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4	Title	Electives closer to home: pre-hospital and retrieval medicine at
5		MedSTAR, South Australia
6		
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12		
13	Biography	Mark is a final year medical student at the University of NSW, currently
14		based at Albury-Wodonga Health. He has a particular interest in critical
15		care medicine, specifically anaesthetics, and is looking to pursue a career
16		in pre-hospital and retrieval medicine. In December 2020, he undertook
17		an elective placement with the South Australian Ambulance Service
18		MedSTAR pre-hospital and retrieval unit based at Adelaide Airport in
19		South Australia.
20		
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24		
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26		hospital and retrieval medicine at MedSTAR, South Australia.
27		
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1 **Abstract**

2 *Introduction*

3 The COVID-19 pandemic radically changed the nature of elective placements undertaken  
4 over the summer of 2020/2021. With an international travel ban in place, students were  
5 forced to cancel overseas placements and look closer to home to find opportunities. This  
6 resulted in the discovery of world-class elective experiences within Australia that may have  
7 otherwise been overlooked by the allure of international travel. This was the case with the  
8 placement I undertook at the Medical State-wide Trauma/Transport Advice and Retrievals  
9 (MedSTAR) service in South Australia.

10

11 *Summary*

12 MedSTAR is unique amongst pre-hospital and retrieval units, given the breadth of  
13 opportunities available to medical students. Participants have full access to both adult and  
14 paediatric cases across all three forms of transport: road, helicopter, and fixed-wing aircraft.  
15 The high-acuity nature of the patient population seen by MedSTAR guarantees access to  
16 numerous interesting, complex, and unusual cases that are typically not seen by medical  
17 students, providing fantastic educational experiences. This article will introduce the  
18 subspecialty of pre-hospital and retrieval medicine, detail the work undertaken by MedSTAR  
19 in delivering care to critically ill patients across South Australia, and provide an account of  
20 the student experience undertaking an elective placement in such a unique environment.

21

22 **Learning points**

- 23 1. Pre-hospital and retrieval medicine is a growing subspecialty within critical care medicine  
24 that has proven benefits in improving morbidity and mortality for critically unwell  
25 patients.
- 26 2. Pre-hospital and retrieval medicine is of particular importance in Australia because of the  
27 vast size of the country and the isolated nature of certain communities.
- 28 3. MedSTAR is unique with respect to its broad range of capabilities, presenting the  
29 opportunity for students to observe a wide variety of pre-hospital and retrieval  
30 experiences from a single elective placement.

1 **Introduction**

2 The COVID-19 pandemic, international travel ban, and ever-changing state border  
3 restrictions made elective placements over the summer of 2020/2021 very different from  
4 previous years. Being forced to look closer to home resulted in the discovery of valuable  
5 opportunities that may have otherwise been overlooked, such as my elective placement with  
6 the South Australian Ambulance Service (SAAS) Medical State-wide Trauma/Transport  
7 Advice and Retrievals (MedSTAR) service. The breadth of opportunities available to  
8 students at MedSTAR is unique, encompassing exposure to critically ill adult and paediatric  
9 patients via road, helicopter, and fixed-wing aircraft. This article seeks to introduce the  
10 subspecialty of pre-hospital and retrieval medicine (PHRM) and document the student  
11 experience of PHRM during an elective placement with MedSTAR.

## 1 **Electives closer to home**

2 For junior medical students, the prospect of an elective term is exciting, with an enormous  
3 breadth of opportunities available across the world. Since my first year in 2016, I listened  
4 with anticipation to final year students speaking about their experiences and began to plan  
5 how I would spend my own elective in the summer of 2020/2021.  
6

7 The expanding discipline of PHRM immediately drew my attention as an exciting placement  
8 option. Attracted by the opportunity for international travel whilst on placement, I began  
9 researching opportunities around the world and, by the start of 2020, I had my sights on a  
10 PHRM placement in London.  
11

12 Then the COVID-19 pandemic hit. With an indefinite ban on international travel, constantly  
13 changing state border restrictions, and a reluctance of many health facilities to accept extra  
14 students due to COVID-19, it seemed that the class of 2021 would miss out on the elective  
15 experience of previous years. Like many of my colleagues, I watched my plans for an  
16 international placement crumble due to the restrictions necessitated by the pandemic.  
17

18 Instead of gravitating overseas, students were forced to look closer to home for elective  
19 experiences. For some, this meant working with their favourite team at their home hospital.  
20 For others, it unearthed local opportunities that may have otherwise been overlooked. The  
21 latter was certainly the case for me, as I undertook a four-week placement at MedSTAR,  
22 South Australia's PHRM service.  
23

## 24 **Pre-hospital and retrieval medicine in Australia**

25 PHRM is increasingly recognised as an important critical care subspecialty. It exists in the  
26 pre- and inter-hospital environment, providing treatment to critically ill patients before and  
27 during transport for definitive care. Between 2010 and 2014, Queensland's PHRM services  
28 responded to 73 042 cases, an average of 40 per day, with an increasing trend from 13 833  
29 cases in 2010 to 15 064 cases in 2014 [1]. Over 80% of cases required transport from remote  
30 or regional locations, highlighting the particular significance of PHRM in Australia due to the  
31 vast size of the country and the isolated nature of certain communities [1,2].  
32

33 Each state and territory in Australia have their own PHRM units, with the exception of the  
34 Australian Capital Territory which is included within the New South Wales (NSW) retrieval  
35 jurisdiction (Table 1). All states and territories other than the Northern Territory have  
36 separate adult and paediatric retrieval teams, with larger states such as NSW, Queensland,  
37 and Western Australia operating out of multiple bases. South Australia is the only state where  
38 both adult and paediatric teams are operated by the same organisation from a single base  
39 covering the entire state.  
40

41 PHRM brings critical care services to the patient, resulting in improved morbidity and  
42 mortality due to both the earlier provision of life-saving interventions by critical care teams  
43 and reduced transport time to hospital [2]. The provision of blood transfusions by retrieval  
44 teams, for example, has repeatedly demonstrated an improvement in mortality in major  
45 trauma [3-5]. A retrospective study of all blood transfusions provided by NSW Ambulance  
46 retrieval teams between 2009 and 2018 revealed significantly improved haemodynamic  
47 stability for transfusion patients upon arrival at hospital [6]. Additionally, one study in  
48 Western Australia found a 5.1% decrease in mortality for major trauma patients transported  
49 directly to a tertiary hospital by helicopter compared to those transported indirectly by road  
50 via a local hospital [7].

1  
2 PHRM teams generally consist of a doctor partnered with a critical care nurse or paramedic  
3 [8]. The doctors are usually drawn from the three main critical care specialties: emergency,  
4 anaesthetics, and intensive care medicine. In 2021, the Australasian College of Emergency  
5 Medicine, in conjunction with other critical care colleges, commenced the Graduate Diploma  
6 of Pre-Hospital and Retrieval Medicine (DipPHRM) in recognition of the growing need for  
7 formal training and qualification in PHRM [9]. This mirrors a similar program established in  
8 the United Kingdom (UK) in 2012 [10].

9  
10 Traditionally, the high-acuity nature of the patient population, alongside space and weight  
11 restrictions on aircrafts, has limited medical student exposure to PHRM. Most budding  
12 retrievalists have to wait until senior registrar level before experiencing PHRM, with only a  
13 small number of units, including MedSTAR, offering elective placements to medical  
14 students.

### 15 16 **MedSTAR**

17 MedSTAR is the PHRM unit for South Australia (SA). Based in a purpose-built facility at  
18 Adelaide Airport, it is a fully integrated component of SAAS and functions alongside  
19 standard ambulance crews. From this single base, specialised adult and paediatric retrieval  
20 teams respond to critically ill patients of all ages across SA, covering an area of  
21 approximately 983 000 km<sup>2</sup> with a population of 1.7 million people [11]. This is unique  
22 amongst PHRM units in Australia.

23  
24 MedSTAR taskings fall into one of two categories: primary or secondary. During primary  
25 responses, the MedSTAR team will travel directly to the incident site, for example, a motor  
26 vehicle accident (MVA) or other major trauma. For these taskings, the team is joined by a  
27 specialist rescue paramedic to assist with any extraction or difficult entry requirements.

28  
29 Secondary responses, or inter-hospital transfers, involve patient transport from one health  
30 facility to another. This includes transport from remote or regional hospitals to a tertiary  
31 facility in Adelaide or transfer from one Adelaide hospital to another. Secondary responses  
32 involve both medical cases, with patients requiring an escalation of care, as well as major  
33 trauma necessitating transfer from a regional hospital to a tertiary centre (Figure 1).

34 Secondary responses are attended only by a two-person team, with no requirement for a  
35 rescue paramedic, and comprise 70% to 80% of all MedSTAR taskings.

36  
37 MedSTAR possesses a uniquely broad range of transport options from the one facility.  
38 Within the Adelaide metropolitan area, MedSTAR has a fleet of four rapid response vehicles  
39 and two fully equipped ambulances for MedSTAR Kids. These ambulances can be quickly  
40 reconfigured to carry either a stretcher or neonate transport system, depending on the age and  
41 requirements of the patient.

42  
43 For taskings beyond Adelaide, MedSTAR utilises two dedicated Bell-412 rescue helicopters  
44 (Figure 2). These helicopters are able to respond to any incident within a 200-kilometre  
45 radius of Adelaide and allow for rapid transfer directly from the incident site to the helipad of  
46 major Adelaide hospitals.

47  
48 For responses beyond a 200-kilometre radius, the Royal Flying Doctor Service supplies  
49 Pilatus PC-12 turboprop aeroplanes and a Pilatus PC-24 jet from their facility located 300  
50 metres from the MedSTAR base (Figure 3). This enables teams to respond to taskings across

1 SA and provide interstate transfers to Melbourne or Sydney. The ability to respond by road,  
2 helicopter or fixed-wing aircraft from the one facility is unique to MedSTAR among  
3 Australian PHRM units.

#### 4 **MedSTAR elective experience**

5 MedSTAR allows students full access to all forms of transport and taskings where space and  
6 weight restrictions allow, offering students a broad range of experiences during their elective  
7 placement. Over the course of four weeks, I went on 37 separate taskings: 23 by road, eight  
8 by helicopter, and six by fixed-wing aircraft.

9  
10  
11 Having both paediatric and adult retrieval teams operate out of the one base further increases  
12 the range of experiences available to students. Seven of the cases I was involved with were  
13 for paediatric patients, including neonates only a few hours old with congenital cardiac  
14 abnormalities, babies with severe sepsis, pyloric stenosis, or congenital hypoventilation  
15 syndrome, and a teenager in a MVA with a significant intracranial haemorrhage.

16  
17 One particularly memorable case that demonstrated the value of the retrieval team was a road  
18 response to a neonate only a few hours old. Upon our arrival, the baby was in severe  
19 respiratory distress with reduced oxygen saturations, pallor, and absent femoral pulses. The  
20 neonatal retrieval team managed to stabilise the baby by establishing a prostaglandin  
21 infusion, intubating and ventilating via rapid sequence induction, and providing ongoing care  
22 during transport to the hospital. The rapid provision of definitive care demonstrated by the  
23 retrieval team was essential in saving the baby's life.

24  
25 The adult cases were equally varied, including severe diabetic ketoacidosis, subarachnoid and  
26 intraparenchymal haemorrhages, aortic dissection, acute respiratory failure, psychosis,  
27 significant gastrointestinal bleeding, and cardiac arrest and coagulopathy resulting from a  
28 snake bite. High acuity cases occasionally seen by medical students on normal placements  
29 are commonplace occurrences in PHRM.

30  
31 The critically ill patient population of MedSTAR results in the provision of significant  
32 interventions, often conducted in unusual environments. The unique requirements of non-  
33 invasive ventilation during flight, for example, where atmospheric and oxygen partial  
34 pressures are reduced, are unique to this field of medicine. Additionally, although students  
35 may be familiar with the use of ketamine infusions to manage acutely psychotic and  
36 aggressive patients, it is not commonplace to witness this occurring while locked in a small  
37 turboprop aircraft several thousand feet in the air.

38  
39 Life-saving interventions performed by MedSTAR often occur in out-of-hospital settings,  
40 where additional challenges including the uncontrolled environment, reduced availability of  
41 resources, and the weather come into play. During one case, a teenage boy who had been in a  
42 MVA required intubation for reduced conscious state and respiratory drive. This was  
43 conducted by the MedSTAR team at the incident site on the side of the road whilst light rain  
44 fell around them. Witnessing how such situations are managed in these circumstances is very  
45 rare and valuable for students, particularly those interested in critical care.

46  
47 MedSTAR has regular team training and education sessions, providing an opportunity for  
48 students to learn more about the delivery of critical care services in PHRM. During my  
49 placement, this included information on the use of cardiac-pacing and balloon pumps in out-  
50 of-hospital settings, the management of facial fractures with significant epistaxis, and how to

1 survive in the event of a bushfire burnover. Furthermore, as fully integrated members of the  
2 retrieval team, students participate in day-to-day activities essential to PHRM, such as  
3 equipment and pack checks and patient follow-up.

4  
5 Given the high-acuity patient population, there are some limitations to what can be done as a  
6 student, including not being allowed to perform any interventional procedures on patients.  
7 Students can, however, assist with these procedures and be highly involved with tasks such as  
8 setting up equipment, taking vital sign observations, and preparing patients for transport.

9  
10 Students are also not permitted to attend helicopter primary responses. This is due to space  
11 restrictions from the addition of a rescue paramedic to the team, taking up the third seat in the  
12 helicopter that is available for students in secondary responses. This excludes students from a  
13 significant portion of the major trauma seen by MedSTAR as they can only attend primary  
14 taskings reached by road within metropolitan Adelaide. As a result, during my four weeks, I  
15 attended only two primary taskings.

16  
17 A further difference between a PHRM placement and a normal hospital position is the  
18 reduced patient numbers. Owing to the time required to travel to an incident, stabilise and  
19 package the patient for transport, and travel back to the destination hospital, each case takes  
20 several hours to complete. This results in a reduced caseload being seen by students during  
21 the placement, as a maximum of two or three cases can be completed per day.

22  
23 The caseload of PHRM is also extremely dependant on what incidents occur throughout the  
24 state. It is not uncommon to spend many hours on base waiting to be tasked, including days  
25 with no cases at all. This is balanced, however, by the intensity of the cases when they do  
26 arrive and the ability to focus entirely on a single case and therefore learn a great deal about  
27 the pathology and its management.



1 **Conclusion**

2 MedSTAR is the only PHRM unit in Australia with both adult and paediatric retrieval teams  
3 responding via road, helicopter, and fixed-wing aircraft to cases across the state from a single  
4 base. This presents an exceptionally broad range of educational opportunities for medical  
5 students, including the management of critically ill patients in the out-of-hospital  
6 environment, exposure to a variety of complex and high acuity cases, and experience in a  
7 growing field of medicine that is not usually accessible to students. With the COVID-19  
8 pandemic continuing to restrict elective placements, MedSTAR offers a unique elective  
9 experience located a little closer to home.

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2 The author has no conflicts of interest to declare.

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