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# Audit of co-management and critical care outreach for high risk postoperative patients (The POST audit)

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## SUMMARY

Co-management and critical care outreach for high risk surgical patients have been proposed to decrease postoperative complications and mortality. We proposed that a clinical project with postoperative co-management and critical care outreach, the Post Operative Surveillance Team: (POST), would be associated with decreased hospital length of stay. We conducted a retrospective before (control group) and after (POST group) audit of this hospital program. POST was staffed for four months in 2010 by two intensive care nurses and two senior registrars who conducted daily ward rounds for the first five postoperative days on high risk patients undergoing inpatient general or urological surgery. The primary endpoint was length of hospital stay and secondary endpoints were Medical Emergency Team (MET) calls, cardiac arrests and in-hospital mortality. There were 194 patients in the POST group and 1,185 in the control group. The length of stay in the POST group, median nine days (Inter-quartile range [IQR]: 5 to 17 days), was longer than the control group, median seven days (IQR: 4 to 13 days): difference two days longer (95.0% confidence interval [95.0% CI]: 1 to 3 days longer, $P$ <0.001). There were no important differences in the proportion of patients having MET calls (16.0% POST versus. 13% control ($P$=0.25)) or mortality (2.1% POST versus 2.8% Control ($P$=0.82)). Our audit found that the POST service was not associated with reduced length of stay. Models of co-management, different to POST, or with different performance metrics, could be tested.

Key Words: surgery, perioperative care, critical care, length of stay

Like elsewhere in the world, patients undergoing surgery in Australia are frequently older with important comorbidities[1–3]. Preoperative patient factors associated with higher risk for postoperative mortality include: increasing age, increasing American Society of Anesthesiologists status, decreased albumin and non-elective surgery[2,3].

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For surgery of intermediate-to-major complexity in patients of intermediate-to-high risk, the proportion of patients experiencing one or more complications frequently exceeds 20%[2]. For patients who have postoperative complications, inadequate surveillance and intervention (failure to rescue) is associated with greater mortality[4].

In addition to admission to the intensive care unit (ICU), there are two (complimentary) proposals to improve outcome in surgical patients: co-management and critical care outreach[5,6]. Studies of perioperative co-management or critical care outreach have however, provided mixed results for improved patient outcomes[5–7]. We have previously tested a combination of co-management and critical care outreach with an expanded role for the Acute Pain Service[8]. This expanded service was associated with improved outcome but was difficult to sustain.

We proposed that a more sustainable model of co-management and critical care outreach may be ICU based. After a funding application from our hospital based on this proposal, the Victorian Government

provided funding for a clinical project of enhanced postoperative management. As part of clinical governance we conducted an audit of this clinical project we called the Post Operative Surveillance Team (POST). We proposed that the POST, providing co-management and critical care outreach, would be associated with decreased length of hospital stay.

## METHODS

Development of the POST project has been described in detail elsewhere[9]. The clinical project was conducted at the Austin Hospital, a quaternary public hospital affiliated with the University of Melbourne. The Human Research Ethics Committee from Austin Health approved this retrospective before-and-after audit and waived the need for informed consent (Approval no. H2010 / 03848).

The POST clinical project was supported by a grant from the Victorian Department of Health with support from the Austin Department of Intensive Care. A steering committee convened monthly to oversee the project, with representatives from Surgery, Anaesthesia, ICU, Internal Medicine, Department of Health Victoria, ward nursing staff and allied health. A management committee oversaw the day-to-day running of the project.

The POST service was staffed by two ICU nurses and two senior registrars, one from ICU and one from general medicine. The service was situated on two adjacent surgical wards and had an office in the ward area. These two wards accepted patients who were admitted under one of five surgical units: four general surgical and one urological. These two wards were the routine discharge destinations from both recovery and ICU for patients admitted under the five surgical units. Each day, one nurse and one registrar rounded between 8:00am and 5:00pm to review surgical patients identified at increased risk of postoperative complications; who were admitted under one of the five participating surgical units. To be included for POST co-management, the patients going to the two wards were: 1) not electively admitted and aged 55 years or older; or 2) electively admitted and aged 80 years or older; and/or 3) admitted to the intensive care unit before being sent to the two surgical wards; or 4) if ward staff were worried about the patients for any other reason.

Between 1 March and 30 June 2010 the POST operated nine hours per day, seven days per week and reported to surgical and ICU consultants as required. While the two wards had over 60 beds, we had decided prior to the project, that for work load reasons[8], the POST would co-manage up to 10 patients at a time. POST co-managed these patients for the first five postoperative days or until discharge. The planned patient criteria for co-management allowed the anticipated workload[9]. The POST did not play any role in preoperative preparation of patients. Length-of-stay and medical emergency team (MET) call data were collected retrospectively.

Table 1
*Group characteristics*

| | POST | Controls |
|---|---|---|
| Period | 4 months 2010 | 2008-2010 |
| n | 194 | 1185 |
| Age, years* | 69 (60 to 80) | 73 (62 to 81) |
| Emergency | 81 (42%) | 645 (54%) |
| ASA 1+2 | 69 (36%) | 385 (32%) |
| ASA 3 | 108 (56%) | 652 (55%) |
| ASA 4 | 17 (9%) | 145 (12%) |

*median (IQR). POST=Post-Operative Surveillance Team, ASA=American Society of Anesthesiologists, IQR=inter-quartile range.

### *Sample size*

The sample size of the POST audit was based on the duration of the POST project, which in turn was determined by the available funding. We proposed to conduct a before-and-after comparison with a matched control group of patients with length of hospital stay as the primary outcome measure. POST was funded for four months and was expected to manage 200 patients. We estimated we needed a control group of 1,000 patients using the following assumptions: 1) the median hospital length-of-stay for the control group would be seven days; 2) POST co-management would be associated with a one day decrease in length-of-stay to a median of six days; 3) power greater than 0.8 and 4) $P<0.05$ (Power and Sample Size Analysis, PASS 2008, NCSS, Utah, USA).

### *Control group*

We used hospital records to create a retrospective control group. We reviewed the hospital electronic database to assess admissions to the two target surgical wards for the period 1 March 2009 to 28 February 2010. A variety of patient cohorts were constructed using variables both predictive of increased postoperative risk and available on the hospital database: age, gender, admission to ICU, unplanned admission to hospital.

### *Pre-existing critical care surgical outreach services*

During both the control and POST phases, the hospital had two existing critical care outreach

Table 2
*Type of surgery*

| | POST (n=194) | Control (n=1,185) |
|---|---|---|
| Surgery type n(%) | | |
| Cholecystectomy | 30 (15%) | 147 (12%) |
| Upper GIT surgery | 27 (14%) | 128 (11%) |
| Major hepatobillary surgery | 17 (9%) | 64(5%) |
| Pancreatic resection | 17 (9%) | 47 (4%) |
| Colorectal | 51 (26%) | 261 (22%) |
| Body wall* | 11 (6%) | 133 (11%) |
| Endoscopy | 8 (4%) | 188 (16%) |
| Major urology | 12 (6%) | 61 (5%) |
| TURP | 16 (8%) | 96 (8%) |
| Other** | 5 (3%) | 61 (5%) |

*Hernia repair, stomal surgery, mastectomy, **Head and neck, debridement, circumcision, radiology. POST=Post-Operative Surveillance Team, GIT=gastrointestinal, TURP=transurethral resection of prostate.

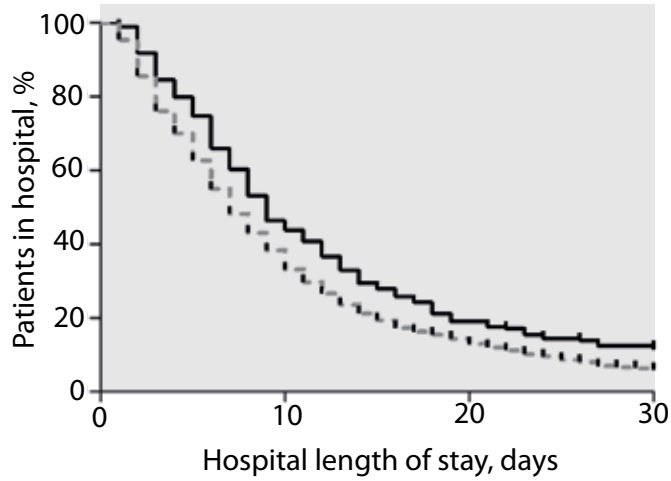


Figure 1: Kaplan Meier curves for hospital length-of-stay. The darker, continuous curve is the POST intervention group who had a longer stay in hospital. POST=Post-Operative Surveillance Team.

services: the MET activated when a patient developed defined criteria that are displayed on posters on hospital wards; and intensive care Nurse Consultants who reviewed patients discharged from ICU and ward patients following a MET call. During the control phase there was no other co-management system for the general and urological patients.

*Statistical analysis*

Data on both the POST and control groups were entered on a MS Excel (Microsoft, Seattle, WA, USA) spreadsheet for analysis. We used GRAPHPAD PRISM Version 5 software (GraphPad Software, San Diego, CA, USA) for data analysis and descriptive statistics. Patient characteristics and categorical variables were compared by the chi-square test and continuous variables were tested for normality and compared by a two sample Wilcoxon rank-sum (Mann-Whitney) test. We created Kaplan-Meier curves to illustrate the length-of-stay over time and used a log rank test as a confirmatory test for the Mann-Whitney test. We reported differences, 95% confidence intervals and considered $P$ values $<0.05$ as statistically significant.

## RESULTS

There were 194 patients in the POST group and 1185 in the control group (Table 1). While the POST and control groups were similar in American Society of Anesthesiologists physical status ($P=0.33$), the groups had several differences (Table 1): the control group were older by two years ($P=0.012$) and 13% more had emergency surgery ($P< 0.001$). The POST group, however, were more likely to have major upper gastrointestinal, pancreatic, major hepatobilary and colorectal surgery ($P<0.001$) than the control group (Table 2).

The length-of-stay in the POST group, median nine days (inter-quartile range: 5 to 17 days), was longer than the control group (Figure 1), median seven days (inter-quartile range: 4 to 13 days); difference two days longer (95% confidence interval: 1 to 3 days longer, $P< 0.001$). Using the log-rank test the difference (Figure 1) was also significant: $P=0.001$. There were no important or statistical differences in the proportions of patients having MET calls during their hospital stay, or MET calls within the first five postoperative days (period of POST surveillance), or in the time to first MET call after surgery (Table 3). In-hospital mortality was about 2.5 % in both groups (Table 3).

## DISCUSSION

We conducted a retrospective before-and-after audit of a clinical project that provided co-management and enhanced critical care out reach for high-risk patients after surgery: the POST. We found that POST co-management was not associated with decreased length of hospital stay, rather, length-of-stay was increased by two days during the POST phase when compared to the control phase. We found no differences in the secondary end-points, including measures of MET calls and mortality.

Table 3
*Secondary Outcomes*

| Outcome, n (%) | POST (n=194) | Control (n=1185) | Difference (95% CI) | P value |
|---|---|---|---|---|
| MET calls, n (%) | 30 (15%) | 158 (13%) | 2% (-3 to 8%) | 0.42 |
| MET calls first 5 days, n (%) | 18 (9%) | 105 (9%) | 0.0% (-3% to 6%) | 0.85 |
| Days to first MET call, median (IQR) | 2 (1 to 4) | 2 (1 to 6) | 0 days (0 to 1 days) | 0.37 |
| Code blue, n (%) | 1 (0.5%) | 11 (0.9%) | 0.4% (-2% to 1%) | 0.92 |
| Mortality, n (%) | 5 (2.6%) | 34 (2.9%) | 0.3% (-3 to 2%) | 0.82 |

POST=Post-Operative Surveillance Team, CI=confidence interval, MET=medical emergency team, IQR=inter-quartile range, code blue=cardiac arrest call.\

The aims of postoperative care include both preventing complications and adequate surveillance and intervention for when complications do occur. In addition to admission to the ICU, there are two complimentary and overlapping proposals to improve outcome in surgical patients — co-management and critical care outreach[5–7]. Co-management involves "…collaboratively managing patients with surgeons and specialists, sharing responsibility and authority"[5]. With some overlap, the objectives of critical care outreach are to avert admissions to critical care beds by the early detection of physiological deterioration; to enable discharges from critical care beds into a supported ward environment; and to share critical care skills into the wider environment of the ward[10]. We have previously tested a combination of co-management and critical care outreach with an expanded role for the Acute Pain Service[8]. While we found an association with decreased complications and mortality, we found that this service was not sustainable without significant increases in management, staffing and budget from the hospital.

Most studies reporting models of medical co-management of surgical patients involve orthopaedic patients, particularly those with hip fractures, rather than the general and urological surgical population in our study[5,11,12]. The only randomised study of co-management of patients undergoing hip and knee replacement found that while co-management was very popular with staff and was associated with fewer minor complications there was no association with decreased major complications or length-of-stay[11]. In contrast, non-randomised studies of sicker and older patients with hip fracture and sicker patients undergoing extensive surgery, found that co-management was associated with shorter length-of-stay[13]. The literature on critical care outreach particularly Medical Emergency or Rapid Response Teams, has also had mixed results[7]. The larger studies, including a randomised trial (the Medical Emergency Response and Intervention Trial study) have not demonstrated an association between medical emergency teams and decreased mortality[14]. In contrast, some non-randomised, often single centre, studies have found association with critical care outreach and decreased mortality[7,15].

The authors from the Medical Emergency Response and Intervention Trial, that did not demonstrate clear benefits of METs, identified several possible reasons for failing to find the expected positive effect of METs[14]. Several of these reasons apply to our study – the POST could be an ineffective intervention, the POST could be effective but was inadequately implemented, or we studied the wrong outcomes. First, it is possible that in our cohort of general surgery and urology patients, co-management with critical care outreach is ineffective. Second, the way we implemented the POST program may have been inadequate. The project may have benefitted from more senior clinical leadership and longer patient co-management. The seniority of staffing of POST and duration of patient co-management was however, limited by funding. Third, a possible reason for the lack of benefit is that the POST service was unable to improve on existing critical care outreach services – MET and intensive care Nurse Consultants. Fourth, length-of-stay and MET calls may not be appropriate outcomes to test the value (or otherwise) of more intensive post-operative care. Greater surveillance and intervention may prolong hospital stay while problems are managed or resolve[16].

An alternative outcome for studies of perioperative care comes from the finding by Ghaferi et al[4] that an important quality marker for surgical patients in hospitals of differing quality is mortality after complications. We did not measure postoperative complications and so cannot comment on the rel-

ationship between complications and mortality or length-of-stay. However further evidence that post-operative complications are an important concern is from our previous multicentre study of mortality and complications after surgery[2], where we found that at least one postoperative complication (20% of patients) was associated with a 30 day mortality of 14%, while patients who did not suffer a complication had a 3% mortality. Further, patients who had a least one complication spent an extra week in hospital[2]. Other patient-focused outcomes that may be important include disability and quality of recovery months to years after surgery[17] .

The strengths of this study include that the project and audit were conducted in a hospital with good results from existing or previously trialled critical care outreach teams[8,15]. Furthermore, staff acceptance of the POST service is supported by a survey of ward nurses and doctors that found strong approval of the POST[18]. These results are similar to a before-and-after study from the United States of co-management of neurosurgical patients that found that co-management was very popular with staff but had no effect on length-of-stay[19]. The major limitations of our study are that it is a retrospective before-and-after audit of a clinical project with sample size determined by funding. Other limitations include that it is a single centre study without data on individual complications. Another limitation of this study is that we had relatively few preoperative data on patient risk. While we did have age and American Society of Anesthesiologists physical status and whether patients had emergency surgery, we did not have other more detailed measures such as the Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity risk score and Charlson comorbidity index[20].

Contrary to our expectations we found that the POST project was associated with longer length-of-stay compared to a control group. It is unclear why this may be the case. However, as an audit of a clinical project there are many methodological limitations of this study. As others have said about MET[7] we think that the concept of combined co-management and critical care outreach for high-risk surgical patients is intuitive and has logical appeal. We propose that future studies, with strong prospective methodology, may want to examine combined co-management and critical care outreach with a consultant led service, for a greater proportion of the inpatient stay, with mortality, with or without out hospital length-of-stay, following complications as a primary endpoint. Longer term quality of recovery or disability scores could also be considered as primary end-points.

## APPENDIX

Detailed list of Austin Health POST project investigators

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*Steering Committee:* Melodie Heland (Chair) (Surgical Charles Sturt University Director); Chris Christophi (Head Division & Surgical Charles Sturt University medical director), Mark Petty (Executive Director, Acute Operations), Rinaldo Bellomo (Director Intensive Care Research); Daryl Jones (Project Medical Lead; Intensive Care Consultant), David Story (Consultant Anaesthetist); Chris O'Callaghan(Director General Medicine); Andrew Shelton (Project Officer) Tammie McIntyre, Helen Young, Carmel Taylor (Intensive Care Nurse Consultants); Dianne Kelleher (Director, Health Service Planning & Performance); Fiona Hull (NUM Recovery); Kate Ireland (NUM Ward 8 West); Arlene Gonzales (NUM Ward 8 East); Rebecca Monger (NUM Ward 8 North); Carmen Yui (Dept of Health Senior Project Officer, Surgical Services Program)

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*Physiotherapy sub-committee:* Kimberley Haines, Selina Parry, Sue Berney

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