?
  - Upper and lower case text?
  - Large enough to be read easily?
  - Dark on a light background?
  - Are there fewer than 10 items per pause point?
  - Is the date of creation (or revision) clearly marked?

- **Have you:**
  - Tied the checklist with front line users either in a real or simulated situation?
  - Modified the checklist in response to repeated trials?

- **Does the checklist:**
  - Fit the flow of work?
  - Detect errors at a time when they can still be corrected?
  - Can the checklist be completed in a reasonably brief period of time?

- **Have you made plans for future review and revision of the checklist?**

http://www.ariadnelabs.org/
Anaphylaxis

Hypotension, bronchospasm, high peak-airway pressures, diacess or lack of breath sounds, tachycardia, urticaria

START

1. Call for help and a code cart
2. Give epinephrine bolus (may be repeated)
3. Open IV fluids and/or give fluid bolus
4. Remove potential causative agents
5. Turn FiO₂ to 100%
6. Establish/secure airway
7. Consider...
   - Turning off volatile anesthetics if patient remains unstable
   - Vasopressin for patients with continued hypotension despite repeated doses of epinephrine
   - Epinephrine infusion for patients who initially respond to bolus doses of epinephrine but experience continued symptoms
   - Diphrenhydramine
   - H₂ blockers
   - Hydrocortisone
   - Tryptophan level: Check within first hour, repeat at 4 h and at 10-24 hrs post reaction
   - Terminate procedure

DRUG DOSES and Treatments

- Epinephrine: 0.1-1 mg, repeat as necessary
- Vasopressin: 1-2 units/IV
- Diphenhydramine: 25-50 mg/IV
- H₂ blockers: Ranitidine 50 mg/IV, Cimetidine 300 mg/IV
- Hydrocortisone: 100 mg/IV

Common CAUSATIVE AGENTS

- Neuronal blocking agents
- Antibiotics
- Latex products
- IV contrast

Critical CHANGES

If cardiac arrest
   - CVRS
   - CHRLS 4: Cardiac Arrest – Antidote/FBA
   - CHRLS 5: Cardiac Arrest – VF/VT

http://www.ariadnelabs.org/
### Poor Checklist Design

#### STAGE 2: OB Hemorrhage

**MONITOR**
- Primary nurse (or charge nurse)
- Call Obs Tech to bedside
- Notify anesthesia
- Notify response team

**PHONE**
- Notify 911 after administering blood, order products as directed
- Notify OB Hemorrhage Team
- Notify OB Hemorrhage Team and second anesthesiologist
- Notify nursing supervisor
- Assign single person to communicate with blood bank
- Call medical social worker or assign other family support person

**ACT**
- Team leader (OB physician)
- Additional warfarin medication: Hemabate 250 mg IV (if not contraindicated)
- Monitor hematocrit 600-1000 mg PL; can repeat hematocrit up to 3 times every 20 min (mild-to-severe response to first dose)
- Do not delay other interventions (see right column) while waiting for response to medications
- Administer whole blood
- Move to OR (call for postanesthesia unit, move to OR or CR) if needed
- Order 2 units of PRBCs and bring to the bedside
- Order labs STAT (CBC, PTAH, FFP, TIB, PTT, fibrinogen, a-SG)
- Transfuse PRBCs based on clinical signs and response, do not wait for lab results

**THINK**
- Hypovolemic shock
- Establish IV access
- Administer IV fluids
- Administer blood products
- Prepare for surgery
- Consider catecholamines

**Sequently advance through procedures and use interventions based on etiology**
- Vaginal birth
  - Pressure or suction
  - Vaginal examination
  - Pudendal block
  - Instillation of syntetan or lignocaine
  - Suture or sutureless sutures
  - Uterine manipulation

**REGIONAL BLOOD**
- High-risk obstetric patients
- Uterine ischemia
- Uterine artery ligation
- Uterine devascularization

**Re-Evaluate Monitoring and Vital Signs**
- If cumulative blood loss >1000 mL, >2 units of PRBCs given, VS unstable or suspicion for DIC, proceed to STAGE 3

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### Application of Checklist Design Principles

#### Obstetrical Hemorrhage

**START**
1. **Call for help**
   - Ask: “Who will be the case manager?”
2. **Gross manager designates checklist reader**
3. **Establish large bore IV access**
4. **Give uterine agents**
5. **Perform exam, Uterine Massage**
   - D&C, Laparoscopic surgery needed?
6. **Announce VS and cumulative blood loss q10 min**
7. **Send lab Cbc/Cheum 12/PT-PTT, Fibrinogen**
8. **Warm patient and fluids**
9. **Obtain pressure infuser**
10. **Bladder catheter**

**Transfusion**
- FFP/CBC: Platelets 04+2 ratio
- Cryoprecipitate 10 units for FFP (250 mL)

**Consider**
- Transfuse to OR
  - ABG, arterial line
  - Calcium administration
  - Intravenous bolus
  - Embolization
  - Call OR or Radiologist-on-Call
  - Uterine artery ligation
  - Uterine compression suture
  - Hysterectomy

**Uterine Agents**
- Pitocin 20-40 U IV
- Methylergometracea 0.25-1 mg q 2-4 hrs
- Ergonovine 2 mg IM
- Terbutaline 250 mg IV
- N Mefenamic Acid

**Postoperative**
- Oxytocin 500-1000 mg PO x 1

---

This material is adapted from the comprehensive Obstetric Hemorrhage Algorithm developed by the Parkland Hospital Department of Obstetrics and Gynecology.
Simulation-Based Trial of Surgical-Crisis Checklists

Alexander F. Arriaga, M.D., M.P.H., Sc.D., Angela M. Bader, M.D., M.P.H.,
Judith M. Wong, M.D., M.P.H., Stuart R. Lipsitz, Sc.D.,
William R. Berry, M.D., M.P.H., M.P.A., John E. Ziewacz, M.D., M.P.H.,
David L. Hepner, M.D., Daniel J. Boorman, B.S., Charles N. Pozner, M.D.,
Douglas S. Smink, M.D., M.P.H., and Atul A. Gawande, M.D., M.P.H.


- Three hospitals (one academic, two community) → 17 teams, 106 simulated crises (2010-2011)
  - All ACLS certified
- Scored on 47 key processes in crisis scenarios
Study Participants

Table 1. Professional Characteristics of the Participants.

<table>
<thead>
<tr>
<th>Position</th>
<th>Participants (N = 67)</th>
<th>Years of Experience in Specialty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>no. (%)</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Anesthesia attending physician</td>
<td>17 (25)</td>
<td>0</td>
</tr>
<tr>
<td>Surgical attending physician</td>
<td>2 (3)</td>
<td>0</td>
</tr>
<tr>
<td>Anesthesia resident*</td>
<td>10 (15)</td>
<td>0</td>
</tr>
<tr>
<td>Surgical resident*</td>
<td>2 (3)</td>
<td>0</td>
</tr>
<tr>
<td>Operating-room nurse</td>
<td>20 (30)</td>
<td>0</td>
</tr>
<tr>
<td>Surgical technologist</td>
<td>9 (13)</td>
<td>0</td>
</tr>
<tr>
<td>Certified registered nurse anesthetist</td>
<td>7 (10)</td>
<td>29</td>
</tr>
</tbody>
</table>

* One anesthesia resident who participated was a first-year anesthesia resident at the end of the first year of clinical anesthesia training (second postgraduate year). The remaining anesthesia residents were in their second or third year of clinical anesthesia training, and the surgical residents were in their second or third postgraduate year of training.

75% Reduction in Omission of Critical Steps

![Graph showing 75% reduction in omission of critical steps with and without checklists](image_url)

P<0.001

23%

6%

With Checklists

Without Checklists
Participants' Perceptions of Crisis Checklists

Table 4. Participants’ Perceptions of Crisis Checklists, with Responses across All Checklist Scenarios.

<table>
<thead>
<tr>
<th>Survey Statement</th>
<th>Response Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>The checklist helped me feel better prepared during the emergency scenario</td>
<td>4.4±0.81</td>
</tr>
<tr>
<td>The checklist was easy to use</td>
<td>4.3±0.84</td>
</tr>
<tr>
<td>I would use this checklist if I were presented with this operative emergency in real life</td>
<td>4.5±0.76</td>
</tr>
<tr>
<td>If I were having an operation and experienced this intra-operative emergency, I would want the checklist to be used</td>
<td>4.7±0.60</td>
</tr>
</tbody>
</table>

* Plus–minus values are means ±SD. Data included 196 responses from 67 participants. Response scores were on a Likert scale and ranged from 1 (disagree strongly) to 5 (agree strongly).

Collaborate, Modify, Implement, Sustain

- **Collaborative, inclusive process**
  - Improves product, recruits champions, builds team

- **Examples:**
  - Choose clinical topics to fit practice
  - Relevant in-house phone numbers
  - Drugs consistent with hospital formulary
  - Equipment instructions (defibrillator-pacer)
  - Blood tubes
  - Dilution formula for rarely used drugs (eg Epi)
Implementation, Sustainment

- Lectures
- High Fidelity Simulation Exercises
- Emergency Drills
- Table Top Simulation
- Time Out
- Critical Incident Review

Questions & Cautions

- Which?
  - Wrong assessment, wrong checklist
- When?
  - Trigger for checklist use
- Who?
  - Checklist reader
Anticipatory Checklist Review

- Procedures at high risk for clinical emergency
- Advance team preparation
- Checklist as discussion/preparation guide
- “Structured Team Huddle”

Non-OR Applications

- OB Emergencies
  - Eclampsia
- Interventional Cardiology Unit
- Med-Surg-ER
  - Loss of Consciousness — Altered MS
- Recovery Room
  - Delayed Emergence
For More Information:

Crisis Checklists:
www.emergencymanuals.org
www.projectcheck.org/crisis
emergencymanual.stanford.edu
www.safesurg.org

ahannenberg@partners.org

Crisis Checklist in Action
Bradycardia – Unstable

HR < 50 bpm with hypotension, acute altered mental status, shock, ischemic chest discomfort, or acute heart failure

START

1. Call for help and a code cart
   - Ask: “Who will be the crisis manager?”

2. Turn FiO₂ to 100%
   - Verify oxygenation/ventilation adequate

3. Give atropine

4. Stop surgical stimulation (fluoroscopy, defibrillation)

5. If atropine ineffective:
   - Shorten epinephrine or dopamine infusion
     - Add...
   - Start transcutaneous pacing

6. Consider...
   - Turning off volatile anesthetics if patient remain unstable
   - Calling for expert consultation (e.g., Cardiologist)
   - Assessing for drug induced causes (e.g., beta blockers, calcium channel blockers, digoxin)
   - Calling for cardiology consultation if myocardial infarction suspected (e.g., EKG changes)

---

**DRUG DOSES and Treatments**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td>0.5 mg IV, may repeat up to 3 mg total</td>
</tr>
<tr>
<td>Epinephrine (I)</td>
<td>0.1 mg IV, 2 – 10 mcg/min IV</td>
</tr>
<tr>
<td>IV - Dopamine</td>
<td>2 – 10 mcg/kg/min IV</td>
</tr>
</tbody>
</table>

**OVERDOSE Treatments**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta-blocker</td>
<td>0.1 mg IV, 2 – 4 mg IV push</td>
</tr>
<tr>
<td>Calcium channel blocker</td>
<td>1g IV, 1g IV push</td>
</tr>
<tr>
<td>Digoxin</td>
<td>0.5 mg IV, 1mg IV, 1mg IV push</td>
</tr>
</tbody>
</table>

**TRANSIENT/FUNCTIONAL PACING INSTRUCTIONS**

1. Place pacing wire in right ventricle
2. Connect T-wire/ECG from pacing wire to the patient
3. Turn monitor/defibrillator on and mode
4. Set PACER RATE to 90 beats/min
   (Adjust based on clinical response once pacing is established)
5. Start at 80 mA of PACER OUTPUT and increase until electrical capture (pace spike, aspade with QRS complex)
6. Set lead impedance to 10-15 kΩ above initial capture level
7. Confirm effective capture
   - Electrolyte assess ECG pacing
   - Mechanical assess AV asynchrony or heart rate uncontrolled

**Critical CHANGES**

If PEA develops: do CPR 3:1 CHIEF

**During RESUSCITATION**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action &amp; ensure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Assess and ensure</td>
</tr>
<tr>
<td>2</td>
<td>Circulation:</td>
</tr>
<tr>
<td></td>
<td>• Confirm airway IV and IO access</td>
</tr>
<tr>
<td></td>
<td>• Consider IV fluids wide open</td>
</tr>
</tbody>
</table>