Post-anesthesia care unit &
patient safety

Dr Afzal Azim
Department of Critical Care Medicine
SGPGIMS, Lucknow
Historical aspects

- 1947 - Anesthesia study commission report
  - 50% of deaths in 1st 24 hours after surgery were preventable

- 1949 - Having PACU reflected standards of care

- Experience of trauma management after 2nd world war

- Advances in surgery

- Concept of day care surgery
Defining and Measuring Patient Safety

• We need definitions and methods of measuring safety, its “shadow” error, and the degree of preventability.

• Understand magnitude of the problem and the degree to which harm is preventable.
Definitions of Commonly Used Terms for Patient Safety

**Patient safety:** the absence of the potential for, or occurrence of, health care–associated injury to patients. Created by avoiding medical errors as well as taking action to prevent errors from causing injury.

**Error:** mistakes made in the process of care that result in, or have the potential to result in, harm to patients. Mistakes include the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim. These can be the result of an action that is taken (error or commission) or an action that is not taken (error of omission).

**Incident:** unexpected or unanticipated events or circumstances not consistent with the routine care of a particular patient, which could have, or did lead to, an unintended or unnecessary harm to a person, or a complaint, loss, or damage.

**Near miss:** as an occurrence of an error that did not result in harm.

**Adverse event:** an injury resulting from a medical intervention.

**Preventable adverse event:** harm that could be avoided through reasonable planning or proper execution of an action.
Framework for Measuring Patient Safety in Critical Care Setting

Have we reduced the likelihood of harm?

How often do we do what we are supposed to?

How often do we use evidence based interventions?

Have we created a culture of safety?

Adapted from Donabedian
Ethical Tenets

• The ethical principles
  – beneficence (the duty to benefit another)
  – nonmaleficence

• Principle of justice

• Compassion and unrestricted by consideration of personal attributes, economic status, or the nature of the health problem.
Futurist goals
Three Design Principles for Safety

• Design systems to prevent errors

• Design procedures to make errors visible

• Design procedures that can mitigate harm from errors

Nolan T. BMJ 2000; 320:771
Safety Culture in Critical Care

Safety culture does not emerge spontaneously.

<table>
<thead>
<tr>
<th>Event</th>
<th>Usual business</th>
<th>Safety Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percutaneous drain came out</td>
<td>Radiologist not contacted; facilities/staff not available for procedure on weekend.</td>
<td>Radiologist contacted. Staffing plan for nonadministrative hours is in effect and team is recruited to reinsert the drain.</td>
</tr>
<tr>
<td>Shortness of breath, readmission to the ICU</td>
<td>Standard evaluation.</td>
<td>Consider consultation given patient’s fragility; re-establish resuscitation wishes with discussion with patient and family, include some staff that will work over the weekend.</td>
</tr>
<tr>
<td>Possible change in physician examination</td>
<td>Treat symptomatically. Wait until Monday for further evaluation.</td>
<td>Residents describe the physical exam when handing off the patient, given fragility of the patient early consultation and advice is sought. Discuss the plan with family and patient.</td>
</tr>
<tr>
<td>Inadequate pain relief</td>
<td>Try usual methods to manage pain.</td>
<td>Discuss the problem with supervisory staff (eg, what other choices might help) and with family and patient to understand their desires on the intubation and comfort trade-off.</td>
</tr>
</tbody>
</table>
Communication breakdowns are frequently the root cause of undesirable outcomes.
The effect of CPOE on potential errors

![Bar chart showing errors per 100 orders before and after CPOE implementation.](chart.png)

**Errors per 100 Orders**

- **Pre-CPOE**:
  - Potential ADE's: 2.2
  - Medication Prescribing Errors: 6.8

- **Post-CPOE**:
  - Potential ADE's: 1.3
  - Medication Prescribing Errors: 0.2
  - Rule Violations: 0.1

*P Value < 0.05 for post-CPOE compared to pre-CPOE*
Standards of care
Design

• Location
  – Close to OR
  – Close to ICU
  – Easy access to x-ray, blood bank, lab

• Size
  – Ideal 1.5 bed per OR (2 in busy theaters)
  – 120 sq ft per patient
  – 7 feet between beds
  – Adequate space for nursing station
  – Utility areas
Design

• Open ward is acceptable
• Piped oxygen, air, vacuum
• Good ventilation
  – (NIOSH) recommends 25 ppm of N2O and 2ppm of volatile inhalation agents
• Fire exits
• Large doors
• Multiple electrical outlets
• Intercom links with theaters and rest areas
• Isolation for immunosuppressed
• Motorized beds
Equipments & Personnel

- Monitors
  - Pulse oximetry
  - Temperature
  - ECG
  - Etco2
  - NIBP
  - IBP / CVP
- Airway cart & oxygen delivery devices
- Defibrillator
- Portable ventilator
- Portable monitor
- NIV
- Neuromuscular monitoring

- Nurse ratio
  - 1:2 is acceptable
  - 1:1 for 1st 15 minutes

- Physiotherapist
Standards of care

• A patient transported to the PACU shall be accompanied by a member of the anesthesia care team who is knowledgeable about the patient's condition.

• The patient shall be continually evaluated and treated during transport with monitoring and support appropriate to the patient's condition.

• Upon arrival in the PACU, the patient shall be re-evaluated and a verbal report provided to the responsible PACU nurse by the anesthesia care team who accompanies the patient.

Miller 7th edition
Standards of care

• The patient's condition shall be evaluated continually in the PACU

• The patient shall be observed and monitored by methods appropriate to the patient's medical condition. Particular attention should be given to monitoring oxygenation, ventilation, circulation, level of consciousness and temperature

• A physician is responsible for the discharge of the patient from the postanesthesia care unit.
Standards of care
Core skills for nursing staff

i. Assessment of vital signs and overall patient status and initiation of management leading to their improvement.

ii. Competence in all aspects of basic life support. At all times, at least one member of staff should be a certified ALS provider and, for children, hold an appropriate paediatric life support qualification. All staff should be encouraged to attain and maintain at least one ‘provider’ qualification.

iii. Assessment of fluid balance and management of intravenous infusions.

iv. Intravenous administration of appropriate drugs.

v. Administration of analgesics, anti-emetics and other drugs by all appropriate routes and use of associated equipment. This should be guided by local protocols.

vi. Initiation of appropriate investigations, often using local protocols.

Recommendations in UK
Factors influencing Care in PACU

- Preoperative status - Pre-anesthetic evaluation
- Co-morbidities
- Type of surgery
- Type of patient population

- Plan your post-operative Monitoring
  - Invasive vs Non-invasive
  - Other vitals monitoring
Assessment & monitoring

<table>
<thead>
<tr>
<th>Routine</th>
<th>Selected Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respiratory</strong></td>
<td></td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Electrocardiogram</td>
</tr>
<tr>
<td>Airway patency</td>
<td></td>
</tr>
<tr>
<td>Oxygen saturation</td>
<td></td>
</tr>
<tr>
<td><strong>Cardiovascular</strong></td>
<td></td>
</tr>
<tr>
<td>Pulse rate</td>
<td></td>
</tr>
<tr>
<td>Blood pressure</td>
<td></td>
</tr>
<tr>
<td><strong>Neuromuscular</strong></td>
<td></td>
</tr>
<tr>
<td>Physical examination</td>
<td>Neuromuscular blockade</td>
</tr>
<tr>
<td></td>
<td>Nerve stimulator</td>
</tr>
<tr>
<td><strong>Mental status</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
</tr>
<tr>
<td><strong>Pain</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Nausea and vomiting</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urine</td>
</tr>
<tr>
<td></td>
<td>Voiding</td>
</tr>
<tr>
<td></td>
<td>Output</td>
</tr>
<tr>
<td></td>
<td>Drainage and bleeding</td>
</tr>
</tbody>
</table>
Adverse events
Adverse events in PACU

• Overall incidence of PACU complications - 23 %

• The most common complication in the PACU is PONV, ranging between 10 & 30 %

• Other complications are
  » upper airway problems
  » hypotension
  » dysrhythmias
  » hypertension
  » altered mental status
  » and suspected or major cardiac events
Adverse events in PACU

Respiratory complications
  » Airway obstruction
  » Laryngospasm
  » Hypoxemia
  » Hypercarbia

Cardiovascular problems
  » Hypotension
  » Hypertension
  » Arrhythmias

Pain & agitation

Hypothermia & shivering
These can be divided into 3 main groups:

- **Patient-specific**: female sex\(^8,13\); non-smoker\(^{13,14}\); history of PONV or motion sickness.\(^{13–15}\)
- **Anaesthetic**: use of volatile anaesthetics within 0 to 2 hours\(^\text{16}\); use of nitrous oxide\(^\text{17}\); use of intraoperative and postoperative opioids\(^{13,18–21}\); high doses of neostigmine.
- **Surgical**: duration of surgery, with each 30-minute increase in duration increasing the risk of PONV by 60\%.\(^{22}\)
Modifiable Factors to prevent PONV

1) Premedication
2) Type of anaesthesia
3) Intraoperative anaesthetic drugs
   (a) Nitrous oxide
   (b) Intravenous agents
   (c) Inhalation agents
   (d) Antagonists of non-depolarising neuromuscular blocking drugs
4) Postoperative management
   (a) Pain management
      (i) Local anaesthetics
      (ii) NSAIDs
      (iii) Opioids
   (b) Movement
   (c) Oral intake
   (d) Non-pharmacological – acupressure/acupuncture
5) Antiemetic drugs
6) Other factors – hypovolemia, gastric distension
# Prophylactic dose and timing of antiemetics

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Timing</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ondansetron</td>
<td>4–8 mg IV(^{30})</td>
<td>At end of surgery(^{31})</td>
<td>Headache, lightheadedness, elevated liver enzymes</td>
</tr>
<tr>
<td>Dolasetron</td>
<td>12.5 mg IV(^{32})</td>
<td>At end of surgery(^{32})</td>
<td>Headache, lightheadedness, elevated liver enzymes</td>
</tr>
<tr>
<td>Granisetron</td>
<td>0.35–1mg IV(^{33–35})</td>
<td>At end of surgery(^{33,35})</td>
<td>Headache, lightheadedness, elevated liver enzymes</td>
</tr>
<tr>
<td>Tropisetron</td>
<td>5 mg IV(^{36,37})</td>
<td>At end of surgery(^{36,37})</td>
<td>Headache, lightheadedness, elevated liver enzymes</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>5–10 mg IV(^{38–40})</td>
<td>Before induction(^{41})</td>
<td>Vaginal itching or anal irritation with IV bolus</td>
</tr>
<tr>
<td>Droperidol</td>
<td>0.625–1.25 mg IV(^{36,37})</td>
<td>At end of surgery(^{42})</td>
<td>Sedation, dizziness, anxiety, hypotension, EPS</td>
</tr>
<tr>
<td>Dimenhydrinate</td>
<td>1–2mg/kg IV(^{43})</td>
<td></td>
<td>Sedation, dry mouth, blurred vision, dizziness, urinary retention</td>
</tr>
<tr>
<td>Prochlorperazine</td>
<td>5–10mg IV(^{44})</td>
<td>At end of surgery(^{44})</td>
<td>Sedation, hypotension, EPS</td>
</tr>
<tr>
<td>Promethazine</td>
<td>12.5–25mg IV(^{44})</td>
<td>At end of surgery(^{44})</td>
<td>Sedation, hypotension, EPS</td>
</tr>
<tr>
<td>Scopolamine</td>
<td>Transdermal patch(^{45,46})</td>
<td>Prior evening or 4 hours before end of surgery(^{46})</td>
<td>Sedation, dry mouth, visual disturbances; CNS effects in elderly patients, renal or hepatic impairment</td>
</tr>
<tr>
<td>Metoclopramide</td>
<td>25 or 50 mg IV for prophylaxis(^{47})</td>
<td></td>
<td>Sedation, hypotension, EPS</td>
</tr>
</tbody>
</table>
Critical respiratory event

- A PACU critical respiratory event (CRE) defined as any
  - unanticipated hypoxemia (hemoglobin oxygen saturation < 90%)
  - hypoventilation (respiratory rate < 8 breaths/min or arterial carbon dioxide tension > 50 mmHg)
  - or upper-airway obstruction (stridor or laryngospasm) requiring an active and specific intervention (ventilation, tracheal intubation, opioid or muscle relaxant antagonism, insertion of oral/nasal airway or airway manipulation)

Identify group at risk for perioperative respiratory event

<table>
<thead>
<tr>
<th>Patient factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with poor exercise capacity</td>
</tr>
<tr>
<td>Obesity</td>
</tr>
<tr>
<td>Obstructive sleep apnea</td>
</tr>
<tr>
<td>COPD patients</td>
</tr>
<tr>
<td>ASA Grade II or higher</td>
</tr>
<tr>
<td>Age &gt;60 yrs</td>
</tr>
<tr>
<td>Pregnant females</td>
</tr>
<tr>
<td>Neuromuscular weakness patient undergoing surgery</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper abdominal surgeries</td>
</tr>
<tr>
<td>Cardiothoracic surgeries</td>
</tr>
<tr>
<td>Prolonged duration surgery (lasting &gt;3hrs)</td>
</tr>
</tbody>
</table>
Schematic Indications

Postoperative
NONINVASIVE VENTILATION

Curative

Acute respiratory failure: YES (present)
Objective: to avoid intubation

CPAP
NIV (=PSV+PEEP)

Preventive

Acute respiratory failure: NO (not present, but at risk)
Objective: to avoid the development of acute respiratory failure

CPAP
NIV (=PSV+PEEP)
Surgery induced

Disruption of abdominal, thoracic and diaphragmatic muscle forces, Induces pain

Anesthesia induced

Decreased muscle tone
Increased retractile lung forces

Patient factors

Poor cardiorespiratory reserve

Pump failure/ gas exchange failure /both

NIV in Perioperative period

*Intensive Care Med (2011)*
NIV in Hypoxemic failure

Hypoxemic episodes of patients in a postanesthesia care unit.
G B Russell and J M Graybeal
Chest 1993;104:899-903
Cardiac risk stratification promotes perioperative outcome

Cardiac risk stratification for noncardiac surgery:
Update from the American College of Cardiology/American Heart Association
2007 guidelines

Clinical risk factors and functional capacity
The Revised Cardiac Risk Index of Lee et al\(^3\) remains the general paradigm for stratifying cardiac risk before noncardiac surgery. This validated index consists of six independent predictors of cardiac complications:
• High-risk surgery (intraperitoneal, intrathoracic, or suprainguinal vascular procedures)
• Ischemic heart disease
• History of congestive heart failure
• History of cerebrovascular disease
• Insulin therapy for diabetes mellitus
• Preoperative creatinine level greater than 2.0 mg/dL.
Infection prevention in PACU

• Critical care environment
• Open areas
• Rapid turnover
  » Clinical aspects
  » Nursing aspects
  » Environmental control
  » Engineering control
  » Administrative changes
Hand hygiene plays great role in the prevention of VAP

- Hand hygiene before and after suctioning, touching ventilator equipment, and/or coming into contact with respiratory secretions.

Albert, NEJM 1981; Preston, AJM 1981; Tablan, 1994
A quick and easy solution
Alcohol rub

• Entrance to ward
• Nursing station
• Bed / cot
• Patient Trolley
Environment in the PACU
Is Your Toilet Cleaner Than Your Keyboard?

- Workstations are much dirtier than bathrooms.
- Microbes per square inch
  - A computer keyboard - 3,295
  - A computer mouse - 1,676.
  - Telephones - 25,127
  - Toilet seat - 49

How contaminated our mobile phones with nosocomial pathogens?

Annals of Clinical Microbiology and Antimicrobials 2009, 8:7
Critical - High touch surfaces

BED RAIL, BED SURFACE, OVER-BED TABLE

LINEN, BED – CONTROL PANEL

SUPPLY CART

INFUSION PUMPS
VAP Bundle

• Handhygeine
• Patient positioning
• Oral care and management of oropharyngeal and tracheal secretions
• Daily “Sedation Vacation”
• Daily assessment of readiness to extubate

CDC Guideline for Prevention of Healthcare Associated Pneumonias 2003
Kollef et al, Chest 1999;116;1339
Central Line Bundle
Key components

» Hand Hygiene

» Maximal Barrier Precautions Upon Insertion

» Chlorhexidine Skin Antisepsis

» Optimal Catheter Site Selection

» Daily Review of Line Necessity with Prompt Removal of Unnecessary Lines
Barrier Precautions

Full body sheet
Discharge criteria

- Scoring systems
  - ALDRETE
  - Modified ALDRETE
  - REACT
  - PADSS
  - PARSAP

Aldrete and Modified Aldrete

- Introduced 1970
- Modified in 1992
- Limitations include
  - Cardiac dysrhythmias with no BP effect
  - Incisional bleeding
  - Pain
  - Persistent nausea and vomiting

Discharge criteria

• Neither an arbitrary time nor a discharge score can be used to define medically appropriate length of stay

• Transfer can be to ward, ICU or discharge to home

• **Usual criteria include**
  » Easily arousable
  » Full orientation
  » Ability to maintain and protect airway
  » Stable vital signs for 30 minutes
  » No obvious surgical complication
Key messages

• Anesthetist must handover the patient to the nurse
• Postoperative orders should be clearly and legibly prescribed
• Discharge criteria can be formulated according to patient population
• Teaching and training of nursing staff
• Administrative reforms for manpower and architecture
“You must do the thing you think you cannot do.”

Eleanor Roosevelt

Thanks