

## Safety Priorities in the Post-Anaesthesia Care Unit

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### Abstract

The Lancet Commission on Global Surgery has identified peri-operative mortality rate as an important quality indicator of access and safety of surgery. Large-scale studies focusing on the availability of post-anaesthesia care units in low and middle-income countries are not available. This article deals with the safety concerns related to the design, staffing patterns, medication error prevention, mandatory equipment and monitoring in the post-anaesthesia care unit and safety concerns related to the patient transfers.

### INTRODUCTION

The Lancet Commission on Global Surgery has identified peri-operative mortality rate (POMR) as an important quality indicator of access and safety of surgery.<sup>1</sup> Many studies regarding POMR have been conducted in high-income countries, but data from low-income and middle-income countries is sparse. In a meta-analysis conducted by Bainbridge et al,<sup>2</sup> there was a significant difference in the adjusted mortality rates between the high-income and low-income countries with respect to anaesthesia-related mortality and anaesthetic contributory mortality. Most of these studies continue to impress on the aspect of the scarcity of published data in low and middle-income countries (LMICs). Another meta-analysis highlighted the differences with respect to different surgeries in low and middle-income groups.<sup>3</sup> Large-scale studies focusing on the availability of post-anaesthesia care unit (PACU) facilities in LMICs are not available. One study in Pakistan found that PACUs were not available in 31.1% of the public healthcare facilities at a district level.<sup>4</sup> In a similar survey in Ethiopia, 84% of the hospitals had a PACU, but the availability of monitoring equipment in the PACUs was significantly limited.<sup>5</sup> The presence and adherence to postoperative care protocols was inadequate. In Togo, the anaesthesia-related mortality rate decreased from 25.7 per 1000 in 2002 to 8.9 per 1000 in 2006 with improved numbers of physician providers, the opening of preoperative clinics, the establishment of PACUs and the initiation of locoregional anaesthesia.<sup>6</sup>

For the purposes of this article, a PACU is defined as a unit, located as close to operating theatres as possible

in order to avoid unnecessary time loss for the transfer of unstable patients, staffed and equipped for serving for treatment and care of patients during their immediate post-anaesthesia or post-surgery period, regardless of the type of interventions, before they are scheduled to be transferred to general wards, other units of the hospital or discharged home.<sup>7</sup> According to Vimlati et al,<sup>7</sup> the focus of a PACU is to provide:

- Immediate post-operative treatment
- Management of acute pain
- Decision on further care, whether it has to happen in the ward, Intensive care unit (ICU)/ High Dependency Unit (HDU)
- In special situations, pre-operative optimisation of severely ill

The most common events that occur in the PACU are included in Table 1.<sup>8-10</sup> A closed claims analysis found that in 39% of the cases, nurses were primarily responsible for taking care of the patients in the PACU when these events occurred. The top three risk management issues were related to clinical judgement, administration and communication. The other primary responsible parties at the time of events were anaesthesiologists, radiologists, obstetricians and general surgeons. The other issues identified were related to documentation, technical skill, equipment issues and non-compliance from patients.<sup>11</sup> Other researchers have highlighted additional considerations such as identification and visualisation of the patients, alarm fatigue, postoperative analgesia, delirium and staffing as safety issues in the PACU.<sup>11</sup>

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**Table I** – Common Adverse Events that Occur in the PACU

System Involved	Events
Respiratory System	Bradypnoea Tachypnoea Apnoea Desaturation Airway obstruction Pneumothorax
Cardiovascular System	Bradycardia Tachycardia Cardiac Arrest Hypotension Hypertension Pulmonary oedema
Renal	Oliguria Urinary retention
Central Nervous System	Agitation Confusion Sedation as per the Ramsey Sedation Scale >1
Others	Haemorrhage Pain Death Inadequate reversal of neuromuscular blockade Hypothermia Prolonged stay Postoperative Nausea and / Vomiting Surgical Emphysema

### Patient Safety and Design of the PACU

The PACU should be a central facility with ease of access from all the operation theatres. There should be separate access for the transfer of patients to the ward. The operation theatre to the PACU bed ratio should be 1:2 when possible but acknowledging that this is dependent on the type of patients and procedures that they have undergone. It is also advised that these areas should be close to the operating rooms and provide for 12-15m<sup>2</sup> space for each bed. The number of beds should also depend on the type and duration of the procedure performed.<sup>7,13</sup> The design of the PACU should allow for the visualisation of all the patients throughout their stay from the nursing station. Hence, it is better to have an open room set up. If the design does not allow for visualisation, additional nurses may be required.

### Staffing Pattern in the PACU

Guidelines recommend that at least 2 nursing staff are available in the PACU if a patient is admitted. The Association of Anaesthetists of Great Britain and Ireland suggests that only PACU-trained and certified staff are included in the PACU team. These staff should also be trained in advanced life support and, if applicable, paediatric advanced life support.<sup>13</sup> European guidelines suggest that nursing

staff trained in resuscitation may serve the purpose.<sup>7</sup> The European guidelines further advise that if the prevailing practice encompasses reversal and tracheal extubation of patients in the PACU, then the presence of an anaesthesiologist should be mandatory. This is an additional requirement to the numbers required to run the operating theatres. If such practice is not possible, then appropriately trained nurses are acceptable to staff the PACU in the absence of critically ill patients.<sup>7</sup> The staffing pattern and workload is also influenced by the type of surgery, the duration of stay and the patient's condition.<sup>11</sup> According to The American Society of PeriAnesthesia Nurses (ASPA), supervising, experienced nurse should be present to assist in dealing with unexpected complications that may occur after surgery.<sup>12</sup>

### Patient Safety During Transfer

Transfer of anaesthetised and recovering patients usually takes place from the operating rooms to the PACU and from the PACU to the wards after complete recovery. The common adverse events during transfer are traumatic injury, pulmonary aspiration of gastric contents, hypoxia, hypothermia and disconnections of the airway, lines and drains. To minimise these, guidelines suggest the usage of properly designed transfer trolleys (provision for head-down tilt and side rails) with the capacity to carry oxygen cylinders, monitoring devices, infusion pumps, fluid infusions and a means to assist ventilation. The patient should be accompanied by a qualified anaesthesiologist

1	Completion of urgent tasks before verbal handoff	
2	Who is in charge of the patient?	
3	Are you ready for report?	
4	General clinical condition:	Stable-unstable
5	Patient	Name and check ID band Allergy Relevant medical history Type of surgery Type of anaesthesia ASA score
6	Procedure	Position Airway management Vascular access Fluid management Intraoperative events or concerns
7	Medications	Analgesia PONV Neuromuscular block Done To do
8	Other	Laboratory results Postoperative concerns
9	Do you have any questions?	
10	Closing the loop by the receiver	

**Figure 1** – The PATH checklist for handover. Borrowed from: Jaulin F et al.<sup>14</sup>

or other appropriately trained anaesthesia provider during transfer. Patients should be haemodynamically stable, receive supplemental oxygen and all lines should be flushed to remove anaesthetics and vasoactive medications.<sup>7,13</sup>

A separate, important safety concern is an effective handover of these patients on transfer from the operating rooms to the PACU. Some authors have suggested the Post Anaesthesia Team Handover (PATH) checklist (Figure 1).<sup>14</sup> The use of a checklist such as PATH assists with facilitating effective communication. The complete handover should take place between the anaesthesiologist in charge of the case and the staff supporting the PACU. The handover should provide details of the intraoperative care, the postoperative care required, fluids, blood loss and drugs administered. The staff posted in the PACU should complete the loop by reciting their understanding of this information.<sup>7,13</sup>

In the PATH protocol, there are 10 steps. Proper introduction and completion of the loop by the person receiving the patient is important. Transfer of patients from the PACU to the ward or discharge home is usually done by using the checklists. These checklists should include assessing vital parameters as relevant such as pulse rate, BP, arterial oxygen saturation, train-of-four ratio and end tidal carbon dioxide if the patient is being ventilated. The checklist should also include instructions for supplemental oxygen, fluid replacement, analgesics, anti-emetics, monitoring, physiotherapy and other relevant instructions. A detailed handover using the PATH protocol or similar process is also important when transferring patients from the PACU to postoperative nursing wards.<sup>14</sup>

## Medication Errors in the PACU and their Prevention

Medication errors may occur frequently in PACUs and may result in harm to patients and increased costs.<sup>15</sup> Medication errors in PACUs may be due to active failures committed by people who are in direct contact with the patient or latent conditions due to reasons within the system when individuals make decisions that have unintended consequences. Common harmful errors may be in prescribing, transcribing, dispensing, administering, and monitoring which may result in increased morbidity and mortality.<sup>16</sup> Jenson and colleagues<sup>17</sup> have published evidence-based recommendations to minimize errors in drug administration during the perioperative period based on a multi-pronged, 12-point strategy (Table 2).

## MANDATORY MONITORING IN THE PACU

Once patients arrive at the PACU, they should be accompanied by a member of the primary team who has knowledge about the preoperative condition, anaesthetic course and surgical details and any intraoperative complications. A detailed handover of patients' present clinical status should be verbally given to the responsible PACU staff and be appropriately documented. Examples of important parameters to assess upon arrival in the PACU setting include level of consciousness, heart rate (HR), electrocardiogram (ECG), blood pressure (BP), airway patency, respiratory rate (RR), oxygen saturation (SpO<sub>2</sub>), and temperature, along with the presence of pain, nausea, or vomiting.<sup>18</sup> If patients have received neuromuscular blockers and are planned for tracheal extubation, neuromuscular function should be assessed by physical examination and the use of a peripheral nerve stimulator. Meticulous monitoring

**Table II** – Recommendations to prevent Medication errors

Recommendation	
(1) The label on any drug ampoule or syringe should be carefully read before a drug is drawn up or injected.	Strongly recommended
(2) Legibility and contents of labels on ampoules and syringes should be optimised according to agreed standards in respect of some or all of font, size, colour and the information included	Strongly recommended
(3) Syringes should be labelled (always or almost always)	Strongly recommended
4) Formal organisation of drug drawers and workspace should be used with attention to: tidiness; position of ampoules and syringes; separation of similar or dangerous drugs; removal of dangerous drugs from the operating theatres	Strongly recommended
5) Labels should be checked specifically with a second person or a device (such as a bar code reader linked to a computer) before a drug is drawn up or administered	Recommended
(6) Errors in intravenous drug administration should be reported and reviewed	Recommended
(7) Management of inventory should focus on minimising the risk of drug error (e.g., a drug safety officer and/or a pharmacist should be appointed for the operating theatres and any changes in presentation should be notified ahead of time)	Recommended
(8) Similar packaging and presentation of drugs contribute to error and should be avoided where possible	Recommended
(9) Drugs should be presented in prefilled syringes (where possible) rather than ampoules (either for emergency drugs or in general)	Possibly recommended
10) Drugs should be drawn up and labelled by the anaesthetist who will administer them	Possibly recommended
(11) Colour coding by class of drug according to an agreed national or international standard should be used – of the syringe, part of the syringe, or of the syringe or ampoule labels	Possibly recommended
(12) Coding by syringe position or size or by the needle on the syringe should be used	Unclear

of fluid administration and urine output, bleeding, and wound drainage should be performed. In patients who have received spinal or epidural anaesthesia, clinical assessment of the return of motor and sensory function should be regularly documented during the PACU stay.

The use of pulse oximetry, non-invasive blood pressure monitoring, heart rate and capnography has been found to reduce cardiovascular, respiratory and neurological complications and should be used for all patients who have received general, neuraxial or regional blocks. Although no practice guidelines exist regarding the frequency at which vital sign monitoring should be done in the PACU, as a matter of practice, vital signs usually should be obtained every five minutes in the first 15 minutes; then after every 15 minutes, in the immediate recovery period (phase I PACU). The heart rate and blood pressure should be maintained within 20% of the patient's baseline values. The respiratory rate and the oxygen saturation should be approximating the patient's baseline levels. In the phase II PACU period (discharge after day-care surgery), the vital signs should be obtained at least every 30 to 60 minutes.<sup>18</sup>

### EQUIPMENT TO BE MAINTAINED IN PACU

In order to ensure the safety of the patient in the PACU, adequate drugs and equipment should be available in the PACU. The list of mandatory equipment to be maintained is shown in Table 3.

### SPECIAL CONSIDERATIONS

#### *Critically ill patients*

Most critically ill patients should be shifted to the intensive care unit and this is usually decided electively. If these patients are being transiently managed in the PACU, the responsibility of monitoring and managing any events often lies with the ICU team, although local staffing models may vary.<sup>8</sup>

### *Regional anaesthesia*

The management of patients who have received regional anaesthesia does not differ much from those who have undergone general anaesthesia in the PACU. The information to be provided during the handover is, however, different. The site of injection, the drug used (concentration and dosage), the approximate duration and management of further pain, relief and the position in which the patient should rest are the important considerations that need to be conveyed.<sup>8</sup> Patients who have received nerve blocks may need to be shifted with support or slings. For those who have received central blocks, the maximum level of sensory and motor blockade achieved, regression times, cardiovascular status, presence, or absence of a urinary catheter and the postoperative pain relief may be the special considerations. If an epidural has been secured, marking and fixing the epidural and continuous infusion equipment may be the most important part of this exercise.

### *Children*

In general, a recovery area for children that is separate from adult patients and with 1:1 staffing is most acceptable. Appropriate paediatric equipment should be available. Bradycardia, nausea and vomiting, and emergence confusion are common in children.<sup>8</sup> In the postoperative period, special attention should be paid to analgesia assessment and management. The presence of a parent or guardian may be permitted depending on the safety aspects of caring for children and considering the socio-cultural aspects of the community.

### *Documentation in the PACU*

Documentation of observations in the PACU should be done at least every 15 minutes by the trained nurse.<sup>8</sup> Prescribed timelines and any tests ordered should be documented.

**Table III** – Equipment to be maintained in PACU

Standard equipment	Emergency equipment
Multichannel monitor with a Pulse oximeter, electrocardiogram, blood pressure monitor with an automatic blood pressure cuff and a temperature monitor.	Airway = oral/nasal airways
Oxygen ports	Breathing = oxygen cannulae/ Simple face mask./non re-breather face mask (mask with oxygen reservoir bag and one-way valves which aims to prevent/reduce room air entrainment) Endotracheal tubes, Laryngeal mask airways (LMAs) Laryngoscopes
Suction ports	Circulation = intravenous catheters and intravenous fluids
Transducers for monitoring arterial, central, and pulmonary artery pressures	Drugs = emergency cart containing all life support equipment
Forced air warming device	
Other Prerequisites	
Provision for uninterrupted power supply for the PACU (Compatible with the equipment)	

### Regular audits

Regular audits should be conducted for quality checks and to examine whether the team is adhering to local and national standards.<sup>8</sup>

### SUMMARY

Perioperative mortality rate is an important quality indicator of access and safety of surgery. Low- and Middle-Income Countries often have limited resources with respect to postoperative care of patients. The PACU/ recovery area for anaesthetised patients should be designed for ease of access to the operating rooms and for ease of visualisation of all patients during their stay by the nursing staff. It is imperative to maintain a proper bed to nursing staff ratio. Following the PATH protocol for handover aids in effective care of the patient. Safety of the patients is ensured by following the mandatory monitoring standards within the PACU. Documentation, regular audits and keeping in mind the necessities of patients with special needs (paediatric, critically ill, and those who have received regional anaesthesia) helps in reducing the morbidity and mortality in the PACU.

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