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ORIGINAL ARTICLE

What do general medicine perioperative services do? A Victorian multicentre cross-sectional study

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Key words
general medicine, perioperative care, service models, models of care, patient outcomes.

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ABSTRACT

Aim: To evaluate the models of general medicine perioperative services and describe the characteristics and outcomes of perioperative referrals.

Methods: A multicentre cross-sectional study involving 11 Victorian public hospitals was conducted over 6 weeks at each site. Adult patient (≥18 years old) referrals from all surgical services were included. Comparative analyses of outcomes based on models of care were undertaken and adjusted for covariates.

Results: The overall service activity was 427 (95% CI: 403–453) referrals per 10 000 surgical admissions per year. Of 1071 referrals, 922 (86.1%) were inpatients and 759 (70.9%) were emergency instances. Median age was 73 (62–83) years and 45.5% were females. Median Charlson Comorbidity Index was 5 (3–6) and clinical frailty scale was 4 (3–5). The most common referral requests were for preoperative risk assessment and optimisation, management of postoperative medical complications and diagnostic input. Clinical outcomes included 43 (4.3%) deaths, 73 (7.9%) medical emergency team (MET) responses and 32 (3.5%) intensive care admissions within 48 h and 116 (11.6%) take-over of care instances. Proactive model of care was significantly associated with fewer MET calls, shorter length of stay, fewer referrals to other subspecialties and take-over of care and higher rates of returning to usual residence. Lower likelihood of MET calls, referral to other subspecialties and take-over of care remained statistically significant in multivariable analyses.

Conclusions: General medicine perioperative services provide care to older, co-morbid, frail and high-risk surgical patients across all perioperative settings. General physicians' role in perioperative care is diverse and wide-ranging. Well-resourced proactive models of perioperative care may confer better outcomes for patients.

Introduction

There are increasing numbers of older people with multiple co-morbidities undergoing complex surgical procedures.

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This cohort of patients is at an increased risk of perioperative complications, including significant impacts on functional outcomes and mortality.[1] These patients are likely to benefit from multidisciplinary coordinated care and shared decision-making, involving a more nuanced assessment of perioperative risks and benefits, careful management of co-morbidities and early detection and management of perioperative complications.[2,3] The Australia and New Zealand College of Anaesthetists (ANZCA), in partnership with other specialist colleges and societies, has developed a perioperative care framework, which calls for providing patients with multidisciplinary, individualised and integrated care from contemplation of surgery to hospital discharge and reintegration into the community, to provide the best possible outcomes.[4] Within the multidisciplinary framework, various craft groups provide specific but overlapping care at different stages of the patient's perioperative journey. Among the physicians, the important role played by geriatric medicine services in perioperative care has been widely recognised around the world.[5–7]

General medicine plays an integral role in the care of patients presenting with complex co-morbidities and undifferentiated diagnoses. General medicine services are the largest provider of acute multiday inpatient care in Victorian hospitals.[8] Often embedded within these are general medicine perioperative services, whose role is to provide consultative care for patients admitted under surgical services. Although there may be significant cross-over of care delivery between different craft groups, general medicine perioperative services often operate in a distinct manner compared to others, such as geriatrics, orthogeriatrics and anaesthesia, with regard to the scope of perioperative care they provide.

Many general medicine perioperative services across Australia operate in 'reactive' models, receiving *ad hoc* referrals from inpatient surgical units to optimise medical co-morbidities before emergency procedures, mitigate postoperative complications, address emerging medical issues, assist in the care of non-operative patients or for consideration of take-over of care by general medicine.[9] *Ad hoc* reactive models offer limited opportunities for preoperative assessment of complex and high-risk elective surgical patients to identify patients who are at high risk for perioperative complications and to institute shared decision-making and appropriate management strategies.

Several international studies have highlighted the value of physicians within shared-care or integrated models of perioperative consultation, lowering the risk of postoperative complications and adverse outcomes as well as reducing length of acute stay, leading to greater patient satisfaction and reduced healthcare costs.[10–12] Despite this evidence, a limited number of Australian studies have specifically evaluated the involvement of general medicine in perioperative care.[9,13] An important component of achieving a more collaborative 'proactive' approach as outlined by the ANZCA perioperative care framework is to better understand the current state of general medicine perioperative services, based on the Donabedian framework, which evaluates the structure, processes and outcomes of a service.[14] This study explores various aspects of general medicine perioperative care, namely models of care, characteristics of perioperative patients, service activities and outcomes. Such data will also identify the critical service gaps and opportunities for improvement. We also hypothesise that more proactive models of care are associated with better patient outcomes.

Methods

This was a multicentre observational study involving 11 hospitals from nine public health services across Victoria. Victorian public hospitals with general medicine departments that provided dedicated perioperative services were invited to participate in this study. Table 1 provides the list of participating health services and hospitals. The participating hospitals represented all major metropolitan health services in Victoria. Two health services which did not have a dedicated general medicine perioperative service at the time of the study were excluded.

All consecutive adult patient (≥18 years old) referrals from surgical services that resulted in in-person consultations were included. These constituted both inpatients and outpatients, as well as elective and emergency referrals. Patients exclusively managed by another specialty's perioperative service (e.g. orthogeriatric service) and telephone consultations were excluded.

The study period was over 7 months from 1 October 2023 to 30 April 2024. Each participating hospital collected data over a block of 6 consecutive weeks, including weekends, during the study period that represented typical activity of its surgical services. Each referred patient was counted only once, unless the same patient was referred again more than 7 days after the index episode for another reason.

Service structures, processes and outcomes of interest, based on the Donabedian model, included (i) a description of the model of care at each hospital, (ii) service activity in terms of total number of perioperative referrals, total number of admissions under surgical units and total number of procedures (including endoscopy) performed; (iii) staffing level (i.e. total full-time equivalent (FTE) allocations for consultants and registrars specifically for perioperative services), (iv) sources and characteristics of referrals; and (v) key clinical outcomes and

TABLE 1 Summary of staffing and models of care description of general medicine perioperative services in participating health services

Health services	1	2	3	4	5	6	7	8	9	10	11
Number of referrals over 6 weeks	125	120	84	67	28	86	156	80	252	60	13
Total number of surgical admissions	2559	2827	2705	996	1393	3651	1832	1533	3007	2859	1699
Total number of surgical procedures performed	2231	1857	2519	985	3342	2204	1657	2900	1860	2352	1388
Number of referrals per 10 000 surgical admissions	488	424	311	673	201	236	852	1644	266	210	77
Number of referrals per 10 000 surgical procedures performed	560	646	333	680	84	390	941	869	430	255	94
Consultant FTE	1	0.6	1.2	0.7	0.8	0.3	0.1	0.6	1.3	0.2	0.2
Registrar FTE	3	2	3	2	0	1	2.5	1	2	0.2	0.2
Combined FTE	4	2.6	4.2	2.7	0.8	1.3	2.6	1.6	3.3	0.4	0.4
Number of referrals per combined FTE	271	400	173	215	303	573	520	433	662	1300	282
Model description	Mixed	Mixed	Mixed	Mixed	Reactive	Reactive	Reactive	Reactive	Proactive	Reactive	Reactive
Referrals	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls	*Ad hoc* basis from ED and wards, and MET calls
MET calls	Attended by periop registrars	Attended by periop registrars	Attended by periop registrars	Attended by periop registrars	Not attended by periop registrars	Attended by periop registrars or rotating medical registrars	Attended by periop registrars	Attended by periop registrars	Not attended by periop registrars other than known patients	Attended by periop registrars	Attended by periop registrars
High risk pre-op clinics	Weekly	Weekly	Weekly	Weekly	None	Weekly	None	None	Weekly, including shared decision-making capacity	None	None
MDT meetings	Weekly	None	*Ad hoc*	*Ad hoc*	None	None	None	Weekly	Fortnightly	None	None
Other proactive approaches	NA	Dedicated General Medical registrar general and trauma	All hip fracture patients are seen by General Medicine	All hip fracture patients are seen by General Medicine	Orthogeriatrics cover when unavailable	NA	NA	NA	Full-time nurse coordinator Daily emails to notify admissions of patients seen	NA	NA

TABLE 1 *Continued*

Health services	1	2	3	4	5	6	7	8	9	10	11
		orthopaedic unit	Guidelines directed referral for high-risk ED admissions (variable uptake)	Guidelines directed referral for high-risk ED admissions (variable uptake)					in perioperative clinics for active review and monitoring		
Other services in place	Orthogeriatrics and trauma-geriatrics	Orthogeriatrics	NA	NA	Orthogeriatrics Perioperative work up through other specialty clinics (e.g., cardiology)	None	Complex decision-making clinic run by geriatrics	Biweekly perioperative care of older patients by geriatrics	Orthogeriatrics	Orthogeriatrics	Orthogeriatrics

Note: Hospitals/Health Services: 1. Alfred Health, 2. Austin Health, 3. Eastern Health (Box Hill Hospital), 4. Eastern Health (Maroondah Hospital), 5. Grampians Health (Ballarat), 6. Monash Health (Monash Medical Centre), 7. Northern Health, 8. Royal Melbourne Hospital, 9. St Vincent's Health, 10. Western Health (Footscray Hospital), 11. Western Health (Sunshine Hospital). "Model description" indicates the predominant model in which the general medicine perioperative service is perceived to operate (reactive: referrals for consultative input are received purely on an *ad hoc* basis; proactive: established systems in place to pre-emptively identify, risk modify and follow up patients who are at high risk of deterioration following a planned surgery, while still providing consultative input on an *ad hoc* basis; and mixed: mainly reactive model with 2 or more components of the proactive model integrated, where processes to pre-emptively identify patients may still not be well established). "Referrals" indicate the mode by which referrals from surgical units are received by general medicine perioperative services. "MET calls" indicate the attendance at medical emergency team responses; a proportion of referrals was received through MET calls. "High-risk pre-op clinics" indicate dedicated clinics in which to identify, assess and manage high-risk elective surgical patients prior to planned procedures, where a team member of general medicine perioperative service is usually present in conjunction with other multidisciplinary specialists such as anaesthetists or geriatricians. "MDT meetings" indicate multidisciplinary team meetings in which high-risk or complex surgical inpatients are discussed in the presence of surgical, general medicine, geriatrics, intensive care and other relevant services. "Other approaches" indicate the mechanisms by which other high-risk surgical patients are identified preemptively for general medical perioperative service's review, on a non *ad hoc* referral basis. "Other services" indicate the presence of perioperative services provided by other specialties within the hospital.Abbreviations: ED, emergency department; FTE, full-time equivalent, MDT, multidisciplinary team; MET, medical emergency team, NA, not applicable.

quality indicators. The FTE data (consultant, registrar and combined total) was collected to benchmark the staffing level against the total number of referrals seen at each participating service. Main characteristics of surgical referrals included patients' demographics and biological sex, Charlson Comorbidity Index (CCI), clinical frailty scale (CFS), American Society of Anesthesiologists' (ASA) score, primary categories and reasons for referral, operative state at the time of referral, preceding medical emergency team (MET) calls and involvement of other medical specialties at the time of referral to general medicine perioperative services. Key clinical outcomes and quality indicators evaluated included inpatient mortality, length of stay, use of perioperative risk assessment tools, goals of care documentation, MET calls and intensive care unit (ICU) admissions following the general medicine perioperative service review and discharge destination. These variables reflected the overall quality of care that can be easily measured across all general medicine perioperative services. For goals of care documentation, only completion of the resuscitation form was taken as having been documented; clinical notes such as progress or outpatient notes were not interrogated as evidence. If the patient was an inpatient, the outcome data were collected until the time of discharge. If the referral encounter was in an outpatient setting, and the patient was subsequently admitted during the data collection period for an elective procedure, the outcome data were also collected. However, if the outpatient referral encounter did not substantiate an inpatient admission episode during the data collection period, the outcome data were not available.

The models of care were categorised into reactive, mixed and proactive. Reactive models were defined as those that received referrals from surgical units on an *ad hoc* basis for medical consultation only when needs emerged. This was taken as the baseline model in which most of the general medicine perioperative services operated. Proactive models had fully integrated systems for identification, referral and multidisciplinary review of high-risk complex patients in preoperative settings, as well as regular multidisciplinary team meetings and a mechanism to continue providing care seamlessly through elective admission for surgical procedures till hospital discharge. Examples of proactive care components/processes included a preoperative clinic run by general physicians that provided holistic assessment and shared decision-making capacity for elective surgical patients; a system to notify for review of elective patients when they had scheduled admissions; criteria-led or guidelines-directed processes for identification, referral and review of high-risk emergency surgical patients; and provision of care coordination. Mixed models are those with some but not all the components of proactive care.

Statistical analysis

Categorical data were expressed as counts and proportions and compared between groups using the chi-squared test. Continuous data were summarised using medians and interquartile ranges (IQR) and compared between groups using the Wilcoxon rank-sum test for two group comparisons and the Kruskal-Wallis test for comparisons involving more than two groups. The groups compared were models of care categories and elective versus emergency admission status to detect differences in referral characteristics. The rates of referrals were calculated as per 10 000 surgical admissions and per 10 000 surgical procedures performed per year, and 95% confidence intervals (95% CI) were derived using the exact binomial distribution. Multivariable analyses were performed using logistic regression for binomial outcomes (MET calls prior 24 h, MET calls 48 h after, ICU admissions 48 h after, ongoing review by general medicine, further referral to other specialties, death, take-over of care under general medicine and discharge destination) and linear regression for length of hospital stay with results presented as odds ratios (OR) (95% CI) or geometric means (95% CI) respectively. As the distribution of length of stay was positively skewed, a log transformation was applied prior to the analysis. Covariates included in the multivariable models were age, male sex, CCI, CFS, emergency nature of referrals, total number of surgical admissions and total number of surgical procedures performed, as clinically these variables may influence outcomes between different perioperative models. Statistical significance was set at a two-sided *P*-value of 0.05. All analyses were performed with the SAS software version 9.4 (SAS Institute, Cary, NC, USA).

Alfred Hospital Human Research and Ethics Committee granted approval to conduct this study (Project number: 96850, Local reference 253/23). The informed consent requirement was waived as this study was for the purpose of service evaluation. This manuscript was written in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies.[15]

Results

Table 1 provides a summary of models of care description for general medicine perioperative services and their current staffing levels. Out of 11 hospitals, six operate in a reactive model, four in mixed models and only one in a predominantly proactive model. Reactive models

generally have lower staffing levels compared to mixed and proactive models. All models receive surgical referrals from the emergency departments, wards or through MET calls on an *ad hoc* basis.

The overall service activity was 427 (95% CI: 403–453) referrals per 10 000 surgical admissions per year and 460 (95% CI: 433–487) referrals per 10 000 surgical procedures performed per year. In terms of combined consultant and registrar FTEs, the service activity equated to 388 (95% CI: 381–396) referrals per FTE per year.

Table 2 provides information on characteristics of 1071 total referrals and quality indicators/outcomes from the encounters. Outcome data were not available for 73 patients who remained as outpatients, who were not yet admitted for elective surgery at the end of the data collection period. Most referred patients were older (median age (IQR): 73 (62–83) years), co-morbid (CCI (IQR): 5(3–6)), and living with frailty (CFS (IQR): 4(3–5)). General surgery (excluding breast and endocrine surgery) and orthopaedic surgery constituted >50% of all referrals (Table S1). Most of the referrals were from an inpatient setting (922, 86.1%) and emergency in nature (759, 70.9%). Notably, almost one-third (346, 32.3%) of referrals had no planned or scheduled surgical procedures.

Preoperative medical optimisation (20.7%), postoperative management of complications or emerging medical issues (20.6%) and diagnostic input (17.8%) were the three most common primary reasons for referral. Expertise was provided by general medicine perioperative services for management of a wide range of medical conditions, with the top five being cardiac disorders including management of arrhythmias and heart failure (31.7%), infection (21.8%), fluid and electrolyte disorders (20.7%), medication management (including review for polypharmacy) (16.6%) and management of acute kidney injury (15.8%).

Of available data on the use of perioperative risk assessment tools ($N = 725$), 572 (78.9%) did not have any tool completed. Duke Activity Status Index (DASI) was the most utilised tool in 14.6% of referrals. The median (IQR) ASA score was 3 (3–3).

In terms of quality indicators and outcomes (Table 2), goals of care were not documented in 401 (37.4%) referrals; notably, 107 of these were outpatients. MET calls occurred in 73 (7.9%) within 48 h after the initial review, 32 (3.5%) referrals resulted in an ICU admission, and death during the index admission occurred in 43 (4.3%) referrals. In two-thirds of referrals, general medicine perioperative services provided ongoing support to the surgical units, and referral to another medical specialty was needed in fewer than one-third of referrals. One hundred and eighteen (11.8%) referrals eventuated in transfer of care to general medicine, and the median (IQR) length of acute hospital stay was 8 (4–15) days. Nearly 60% of patients returned to their home or usual residence.

Table 3 provides a comparative analysis between different models of perioperative care. The proactive model of care was significantly associated with fewer MET calls in the preceding 24 h (8.3% proactive vs 13.7% mixed vs 17.3% reactive models, $P = 0.04$) or superseding 48 h of referral (0.9% proactive vs 10% mixed *vs*. 8.3% reactive models, $P = 0.012$), shorter median length of stay (6 days (3–10) proactive versus 9 days (5–17) mixed versus 8.1 days (5–15.8) reactive models, $P < 0.001$) and more patients returning to home or usual residence (73.2% proactive vs 56.2% mixed vs 62.6% reactive models, $P = 0.017$) compared to reactive and mixed models, despite similar complexity and frailty of patients. Notably, there were more elective referrals in the proactive model; the comparative outcomes between elective and emergency patients are provided in Table S2.

When binary outcomes were evaluated using the reactive model as the reference (Table 4), the proactive model of care was associated with lower likelihood of MET calls within the preceding 24 h (OR 0.18, 95% CI: 0.09–0.36, $P < 0.0001$) and subsequent 48 h of referrals (OR 0.10, 95% CI: 0.01–0.77, $P = 0.026$), referral to another medical specialty (OR 0.16, 95% CI: 0.09–0.27, $P < 0.0001$), take-over of care under general medicine (OR 0.06, 95% CI: 0.02–0.26, $P < 0.0001$) and higher likelihood of patients returning home (OR 1.57, 95% CI: 1.01–2.42, $P = 0.044$). After adjusting for covariates (age, sex, CCI, CFS, emergency referrals, volume of surgical admissions and surgical procedures performed), which may confound outcomes, significant associations remained for MET calls within subsequent 48 h of referrals (OR 0.11, 95% CI: 0.01–0.81, $P = 0.03$), referral to another medical specialty (OR 0.09, 95% CI: 0.04–0.19, $P < 0.0001$) and take-over of care under general medicine (OR 0.12, 95% CI: 0.02–0.64, $P = 0.012$). Additionally, mixed models, compared to reactive models, were associated with lower likelihood of referral to another medical specialty, and this association remained significant after adjusting for covariates (OR 0.47, 95% CI: 0.33–0.66, $P < 0.0001$). However, mixed models were also associated with the provision of ongoing input by general medicine subsequent to the index referral (OR 1.62, 95% CI: 1.14–2.32, $P = 0.007$).

Discussion

The contribution of general medicine to perioperative care has not previously been systematically measured on a large scale in Australia. This is the first multicentre

TABLE 2 Overall characteristics of surgical referrals to General Medicine perioperative services and key outcomes/quality indicators

Characteristics	
Total number of referrals	1071
Total number of surgical admissions	25 061
Number of referrals per 10 000 surgical admissions (95% CI)	427 (403–453)
Total number of surgical procedures performed (including endoscopes)	23 295
Number of referrals per 10 000 procedures performed (95% CI)	460 (433–487)
Patient age, years, median (IQR)	73.0 (62.0–83.0)
Biological sex, male, *n* (%)	584 (54.5)
Charlson Comorbidity Index Score, median (IQR)	5.0 (3.0–6.0)
Clinical Frailty Scale, median (IQR)	4.0 (3.0–5.0)
Location of referral, *n* (%)	
Inpatient (including emergency department)	922 (86.1)
Outpatient clinics	149 (13.9)
Nature of referral, *n* (%)	
Emergency	759 (70.9)
Elective	312 (29.1)
Primary reason for referral, *n* (%)	
Perioperative risk assessment	46 (4.3)
Preop medical optimisation	222 (20.7)
Postop management of complications/emerging medical issues	221 (20.6)
Post-MET call	73 (6.8)
Monitoring of a known high-risk patient	51 (4.8)
Complex medical co-morbidity management	146 (13.6)
Medication management	22 (2.1)
Diagnostic input	191 (17.8)
Discharge planning	3 (0.3)
Take-over of care	89 (8.3)
Other	7 (0.7)
Areas of medical input, *n* (%)	
Acute kidney injury/renal impairment	169 (15.8)
Anaemia	95 (8.9)
Anticoagulation management	112 (10.5)
Cardiac disorders (arrhythmia/heart failure)	340 (31.7)
Cognition/dementia assessment	18 (1.7)
Delirium/behaviours of concern (excluding substance misuse/addiction)	147 (13.7)
Diabetes management	136 (12.7)
Discharge planning	58 (5.4)
Endocrinology disorders (excluding diabetes management)	65 (6.1)
Frailty, poor functional status, exercise tolerance assessment	102 (9.5)
Falls/syncope workup	147 (13.7)
Fluids/electrolyte disorders (including hyponatraemia)	222 (20.7)
Gastroenterlogy disorders	80 (7.5)
Goals of care discussion	57 (5.3)
Hypertension	55 (5.1)
Infection (including pneumonia, UTI, surgical site infections, etc.)	233 (21.8)
Medication management (including review for polypharmacy)	178 (16.6)
Neurology disorders (excluding delirium)	42 (3.9)
Pain	77 (7.2)
Postop nausea and vomiting	7 (0.7)
Respiratory disorders (excluding acute infections)	121 (11.3)
Substance misuse/addiction disorders	36 (3.4)
Other	55 (5.1)
Operative state at initial review, *n* (%)	
Preoperative	316 (29.5)
Postop operative	400 (37.3)
Between scheduled operations	9 (0.8)
No scheduled operation	346 (32.3)
Perioperative risk assessment tool completed, *n* (%) ($N = 725$)*	
NSQIP	66 (9.1)
POSSUM	1 (0.1)
SORT	1 (0.1)
Other	106 (14.6)
If other, DASI	106 (14.6)
None completed	572 (78.9)
ASA score, median (IQR) ($N = 533$)	3.0 (3.0–3.0)
MET call within prior 24 h of initial review, *n* (%)	140 (13.1)
Goals of care documentation at initial review, *n* (%)	
Full resuscitation	371 (34.6)
Not for cardiopulmonary resuscitation but for ICU/HDU level management	176 (16.4)
For ward-based management only (may receive renal replacement therapy or low-level inotropes)	117 (10.9)
For end-of-life care only	6 (0.6)
Not documented	401 (37.4)
Outcomes	
MET calls within 48 h after initial review, *n* (%)†	73 (7.9)
ICU admission within 48 h after initial review, *n* (%)†	32 (3.5)
Ongoing input by general medicine perioperative service, *n* (%)‡	632 (63.3)
Referral to another medical specialty after initial review, *n* (%)‡	306 (30.7)
Death during index admission, *n* (%)‡	43 (4.3)
Day of surgery cancellation (if pre-op review), *n* (%)	
Yes	12 (1.1)
No	231 (21.6)
NA	828 (77.3)
Take over of care under general medicine, *n* (%)‡	118 (11.8)
Length of acute hospital stay, days, median (IQR)‡	8.0 (4.0–15.0)
Discharge destination, *n* (%)‡	
Home (or usual residence)	626 (58.5)
Rehabilitation/subacute care (including transitional care)	202 (18.9)
Long term residential care	37 (3.5)
Other (e.g. death, interhospital transfer and interstate transfer)	133 (12.4)

Abbreviations: ASA: American Society of Anesthesiologists physical status classification system score, CI: confidence interval, CPR: cardiopulmonary resuscitation, DASI: Duke Activity Status Index, ENT: ear, nose and throat, GI: gastrointestinal, HDU: high dependency unit, ICU: intensive care unit, IQR: interquartile range, MET: medical emergency team, NA: not applicable, NSQIP: National Surgical Quality Improvement Program, POSSUM: Physiologic and Operative Severity Score for the Study of Mortality and Morbidity, SORT: Surgical Outcome Risk Tool, UTI: urinary tract infection.†Outcomes data were not available from 150 referrals, which took place in outpatient clinics, i.e. $N = 921$.‡Outcomes data were not available from 73 referrals, which took place in outpatient clinics, i.e. $N = 998$.*Some patients had assessments with more than one tool.

Australian study to evaluate the characteristics of general medicine perioperative services. Additionally, it also describes the varying models of care and examines key clinical outcomes.

In the last two decades, the ageing Australian population has significantly contributed to the total disease burden.[16] The changing epidemiology and characteristics of ageing surgical patients will have significant implications for the way perioperative care is delivered. Notably, a large proportion of surgical patients who were referred to general medicine were older people living with comorbidities and frailty, which put them at increased risk of perioperative complications and poorer functional outcomes.[17] Hence, ideal perioperative care for this patient cohort requires a multidisciplinary, person-centred approach from the contemplation of surgery to reintegration into the community.[4] This study highlights the importance of general physicians in providing value-added care across different stages of patients' perioperative journey within the multidisciplinary framework. General physicians' input was sought for a wide range of reasons and medical conditions, many of which are often beyond the scope of other perioperative disciplines to adequately provide.

Interestingly, in one-third of the referrals, a non-operative approach is the preferred management option, likely due to advanced age, medical comorbidities and complexities, and personal preferences. In conventional terms, these patients are typically not considered 'perioperative'. However, they will still benefit from general physicians' input and multidisciplinary care through shared decision-making to optimise outcomes.[10,18] Transfer of care to general medicine eventuated in almost one in five non-operative patients, further highlighting the important service provided.

This study found that in Victorian public hospitals, there is a range of general medicine perioperative models of care. All models fundamentally received *ad hoc* referrals from surgical units and emergency departments; however, the degree of and specific components/processes instituted for proactive care differed between health services. Proactive care conferring better patient outcomes has been demonstrated in other perioperative disciplines, such as orthogeriatric models and Perioperative care of Older People undergoing Surgery (POPS) models.[5–7] Proactive care models generally incorporate processes to identify high-risk surgical patients, in both emergent and non-emergent settings, and provide an opportunity to intervene or optimise medical issues before complications arise or patients become sicker after surgery.[4] They also offer mechanisms for multidisciplinary care coordination, including goals of care discussions and shared decision-making. Not surprisingly, the current study demonstrated that within general medicine perioperative services, a proactive model and, to some extent, mixed models of care contributed to better patient outcomes in terms of lower MET call rates, lower rates of take-over care under general medicine, shorter length of stay, lower rates of input required by other medical subspecialties and a higher proportion of patients being able to return home. Although a significantly higher proportion of patients in the proactive model of care were elective referrals, who may confer more favourable outcomes (Table S2), many of the observed outcome associations remained statistically significant even after adjusting for important confounders, such as patient characteristics (age, sex, CCI and CFS), emergent nature of referral and volume of surgical care. While we acknowledge that there may be residual confounders given the observational design, this study undoubtedly provides important signals indicating better outcomes from proactive approaches, which will need further validation through well-designed randomised controlled trials.

Several areas for service improvement were identified in this study. First, there is an opportunity for general physicians to be more involved in preoperative risk assessment and optimisation, especially in elective settings. Second, limited use of validated perioperative risk scores was noted overall. Perioperative risk scores can provide an objective estimation of risks for mortality; specific functional and physiological outcomes compared to subjective assessment and are useful tools in the shared decision-making process.[19–22] Third, there are suboptimal levels of documentation of patients' goals of care and resuscitation status. The National Safety and Quality Health Service (NSQHS) Standards recognises the importance of establishing clear goals of care, particularly for patients with complex comorbidities or life-limiting illnesses.[23] In the current study, surprisingly, the rate of non-documentation was notably higher in the proactive model of care. This may be attributed to a large proportion of patients being seen in outpatient settings in the proactive model where goals of care discussions may have taken place but were not appropriately documented, especially on the resuscitation forms.[24,25]

This study has some limitations. Despite adjustments for risks, there may still be unmeasured confounders in patient and hospital characteristics, or care pathways and processes, that could influence outcomes. The outcome evaluations in this observational study are only exploratory and will require further assessment through more appropriate study designs. The generalisability of findings is limited as this study was conducted in predominantly metropolitan Victorian public hospitals. Hospitals in other states and private hospitals may not have the

TABLE 3 Comparisons of characteristics and outcomes between patients referred in reactive, mixed and proactive models of general medicine perioperative services ($N = 1071$)

Characteristics/outcomes	Reactive models	Mixed models	Proactive models	*P*-value
Number of patients	543	276	252	NA
Patient's age, median (IQR), years	73 (61–83)	76 (64–85)	70 (61.5–78)	**<0.001**
Biological sex, male, *n* (%)	290 (53.4)	154 (55.8)	140 (55.6)	0.76
CCI, median (IQR)	5 (3–7)	5 (3–6)	4 (3–6)	0.18
CFS, median (IQR)	3 (3–5)	4 (3–6)	4 (3–5)	0.093
Location of referral, *n* (%)				
Inpatient	543 (100.0)	271 (98.2)	108 (42.9)	**<0.001**
Outpatient	0 (0)	5 (1.8)	144 (57.1)	
Nature of referral, *n* (%)				
Emergency	436 (80.3)	239 (86.6)	84 (33.3)	**<0.001**
Elective	107 (19.7)	37 (13.4)	168 (66.7)	
Perioperative risk assessment tool completed, *n* (%)	269 (49.5)	169 (61.2)	134 (53.2)	**0.007**
ASA score, median (IQR)	3 (3–3)	3 (3–3)	3 (3–3)	0.74
MET calls within prior 24 h of initial review, *n* (%)†	94 (17.3)	37 (13.7)	9 (8.3)	**0.04**
Goals of care documentation, *n* (%)				
Full resuscitation	227 (41.8)	100 (36.2)	44 (17.5)	**<0.001**
Not for CPR but for HDU/ICU level management	96 (17.7)	56 (20.3)	24 (9.5)	
For ward-based management only	65 (12.0)	37 (13.4)	15 (6.0)	
For end-of-life care only	5 (0.9)	1 (0.4)	0 (0)	
Not documented	150 (27.6)	82 (29.7)	169 (67.1)	
MET calls within 48 h after initial review, *n* (%)				
Yes	45 (8.3)	27 (10.0)	1 (0.9)	**0.012**
No	498 (91.7)	244 (90.0)	106 (99.1)	
Data not available	0	5	145	
ICU admission within 48 h after initial review, *n* (%)				
Yes	19 (3.5)	13 (4.8)	0 (0)	0.072
No	524 (96.5)	258 (95.2)	107 (100)	
Data not available	0	5	145	
Ongoing input by general medicine perioperative service after initial review, *n* (%)				
Yes	328 (60.4)	204 (73.9)	100 (55.9)	**<0.001**
No	215 (39.6)	72 (26.1)	79 (44.1)	
Data not available	0	0	73	
Referral to another medical specialty after initial review, *n* (%)				
Yes	218 (40.1)	71 (25.7)	17 (9.5)	**<0.001**
No	325 (59.9)	205 (74.3)	162 (90.5)	
Data not available	0	0	73	
Death during index admission, *n* (%)				
Yes	23 (4.2)	17 (6.2)	3 (1.7)	0.07
No	520 (95.8)	259 (93.8)	176 (98.3)	
Data not available	0	0	73	
Take-over of care, *n* (%)				
Yes	82 (15.1)	34 (12.3)	2 (1.1)	**<0.001**
No	461 (84.9)	242 (87.7)	177 (98.9)	
Not available/applicable	0 (0)	0 (0)	73	
Length of stay, median (IQR), days ($n = 898$)	8.1 (5.0–15.8)	9.0 (5.0–17.0)	6.0 (3.0–10.0)	**<0.001**
Discharge destination				
Home (or usual residence)	340 (62.6)	155 (56.2)	131 (73.2)	**0.017**
Rehabilitation/subacute care (including transitional care)	111 (20.4)	62 (22.5)	29 (16.2)	
Long-term residential care	19 (3.5)	15 (5.4)	3 (1.7)	
Other (e.g. death, interhospital transfer and interstate transfer)	73 (13.4)	44 (15.9)	16 (8.9)	
Data not available	0	0	73	

Note: Statistically significant associations are presented in bolded *P*-values. Abbreviations: ASA: American Society of Anesthesiologists physical status classification system score, CCI: Charlson Comorbidity Index, CFS: clinical frailty scale, CPR: cardiopulmonary resuscitation, ENT: ear, nose and throat, GI: gastrointestinal, HDU: high dependency unit, ICU: intensive care unit, IQR: interquartile range, MET: medical emergency team. †Outpatients were excluded from analysis.

TABLE 4 Evaluation of outcomes between general medicine perioperative models of care

Outcomes	Models of care	Unadjusted OR (95% CI)	*P*-value	Adjusted OR (95% CI)	*P*-value
MET calls prior 24 h†	Reactive	Reference		Reference	
	Mixed	0.74 (0.49–1.12)	0.151	0.84 (0.52–1.35)	0.47
	Proactive	0.18 (0.09–0.36)	**<0.0001**	0.53 (0.17–1.60)	0.26
MET calls post 48 h‡	Reactive	Reference		Reference	
	Mixed	1.22 (0.74–2.02)	0.43	1.23 (0.74–2.05)	0.43
	Proactive	0.10 (0.01–0.77)	**0.026**	0.11 (0.01–0.81)	**0.03**
ICU admissions*	Reactive	Reference		Reference	
	Mixed	1.39 (0.68–2.86)	0.37		
Ongoing input by General Medicine perioperative service†	Reactive	Reference		Reference	
	Mixed	1.86 (1.35–2.56)	**0.0001**	1.62 (1.14–2.31)	**0.007**
	Proactive	0.83 (0.59–1.17)	0.28	0.84 (0.44–1.60)	0.60
Referral to another medical specialty†	Reactive	Reference		Reference	
	Mixed	0.52 (0.38–0.71)	**<0.0001**	0.47 (0.33–0.66)	**<0.0001**
	Proactive	0.16 (0.09–0.27)	**<0.0001**	0.09 (0.04–0.19)	**<0.0001**
Death during index admission‡	Reactive	Reference		Reference	
	Mixed	1.48 (0.78–2.83)	0.23	1.58 (0.82–3.04)	0.17
	Proactive	0.39 (0.11–1.30)	0.12	0.41 (0.12–1.40)	0.16
Take-over of care†	Reactive	Reference		Reference	
	Mixed	0.79 (0.51–1.21)	0.28	0.79 (0.49–1.29)	0.35
	Proactive	0.06 (0.02–0.26)	**0.0001**	0.12 (0.02–0.64)	**0.012**
Home as discharge destination†	Reactive	Reference		Reference	
	Mixed	0.77 (0.55–1.08)	0.13	0.92 (0.61–1.39)	0.70
	Proactive	1.57 (1.01–2.42)	**0.044**	0.93 (0.41–2.12)	0.87
		GM (95% CI)	*P*-value	Adjusted GM (95% CI)	*P*-value
Length of stay (days)**	Reactive	8.39 (7.59–9.27)	**<0.0001**	7.77 (6.94–8.70)	0.17
	Mixed	8.17 (7.10–9.39)		7.95 (6.93–9.13)	
	Proactive	4.48 (3.77–5.33)		5.90 (4.52–7.70)	

Note: Statistically significant associations are presented in bolded *P*-values. Abbreviations: CI: confidence interval, GM: geometric mean, MET: medical emergency team, OR: odds ratio. †Odds ratio was adjusted for age, male sex, Charlson Comorbidity Index, clinical frailty scale, emergency referrals, total number of surgical admissions and total number of surgical procedures performed. ‡Odds ratio was adjusted for age, male sex, Charlson Comorbidity Index, clinical frailty scale and emergency referrals. *Given low event rates overall and zero event rate in the proactive model, odds ratios cannot be calculated. **Length of stay is expressed as a geometric mean, in days, with 95% confidence intervals, and adjusted for age, male sex, Charlson Comorbidity Index, clinical frailty scale, emergency referrals, total number of surgical admissions and total number of surgical procedures performed.

same structures, while in most rural and regional centres, general medicine may be the only medical specialty available to support surgical services. Additionally, other forms of consultations (e.g. telephone), which also contributed to general medicine workload, were not captured. Nevertheless, we were able to characterise the clinical activity of general medicine perioperative services and described the existing differences in models of care.

Conclusion

Perioperative medicine is becoming an increasingly recognised and important area of medicine, particularly as surgical patients are becoming more complex. General physicians play a significant role in this field, contributing extensively as part of multidisciplinary teams and covering many aspects of the perioperative care journey. However, there is variation in models of care. Although there is considerable heterogeneity, the implementation of more proactive models with established pathways may improve patient outcomes. There remains room for improvement with more proactive care across the board, equity in staffing across institutions and increased involvement of general physicians in risk assessment, medical optimization and goals of care discussions, which could further enhance the patient journey.

Acknowledgements

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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Appendix A

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page no.
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	2 and 5
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case–control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	2
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case–control study*—For matched studies, give matching criteria and the number of controls per case	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	2 and 5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	2
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	5
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case–control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5 and 6
		(b) Give reasons for non-participation at each stage	2
		(c) Consider use of a flow diagram	NA

	Item No.	Recommendation	Page no.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	Tables 2 and 3
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	NA
		Case–control study—Report numbers in each exposure category, or summary measures of exposure	NA
		Cross-sectional study—Report numbers of outcome events or summary measures	6
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Tables 1 and 4
		(*b*) Report category boundaries when continuous variables were categorised	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—for example, analyses of subgroups and interactions, and sensitivity analyses	Table 4
Discussion			
Key results	18	Summarise key results with reference to study objectives	6–10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8–10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	6–10
Generalisability	21	Discuss the generalisability (external validity) of the study results	8
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org. *Give information separately for cases and controls in case–control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web-site:

Table S1. Referring surgical units to General Medicine perioperative services and other specialty services involved in patient care at the time of referral ($N = 1071$).

Table S2. Comparisons of characteristics and outcomes between emergency and elective referrals to General Medicine perioperative services ($N = 1071$).