Post-anaesthetic discharge scoring criteria: A systematic review

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Executive Summary

Aim This systematic review investigates the essential components of an effective and feasible scoring system to assess patients following anaesthesia and surgery, thereby enhancing patient safety through timely and appropriate discharge from the Post-Anaesthetic Care Unit. The findings of the evidence synthesis will be used to inform the development of a Post-Anaesthetic Care Unit discharge tool.

Methods A systematic review of quantitative research conducted in adult populations on post-anaesthetic discharge assessment strategies utilised in post-anaesthetic care units following any type of surgical procedure. An extensive literature search was constructed to identify all relevant studies published between 1970 and 2010. Studies were appraised and data was extracted by two reviewers using the standardised critical appraisal and data extraction tools from the Joanna Briggs Institute.

Results A total of eight studies were included in the review. One randomised controlled trial and four observational studies provided evidence on the effectiveness and feasibility of discharge assessment tools. All studies identified pain, conscious state, and nausea and vomiting as important variables to consider in assessing a patient's readiness for discharge from the post-anaesthetic care unit. Two additional observational studies and a retrospective records analysis investigated the recovery of patients in the post-anaesthetic care unit, providing data on psychomotor and cognitive recovery following anaesthetic.

Conclusion There was general agreement amongst the studies that post-anaesthetic care unit discharge assessment should consider levels of pain, conscious state, and nausea and vomiting. Although vital signs were included in all the discharge assessment

tools, there was variation in the specific vital signs included within tools, with blood pressure being the only vital sign consistently used. The value of including urine output, oral intake or psychomotor testing in assessing readiness for post-anaesthetic care unit discharge was inconclusive and therefore requires further investigation.

Implications for practice Based on the evidence from studies at moderate to high risk of bias analysed in this systematic review, the following recommendations are considered important for the assessment of the readiness of adult patients to be discharged from the post-anaesthetic care unit:

- Assessment of pain, conscious state, blood pressure and nausea and vomiting should be made before discharging a patient. Assessment of other vital signs should be considered before discharging a patient from post-anaesthetic care unit

Implications for research The synthesised evidence suggests there is limited consensus on criteria for post-anaesthetic care unit discharge assessment and further investigation using sound methodologies is required, especially with regard to patient outcomes. The following recommendations can be made:

- Further research should investigate the validity and reliability of assessment variables on post-anaesthetic care unit discharge tools, the implementation of validated post-anaesthetic care unit discharge criteria for assessment of patient readiness for discharge, and, the relationship between post-anaesthetic care unit discharge assessment and patient safety.

Key words discharge assessment, post anaesthetic care unit, PACU, systematic review

Background

The time immediately following a general anaesthetic is a critical period for patient recovery, requiring intensive observation to enable early detection of complications from surgery. Since its introduction in 1923, the Post Anaesthesia Care Unit (PACU) is the preferred location for the immediate recovery of the postoperative patient.[1] A patient's length of stay in the PACU is dependent upon a number of factors, including pre-operative health status, surgical procedure, type of anaesthetic and the stability of vital signs. It has been common practice for PACU discharge policies to stipulate a minimum length of stay, with a patient's readiness for discharge traditionally relying upon nursing assessment of normality and stability of physiological parameters.

A patient's condition can deteriorate quickly and much work has been carried out to develop tools to assist the identification of deteriorating vital signs. Utilisation of such tools have been associated with a reduction in adverse events in ward-based patients.[2] Since the advent of day procedure surgical units there has been an increasing trend towards the use of similar objective scoring systems to aid decision-making and quantify patient readiness for discharge from PACU.

In 1970 Aldrete[3] was the first to propose a scoring method to evaluate patient readiness for discharge from the immediate post-operative recovery area. Aldrete asserted that a method of patient evaluation should be simple to implement, easy to memorise, have a low burden on PACU staff and be applicable to patients in all post-operative situations. Aldrete developed a scoring system that incorporated assessment of activity, respiration,

circulation, conscious state and colour.[3] Although the effectiveness of this scale has had minimal exploration, it has been used in PACUs internationally since its development. Aldrete proposed revisions to the scale in 1995[4] to address the "modern phenomenon" of discharge to home directly from the PACU. The revised Aldrete score incorporates evaluation of dressing appearance, pain, mobility, ability to tolerate oral fluids and spontaneous urination. Although Aldrete did not validate the revised scale for post-operative patients, its ease of use has led to its adoption in many PACUs, as a standard post-operative assessment.[4]

Several other scoring systems have also been developed and tested.[3, 5-7] However, one study highlighted the methodological problems in developing a valid measurement tool for post-anaesthetic discharge scoring.[8] Currently there is no consensus regarding the variables that should be used to assess readiness for PACU discharge and a particular need has been identified to establish criteria to assess a patient's "home readiness" given the increasing frequency of day surgery procedures.[1]

The impetus for this systematic review has been concern about anecdotal reports of a growing number of patient safety issues relating to post-anaesthetic care at different metropolitan hospitals.[9] Reporting of adverse events is mandatory for all Australian hospitals; however, the indicators of patient safety which are collated do not allow the incidence of events relating to post-anaesthetic care to be determined. Substantial research attention is now being given to generating and synthesising findings in ways that are designed to have immediate applicability to healthcare practitioners.[10-12]

Guidelines for the management of patients in the PACU and assessing their readiness for discharge have been implemented internationally. For example, the Association of Anaesthetists of Great Britain and Ireland[13] have developed recommended discharge criteria and the Australian and New Zealand College of Anaesthetists[14] also have recommendations for post-anaesthetic care. In the UK, the Scottish Intercollegiate Guidelines Network provide brief guidelines on post-operative patient assessment prior to discharge from PACU; however these guidelines are not supported by evidence of effectiveness.[15]

Post anaesthetic assessment guidelines are often focussed on the role of the anaesthesiologist; however, due to nurses central role in the management of patients in the PACU setting, anaesthetists often delegate the responsibility for evaluation of patient suitability for discharge to the PACU nurse.[16] Basing nursing practice on evidence is fundamental to optimal and effective care.[17] Even experienced nurses can face a dilemma about the right time to transfer or discharge patients.[16] Many and varied criteria are used to assess a patient for discharge from PACU; however, evaluation of the validity and reliability of these criteria requires further research.[18] To date a systematic review of the literature relating to safe discharge for patients from PACU to either the ward or directly to the home environment has not been conducted.

Aims

Review question

What are the essential components of an effective and feasible scoring system to assess patients, following anaesthesia and surgery, thereby enhancing patient safety through timely and appropriate discharge?

The aim of this review was to systematically examine the evidence to determine the essential components of an effective discharge PACU scoring system to assess patients following anaesthesia and surgery, thereby enhancing patient safety through timely and appropriate discharge. The review sought to identify current best evidence for the effectiveness and feasibility of components of a scoring system to assess patients following surgery and anaesthesia.

Key objectives

The key objectives to be addressed were:

1. To identify the most commonly used, predetermined PACU discharge criteria, which can be used, predominantly but not exclusively, by nurses to assess patient readiness for discharge from PACU and;
2. To investigate whether some variables have greater effectiveness and feasibility than others in terms of determining readiness for discharge.

The findings of this review will be used to inform the development of a discharge tool that can be later submitted for review by a panel of experts to establish content validity

Inclusion Criteria

Types of participants

The review considered studies that included adult patients (over 18 years of age), male and female, who had received care in the PACU for any type of surgery, planned or unplanned.

Type of interventions

Studies that evaluated variables suitable for assessment of patient readiness for discharge from the PACU were considered for inclusion. Studies were eligible if they evaluated pre-determined discharge criteria (individual or grouped in a discharge tool); for example, measure of vital signs (temperature, respiratory rate, heart rate, blood pressure), capillary oxygen saturation, level of consciousness, blood loss, pain, and existing tools for discharge.

Type of outcomes

The review considered studies that included variables for patient assessment, for example:

- vital signs and/ or capillary oxygen saturation
- nausea and/ vomiting
- pain
- medication administration (such as anti-emetics and analgesics)
- time spent in PACU
- discharge delay from PACU
- adverse events related to early discharge from PACU, for example:
    - complications that may have been avoided

- contact with medical emergency teams
- unexpected admissions to intensive care, critical care or high dependency units
- readmission rates
- increased length of hospital stay

Type of studies

The search was initially designed to retrieve randomised controlled trials (RCTs) and quasi-RCTs that compared sets of variables or discharge tools to identify readiness for discharge from that PACU. However, initial searches indicated a paucity of RCTs that met the inclusion criteria. We therefore considered other research designs, including non-randomised controlled trials, before and after studies and descriptive studies. Qualitative studies were not included.

Search Strategy

In the early 1970s discharge scores were first introduced to determine discharge from the PACU environment. The review therefore considered studies published in the English language between January 1970 and June 2010. A preliminary search conducted in MEDLINE identified relevant MeSH terms and keywords. A comprehensive second search used identified keywords and index terms, adapted accordingly to different databases. This main search was conducted in 12 databases: AMED, BioMedCentral, British Nursing Index, CINAHL, the Cochrane Central Register of Controlled Trials, EBM reviews, EMBASE, MEDLINE, Psyc Info, SCOPUS and Web of Science. The reference lists of included studies were searched for additional studies that may meet inclusion criteria. The search also sought to include grey literature such as conference proceedings and articles identified in searches of Google Scholar and Dissertations International. Identified material was assessed for relevance to the review based on title and abstract and the full report was retrieved where studies appeared to meet the inclusion criteria.

Initial keywords used in the search were:

- Post-operati* OR post-surg*
- Post-operative care OR post-operative complication*
- Post-anaesth OR post-anesth*
- Nurs* assessment
- Surgical/ adverse effect*
- Adverse event*
- PACU
- Recovery
- Discharge scor*
- Criteria
- Length of stay

Methods of the review

Assessment of methodological quality

Papers selected for retrieval were assessed by two independent reviewers for methodological validity. The two reviewers used the standardised critical appraisal instruments from Joanna Briggs Institute JBI-MAStARI (Meta Analysis of Statistics Assessment and Review Instrument; Appendix I). Any disagreements that arose between the two reviewers were resolved through discussion until agreement was reached.

Data Collection

Quantitative data was extracted using the standardised data extraction tool from the JBI-MAStARI (Appendix II). The data extracted included specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives.

Data Synthesis

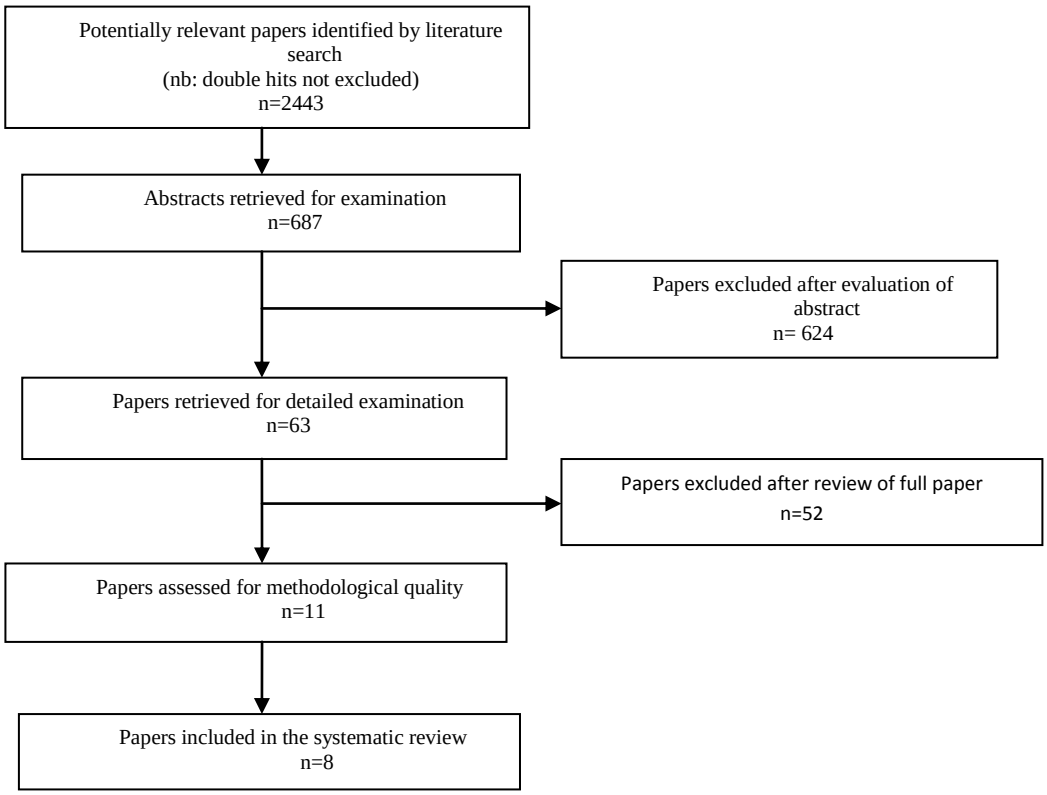
Statistical pooling was inappropriate due to the wide range of study methods and outcome measures. The findings were presented in narrative form and general themes identified in the discussion.

Results of the Search

Results of the search

The flowchart below (figure 1) details identification and selection of studies. Appendix III summarises the details of the included studies and Appendix IV lists the studies that were excluded following assessment of the full text article, together with reason for exclusion. The primary reasons retrieved studies were excluded from the review were because the studies did not address the aims of this review, or the research was conducted in a setting other than PACU. Studies that included child populations were also excluded.

Figure 1: Identification and selection of studies



Methodological Quality of Included Studies

The studies represented an international perspective on PACU discharge, with four set in the United States (US),[7, 19-21] two conducted in Canada,[22, 23] one in Denmark[24] and one in Wales.[25] Of the eight included studies, only one[22] was a RCT. It investigated the use of a discharge tool with the aim of determining eligibility for bypassing PACU. Four[7, 19, 23, 24] were descriptive observational studies, of moderate to high risk of bias, investigating the use of various PACU discharge assessment tools. These four studies were conducted using convenience samples of PACU patients, the assessment tools used were generally not validated, confounding factors were poorly addressed, and analysis was often limited. Two[20, 21] additional observational studies and a retrospective records analysis[25] investigated the recovery of patients in the PACU and provided data useful for the development of a PACU assessment tool.

Appendix V provides a summary of the variables assessed in each of the studies included in this review. While a range of variables was investigated, the most common variables were pain, conscious state, vital signs and nausea and vomiting.

Results of the Review

Studies investigating tools used to assess discharge readiness from PACU

A total of five studies[7, 19, 22-24] investigated the use of specific tools to assess the readiness of patients for discharge from the PACU. Each tool contained a pre-determined combination of assessment variables and where provided in the study these tools are presented in the appendices to this review.

A non-blinded RCT[22] conducted in 2004 at a Canadian day surgery facility investigated the time and cost savings of utilising a fast-track score system used in discharging patients directly from the operating theatre to a day surgery unit, thereby bypassing the PACU. Outpatients scheduled for gynaecological laparoscopy, hysteroscopy or arthroscopy who were aged between 18 and 65 years, classified as levels I or II on the American Society of Anaesthesiologists physical status classification system (ASA) and with no history of significant disease or substance abuse were randomised to a fast-track group (n=110) or a routine recovery group (n=97). Randomisation was by computer generated numbers and allocation concealment methods were not reported. The two groups were not significantly different with respect to demographics, mean duration of anaesthetic or surgery, anaesthetic doses, intraoperative fluids or intraoperative or postoperative hypnotic levels. The outcome measures for the trial were nursing hours, financial costs, time to discharge, postoperative and at home nausea and pain, and patient satisfaction.[22]

Patients in both groups were assessed on waking in the operating theatre using the fast-track scoring tool that was of interest to this review (see Appendix VI). Patients in the fast-track group who met the fast-track criteria within 10 minutes were discharged to the day surgery unit. The routine recovery group were discharged to PACU regardless of meeting

the fast-track criteria. There was no significant between-group difference in number of patients meeting the fast track criteria (81% versus 75%). Patients in the routine recovery group were further assessed in PACU using the facility's standard discharge assessment tool before being discharged to the day surgery unit. Both the fast-track assessment tool and the PACU discharge tool included a scoring system with well-defined criteria for each variable; however, the variables included on each were slightly different. The fast-track tool included assessment of level of consciousness, oxygen saturation and respiratory stability and the PACU discharge included assessment of surgical bleeding.[22]

Patients in the fast-track group had a significantly shorter hospital stay (average time saving 17 mins, $p<0.05$) compared to the routine recovery group. Using the fast track discharge tool, time to discharge was faster for patients undergoing hysteroscopy (saving of 43 minutes, $p<0.05$) or arthroscopy (saving of 35 minutes, $p<0.05$) but there was no statistically significant difference (p=ns, value not reported) in time to discharge for patients undergoing laparoscopy. There was no statistically significant between-group difference in pain or nausea either immediately postoperative or in the 24 hours following discharge. The significant reduction in time to discharge for the fast-track group did not translate to significant savings in nursing time or financial costs.[22]

The results of this trial suggested that using the discharge scoring tool in the operating theatre for the fast-track group was as effective as the PACU discharge assessment tool in identifying readiness for discharge. There was no difference in the number of patients in each group who were able to achieve criteria for discharge on the fast-track scoring system. Increasing the time and surveillance of postoperative day surgery patients through admission to PACU and assessment with the PACU discharge tool was not associated with a reduction in adverse events. There were; however, significant time savings for patients in being assessed within the operating theatre and by-passing PACU.[22]

One descriptive trial[23] conducted in a Canadian university teaching hospital sought to validate an objective post-anaesthetic discharge criteria checklist, the Post-anaesthetic Discharge Scoring System (PADSS), in order to replace the discharge criteria tool being used in an ambulatory surgery unit. The study, conducted in the early 1990s, did not report the recruitment and selection methods of the 247 patients included in the trial. Of the participants, 151 underwent a dilatation and curettage (D&C) short procedure (mean anaesthetic time 20 ± 7 minutes) and the remainder underwent longer minor ambulatory surgical procedures including arthroscopy and laparoscopy (mean anaesthetic time 62 ± 26 minutes). A sample of patients undergoing D&C was used to establish inter-observer and intra-observer reliability of the PADSS, both of which were reported to be high.[23]

Patients were assessed using the PADSS tool one hour postoperatively and at 30 minute intervals thereafter by an independent researcher. Participants were also assessed using the tool that was currently being used in the PACU, the Clinical Discharge Criteria (CDC), and the decision to discharge the patient was made independently by PACU staff using the CDC. All patients were followed up with a telephone survey 24 hours following discharge to identify any significant complications.[23]

The PADSS tool (see Appendix VII) incorporated five categories: vital signs; activity and mental status; pain, nausea and/or vomiting; surgical bleeding; and intake and output, each of which were scored to determine eligibility for discharge. The CDC required

patients to have stable vital signs, be alert and oriented, be free from nausea and vomiting, have a steady gait and have no significant bleeding. Clear definitions of parameters that met these requirements were not included in the study.[23]

For patients undergoing D&C there was no statistically significant difference (p=not significant [ns]) in the mean time to meet discharge criteria between the two tools; mean of 115 minutes (range 10 to 210 minutes) using the PADSS criteria compared with a mean of 120 minutes (range 10 to 230 minutes) to meet CDC criteria. Patients undergoing longer surgical procedures met the PADSS criteria after a mean of 125 minutes (range 0 to 385 minutes) and CDC criteria after a mean of 140 minutes (0 to 385 minutes) which was also not a statistically significant difference (p=ns).[23] While this trial showed no significant difference in time to meet discharge criteria following assessment with an objective discharge checklist compared with a non-validated subjective tool, there were however, significant delays between meeting discharge criteria and actual discharge for both groups ($p<0.05$ for both D&C patients and those undergoing other surgical procedures). The primary reasons for discharge delay were preparing discharge information, organising follow-up appointments and patient factors such as dressing or awaiting escort.[23]

A 2008 observational study[19] conducted in a large US tertiary care teaching hospital compared the discharge of adult patients, following a general anaesthetic, from the PACU using traditional discharge practice [TDG] or a discharge criteria tool [DCG]. Patients who received a spinal or epidural anaesthetic or who were scheduled for a same day discharge were excluded. All patients admitted to the PACU over the study timeframe who met inclusion criteria were included in the study. In the first phase of the study, patients (TDG, n=631) were discharged by the anaesthetist after an initial alert from nursing staff that the patient was ready. A second cohort of patients admitted to the same PACU was observed in the second phase of the study (DCG, n=567). This group was discharged using a predetermined, nurse-administered discharge screening tool. The groups were comparable for age and gender but comparability for surgical factors (e.g. duration of surgery/anaesthetic) was not reported. Outcome measures were time to readiness for discharge, time to actual discharge, frequency of delay in discharge and frequency of PACU stays exceeding 60 minutes.[19]

The discharge criteria checklist used to assess the DCG group, of interest to this review, is shown in Appendix VIII. The checklist included defined outcomes for activity, respiration rate, blood pressure, pulse, oxygen saturation, consciousness/ mental state, pain, urine output, nausea and vomiting and laboratory results.[19]

This study reported a significant (p=0.00) 24% reduction in time spent in PACU when nursing staff implemented the discharge criteria checklist. Eighty per cent of patients discharged using the traditional method were delayed in PACU after meeting discharge criteria compared with 42% of the DCG group (p=0.00). The most common reason for discharge delay for both groups was lack of an available bed within the admitting ward (48% TDG versus 45% DCG, p=ns). More patients in the DCG were delayed due to lack of availability of a nurse to transfer the patient (16% vs 3%, p=0.00) which the researchers proposed to be related to the change in work flow patterns arising from the change in discharge policy. More patients in the TDG had a delayed discharge due to multiple reasons (36% vs 25%, p=0.008). There was no significant between-group

difference in delays due to radiography investigations, patient pain or other complications.[19]

Nurses receiving those patients in the ward following discharge from PACU were surveyed regarding their satisfaction with the patient and the patient's records. On admission to the ward significantly more patients in the TDG had unstable vital signs (2% vs <1%, p=0.042) and significantly more patients in the DCG had high levels of anxiety (8% vs 4%, p=0.014). The researchers proposed that high anxiety may reflect delays in PACU, whilst the lower level of vital sign instability in the DCG may reflect greater caution of nursing staff in ensuring the patient was ready for discharge. There were no significant difference between the two groups in level of reporting, pain control, experience of nausea and/ or vomiting, excessive bleeding or overall satisfaction of the admitting nurse of the condition of the patient.[19]

The recent (2010) observational study by Gartner et al.[24] investigated PACU discharge delay in patients undergoing breast cancer surgery in a facility in Denmark. Patients in the study underwent either mastectomy or breast conserving surgery combined with either sentinel lymph node dissection or axillary lymph node dissection. The discharge assessment tool in use in the PACU was the Danish Society of Anaesthesiology and Intensive Care Medicine (DASAIM). The DASAIM (see Appendix IX) includes assessment of post-anaesthetic nausea and vomiting, pain, sedation levels, oxygen saturation, and vital signs.[24] Over a three month period, the instrument was administered every 15 minutes to 116 consecutive patients admitted to the PACU. Patient ages ranged from 33 to 86 years and 84% were categorised as ASA 1 or 2.[24]

In this trial the DASAIM criteria for discharge were met on admission to the PACU by 31% of patients. Mean time to meet discharge criteria was 40 minutes (SD 46 minutes) and mean time to discharge from the PACU was 110 minutes (SD 75 minutes). Aside from logistical factors, the primary reason for delayed discharge was inability to meet the discharge criteria of an oxygen saturation of at least 90%. In the sample, 19% of patients failed to meet the DASAIM oxygen saturation discharge criteria and were discharged by anaesthesiologists.[24] There was no correlation between low oxygen saturation levels and administration of injectable Patent Blue (injected intradermally into the breast of patients who underwent sentinel lymph node dissection), a substance reported to be related to falsely low peripheral oxygen saturation levels.[24] In addition, there was no significant difference in oxygen saturation levels between patients who received intraoperative long-acting opioids and those who did not. There was no statistically significant relationship (p=ns) between oxygen saturation level and respiration rate on arrival at the PACU.

The researchers proposed that as almost 20% of patients failed to achieve the DASAIM criteria for oxygen saturation level prior to their discharge from PACU, this requirement should be reconsidered on discharge checklists. As adverse events following discharge were not reported in this study, it is uncertain whether discharging patients who have modest low oxygen saturation levels (<90%) with oxygen via nasal prongs would be associated with an increase in postoperative complications.[24]

Waddle et al.[7] published findings from an observational study conducted in the PACU of a US tertiary level hospital which compared discharge outcomes in a convenience sample of 340 post-surgical patients. Participants involved in the study were classified as ASA categories II and III, had a mean age of 51 years, mean anaesthetic duration of 118

minutes ± 83 minutes and a mean anaesthetic time 181 minutes ± 96 minutes.[7] The primary outcome measure was actual length of stay in the PACU and predictive factors for delayed discharge including anaesthetic type, surgery type and co-morbidity were also calculated.[7] Patients were excluded from the trial if they were undergoing thoracic, neurosurgery, ophthalmology or ear-nose-throat surgery; were receiving monitored anaesthesia care, if they were admitted to the PACU on a weekend, or when the researcher was already assessing six patients.

The researcher assessed participants at 30-minute intervals to determine "medically appropriate" time for discharge. The criteria used for determining readiness for discharge was not fully reported in the study; however, reasons for delaying discharge included decreased level of consciousness, agitation, a blood pressure not within 20% of pre-operative measure, tachycardia (>100bpm), arrhythmias, hypoxia (<90% saturation on air), a pain score above 6 (scale of 0 to 10), emesis, a temperature less than 34°C, oliguria, or endotracheal intubation. Patients were assessed concurrently using the facility's normal PACU discharge protocol, which required review by an anaesthetist to confirm the patient's readiness for discharge. The criteria used by the anaesthetist were not reported.[7]

The mean length of PACU stay as determined by the anaesthetist's assessment was 95 ± 43 minutes (median 90 minutes, range 30 to 330 minutes), compared to the mean medically appropriate discharge time of 71 ± 37 minutes (median 60 minutes, range 0 to 240 minutes). More than 20% of patients were classified by the researcher as having a delayed discharge, of which almost 8% were considered to have been delayed in the PACU due to the anaesthetist's assessment. Other reasons for a discharge delay were related to bed availability, transportation delays, awaiting tests and nursing decisions.[7]

Anaesthetic and surgery durations (p=0.0001 for both), anaesthetic technique (e.g. general mask, regional etc) p=0.0004), intraoperative fluid replacement (p=0.0001) and amount of blood loss (p=0.0001) were independent predictive factors of the medically appropriate length of stay in PACU. There was no predictive relationship between age, gender, race, body mass index, ASA category or type of operation and the length of PACU stay considered appropriate.[7]

The study[7] findings suggested that implementation of a formal assessment of readiness for discharge may reduce PACU length of stay. However, the results may have been biased by the patient selection criteria and lack of validation of the researcher's assessment. Selection for inclusion in the trial was less likely during the PACU's busier time frames (as the observer was already assessing 6 patients). The study[7] findings also showed that blood loss was predictive of a longer PACU stay. Mean length of stay for patients with less than 150 ml blood loss was 64 minutes compared with 82 minutes for patients with more than 500 ml blood loss (p=0.0001). Amount of blood loss could be used as a variable for determining readiness for discharge, although the study did not address the feasibility of such an assessment.

The most common variables included in PACU discharge assessment tools were pain, conscious state, vital signs and nausea and vomiting. All tools used blood pressure as a criterion for assessing discharge readiness; however there was limited consistency on which other vital signs provide an effective indication of discharge readiness and can be feasibly assessed in the PACU. There was consensus on the inclusion of an assessment

of pain, nausea and vomiting and conscious level prior to discharge, with different tools varying only slightly in the strategies used to assess these variables.

Studies assessing the relevance of specific variables in terms of determining readiness for discharge from the PACU

A total of three studies[20, 21, 25] addressed the relevance of specific variables in terms of determining readiness for discharge from the PACU.

An observational study[20] conducted in the UK and published in 1990, involving 33 patients who had undergone orthopaedic day surgery, investigated patient recovery following surgery using variables determined by the results of a literature review. Selection of patients and their demographic characteristics were not reported. The assessment tool included 17 variables to be ranked by the patient on a 10-point Likert scale. The variables were designed to assess mental state, educational factors, cognitive performance, mobility, oral intake, and pain. Patient ratings were included for nausea and vomiting, appetite, thirst, alertness, pain, coordination, dizziness, headache, energy levels, temperature, feeling of wellness, interest levels, clarity and speed of thought, excitability, feeling troubled, and happiness. The assessment was administered prior to surgery to establish baseline values, and postoperatively at 30 minute intervals for 2 hours with a final assessment conducted after discharge from hospital. The patient's location in the postoperative period was not explicitly stated in the report so for the purposes of this review we considered assessments conducted at baseline, 30 minutes and 120 minutes postoperatively. Although the paper reported quantitative outcomes, values for all variables at all timeframes were not reported.[20]

Prior to surgery the baseline mean value for the two variables assessing mental state, alertness and energy, was 2 on a 10-point Likert scale (zero being optimal). At 30 minutes postoperatively the mean value for both items increased to 6 points. By 120 minutes both had decreased; the mean value for alertness had returned to baseline and the mean value for energy was 4.[20] For cognitive function, which included headache, clarity of thought and speed of thought, at baseline the mean values were low (zero being optimal); 2 out of 10 for both speed and clarity of thought, 9% of patients experienced headache. Thirty minutes postoperatively the mean ranking for both speed and clarity of thought was 5 and these both returned to baseline values by 120 minutes. Complaints of headache rose slightly to 12% of patients at 30 minutes and 18% of patients at 120 minutes.[20]

The mean value for pain at baseline was 2 (zero being no pain). Thirty minutes postoperatively this rose to 5.6 and was 5 at 120 minutes. Despite the mean increase in pain rating in the sample, only 30% of the patients were administered analgesia. Nine per cent of patients indicated in additional comments that pain was the worst aspect of undergoing surgery, reinforcing the importance of analgesia in the postoperative period.[20]

Patient perception of mobility was not reported; however, less than 10% of patients experienced dizziness. The researchers reported that appetite peaked 60 minutes postoperatively and thirst peaked 30 minutes postoperatively. Nausea and vomiting peaked at 90 minutes postoperatively; however the relationship between this and oral intake (or analgesia administration) was not investigated and oral intake was not reported. The researchers reported higher values preoperatively for the variables

assessing “educational factors” (excitability, feeling troubled and happiness), with significant decrease immediately following surgery as patients experienced relief that the event was completed, however the actual values were not reported.[20]

The researchers proposed criteria to be met prior to discharge from day surgery based on the study results and a literature review.[20] They suggested essential criteria were mental state (alert and responsive), mobility (mobility consistent with pre-operative level and type of surgery, lack of dizziness), pain (analgesia provided), oral intake (retaining oral fluids), information provision, and social (support). They proposed that it is also desirable for the patient to have voided, have minimal pain, be clear-headed without headache and be eating and drinking without nausea or vomiting prior to discharge.[20] The researchers did not investigate use of these criteria in the PACU setting or practical methods by which the criteria could be assessed.

A 2002 observational study[21] conducted in a US endoscopy suite investigated one variable, the use of psychomotor tests, in the PACU to assess recovery from sedation. Thirty-one adult participants (n=31) undergoing endoscopy under sedation with analgesia that had a normal functional status at baseline, no significant cardiopulmonary or neurological impairment and were not blind were included in the study. Recruitment methods were not reported. The mean age of the sample group was 43 years, with reported co-morbidities including anxiety, depression, diabetes, hypothyroidism and cerebrovascular accident. The mean procedural time was 10 minutes (maximum 30 minutes) and mean duration since last medication dose prior to admission to PACU was 16 minutes.[21]

Patients were administered four validated psychomotor tests; the Manual Dexterity Test (MDT, a timed task to assess fine motor skills), Letter Cancellation Test (LCT, to assess concentration and perception) Multi-choice Reaction Time Test (MRTT, assesses complex reaction time) and the Critical Tracking Test (assesses complex psychomotor coordination using a computer program). The psychomotor tests were administered prior to the procedure and from admission to the PACU at 15 minute intervals until the patient’s discharge from the PACU. In the PACU patients were also assessed for discharge readiness by nursing staff, independent of the study. The facility’s discharge policy required patients to meet modified Aldrete criteria, be able to ambulate independently and maintain a simple conversation. The mean time to discharge was 26 minutes (maximum 45 minutes).[21]

The researchers investigated the level of recovery on psychomotor tests at two time points: the time of meeting the modified Aldrete discharge criteria and at the time of PACU discharge. Ninety-seven per cent of patients met the modified Aldrete discharge criteria on arrival in the PACU. Mean recovery on the MDT was 61.0% ± 0.3% (95% CI 55.8 to 66.3%, $p<0.0001$ compared to baseline) and on the LCT mean recovery was 64.4% ± 0.3% (95% CI 58.1 to 70.7%, $p<0.0001$). For the MRTT mean recovery, when the modified Aldrete discharge criteria was reached, was 62.7% ± 0.3% (95% CI 56.4 to 69.0%, $p<0.0001$) and for the CTT the group achieved a mean recovery of 70.0% ± 0.3% (95% CI 64.6 to 75.4%, $p<0.0001$).[21]

Although almost all patients met the modified Aldrete criteria for discharge on admission to PACU (see Appendix X), psychomotor testing showed significant impairment at the same time frame. By the time of discharge from the PACU participants had achieved

greater psychomotor recovery; however impairment remained significant (p<0.0001 for all tests) compared to baseline, ranging between 82% and 92% across the four tests.[21]

This study[21] highlighted that the modified Aldrete score was unable to identify significant psychomotor impairment. The researchers[21] discussed the development of the Aldrete score as a tool to assess safe discharge to a monitored care ward as opposed to discharge home directly from the PACU following sedation. The authors questioned the appropriateness of the use of the tool for patients being discharged directly to home. The addition of criteria relating to ambulation and conversation, to the discharge criteria, allowed for an increase in psychomotor recovery at the time of discharge. The researchers reported the LCT to be a simply administered tool that could be added to an assessment of discharge readiness following sedation with the possibility of increasing patient safety.[21] However, no appropriate level of psychomotor recovery was proposed to guide the use of the test.

A 2008 observational study set in Wales[25] focused on one variable, the incidence of postoperative urinary retention (POUR), defined as a bladder volume of at least 500 mL and inability to void for at least 30 minutes, in the PACU. The study included 112 adults receiving surgery under spinal anaesthetic in a US military PACU. Records for all patients admitted during the pre-determined audit period were reviewed to identify patients who experienced POUR, predictors of POUR and the relationship between POUR and length of stay in the PACU. The patients were predominantly male, with a mean age of 47 years, mean anaesthetic time of 121 minutes and mean intraoperative fluids of 1143 ml.[25]

During recovery in the PACU, 44% of the participants experienced POUR, defined as a bladder volume of at least 500ml and inability to void for at least 30 minutes. The only predicting factor for POUR was a bladder volume of at least 500ml on admission to the PACU. Patient characteristics including age, gender, type or duration of surgery and amount of intra-operative fluids administered were not significantly (p=ns) associated with experiencing POUR. Although patients with POUR were not found to have a significant increase in time spent in PACU compared to patients not experiencing POUR, the study was insufficiently powered to measure this outcome.[25]

The authors suggested that POUR was a frequently occurring adverse event for patients undergoing spinal anaesthetic that should be addressed prior to discharge from the PACU in order to promote patient comfort. However, the study did not investigate assessment of POUR as a discharge criteria in the PACU, its effectiveness in reducing PACU length of stay or any associated adverse events.[25]

These studies provide some evidence on the effectiveness and feasibility of specific variables that could be included on PACU discharge checklists; however the validity and reliability of the variables explored (psychomotor testing, urine output) in determining readiness for discharge requires further investigation.

Discussion

The aim of this review was to determine the essential components of an effective scoring system to assess patients following anaesthesia and surgery, thereby enhancing patient safety through timely and appropriate discharge from the PACU. The review sought to identify the essential components of an effective scoring system to assess patients following surgery and anaesthesia. Five studies investigated the use of differing PACU

discharge assessment tools and three studies considered the relevance of specific variables in determining patient readiness for discharge. The most common variables were pain, conscious state, vital signs and nausea and vomiting.

Variables assessed for PACU discharge readiness

Pain

In observing patient recovery following surgery, Stephenson[20] reported mean pain levels of 5 on a 10-point Likert scale at 30 minutes postoperatively, rising to 5.6 at 120 minutes postoperatively. In the study[20] patients reported pain to be the most distressing aspect of the surgical experience, suggesting this variable is meaningful to patients.

Four specific tools[19, 22-24] were used to assess discharge readiness included a pain assessment. Three of the tools[22-24] using a discharge scoring system defined criteria for pain on 3- or 4-point scales using descriptors such as 'light',[24] 'minimal',[23] 'moderate'[22-24] and 'severe'.[22-24] One of the tools[23] combined assessment of pain with nausea and vomiting, with the descriptor referring to requiring, or having required, intervention to manage symptoms. Brown et al.'s[19] tool, which described specific criteria to be met before discharge referred to a score of no more than 4 on a 10-point Likert scale. This definition may seem unrealistic criteria for many patients in the PACU; however, Stephenson[20] also noted that only 30% of patients received analgesia. Waddle et al.[7] did not describe a specific tool by which discharge readiness was assessed, but did report pain above 6 points on a 10-point scale as indicating the patient was not medically ready for PACU discharge.

Nausea and vomiting

Nausea and vomiting were variables included in five discharge assessments.[7, 19, 22-24] On two discharge tools this variable was scored according to definitions describing nausea and vomiting as light/minimal, moderate or severe.[23, 24] Song et al.[22] used the descriptors none/mild, transient, or persistent, to classify the patient's nausea and vomiting. Waddle et al.[7] reported that emesis was an indicator that the patient was not fit for PACU discharge but did not report definitions or qualifiers for an assessment and Brown et al.'s[19] criteria for discharge required no intractable nausea and vomiting.

Despite nausea and vomiting being one of the most common assessment variables for PACU discharge, Stephenson et al.[20] noted nausea and vomiting peaked at 90 minutes following surgery, suggesting that this variable may not become significant to the patient until after PACU discharge.

Vital signs

Five PACU discharge assessments[7, 19, 22-24] included various combinations of vital signs, with large variation between the assessments as to values that constitute readiness for discharge. One assessment tool was non-specific, with a single 3-point scale simply requiring "vital signs" to be at least within 40% of preoperative values.[23] Song et al[22] also used a 3-point scoring system, requiring blood pressure to be at least within 30% of the preoperative measurement and respiration stability assessed according to rate and cough reflex. The tool proposed by Gartner et al's[24] included respiration rate, systolic blood pressure and heart rate, each with a 4-point scoring scale with defined objective values for each variable that were non-dependent on baseline measures. Brown et al.[19] also used defined values for respiration rate, pulse and blood pressure; however this tool included a range of the preoperative measure (10% for pulse and respirations, 20% for

blood pressure) that could be considered appropriate for patients with vital signs outside the defined discharge criteria. Waddle et al.[7] reported reasons for which a patient was not considered fit for PACU discharge including blood pressure not within 20% of baseline readings, tachycardia or arrhythmias. Waddle et al.[7] was the only study indicating an assessment of temperature should be considered when determining PACU discharge readiness.

The DASAIM tool used by Gartner et al.[24] required the most extensive assessment of vital signs but gave no concession to the patient's preoperative vital sign measures. However, patients assessed with this tool achieved the fastest PACU discharge time, suggesting that meeting vital sign criteria does not significantly delay discharge.

Oxygen saturation was included in four discharge assessments.[7, 19, 22, 24] Requiring oxygen saturation to be at least above 94% on air, Gartner et al.[24] found the oxygen saturation criteria were related to the most discharge delays. Twenty per cent of patients in the study required supplemental oxygen for at least 60 minutes.[24] The researchers[24] proposed that the need to meet oxygen saturation criteria may needlessly increase PACU stays and that discharge with oxygen via nasal prongs may be an appropriate concession.

Cognitive variables

Conscious state was included in five of the assessments of PACU discharge readiness[7, 19, 22-24] however, there was no consensus in the criteria. Brown et al.'s[19] required the patient to have achieved "appropriate" responsiveness or meet preoperative status before discharge. Chung et al.'s[23] assessed activity and mental state as a combined outcome, requiring the patient to be orientated and / or have a steady gait. Gartner et al.[24] and Song et al.[22] both assessed consciousness based on level of arousal. Waddle et al.[7] reported decreased level of consciousness as a reason to retain a patient in PACU, but did not provide any defining criteria.

Psychometric testing was the subject of one study.[21] The researchers found that none of the participants had fully recovered their cognitive status as assessed on the validated psychometric tests by the time of discharge from PACU. However, the mean performance on all of the tests was in the range of 82% to 92% of preoperative ability at discharge, indicating that psychomotor performance generally recovers promptly following sedation.[21] Similar findings were reported in Stephenson's observational study[20] in which patients subjectively rated their clarity and speed of thought at 5 on a 10-point Likert scale 30 minutes after surgery and ratings had returned to baseline by 120 minutes following surgery.[20] The inclusion of such tests on routine PACU discharge criteria was not investigated in either study,[20, 21] and may not warrant the additional time and resources. However the importance of promoting patient safety following day surgery with appropriate discharge education (e.g. avoiding driving, having a support person) was highlighted.[21]

Urinary output

Urinary output was considered in three discharge assessments.[7, 19, 23] Assessment of urinary output and oral intake, requiring the patient to have voided and /or had oral fluids before being ready for discharge was included by Chung et al.[23] Brown et al.[19] included a criteria requiring clear and adequate urine output where the patient had a catheter in-situ while oliguria was reported as a condition preventing discharge.[7]

The incidence of POUR was the focus of Feliciano et al's[25] retrospective study. The incidence of POUR was reported to be 44% and a bladder volume over 500 mL on admission to PACU was the only identified predictive factor of potential POUR. The researchers proposed that assessment of bladder volume using ultrasonic bladder scanning on admission to PACU and performing intermittent catheterisation may relieve patient discomfort and enable faster PACU discharge.[25] However, the benefits of such a strategy were not investigated and the influence on PACU discharge time is questionable given the lack of standard urinary output assessment on discharge criteria tools in use in PACUs.

Determining overall readiness for PACU discharge

Of the five studies using a discharge assessment tool, three[22-24] implemented a scoring system to give an overall indication of PACU discharge readiness. The three scoring systems required a score on a 3- or 4- level scale to be assigned to each variable assessed and a cut-off point for the overall score was used to establish if the patient could be discharged. The scoring systems required the patient to achieve full recovery on the majority of variables prior to discharge, allowing for partial recovery on only one or two assessment criteria. These systems appeared more flexible than the 10-item tool implemented by Brown et al.,[19] which provided a single description of the criteria for each variable, each of which must be met before discharge. Waddle et al.'s[7] assessment was not described sufficiently to determine how the overall readiness for discharge was made.

Despite appearing less flexible, the mean time following day surgery to meet the discharge criteria used by Brown et al.[19] was 66.3 ± 30 minutes. This compared with a mean 125 minutes for long procedure day surgery patients to meet the discharge criteria defined on the 5-item tool used by Chung et al.[23] and a mean of 40 ± 46 minutes before discharge using Gartner et al.'s[24] 7-item assessment tool. Ninety-seven per cent of patients in Song et al.'s[22] study were able to meet the discharge criteria on the 7-item tool before leaving theatre, allowing them to be fast-tracked and bypass PACU.

Patient safety considerations

Two studies[19, 22] investigated the rate of complications in patients discharged using assessment tools. In the RCT conducted by Song et al.,[22] patients assessed using a fast-track scoring system reported no significant increase in pain or nausea in the immediate postoperative period or over the 24-hour period at home compared to those who received additional discharge assessments.[22] Nursing staff in receiving wards reported a significant decrease in patients arriving on the ward with unstable vital signs after assessment using discharge criteria, compared to patients discharged from PACU at the direction of the anaesthetists. However, there was an increase in anxiety of patient's discharged using the tool, perhaps due to lack of a final medical review before leaving the PACU.[19]

Conclusion

There was agreement amongst the studies included in this review that PACU discharge assessment includes assessment of pain, conscious state, and nausea and vomiting. Although vital signs were included in all the discharge assessments, there was variation in the specific vitals included on tools, with blood pressure being the only vital sign adopted in every assessment. The only tool that appeared to have any form of validation, the DASAIM discharge tool,[24] included assessment of blood pressure, pulse, respirations

and oxygen saturation. The value of including urine output, oral intake or psychomotor testing was doubtful and requires further investigation.

Limitations

The findings of this review were limited as only studies reported in English were included. This may have resulted in the exclusion of studies that were relevant and thus important for this review. As the literature search was limited to studies published between 1970 and 2010, there could have been studies earlier than 1970 that were of relevance to this review, however this is considered unlikely as it was during the 1970s that discharge scores were first introduced to determine discharge from the PACU environment. Qualitative studies were excluded from the review and these studies may have been able to contribute to the feasibility aspects of using/applying the scoring criteria.

Implications for practice

Based on the evidence analysed in this systematic review, the following recommendations are considered important for the assessment of adult patient readiness for discharge from the PACU environment. Levels of evidence have been assigned to each recommendation according to the JBI levels of evidence (Appendix XI):

- Assessment of pain, conscious state, blood pressure and nausea and vomiting should be made before discharging a patient from PACU (JBI Level 2 evidence)

- Assessment of other vital signs should be considered before discharging a patient from PACU (JBI Level 2 evidence)

This evidence synthesis will be used to inform the development of a draft tool for assessing the readiness of adults for discharge from the PACU.

Implications for research

This review found a paucity of studies investigating PACU discharge assessment and the studies meeting inclusion criteria were generally at high risk of bias. There is a need for greater consensus with regard to the criteria to be assessed and the appropriate values of those criteria before patient discharge from the PACU.

Further research is required using sound methodologies that investigate:

- the validity and reliability of assessment variables on PACU discharge tools (JBI Level 2 evidence);
- the implementation of validated PACU discharge criteria for assessment of patient readiness for discharge (JBI Level 2 evidence) and
- the relationship between PACU discharge assessment and patient safety (JBI Level 2 evidence).

Conflicts of Interest

The authors had no conflicts of interest to declare.

References

1. Truong L, Moran J & Blum P, *Post anaesthesia care unit discharge: a clinical scoring system versus traditional time-based criteria.* Anaesth Intensive Care, 2004. **32**(1): p. 33-42.

2. National Institute for Health and Clinical Excellence (NICE), *Acutely ill patients in hospital. Recognition of and response to acute illness in adults in hospital. (Clinical guideline no. 50)*. 2007, London (UK): NICE.

3. Aldrete J & Kroulik D, *A postanesthetic recovery score.* Anesth Analg 1970. **49**(6): p. 924-934.

4. Aldrete J, *The post-anesthesia recovery score revisited.* J Clin Anesth., 1995 **7**(1): p. 89-91.

5. Aldrete J, *Modifications to the postanesthesia score for use in ambulatory surgery.* Journal of PeriAnesthesia Nursing, 1998. **13**(3): p. 148-155.

6. Mortensen M & McMullin C, *Discharge score for surgical outpatients.* Am J Nurs 1986. **86**(12): p. 1347-1349.

7. Waddle J, Evers A & Piccirillo J, *Postanesthesia care unit length of stay: quantifying and assessing dependent factors.* Anesth Analg, 1998. **87**(3): p. 628-633.

8. Riley R, Brotto B & Alexander L, *Developing a post-anaesthetic discharge scoring system: methodological and clinical issues.* Australian Society of Postanaesthesia and Anaesthesia Nurses Newsletter, 2006. **10**(4): p. 6-14.

9. Riley R, *Personal verbal communication*. 2010: Operating Suite Manager, Box Hill Hospital, Eastern Health.

10. Frewin D, *Evidence-based healthcare.* International Journal of Evidence-Based Healthcare, 2005. **3**(1): p. 1.

11. Pearson A & et al., *The JBI model of evidence-based healthcare.* International Journal of Evidence-Based Healthcare, 2005. **3**(8): p. 207-215.

12. Evans D, *The systematic review report.* Collegian, 2004. **11**(2): p. 8-11.

13. Smith B & Hardy D, *Discharge criteria in recovery: 'just in case'.* Journal of Perioperative Practice, 2007. **17**(3): p. 102.

14. Australian and New Zealand College of Anaesthetists (ANZCA). *Recommendations for the post-anaesthesia recovery room 2006*. 2006 [cited 2010 15 March]; Available from: www.anzca.edu.au/resources/professional-documents/professional-standards/ps4.html.

15. Scottish Intercollegiate Guidelines Network, *Postoperative management in adults: A practical guide to postoperative care for clinical staff*. 2004, Edinburgh: SIGN.

16. Swatton S, *A discharge protocol for the postanaesthetic recovery unit.* British Journal of Perioperative Nursing, 2004. **14**(2): p. 74-80.

17. Clinton M, *Best available evidence.* International Journal of Evidence-Based Healthcare, 2007. **5**(1): p. 1.

18. Hegarty J & Burton A, *Post anaesthetic care units in the Republic of Ireland: a survey of discharge criteria.* Journal of Perioperative Practice, 2007. **17**(2): p. 58-66.

19. Brown I, Jellish W, Kleinman B, Fluder E, Sawicki K, Katsaros J & Rahman R, *Use of postanesthesia discharge criteria to reduce discharge delays for inpatients in the postanesthesia care unit.* J Clin Anesth, 2008. **20**(3): p. 175-9.

20. Stephenson M, *Discharge criteria in day surgery.* J Adv Nurs 1990. **15**(5): p. 601-13.

21. Willey J, Vargo J, Connor J, Dumot J, Conwell D & Zuccaro G, *Quantitative assessment of psychomotor recovery after sedation and analgesia for outpatient EGD.* Gastrointest Endosc Clin N Am, 2002. **56**(6): p. 810-6.

22. Song D, Chung F, Ronayne M, Ward B, Yogendran S & Sibbick C, *Fast-tracking (bypassing the PACU) does not reduce nursing workload after ambulatory surgery.* Br J Anaesth 2004. **93**(6): p. 768-774.

23. Chung F, Chan V & Ong D, *A post-anesthetic discharge scoring system for home readiness after ambulatory surgery.* J Clin Anesth, 1995. **7**(6): p. 500-6.

24. Gartner R, Callesen T, Kroman N & Kehlet H, *Recovery at the post anaesthetic care unit after breast cancer surgery.* Dan Med Bull 2010. **57**(2): p. 1-5.

25. Feliciano T, Montero J, McCarthy M & Priester M, *A retrospective, descriptive, exploratory study evaluating incidence of postoperative urinary retention after spinal anesthesia and its effect on PACU discharge.* Journal of PeriAnesthesia Nursing, 2008. **23**(6): p. 394-400.

26. *Joanna Briggs Institute Levels of Evidence*. [cited 2011 1st June]; Available from: http://www.joannabriggs.edu.au/About%20Us/JBI%20Approach/Levels%20of%20Evidence%20%20FAME.

Appendix I: JBI MAStARI critical appraisal checklists: a) quantitative studies, b) comparable cohort/case control and c) descriptive and case series studies

a) JBI MAStARI Critical Appraisal Checklist for Quantitative studies

Experimental studies

Reviewer: _____ Date: _____

Citation: _____ Record Number: _____

Was the assignment to treatment groups truly random?	Yes / No / Unclear
Were participants blinded to treatment allocation?	Yes / No / Unclear
Was allocation to treatment groups concealed from the allocator?	Yes / No / Unclear
Were outcomes of people who withdrew described and included in the analysis?	Yes / No / Unclear
Were those assessing outcomes blinded to the treatment allocation?	Yes / No / Unclear
Were the control and treatment groups comparable at entry?	Yes / No / Unclear
Were outcomes measured in the same way for all groups?	Yes / No / Unclear
Were outcomes measured in a reliable way?	Yes / No / Unclear
Was appropriate statistical analysis used?	Yes / No / Unclear

Include?

Reason if excluded?

b. Comparable cohort/case control

Reviewer _____ Date _____

Author _____ Year _____ Record No _____

	Yes	No	Unclear
1. Is sample representative of patients in the population as a whole?			
2. Are the patients at a similar point in the course of their condition/illness?			
3. Has bias been minimised in relation to selection of cases and of controls?			

4. Are confounding factors identified and strategies to deal with them stated?			
5. Are outcomes assessed using objective criteria?			
6. Was follow up carried out over a sufficient time period?			
7. Were the outcomes of people who withdrew described and included in the analysis?			
8. Were outcomes measured in a reliable way?			
9. Was appropriate statistical analysis used?			

Overall appraisal: Include

Exclude Seek further info

c. Descriptive and Case Series Studies

Reviewer _____ Date _____

Author _____ Year _____ Record No _____

Was study based on a random or pseudo-random sample?	Yes / No / Unclear
Were the criteria for inclusion in the sample clearly defined?	Yes / No / Unclear
Were confounding factors identified and strategies to deal with them stated?	Yes / No / Unclear
Were outcomes assessed using objective criteria?	Yes / No / Unclear
If comparisons are being made, was there sufficient descriptions of the groups?	Yes / No / Unclear
Was the follow up carried out over a sufficient period of time?	Yes / No / Unclear
Were the outcomes of people who withdrew described and included in the analysis?	Yes / No / Unclear

Were outcomes measured in a reliable way?	Yes / No / Unclear
Was appropriate statistical analysis used?	Yes / No / Unclear

Include?

Reason if excluded?

Appendix II: JBI-MAStARI data extraction form

a. JBI MAStARI Data Extraction Form for Quantitative Data

Author _____ Journal _____

Reviewer _____ Year _____ Record No _____

Method _____ _____

Setting _____

Participants _____

Number of participants:

Group A _____ Group B _____

Interventions:

Intervention A _____ Intervention B _____

Outcome measures:

Outcome description	Scale/measure

Results: dichotomous data

Outcome	Treatment group Number/total number	Control group Number/total number

Results :continuous data

Outcome	Treatment group Mean &SD (number)	Control group Mean &SD (number)

Author conclusions _____

Reviewer conclusions _____

Appendix III: Summary of included studies

Study	Assessment tool	Comparison tool	Type of study	Number of participants	Type of surgery	Time to meet criteria	Findings
Song et al, 2004[22]	Fast track assessment tool to bypass PACU	Discharge from operating theatre to PACU	*RCT	Fast track group: 110 Traditional discharge: 97	Day surgery Laparoscopic gynaecology, hysteroscopy or arthroscopy	*N/A –screening tool administered in operating theatre	• 97% of patients met fast track criteria. • Average time saving in recovery was 17 minutes.
Chung et al, 1995[23]	Post anaesthetic discharge scoring system (PADSS)	Clinical Discharge Criteria (subjective checklist)	Observational	247	Day surgery short procedure Dilatation and curettage Day surgery long procedure Arthroscopy and laparoscopy	Short procedure patients Mean 115 mins (range 10 to 210 mins) Long procedure patients Mean 125 mins (range 0 to 385 mins)	• Average time in PACU not significantly different. • Times may have been shorter if other causes for delay were avoided.
Brown et al, 2008[19]	Discharge criteria	Discharge by anaesthetist	Observational	Anaesthetist discharge: 631 Discharge criteria: 567	Day surgery Procedures under epidural or spinal anaesthetic	66.3 mins ± 30 mins	• Significant 24% reduction (p=0.0) in time spent in PACU. • Significant reduction (p=0.0) in delayed discharge due to waiting for nurse escort. • Significant reduction (p=0.008) in multiple causes for discharge delay. • Significant decrease (p=0.042) in arrival at ward with unstable vital

							signs.
Feliciano et al, 2008[25]	Postoperative urinary retention (POUR)	N/A	Retrospective record analysis	112	Procedures under spinal anaesthetic	N/A – record analysis	• 44% of patients experienced POUR • Only predictive factor was bladder volume ≥500ml on admission to PACU
Gartner et al, 2010[24]	Danish Society of Anaesthesiology and Intensive Care Medicine (DASAIM)	N/A	Observational	116	Breast cancer surgery	40 mins ± 46 mins	• Primary cause for delay was inability to meet criteria for oxygen saturation (at least 90%).
Stephenson, 1990[20]	Tool with 17 different subjective patient assessments	N/A	Observational	33	Day surgery Orthopaedic procedures	N/A - recovery to preoperative status was observed up to and following discharge.	• Pain and mental alertness were not at preoperative levels by 120 minutes. • Cognitive function, mobility and educational factors were at or superior to preoperative levels within 120 minutes. • Nausea and vomiting peaked at 90 minutes following surgery.
Waddle et al, 1998[7]	Medically appropriate length of stay	Discharge by anaesthetist	Observational	340	Procedures excluding thoracic, neurosurgery, ophthalmology and ENT	71 mins ± 37 mins	• 8% of patients considered to have delayed discharge due to anaesthetist assessment. • 20% of patients had delayed discharge when other causes were included (e.g. awaiting

							escort). • Anaesthetic, type of surgery, amount of blood loss and intraoperative fluid replacement were predictive factors for length of stay.
Willey et al, 2002[21]	Manual Dexterity test Letter Cancellation test Critical Tracking test Multi-choice Reaction Time	Aldrete criteria	Observational	31	Day procedure Endoscopy under sedation	N/A – recovery to preoperative status was observed and not reached	• Mean time to discharge by Aldrete criteria was 26 mins. • On admission to PACU 97% patients met Aldrete criteria but psychomotor function was significantly impaired (p<0.0001) on all four tests. • Impairment remained significant (p<0.0001) on all four tests at discharge from PACU.
* Note: RCT- randomised controlled trial N/A- not applicable							

Appendix IV: Excluded studies

Key for reasons for exclusion
1. Discursive article / literature review/ case report or qualitative study
2. Quality of data reporting insufficient to include in review
3. Study does not address objectives of review
4. Participants did not meet inclusion criteria (< 18 years and/or non-PACU patients)
5. Not in English
6. Unable to retrieve for review

Citation	Reason
Apfelbaum J, Bypassing PACU: a cost effective measure. Can J Anaesth. 1998; 45(5 Pt 2):R91-4.	2
Awad I, Chung F. Factors affecting recovery and discharge following ambulatory surgery. Canadian Journal of Anesthesia. 2006; 53(9): 858-872.	1
Beatty A, Martin D, Couch M, Long N. Relevance of oral intake and necessity to void as ambulatory surgical discharge criteria. Journal of PeriAnesthesia Nursing. 1997 Dec; 12(6):413-21.	4
Bickert A, Gallagher C, Reiner A, Hager W, Stecker M. Nursing neurologic assessments after cardiac operations. Ann Thorac Surg. 2008 Feb; 85(2):554-60.	4
Botti M, Hunt JO. The routine of post anaesthetic observations. Contemporary Nurse.1994 Jun; 3(2):52-7.	1
Bush M, Stewart M, Speir N, Rawlinson T. Lessons in good nursing judgment related to post endoscopy. Gastroenterology Nursing. 1995 Nov-Dec; 18(6):231-2.	1
Chung F, Chan V, Ong D. A post-anesthetic discharge scoring system for home readiness after ambulatory surgery. J Clin Anesth. 1995 Sep;7(6):500-6.	1
Chung F. Discharge criteria - A new trend. Can J Anaesth.1995; 42(11):1056-1058.	1
Chung F. Are discharge criteria changing? J Clin Anesth. 1993; 5(6 Supp.):64S-68S.	1
Dai Y, Chang Y, Hsieh CY, Tai T. Effectiveness of a pilot project of discharge planning in Taiwan. Res Nurs Health. 2003 Feb; 26(1):53-63.	4
Diallo T, Dufeu N, Marret E, Covili F, Sin-Lie M, Gentili M. Walking in PACU after unilateral spinal anesthesia a criteria for hospital discharge: A 100 out patients survey. Acta Anaesthesiol Belg. 2009; 60(1):3-6.	1
Duncan P, Shandro J, Bachand R, Ainsworth L. A pilot study of recovery room bypass ("fast-track protocol") in a community hospital. Can J Anaesth. 2001;48(7):630-636.	3
Ead H. From Aldrete to PADSS: Reviewing discharge criteria after ambulatory surgery. Journal of PeriAnesthesia Nursing. 2006 Aug; 21(4):259-67.	1
Engel J, Junger A, Bottger S, Benson M, Michel A, Rohrig R, Jost A. Outcome prediction in a surgical ICU using automatically calculated SAPS II scores. Anaesth Intensive Care. 2003;31(5):548-554).	1
Fetzer S, Hand M, Bouchard P, Smith H, Jenkins M. Evaluation of the Rhodes Index of Nausea and Vomiting for ambulatory surgery patients. J Adv Nurs. 2004; 47(1):74-80.	4
Fraulini K, Murphy P. R.E.A.C.T. A new system for measuring postanesthesia recovery. Nursing. 1984 Apr; 14(4):101-2.	1
Habib A, Chen Y-T, Taguchi A, Hu X, Gan T. Postoperative nausea and vomiting following inpatient surgeries in a teaching hospital: A retrospective database analysis. Curr Med Res Opin. 2006; 22(6):1093-1099).	4
Hegarty J, Burton A. Post anaesthetic care units in the Republic of Ireland: a survey of discharge criteria. Journal of Perioperative Practice. 2007	1

Feb;17(2):58-66.	
Hartwell P. Discharge criteria. Int Anesthesiol Clin. 1983; 21(1):107-14.	1
Herrera F, Wong J, Chung F. A systematic review of postoperative recovery outcomes measurements after ambulatory surgery. Anesth Analg. 2007 Jul;105(1):63-9.	3
Hibbert G. Patient discharge criteria. AORN Journal. 2006 Sep; 84(3):367.	1
Kajiyama S, Kobayashi M, Okada Y. Criteria for postoperative discharge of the patients managed by anesthesiologists in an ambulatory surgery unit. Japanese Journal of Anesthesiology. 2004; 53(8):882-887.	5
Keenihan G. The importance of assessment. Contemporary Nurse. 1993 Dec; 2(3):131-2.	1
Klein S, Nielsen K, Greengrass R, Warner D, Martin A, Steele S. Ambulatory discharge after long-acting peripheral nerve blockade: 2382 Blocks with ropivacaine. Anesth Analg. 2002; 94(1):65-70).	3
Kleinbeck S. Self-reported at-home postoperative recovery. Res Nurs Health. 2000 Dec; 23(6):461-72.	4
Knoerl D, McNulty P, Estes C, Conley K. Evaluation of orthostatic blood pressure testing as a discharge criterion from PACU after spinal anesthesia. Journal of PeriAnesthesia Nursing. 2001 Feb; 16(1):11-8.	2
Lugay M, Otto G, Kong M, Mason D, Wilets, I. Recovery time and safe discharge of endoscopy patients after conscious sedation. Gastroenterology Nursing. 1996;19(6):194-200.	3
Lyon M, West B. Immediate postoperative recovery: measurement and care. British Journal of Nursing. 1994 Sep 22-Oct 12; 3(17):866, 868-70.	6
Mariette C, Piessen G, Balon J, Guidat A, Lebuffe G, Triboulet J. The safety of the same-day discharge for selected patients after laparoscopic fundoplication: a prospective cohort study. Am J Surg. 2007;194(3):279-282.	3
McGrath B, Chung F. Postoperative recovery and discharge. Anesth Clinics of North America. 2003;21(2): 367-386.	1
McMurray A, Johnson P, Wallis M, Patterson E, Griffiths S. General surgical patients' perspectives of the adequacy and appropriateness of discharge planning to facilitate health decision-making at home. Journal of Clinical Nursing. 2007; 16(9):1602-9.	3
Meyer S, Bass M, Ash R, Duffy S, Gazarian G, Parello A, Parmenter K, Snowden S, Toomey M. Postoperative care of the lung transplant recipient. Crit Care Nurs Clin of North America. 1996; 8(3):239-52.	3
Mortensen M, McMullin C. Discharge score for surgical outpatients. Am J Nurs.1986 Dec; 86(12):1347-9.	2
Naimark T. A comparison study of the post anesthesia recovery score and pulse oximetry. Journal of Post Anesthesia Nursing. 1990 Jun; 5(3):168-76.	6
Naughton C, Prowroznyk A, Feneck R. Reasons for prolonged hospital stays following heart surgery British Journal of Nursing. 1999 Sep 9;8(16):1085-94.	3
Pasero C, Belden J. Evidence-based perianesthesia care: accelerated postoperative recovery programs. Journal of PeriAnesthesia Nursing. 2006 Jun; 21(3):168-76.	1
Patterson P. "Fast tracking" of patients through PACU: is it safe? OR Manager. 1998 Jun; 14(6):1, 8-9.	1
Patterson P. Discharge criteria: are they keeping up with practices? OR Manager. 1999; 15(9).	6
Persson K. Ostman M. The Swedish version of the PACU-Behavioural Pain Rating Scale: A reliable method of assessing postoperative pain? Scand J Caring Sciences. Sep 2004; 18(3): 304-309.	3
Petersen C. Postoperative follow-up: tracking compliance and complications. Seminars in Perioperative Nursing. 1992 Oct; 1(4):255-60.	1
Royse C, Newman S, Chung F, Stygall J, McKay R, Boldt J, Servin F, Hurtado	4

I, Hannallah R, Yu B, Wilkinson D. Development and Feasibility of a Scale to Assess Postoperative Recovery: The Post-operative Quality Recovery Scale. Anesthesiology. 2010 Jul 1.	
Russon K, Thomas A. Anaesthesia for day surgery. Journal of Perioperative Practice. 2007; 17(7):302-7.	1
Sandberg W, Canty T, Sokal S, Daily B, Berger D. Financial and operational impact of a direct-from-PACU discharge pathway for laparoscopic cholecystectomy patients. Surgery. 2006; 140(3):372-378).	3
Schumacher S. Monitoring vital signs to identify postoperative complications. MEDSURG Nursing. 1995 Apr; 4(2):142-5.	4
Small A, Klinke P, Della Siega A, Fretz E, Kinloch D, Mildenberger R, Williams M, Hilton D. Day procedure intervention is safe and complication free in higher risk patients undergoing transradial angioplasty and stenting. The discharge study. Cathet Cardiovasc Interventions. 2007; 70(7):907-912.	3
Smith B, Hardy D. Discharge criteria: 'just in case'. Journal of Perioperative Practice. 2007 Mar; 17(3):102, 104-7.	1
Strong N. Assessing the postanesthesia patient. Critical Care Nursing Quarterly. 1993 May;16(1):1-7.	1
Susilahti H, Suominen T, Leino-Kilpi H. Recovery of Finnish short-stay surgery patients. MEDSURG Nursing. 2004 Oct; 13(5):326-35.	4
Toledo L, Wiley D. Stable and ready for transfer: nursing judgment of readiness for transfer from the PACU. Journal of Post Anesthesia Nursing. 1989 Aug; 4(4):247-50.	4
Truong L, Moran J, Blum P. Post anaesthesia care unit discharge: a clinical scoring system versus traditional time-based criteria. Anaesth Intensive Care. 2004 Feb; 32(1):33-42.	4
Weiss M, Piacentine L, Lokken L, Ancona J, Archer J, Gresser S, Holmes S, Toman S, Toy A, Vega-Stromberg T. Perceived readiness for hospital discharge in adult medical-surgical patients. Clinical Nurse Specialist. 2007 Jan-Feb; 21(1):31-42.	4
Wender R. Do current antiemetic practices result in positive patient outcomes? Results of a new study. Am J Health Syst Pharm. 2009; 66(1 Supp 1):S3-S10.	4
White P, Song D. New criteria for fast-tracking after outpatient anesthesia: a comparison with the modified Aldrete's scoring system. Anesth Analg 1999; 88: 1069–72	3
Wiesenack C, Wiesner G, Hobbhahn J. Discharge criteria after ambulatory surgey in general anaesthesia. Anasthesiologie und Intensivmedizin. 1997; 38(2):61-68.	5
Zeitz K, McCutcheon H. Observations and vital signs: ritual or vital for the monitoring of postoperative patients? Appl Nurs Res. 2006 Nov;19(4):204-11.	4

Appendix V: Variables assessed in included studies

	Blood pressure	Respiratory status	Pulse	O_2 sat	Pain	Nausea / vomiting	Conscious state	Activity	Bleeding	Oral intake	Urine output	Laboratory values	Anxiety/ happiness	Temperature	Psychomotor
Song et al, 2004[22]	*	*		*	*	*	*	*							
Chung et al, 1995[23]	Combined variables				Combined variables		Combined variables		*	Combined variables					
Brown et al, 2008[19]	*	*	*	*	*	*	*				*	*			
Feliciano et al, 2008[25]											*				
Gartner et al, 2010[24]	*	*	*	*	*	*	*								
Stephenson, 1990[20]					*	*	*	*		*			*		
Waddle et al, 1998[7]	*		*	*	*	*	*	*			*			*	
Willey et al, 2002[21]															*

Appendix VI: Fast track score used by Song et al, 2004[22]

	Score
I. Level of consciousness	
Awake and oriented	2
Arousable with minimal stimulation	1
Responsive only to tactile stimulation	0
II. Physical activity	
Able to move all extremities on command	2
Some weakness in movement of extremities	1
Unable to voluntarily move extremities	0
III. Haemodynamic stability	
Blood pressure <15% below baseline MAP value	2
Blood pressure within 15–30% of baseline MAP value	1
Blood pressure >30% below baseline MAP value	0
IV. Respiratory stability	
Able to breathe deeply	2
Tachypnoea with good cough	1
Dyspnoeic with weak cough	0
V. Oxygen satuation	
Maintains value >90% on room air	2
Requires supplementary oxygen (nasal prongs)	1
Saturation <90% with supplementary oxygen	0
VI. Postoperative pain assessment	
None or mild discomfort	2
Moderate to severe pain controlled with i.v. analgesics	1
Persistent severe pain	0
VII. Postoperative emetic symptoms	
None or mild nausea with no active vomiting	2
Transient vomiting or retching	1
Persistent moderate-severe nausea and vomiting	0
Total score	
A minimum of 12 (with no score less than 1 in any individual category) would be required for a patient to be fast-tracked (i.e. to bypass the postanaesthesia care unit) after general anaesthesia	

Appendix VII: Post Anaesthetic Discharge Scoring System (PADSS) used by Chung et al, 1995[23]

1. **Vital signs**
   2 = Within 20% of preoperative value
   1 = 20–40% of preoperative value
   0 = >40% of preoperative value
2. **Activity and mental status**
   2 = Oriented x3 AND has a steady gait
   1 = Oriented x3 OR has a steady gait
   0 = Neither
3. **Pain, nausea and/or vomiting**
   2 = Minimal
   1 = Moderate, having required treatment
   0 = Severe, requiring treatment
4. **Surgical bleeding**
   2 = Minimal
   1 = Moderate
   0 = Severe
5. **Intake and output**
   2 = Has had PO fluids AND voided
   1 = Has had PO fluids OR voided
   0 = Neither

Total PADSS score is 10, ≥9 considered fit for discharge

Appendix VIII: Discharge criteria tool used by Brown et al, 2008[19]

(a) Activity: voluntary movement of all 4 extremities similar to preoperative conditions

(b) Respirations: 12 to 25 breaths/min or, if out of this range, ± 10% of preoperative

(c) Pulse: 60 to 100 beats/min or, if out of this range, ± 10% of preoperative

(d) Blood pressure: two consecutive blood pressures 15 mins apart, ±20% of preoperative blood pressure taken

(e) Oxygen saturation: greater than 96% on room air or with supplemental oxygen

(f) Consciousness/Mental status: appropriately responsive or unchanged from preoperative status

(g) Pain score:

I. ≤4 before discharge based on a 0 to 10 pain scale

II. <12 y of age must be without any signs of significant pain or distress

(h) Urine output: with indwelling Foley catheter, clear and adequate urine output (0.5–1.0 mL/kg per hour)

(i) No intractable nausea or vomiting, anxiety or agitation, and no evidence of excessive bleeding

(j) Any laboratory values or ancillary tests ordered by the anaesthesiologist must be reviewed.

Appendix IX: Danish Society of Anaesthesiology and Intensive Care Medicine (DASAIM) discharge assessment tool used by Gartner et al, 2010[24]

Modality	Score	Criteria
Sedation (nurse evaluation)		
	0	The patient is fully awake
	1	The patient is asleep, aroused by verbal stimulation
	2	The patient is asleep, aroused by physical stimulation
	3	The patient is asleep, cannot be aroused
Respiration rate (nurse count)		
	0	Regular rate > 10
	1	Snoring, 10 > RR > 30
	2	RR < 10 or RR > 30/min
	3	Periods of apnoea or obstructive pattern
Oxygen saturation, no supplementary oxygen for 10 mins		
	0	$SPO_2 \geq 94\%$
	1	$90\% \leq SPO_2 < 94\%$
	2	$85\% \leq SPO_2 < 90\%$
	3	$SPO_2 < 85\%$
Systolic blood pressure (automatic NIBP)		
	0	SBP ≥ 100mmHg
	1	90mmHg ≤ SBP < 100mmHg

2	80mmHg ≤ SBP < 90mmHg or SBP > 220mmHg
3	SBP < 80 mmHg
Heart rate (automatically derived from ECG)	
0	50 < HR ≤ 100
1	100 HR ≤ 120
2	40 HR ≤ 50 or 120 < HR ≤ 130
3	HR < 40 or HR > 130
Pain (patient evaluation)	
0	No pain
1	Light pain
2	Moderate pain
3	Severe pain
Nausea (patient evaluation and nurse observation)	
0	No nausea and not vomiting
1	Light nausea or vomiting without previous nausea
2	Moderate nausea and/or vomiting
3	Severe nausea and/or recurring vomiting

RR = respiration rate; SPO_2 =oxygen saturation; SBP systolic blood pressure; HR = heart rate; NIBP = non-invasive blood pressure; ECG = electrocardiography
Modified version of the discharge criteria scoring system recommended by the Danish Society of Anaesthesiology and Intensive Care Medicine. Patients were considered dischargeable from the post-anaesthesia care unit when the score sum of all criteria was four or less and the patients had no single score above one.

Appendix X: Modified Aldrete criteria used by Wiley et al[21]

Time	Before	After	Discharge
Moves 4 extremities voluntarily or on command	2	2	2
Moves 2 extremities voluntarily or on command	1	1	1
Moves 0 extremities voluntarily or on command	0	0	0
Spontaneous, unlaboured respirations	2	2	2
Dyspnoea	1	1	1
Apnoea	0	0	0
BP ± 20% of preanaesthetic level	2	2	2
BP ± 20%-50% of preanaesthetic level	1	1	1
BP ± 50% of preanaesthetic level	0	0	0
Awake and oriented x 3	2	2	2
Arousable to verbal stimuli	1	1	1
Not responsive	0	0	0

Maintaining O_2 saturations >90% on room air	2	2	2
Needs O_2 inhalation to maintain O_2 saturations >90%	1	1	1
O_2 saturation <90% even with O_2 supplementation	0	0	0
TOTAL*			

Total* *A score of 10 was required for discharge from the endoscopy/recovery room

Appendix XI JBI Levels of Evidence.[26]

Levels of Evidence	Feasibility F(1-4)	Appropriateness A (1-4)	Meaningfulness M(1-4)	Effectiveness E(1-4)	Economic Evidence
1	Metasynthesis of research with unequivocal synthesised findings	Metasynthesis of research with unequivocal synthesised findings	Metasynthesis of research with unequivocal synthesised findings	Meta-analysis(with homogeneity) of experimental studies (eg RCT with concealed randomisation) OR One or more large experimental studies with narrow confidence intervals	Metasynthesis (with homogeneity) of evaluations of important alternative interventions comparing all clinically relevant outcomes against appropriate cost measurement, and including a clinically sensible sensitivity analysis
2	Metasynthesis of research with credible synthesised findings	Metasynthesis of research with credible synthesised findings	Metasynthesis of research with credible synthesised findings	One or more smaller RCTs with wider confidence intervals OR Quasi-experimental studies (without randomisation)	Evaluations of important alternative interventions comparing all clinically relevant outcomes against appropriate cost measurement, and including a clinically sensible sensitivity analysis
3	a. Metasynthesis of text/opinion with credible synthesised findings b. One or more single research studies of high quality	a. Metasynthesis of text/opinion with credible synthesised findings b. One or more single research studies of high quality	a. Metasynthesis of text/opinion with credible synthesised findings b. One or more single research studies of high quality	a. Cohort studies (with control group) b. Case-controled c. Observational studies(without control group)	Evaluations of important alternative interventions comparing a limited number of appropriate cost measurement, without a clinically sensible sensitivity analysis
4	Expert opinion	Expert opinion	Expert opinion	Expert opinion, or physiology bench research, or consensus	Expert opinion, or based on economic theory