

## **Supplementary Material for**

### **Emergency general surgery models in Australia: a cross-sectional study**

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**Table S1. Australian hospitals that have published their emergency general surgery model**

<b>Location</b>	<b>Emergency general surgery model</b>
<u>Australian Capital Territory</u>	
The Canberra Hospital, Canberra	Acute surgical unit (1)
<u>New South Wales</u>	
John Hunter Hospital, Newcastle	Acute surgical unit (2)
Nepean Hospital, Nepean	Acute surgical unit (3)
Prince of Wales Hospital, Sydney	Acute surgical unit (4)
St George Hospital, Sydney	Sub-specialty model (5)
<u>Northern Territory</u>	
–	–
<u>Queensland</u>	
Gold Coast Hospital, Gold Coast	Acute surgical unit (6)
Nambour General Hospital, Nambour	Acute surgical unit (7)
<u>South Australia</u>	
Lyell McEwin Hospital, Adelaide	Acute surgical unit (8)
<u>Tasmania</u>	
–	–
<u>Victoria</u>	
Bendigo Health, Bendigo	Acute surgical unit (9)
Dandenong Hospital, Melbourne	Acute surgical unit (10)
Eastern Health, Melbourne	Acute surgical unit (11)
Geelong Hospital, Bendigo	Acute surgical unit (12)
Latrobe Regional Hospital, Traralgon	Traditional (13)
Monash Medical Centre (Clayton), Melbourne	Acute surgical unit (14)
Royal Melbourne Hospital, Melbourne,	Acute surgical unit (15)
Wagga Wagga Health Service, Wagga Wagga	Acute surgical unit (16)
<u>Western Australia</u>	
Fiona Stanley Hospital, Perth	Acute surgical unit (17)
Fremantle Hospital, Fremantle	Acute surgical unit (18)

**Table S2. Australian Institute of Health and Welfare hospital peer groups relevant to general surgery, abbreviated**

ACASPA: acute casemix-adjusted separations per annum. P.a.: per annum.

<b>Hospital type</b>	<b>Location</b>	<b>Workload †</b>	<b>Number ‡</b>
Major	Major cities, <i>or</i>	>20,000 ACASPA, <i>or</i>	31
	Regional	>16,000 ACASPA, respectively.	
Large metropolitan	Major cities	>10,000 ACASPA	34
	Regional, <i>or</i>	>8,000 ACASPA, <i>or</i>	
Large regional	Remote	>5,000 ACASPA, respectively.	26
	Major cities	>2,000 ACASPA	
Medium metropolitan	Regional	>2,000 separations p.a., unadjusted	21
Medium regional	Regional	<2,000 separations p.a., unadjusted	95 §
Small regional	Remote	<2,000 separations p.a., unadjusted	
Small remote	N/A	Offer paediatric surgery only	4 §
Children's	N/A	Prison medical services, dental hospitals, and hospitals not defined above	10 §

†: includes patient separations across all specialties, including medicine, surgery, psychiatry and other.

‡: as published by the Australian Institute of Health and Welfare, December 2018 (19). Numbers do not include one additional site introduced subsequent to AIHW list publication (Northern Beaches Hospital, large metropolitan hospital, New South Wales), which was included in the study.

§: not included in study; see Methods.

## Text S1. Telephone questionnaire template

### *i. On-call registrar*

Following introduction, verbal consent, and explanation of the study's confidential and voluntary nature;

1. Are you responsible for emergency general surgical (EGS) referrals today?
2. Are you an accredited or unaccredited registrar?
3. What is your post-graduate year?
4. How many registrars share on-call?
5. What is your longest duration on-call?
6. Can you please describe your hospital's EGS model?
7. When the registrar is on-call, do they still have elective duties?
8. When the consultant is on-call, do they still have elective duties?
9. Is there an emergency operating list (need not be specific to EGS) every weekday?
10. Is there any protected EGS operating time?
11. Is there routine handover of EGS patients?
12. How are emergency urological patients managed?
13. How would you self-assess your satisfaction with the EGS model on a scale -2 to +2?
14. What is good about your hospital's EGS model?
15. What could be improved?
16. How would you self-assess your operative exposure -2 to +2?

### *ii. General Surgery head of unit or senior surgeon*

Following study explanation, verbal consent, and explanation of confidentiality and voluntary nature;

1. Can you please confirm your role in the EGS service at your hospital?
2. Can you please describe your hospital's EGS model?
3. When the registrar is on-call, do they still have elective duties?
4. When the consultant is on-call, do they still have elective duties?
5. How many consultants participate in the EGS on-call roster, and what is the on-call duration?
6. If an acute surgical unit (ASU) or Hybrid model exists, what year and why did this commence and has financial assessment occurred compared with the prior model?
7. If not, have these models been considered, and if so, what barriers prevented commencement?
8. Are there dedicated emergency general surgery (EGS) beds/ ward?
9. Is there an emergency operating list (need not be specific to EGS) every weekday?
10. Can you please describe your hospital's trauma model?
11. Do you have any subspecialty trauma surgeons (not part of another specialty)?
12. What is good about your hospital's EGS model?
13. What could be improved?
14. How would you self-assess your satisfaction with the EGS model on a scale -2 to +2?

**Table S3. Australian medium to major public hospitals contacted in this study**

<b>Hospital</b>	<b>State</b>	<b>Local Hospital Network (LHN)</b>	<b>Peer group</b>
Calvary Public Hospital	ACT	Australian Capital Territory	Medium metropolitan hospitals
The Canberra Hospital	ACT	Australian Capital Territory	Medium metropolitan hospitals
Armidale Hospital	NSW	Hunter New England	Medium regional hospitals
Auburn Hospital	NSW	Western Sydney	Medium metropolitan hospitals
Bankstown Lidcombe Hospital	NSW	South Western Sydney	Large metropolitan hospitals
Bathurst Health Service	NSW	Western NSW	Large regional hospitals
Belmont Hospital	NSW	Hunter New England	Medium metropolitan hospitals
Blacktown Hospital	NSW	Western Sydney	Large metropolitan hospitals
Bowral Hospital	NSW	South Western Sydney	Medium regional hospitals
Broken Hill Hospital	NSW	Far West	Medium regional hospitals
Calvary Mater Newcastle Hospital	NSW	Hunter New England	Large metropolitan hospitals
Campbelltown Hospital	NSW	South Western Sydney	Large metropolitan hospitals
Canterbury Hospital	NSW	Sydney	Medium metropolitan hospitals
Coffs Harbour Hospital	NSW	Mid North Coast	Large regional hospitals
Concord Hospital	NSW	Sydney	Major hospitals
Dubbo Hospital	NSW	Western NSW	Large regional hospitals
Fairfield Hospital	NSW	South Western Sydney	Medium metropolitan hospitals
Gosford Hospital	NSW	Central Coast	Large metropolitan hospitals
Goulburn Hospital	NSW	Southern NSW	Medium regional hospitals
Grafton Base Hospital	NSW	Northern NSW	Medium regional hospitals
Griffith Base Hospital	NSW	Murrumbidgee	Large regional hospitals
Hawkesbury Hospital	NSW	Nepean Blue Mountains	Medium metropolitan hospitals
Hornsby Ku-ring-gai Hospital	NSW	Northern Sydney	Large metropolitan hospitals
John Hunter Hospital	NSW	Hunter New England	Major hospitals
Kempsey Hospital	NSW	Mid North Coast	Medium regional hospitals
Lismore Hospital	NSW	Northern NSW	Large regional hospitals
Liverpool Hospital	NSW	South Western Sydney	Major hospitals
Maitland Hospital	NSW	Hunter New England	Medium metropolitan hospitals
Manly Hospital	NSW	Northern Sydney	Large metropolitan hospitals
Manning Hospital	NSW	Hunter New England	Large regional hospitals
Mona Vale Hospital	NSW	Northern Sydney	Large metropolitan hospitals
Mount Druitt Hospital	NSW	Western Sydney	Medium metropolitan hospitals
Nepean Hospital	NSW	Nepean Blue Mountains	Major hospitals
Northern Beaches Hospital	NSW	Northern Sydney	Large metropolitan hospitals
Orange Health Service	NSW	Western NSW	Large regional hospitals
Port Macquarie Hospital	NSW	Mid North Coast	Large regional hospitals
Prince of Wales Hospital	NSW	South Eastern Sydney	Major hospitals
Royal Hospital for Women	NSW	South Eastern Sydney	Medium metropolitan hospitals
Royal North Shore Hospital	NSW	Northern Sydney	Major hospitals
Royal Prince Alfred Hospital	NSW	Sydney	Major hospitals
Ryde Hospital	NSW	Northern Sydney	Medium metropolitan hospitals
Shellharbour Hospital	NSW	Illawarra Shoalhaven	Medium metropolitan hospitals
Shoalhaven Hospital	NSW	Illawarra Shoalhaven	Large regional hospitals
South East Regional Hospital	NSW	Southern NSW	Medium regional hospitals
St George Hospital NSW	NSW	South Eastern Sydney	Major hospitals
St Vincents Hospital	NSW	St Vincent's Health Network	Major hospitals
Sutherland Hospital	NSW	South Eastern Sydney	Large metropolitan hospitals
Tamworth Hospital	NSW	Hunter New England	Large regional hospitals
The Tweed Hospital	NSW	Northern NSW	Large metropolitan hospitals
Wagga Wagga Rural Referral Hospital	NSW	Murrumbidgee	Large regional hospitals
Westmead Hospital	NSW	Western Sydney	Major hospitals
Wollongong Hospital	NSW	Illawarra Shoalhaven	Major hospitals
Wyong Hospital	NSW	Central Coast	Large metropolitan hospitals
Alice Springs Hospital	NT	Central Australia (NT)	Large regional hospitals
Royal Darwin Hospital	NT	Top End (NT)	Major hospitals
Bundaberg Base Hospital	Qld	Wide Bay	Large regional hospitals
Caboolture Hospital	Qld	Metro North (Qld)	Medium metropolitan hospitals
Cairns Hospital	Qld	Cairns and Hinterland	Large regional hospitals
Caloundra Health Service	Qld	Sunshine Coast	Medium metropolitan hospitals
Gladstone Hospital	Qld	Central Queensland	Medium regional hospitals
Gold Coast University Hospital	Qld	Gold Coast	Major hospitals
Gympie Hospital	Qld	Sunshine Coast	Medium regional hospitals
Hervey Bay Hospital	Qld	Wide Bay	Large regional hospitals
Ipswich Hospital	Qld	West Moreton	Large metropolitan hospitals
Logan Hospital	Qld	Metro South (Qld)	Large metropolitan hospitals
Mackay Base Hospital	Qld	Mackay	Large regional hospitals
Maryborough Hospital	Qld	Wide Bay	Medium regional hospitals
Mater Hospital Brisbane	Qld	Not applicable	Large metropolitan hospitals

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<b>Hospital</b>	<b>State</b>	<b>Local Hospital Network (LHN)</b>	<b>Peer group</b>
Mount Isa Base Hospital	Qld	North West (Qld)	Medium regional hospitals
Nambour General Hospital	Qld	Sunshine Coast	Large metropolitan hospitals
Princess Alexandra Hospital	Qld	Metro South (Qld)	Major hospitals
Queen Elizabeth II Jubilee Hospital	Qld	Metro South (Qld)	Large metropolitan hospitals
Redcliffe Hospital	Qld	Metro North (Qld)	Large metropolitan hospitals
Redland Hospital	Qld	Metro South (Qld)	Medium metropolitan hospitals
Robina Hospital	Qld	Gold Coast	Medium metropolitan hospitals
Rockhampton Hospital	Qld	Central Queensland	Large regional hospitals
Royal Brisbane & Women's Hospital	Qld	Metro North (Qld)	Major hospitals
The Prince Charles Hospital	Qld	Metro North (Qld)	Major hospitals
The Townsville Hospital	Qld	Townsville	Major hospitals
Toowoomba Hospital	Qld	Darling Downs	Large regional hospitals
Flinders Medical Centre	SA	Southern Adelaide	Major hospitals
Lyell McEwin Hospital	SA	Northern Adelaide	Large metropolitan hospitals
Modbury Hospital	SA	Northern Adelaide	Large metropolitan hospitals
Mount Gambier and Districts Health Service	SA	Country Health SA	Medium regional hospitals
Noarlunga Public Hospital	SA	Southern Adelaide	Medium metropolitan hospitals
Port Augusta Hospital and Regional Health Services	SA	Country Health SA	Medium regional hospitals
Repatriation General Hospital	SA	Southern Adelaide	Large metropolitan hospitals
Royal Adelaide Hospital	SA	Central Adelaide	Major hospitals
The Queen Elizabeth Hospital	SA	Central Adelaide	Large metropolitan hospitals
Whyalla Hospital and Health Services	SA	Country Health SA	Medium regional hospitals
Launceston General Hospital	Tas	Tasmanian Health Service	Large regional hospitals
Mersey Community Hospital	Tas	Tasmanian Health Service	Medium regional hospitals
North West Regional Hospital	Tas	Tasmanian Health Service	Large regional hospitals
Royal Hobart Hospital	Tas	Tasmanian Health Service	Major hospitals
Angliss Hospital	Vic	Eastern Health	Medium metropolitan hospitals
Austin Hospital [Heidelberg]	Vic	Austin Health	Major hospitals
Ballarat Health Services [Base Campus]	Vic	Ballarat Health Services	Large regional hospitals
Box Hill Hospital	Vic	Eastern Health	Large metropolitan hospitals
Casey Hospital	Vic	Monash Health	Medium metropolitan hospitals
Dandenong Campus	Vic	Monash Health	Large metropolitan hospitals
Frankston Hospital	Vic	Peninsula Health	Large metropolitan hospitals
Goulburn Valley Health [Shepparton]	Vic	Goulburn Valley Health	Large regional hospitals
Latrobe Regional Hospital [Traralgon]	Vic	Latrobe Regional Hospital	Large regional hospitals
Maroondah Hospital [East Ringwood]	Vic	Eastern Health	Large metropolitan hospitals
Mercy Hospital for Women	Vic	Mercy Public Hospital Inc.	Medium metropolitan hospitals
Monash Medical Centre [Clayton]	Vic	Monash Health	Major hospitals
Monash Medical Centre [Moorabbin]	Vic	Monash Health	Large metropolitan hospitals
Northeast Health Wangaratta	Vic	Northeast Health Wangaratta	Large regional hospitals
Royal Melbourne Hospital [Parkville]	Vic	Melbourne Health	Major hospitals
Royal Women's Hospital [Parkville]	Vic	Royal Women's Hospital	Medium metropolitan hospitals
Sandringham Hospital	Vic	Alfred Health	Medium metropolitan hospitals
St Vincent's Hospital [Fitzroy]	Vic	St Vincent's Hospital Ltd	Major hospitals
Sunshine Hospital	Vic	Western Health	Medium metropolitan hospitals
The Alfred	Vic	Alfred Health	Major hospitals
The Bendigo Hospital	Vic	Bendigo Health Care Group	Large regional hospitals
The Northern Hospital [Epping]	Vic	Northern Health	Large metropolitan hospitals
University Hospital Geelong	Vic	Barwon Health	Major hospitals
Werribee Mercy Hospital	Vic	Mercy Public Hospital Inc.	Medium metropolitan hospitals
West Gippsland Healthcare Group [Warragul]	Vic	West Gippsland Healthcare Group	Medium regional hospitals
Western Hospital [Footscray]	Vic	Western Health	Large metropolitan hospitals
Williamstown Hospital	Vic	Western Health	Medium metropolitan hospitals
Albany Hospital	WA	WA Country Health Service	Medium regional hospitals
Armadale-Kelmscott Memorial Hospital	WA	East Metropolitan Health Service	Large metropolitan hospitals
Fiona Stanley Hospital	WA	South Metropolitan Health Service	Major hospitals
Fremantle Hospital	WA	South Metropolitan Health Service	Large metropolitan hospitals
Geraldton Hospital	WA	WA Country Health Service	Medium regional hospitals
Joondalup Health Campus (Public)	WA	North Metropolitan Health Service	Large metropolitan hospitals
Kalgoorlie Hospital	WA	WA Country Health Service	Medium regional hospitals
Peel Health Campus	WA	South Metropolitan Health Service	Medium metropolitan hospitals
Rockingham General Hospital	WA	South Metropolitan Health Service	Large metropolitan hospitals
Royal Perth Hospital Wellington Street Campus	WA	East Metropolitan Health Service	Major hospitals
Sir Charles Gairdner Hospital	WA	North Metropolitan Health Service	Major hospitals
South West Health Campus	WA	WA Country Health Service	Medium regional hospitals
St John of God Midland Public Hospital	WA	Unknown	Large metropolitan hospitals
Swan District Hospital	WA	Unknown	Medium metropolitan hospitals

**Table S4. Reported reasons for and against change towards an Acute Surgical Unit model**

ASU: acute surgical unit. ED: emergency department. EGS: emergency general surgery. NEAT: National Emergency Access Target. In 2009, the Australian Federal Government introduced the 4-hour NEAT, defined as a target whereby 85% of patients must spend less than four hours in the emergency department (20). No.: number. Trad.: Traditional. TTT: time to theatre.

Reasons for ASU/Hybrid model implementation †	No.	Perceived barriers against commencing an ASU ‡	No.
Improve care of EGS patients	12	Insufficient EGS load	30
Reduce after-hours operating	11	Insufficient surgeons to both staff ASU and elective workload	11
Cater to rising EGS load	9	Insufficient emergency theatre access	9
Improve theatre access/ reduce TTT	8	Insufficient funding	5
Create surgeon protected off-call	6	Not cost effective	5
Reduce elective work interruptions	5	Current system works well	3
Publicised ASU benefits §	4	Would dilute registrar operative exposure	2
Government/ specialty-group report	3	Frequent patient handover in ASU model	2
Patient suffered complications due to surgeon unavailability in Trad. model	3	Change would disrupt older surgeons	1
To improve surgical registrar training	3		
To meet ED 4-hour NEAT rule (20)	3		
Positive ASU experience at prior site	2		
Increasing no. of employed surgeons	2		
To improve trauma care	2		
To cater to sub-specialty general surgeons seeking no on-call duties	1		
<b>Total</b>	<b>74</b>	<b>Total</b>	<b>68</b>

†: reasons reported by 34 hospitals employing an ASU or Hybrid EGS model.

‡: reasons reported by 56 hospitals employing a Hybrid or Traditional model.

§: includes publications, conference presentations or hospital visits.

**Table S5. Case vignettes of hospitals which reverted to Traditional or Hybrid structures following trial of an Acute Surgical Unit model**

ASU: acute surgical unit.

Year commenced †	Post-ASU model	Reason(s) for reversion
2005-2009	Hybrid	<ul style="list-style-type: none"> <li>Lack of protected EGS operating theatre access combined with fee-for-service surgeon contracts led to frequent unproductive daytime hours, and significant time spent operating after-hours.</li> <li>Seven consecutive days on-call for a team of one surgeon/ one registrar created unsustainably high workload/ fatigue when each team rotated on-call</li> </ul>
2010-2014	Hybrid	<ul style="list-style-type: none"> <li>As above (fatigue of seven consecutive days on-call)</li> <li>Disruptive to surgeons' private practice</li> </ul>
2015-2019	Hybrid	<ul style="list-style-type: none"> <li>Insufficient EGS load</li> <li>Too few surgeons to both staff ASU &amp; elective work</li> </ul>
2015-2019	Hybrid	<ul style="list-style-type: none"> <li>As above (fatigue of seven consecutive days on-call)</li> </ul>
2015-2019	Traditional	<ul style="list-style-type: none"> <li>Too few surgeons to both staff ASU &amp; elective work</li> <li>Too few major operations for trainee requirements ‡</li> </ul>

†: Year of ASU commencement is reported as occurring at an unspecified point during a five-year range, for confidentiality.

‡: Registrars undergoing accredited training with General Surgery Australia are required to be scrubbed in for a minimum of 100 'major' cases per six-month term (21). Common 'major' cases include cholecystectomy and bowel resection, whereas common 'minor' cases include appendicectomy and simple hernia repair.

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