Length of stay variation in metropolitan Adelaide public acute hospitals

Follow up report to the Health Performance Council's 2022 4-yearly indicator report to the South Australian Minister for Health and Wellbeing

September 2023

Health Performance Council

Government of South Australia
Health Performance Council

Acknowledgment of the Aboriginal peoples of South Australia

The Health Performance Council acknowledges the Aboriginal peoples of South Australia and their ongoing contributions to and participation in the life of South Australia. We acknowledge and respect their spiritual relationship with their respective countries.

Recommended citation

Health Performance Council, Government of South Australia, 2023. *Length of stay variation in metropolitan Adelaide public acute hospitals*.

Contact

Nicholas Cugley
Principal Health Statistician
Health Performance Council Secretariat
South Australian Commission on
Excellence and Innovation in Health

E-mail: nicholas.cugley@sa.gov.au

Findings

In the Health Performance Council's ("the Council", "we") four-yearly report released in December 2022, we identified significant variation in hospital efficiency across the state. This is occurring at the same time as ambulance ramping and long waiting times. If efficiency could be improved, this would help to address those access issues. This report explores that issue further, focusing on variation in length of stay as an efficiency opportunity.

Though there are opportunities to improve patient flow in any hospital, we elected to profile potential opportunities at Royal Adelaide Hospital due to its lengthy average length of stay and high volume of activity. If the Royal Adelaide Hospital reduced the average length of stay for its acute overnight inpatient stays to the same as in other hospitals in metropolitan Adelaide for similar patients in 2021-22, then this would make available the equivalent of:

- Approximately 40 additional beds
- Approximately 3,000 additional inpatient hospitalisations per year.

The Royal Adelaide Hospital sees more complex patients, observed when we adjust hospital stay for inpatient clinical complexity mix, and also measured by number of comorbidities at time of admission. We expect higher complexity patients will stay longer. However, even after accounting for patient complexity there remains a component of total bed capacity that can still potentially be freed-up to allow other patients to be admitted.

The Royal Adelaide Hospital also has higher in-hospital complication rates for the majority of complication categories that can occur during the course of a hospital admission, a lower proportion of acute overnight inpatients staying a single night, and a higher proportion of long-stay patients. With changes to models of care these factors are opportunities to improve, as seen internationally.

The Royal Adelaide Hospital has a demonstrated capability to reduce acute overnight average length of stay. This historic achievement suggests sizable shifts in length of stay can be achieved. This report highlights that a focus on reducing length of stay is required again.

This report has a focus on the Royal Adelaide Hospital as the state's flagship hospital. However, all local health networks would benefit from analysing opportunities for improved patient flow, including the reduction of in-hospital complications among patients.

Introduction

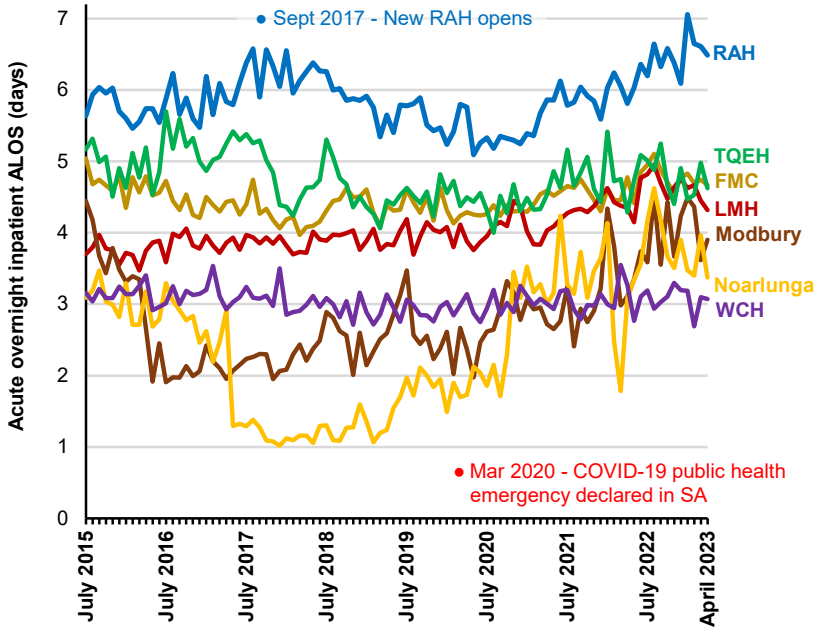
1. In December 2022 the Minister for Health and Wellbeing, the Honourable Chris Picton MP, released the Health Performance Council's report *Monitoring the performance of the South Australian health system 2018-19 to 2021-22: 4-yearly indicator report to the South Australian Minister for Health and Wellbeing*.
2. In that report we noted that "the South Australian public hospital system is relatively inefficient. In the context of poor access, this is a missed opportunity: money is tied up in waste when people can't get admitted".
3. We noted significant variation in hospital efficiency across the state. In the Central Adelaide Local Health Network — which includes the Royal Adelaide Hospital and The Queen Elizabeth Hospital — the cost of treating a patient is almost 30% more than the Australian average even after accounting for the mix of patients.
4. This report follows up on the four yearly report to examine reasons for this efficiency variation, focusing particularly on variations in how long patients stay in hospital (average length of stay, ALOS). We focus on length of stay because it is an unambiguous, well-defined measure which is easy to understand and can be a focus of action while a patient is still in hospital.
5. Although the analyses highlighted in this follow-up report focuses on comparing the Royal Adelaide Hospital (RAH) with other metropolitan public acute hospitals, *each local health network would benefit from examining the detailed results presented in this report to identify potential areas for improvement*.

Common reasons advanced for variation in stay

6. We start by looking at *acute overnight inpatient hospitalisations* at the major metropolitan Adelaide public hospitals— Flinders Medical Centre, Lyell McEwin Hospital, Modbury Hospital, Noarlunga Hospital, Royal Adelaide Hospital, The Queen Elizabeth Hospital, and Women's and Children's Hospital.
7. In 2021-22, RAH saw nearly 38,000 acute overnight inpatient hospitalisations (26% of all major metro) with a much longer acute overnight ALOS compared to the combined major metropolitan Adelaide public hospital acute overnight ALOS (6.0 days compared to 4.7 days).
8. RAH has had a consistently higher ALOS than the other metropolitan Adelaide public acute hospitals for acute overnight inpatient hospitalisations since the new RAH opened in September 2017.
9. Although we will show that it would not explain the observed differences in ALOS pre-pandemic, RAH played a unique role during the COVID-19 emergency. Lower-risk patients at the RAH were directed to other public sites and private hospitals, resulting in the RAH retaining complex, COVID-19 infected patients who may have had multiple comorbidities alongside their COVID-19 infection. Further, the cohort of patients whose care was able to be transferred needed to meet specific acceptance criteria such as no psychosocial issues, no moribund patients and patients who were unlikely to stay longer than the expected ALOS. This meant that RAH was by default servicing a larger proportion of complex, general medical patients, which is a cohort of patients who often have a longer stay. Conversely, the less complex and those destined for a shorter stay were directed away from the RAH. RAH also had more 'outlying patients' due to having to have dedicated COVID wards, noting that outliers in terms of being outside of their usual 'home hospital' can add days to patients' length of stay.

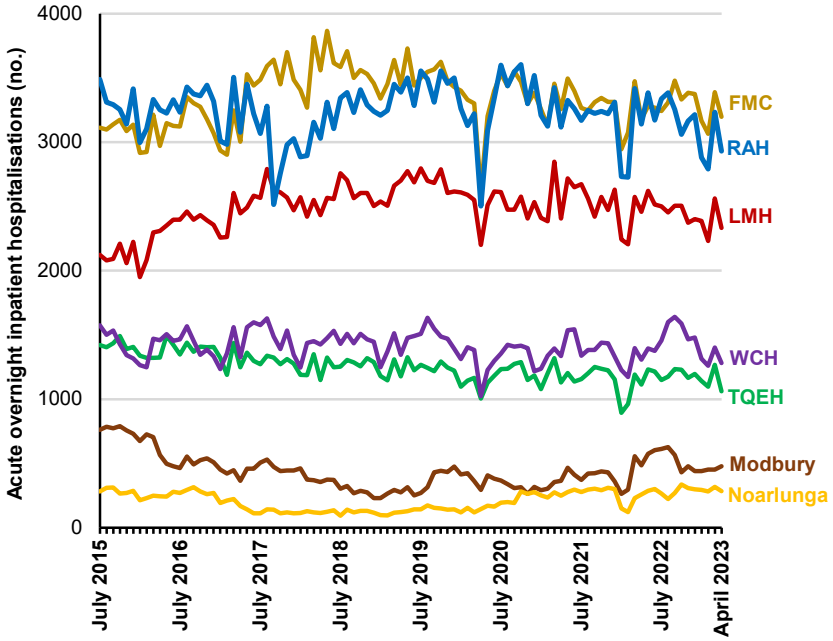
10. Figure 1 shows the trend in hospital length of stay. What is impressive is there was a significant pre-COVID reduction in RAH's ALOS in slightly over two years after the new RAH opened – from 6.6 days in October 2017 to 5.2 days in January 2020. There appears to be a COVID-associated increase in ALOS after that (as discussed above). The historic achievements demonstrates sizable shifts in ALOS stay can be achieved, and our analyses suggests a focus on reducing length of stay is required again. Figure 2 shows volume of hospital activity for context.

Figure 1: Acute overnight inpatient average length of hospital stay (days) per month by major metropolitan Adelaide public acute hospital, July 2015 to April 2023



Source: SA Health Admitted Patient Care data domain. Length of stay not standardised for differences in casemix

Figure 2: Number of acute overnight inpatient hospitalisations per month by major metropolitan Adelaide public acute hospital, July 2015 to April 2023



Source: SA Health Admitted Patient Care data domain

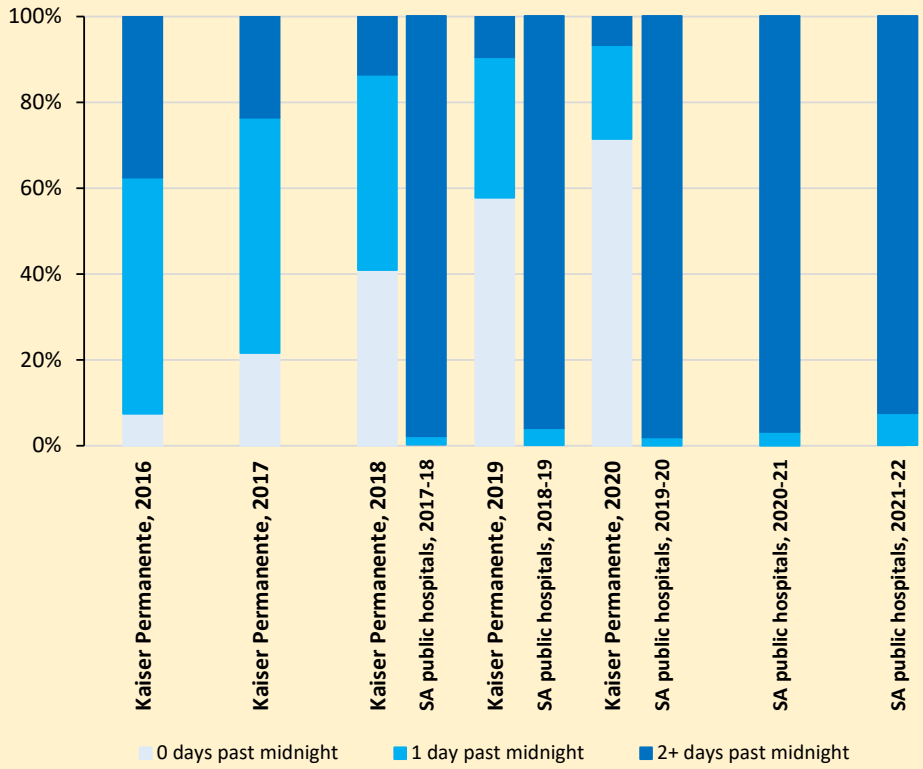
Change can happen!

The average length of stay for a person receiving an elective primary total hip replacement (THR) for osteoarthritis in a public hospital in South Australia was 3.9 days in 2021-22, and in a South Australian private hospital slightly longer at 4.3 days. We perform better than the German hospital system (German *AOK Federation* health insurance system data) on length of stay but worse than *Kaiser Permanente*, a well-regarded, integrated health system in the United States. The typical Kaiser Permanente THR inpatient is in and out on the same day. This is a result of careful planning, and a change process over a number of years[1].

Figure 2 shows the changing composition of THR stays for Kaiser Permanente. It contrasts with South Australian public hospitals where there has been almost no change over a five-year period.

A 2022 Canadian study suggests that same-day total hip replacement may be a cost-saving procedure compared to overnight from both health care payer and societal perspectives[2].

Figure 3: Length of stay cohort for Kaiser Permanente and South Australian public hospital total hip replacement hospitalisations for patients affected by osteoarthritis



Sources:

Simon, B. et al (2023). 'Patient Pathway Comparison for Total Hip Replacement in the United States and Germany — Why the Payment Model Matters', NEJM Catalyst 4(6). doi:https://doi.org/10.1056/cat.22.0456

SA Health Admitted Patient Care data domain

[1] Simon, B., Navarro, R., Reddy, N.C., Convissar, J.L., Rabrenovich, V., Paxton, E., Fasig, B.H., Harris, J., Prentice, H., Bottomley, E.M., Ross, M.N., Walker, M., Grimberg, A., Spoden, M. and Malzahn, J. (2023). 'Patient Pathway Comparison for Total Hip Replacement in the United States and Germany — Why the Payment Model Matters', NEJM Catalyst 4(6). doi:https://doi.org/10.1056/cat.22.0456.

[2] Zomar, B. O., Marsh, J. D., Bryant, D. M., Lanting, B. A. (2022). 'The cost of outpatient versus inpatient total hip arthroplasty: a randomized trial'. Canadian Journal of Surgery (Vol. 65, Issue 5, pp. E553–E561). https://doi.org/10.1503/cjs.003821

Why do patients stay longer?

11. A hospital's ALOS may be longer than other hospitals for a host of legitimate reasons, most obviously, more complex patients will stay longer.

12. We adjusted for the complexity mix by standardising for the Diagnosis Related Group (DRG) to which the patient was assigned, a process known as DRG-standardisation.[3]

13. After adjusting for inpatient complexity using DRG standardisation, acute overnight inpatients at the RAH stay longer than the all-metropolitan weighted average (5.1 days vs 4.7 days) (see Table 1). As the differential drops from 1.3 days unadjusted to 0.4 days adjusted, we conclude that around 70% of the excess ALOS at the RAH is because it treats a more complex acute overnight inpatient complexity mix.

14. Although the 0.4 days' difference in ALOS looks small, it adds up. Because of the large number of acute overnight patients (38,000) treated at the RAH, **this excess could account for over 15,000 beddays of inpatient care in 2021-22 (38,000 × 0.4), or over 3,000 additional inpatients per year (15,000 ÷ metro. average of 4.7 days), or over 40 beds (15,000 beddays ÷ 365 days in year). No adjustment has been made for occupancy rate; such an adjustment would increase the number of beds freed up.**

15. We then examined whether there are other reasons why patients might stay longer at the RAH. Two common reasons advanced for a longer ALOS are that firstly, Aboriginal and Torres Strait Islander (ATSI) inpatients might have a longer ALOS; and secondly, patients from Country SA might have a different pattern of care due to difficulties in organising transport home. If these patients have longer stays on average, then if a hospital treats a larger proportion of these patients than other hospitals, a longer ALOS would be expected.

16. The *DRG-standardised* acute overnight ALOS for all-ATSI patients in major metropolitan Adelaide public hospitals is in fact shorter than the all-non-ATSI patient cohort: 3.8 days compared to 4.7 days (see table 1).[4] However, note that *without DRG-standardisation*, the all-ATSI vs all-non-ATSI ALOS in 2021-22 is 4.9 days vs 4.7 days (and specifically at the RAH — 6.0 days vs 5.9 days).

17. The shorter *DRG-standardised* ALOS for ATSI patients holds true regardless of where the patient lives.

18. Another challenge in relation to assessing ATSI ALOS is that Aboriginal and Torres Strait Islander persons may not wish to identify as such and their status not recorded. This may impact length of stay comparison between specific population cohorts but the effect is likely to be spread across all metropolitan hospitals. It would not account for the magnitude of differences between RAH and other identified metropolitan facilities.

19. The rural-metro hypothesis for increased ALOS is somewhat, but not consistently, supported. For some hospitals, patients who live in metropolitan Adelaide stay longer than Country SA patients, for others, they do not. There is a small difference in the overall acute overnight ALOS between metro and country residents hospitalised in metropolitan Adelaide public hospitals (4.6 vs 4.8 days). A 0.2 day differences could be material given the volume of hospitalisations (see Table A.1). The care and timely discharge of country patients is another area potential improvement at RAH.

20. Given the above, further analyses in this report do not distinguish ATSI from other patients, or by region of residence.

[3] We adjusted for acute overnight inpatient complexity mix using DRG standardisation. The ALOS for each hospital was weighted against the 2021-22 DRG separation profile of the combined metropolitan Adelaide public hospitals (direct standardisation) of each patient cohort. In this report this is termed the DRG-standardised ALOS. Note that DRGs related to pregnancy, childbirth and the puerperium, newborns and other neonates were excluded from the standardisation as RAH is not a maternity hospital. Major metro totals are occupied bed days (OBDS)-weighted averages.

[4] The numbers of patients involved is shown in Appendix Table A.1.

Table 1: Acute overnight average length of hospital stay (days, DRG-standardised) by major metropolitan Adelaide hospital and inpatient cohort, 2021-22

Patient cohort	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
				ALOS (days) (DRG-standardised)				
ATSI metro residents	2.7	2.8	Insufficient activity to standardise with confidence		3.5	2.4	1.9	2.8
ATSI country residents	1.8	1.8			4.8	1.3	1.5	3.5
All ATSI	**3.8**	**2.9**			**4.7**	**2.7**	**3.0**	**3.8**
Non-ATSI metro residents	4.7	4.8	2.6	2.8	4.9	4.5	2.7	4.6
Non-ATSI country residents	5.2	4.2	0.9	0.9	5.3	3.7	3.1	4.8
All non-ATSI	**4.9**	**4.8**	**2.5**	**2.7**	**5.0**	**4.6**	**3.3**	**4.7**
All metro residents	4.7	4.7	2.6	2.8	4.9	4.5	2.8	4.6
All country residents	5.2	4.1	0.9	0.9	5.3	3.9	3.3	4.8
Elective admissions	4.1	2.1	0.8	0.7	3.7	2.7	2.0	3.3
Emergency admissions	5.0	5.0	2.6	2.6	5.3	4.8	3.8	4.9
Ages 0-34 years	2.7	2.3	0.9	0.7	3.4	1.9	3.1	2.9
Ages 35-64 years	4.8	4.3	1.3	1.1	4.7	4.1	0.2	4.5
Ages 65+ years	5.6	5.7	3.0	3.3	5.9	5.4	Insuff. data	5.6
DRGs with extreme complexity	Insufficient activity to standardise with confidence							
DRGs with major complexity	7.7	7.9	4.3	4.4	8.2	7.4	5.8	7.7
DRGs with intermediate complexity	6.6	5.4	1.7	2.4	5.8	5.7	4.5	5.9
DRGs with minor complexity	2.8	2.6	1.4	1.6	2.9	2.7	2.0	2.7
DRGs with no defined complexity	2.3	2.3	0.8	1.4	2.3	1.9	1.4	2.1
TOTAL	**4.9**	**4.7**	**2.5**	**2.6**	**5.1**	**4.6**	**3.6**	**4.7**

Source: SA Health Admitted Patient Care data domain

21. Private patients in major metropolitan Adelaide public hospitals stay longer on average than public patients (5.6 days vs 4.5 days). When we adjust for complexity via DRG-standardisation and adjusting for admission mode (emergency vs planned) the metropolitan hospital total average gap narrows, to 4.7 days vs 4.6 days. **RAH has the highest proportion of private patients at 23% in 2021-22, compared to the major metropolitan Adelaide public hospital average of 16%.**

22. Unlike age or diagnosis, private status does not inherently affect length of stay. That is, the length of stay of a private patient is something that the hospital can control. We have therefore not adjusted for the proportion of private patients in a hospital.

23. Analysis of patient complexity showed that almost one third (31%) of South Australia's more complex patients (DRGs with major complexities) admitted to metropolitan hospitals are treated at the RAH (see Table A.1), and a higher proportion of the RAH's patients are in this most complex group compared to the metropolitan average (41% compared to 35%). Similarly, the RAH has a smaller proportion of patients at the lower complexity end of the spectrum (49% vs 53%). The exception is patients assigned

to the 'intermediate' complexity band (10% of RAH patients compared to 12% across all metro hospitals).

24. Therefore, except for the intermediate complexity band, the RAH's pattern of a longer ALOS is still seen across all levels of complexity. The care and timely discharge of patients of all levels of complexity is another area potential improvement at RAH.

25. Across all metropolitan hospitals and patient cohorts, there are other hospitals that have opportunities to improve acute overnight ALOS. For example, FMC has the longest DRG-standardised ALOS for elective admissions (see Table 1).

Inpatient complexity

26. As the main quaternary teaching and research facility for South Australia, RAH treats a higher proportion of high acuity patients compared to other South Australian public hospitals. The RAH is a major trauma centre and the primary site for multi-trauma patients, patients requiring up-transfers from country facilities. The RAH receives transferred patients who have deteriorated at other facilities and patients with complex discharge situations that require support before the patient can go home.

27. It could be argued that this is not adequately adjusted for in our analysis using DRG standardisation. There may be within-DRG variation that could account for RAH's longer length of stay.

28. We looked at this by applying the Multipurpose Australian Comorbidity Scoring System (MACSS) to the acute overnight inpatient hospitalisations dataset as a measure of patient complexity not used in DRG assignment. MACSS was chosen as it is based on 102 comorbid conditions and has been shown to outperform other commonly used comorbidity measures[5].

29. We calculated the MACSS score for each patient using all additional diagnoses present on admission. That is, the number of comorbidities already present when the acute overnight inpatient was admitted, excluding conditions that occurred in-hospital.

30. We started by noting that the average number of non-hospital-acquired MACSS-defined comorbidities amongst RAH acute overnight inpatients was indeed statistically significantly[6] higher in 2021-22 than the non-RAH group of metropolitan Adelaide public acute hospitals (2.2 vs 1.8).

31. Also, we noted a statistically significant[7] positive correlation between length of stay and number of non-hospital-acquired MACSS-defined comorbidities amongst metropolitan Adelaide public acute hospitals in 2021-22. The coefficient of determination (R-squared) between length of stay and number of comorbidities is 0.196. That is, just under 20% of variation in eventual length of stay can be explained by variation in number of comorbidities at time of admission, across all DRGs. This nominally equates to eight beds of the 40 equivalent beds identified that could be freed up at RAH.

32. Further, analysis of variance (ANOVA) indicates that DRG is a statistically significant[8] factor on number of non-hospital-acquired MACSS-defined comorbidities at metropolitan Adelaide public acute hospitals in 2021-22.

33. So we did a deeper dive into the relationship between comorbidities and length of stay, taking into account the patient's DRG. We looked at correlations between length of stay and non-hospital-acquired MACSS-defined comorbidities at the individual DRG level. We identified 314 DRGs with more than 30 acute overnight inpatient hospitalisations (excluding haemodialysis) at the RAH in 2021-22. Of these, only 59 (19%) were DRGs where the average number of comorbidities at the RAH was statistically significantly greater than the average for the non-RAH group of metropolitan Adelaide public acute

[5] Toson, B., Harvey, L. A.; Close, J. C. T. (2016). 'New ICD-10 version of the multipurpose Australian comorbidity scoring system outperformed Charlson and Elixhauser Comorbidities in an older population'. Journal of Clinical Epidemiology, 79, 62–69 https://doi.org/10.1016/j.jclinepi.2016.04.004.

[6] $t(63572)= 24.915$, $p<0.001$

[7] $r(145310)=0.443$, $p<0.001$

[8] $F(774)=123.5$, $p<0.001$

hospitals (see appendix Table A.2). Of the 59 DRGs, coefficients of determination (R-squared) for length of stay vs comorbidities vary between 46% and 0%.

34. Combined, we calculate that these 59 DRGs account for only around two beds of the approximately 40 equivalent beds we identified that could be freed up at RAH.

35. The number of comorbidities present on admission and resulting length of stay are correlated; and RAH acute overnight inpatients have slightly more comorbidities on admission than their metropolitan hospital counterparts. RAH certainly has some DRGs where DRG-standardisation does not pick up the extra within-DRG complexity of RAH patients, but this is a minority of DRGs. We believe that additional inpatient complexity as we have defined it at RAH could account for between two and eight of the 40 additional beds identified as having potential to be freed up.

36. Looking at national peer hospital comparison casemix data provided by the RAH to the HPC, RAH is ranked 18th of its directly-comparable Australian peers for acute care type average length of stay and 10th for acute relative stay index.

In-hospital complications

37. Another hypothesis why RAH patients might stay longer than patients in other hospitals is that RAH patients may have more in-hospital complications. We examined this factor by analysing whether or not a patient had a new diagnosis made in hospital, which was not present on admission (e.g. hospital-acquired infection). We classified these additional diagnoses using a 'simplified' version (excluding conditional diagnoses) of the Classification of Hospital-Acquired Diagnoses (CHADx).[9]

38. This approach does not claim that any or all of these diagnoses could have been prevented, so it is unlike the designated Hospital Acquired Complication list which is used to impose financial penalties as part of the national hospital funding arrangements when there are higher rates of those conditions. The designated list was developed in 2016 and *de facto* identified the highest priority areas for action to improve hospital safety at that time. We take a broader approach, looking at all areas for potential improvement.

39. A higher rate of patients who have at least one additional diagnosis ('CHADx complication') in one hospital compared to another indicates a potential area for improvement. The frequency of occurrence may be reducible if not totally preventable. The finer-grained categorisations provide information for targeting quality improvement efforts, both for the hospital and in individual specialties.

40. We use the 'all complications' approach rather than the narrower list of 'hospital acquired complications' used by South Australia Health because there are substantially more patients affected by the 'all complications' approach, which means there is a greater potential for improvement.

41. A 2018 *Grattan Institute* report[10] found that between 2012-13 to 2014-15, one in every nine (11%) people admitted to hospital in Australia developed a CHADx-defined complication. For patients who were in hospital overnight, the rate was even higher: more than one in four (25%).

42. In this analysis we find that of the 145,312 acute overnight inpatient separations from metropolitan hospitals, 26,823 had at least one CHADx complication (simplified), a rate of 1845.9 per 10,000 separations (18%) (see Table 2).

43. There was almost four-fold variation in complication rates across metropolitan hospitals with the highest rates recorded in 2021-22 for FMC, RAH and WCH (5,022.4, 4,266.6 and 4,118.6 per 10,000 hospitalisations, respectively) (see Table 2).

[9] The CHADx classification also includes certain other diagnoses and codes which indicate the diagnosis was 'hospital-acquired'. Jackson, Terri, et al. (2009), 'A classification of hospital-acquired diagnoses for use with routine hospital data', *Medical Journal of Australia*, 191 (10), 544-48.

[10] Duckett, Stephen, et al. (2018), 'All complications should count: Using our data to make hospitals safer' (Melbourne, Vic.: Grattan Institute).

Table 2: CHADx-defined (simplified) complication rates by metro hospital and CHADx type, acute overnight hospitalisations in 2021-22*

Hosp name	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
Number of acute overnight separations	*39,017*	*29,946*	*5,225*	*3,128*	*37,983*	*13,828*	*16,185*	***145,312***
CHADx* occurrences per 10k separations								
CHADx 1 Postprocedural complications	402.1	298.5	122.5	121.5	**506.5**	397.7	137.8	**362.1**
CHADx 2 Adverse drug events	764.5	393.0	246.9	425.2	702.7	500.4	226.8	**560.9**
CHADx 3 Accidental injuries	71.5	56.8	65.1	54.3	52.9	83.9	4.3	**56.7**
CHADx 4 Infections	460.6	207.4	72.7	127.9	**521.5**	379.7	287.9	**376.3**
CHADx 5 Cardiovascular complications	300.4	146.6	90.0	105.5	**361.5**	176.5	103.2	**239.1**
CHADX 6 Respiratory complications	244.5	110.5	126.3	73.5	**264.1**	208.3	100.7	**194.6**
CHADx 7 Gastrointestinal complications	236.1	110.9	44.0	127.9	**288.8**	209.7	94.5	**196.5**
CHADx 8 Skin conditions	54.6	27.4	-	54.3	30.3	41.2	48.8	**38.7**
CHADx 9 Genitourinary complications	226.8	134.9	76.6	99.1	**257.2**	154.8	93.9	**186.0**
CHADx 10 Hospital-acquired psychiatric states	27.4	12.4	9.6	9.6	24.7	13.7	16.7	**20.1**
CHADx 11 Early pregnancy complications	1.0	-	-	-	-	-	3.7	**0.7**
CHADx 12 Labour, delivery & postpartum complications	760.2	920.3	-	-	-	0.7	2,375.0	**658.4**
CHADx 13 Perinatal complications	0.5	6.3	-	-	-	-	15.4	**3.2**
CHADx 14 Haematological disorders	140.7	53.4	21.1	35.2	**206.9**	96.2	93.3	**123.9**
CHADx 15 Metabolic disorders	890.4	100.5	86.1	259.0	642.9	467.2	183.5	**501.4**
CHADx 16 Nervous system complications	35.1	14.0	11.5	9.6	**40.0**	18.8	18.5	**27.3**
CHADx 17 Other complications.	406.0	216.4	137.8	195.0	366.5	276.3	314.5	**319.9**
***TOTAL* CHADx OCCURRENCES**	**5,022.4**	**2,809.4**	**1,110.0**	**1,697.6**	**4,266.6**	**3,025.0**	**4,118.6**	**3,865.8**
***AT LEAST ONE* CHADx OCCURRENCE**	**2,246.5**	**1,596.5**	**710.0**	**1,051.8**	**1,796.9**	**1,428.3**	**2,333.6**	**1,845.9**

* Simplified CHADx excludes conditional diagnoses for CHADx classifications 2 and 3

Sources: SA Health Admitted Patient Care data domain

44. The RAH has a higher rate of complications in eight out of the fourteen non-maternity major CHADx (simplified) groups. RAH is not a maternity hospital.

45. In 2021-22, the most common complications — other than maternity complications — were adverse drug events occurring at a rate of 560.9 per 10,000 separations; infections occurred at a rate of 376.3 per 10,000 separations.

46. More complex patients have a higher rate of complications, and so part of RAH's higher rate is due to the patients it treats. However, even after DRG standardisation, RAH has more complications than the metropolitan average (see Table 3).

Table 3: Non-maternity CHADx-defined (simplified) complication rates by metro hospital, actual and DRG-standardised, acute overnight hospitalisations in 2021-22*

At least one non-maternity CHADx occurrence per 10k separations	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
Actual	1846.9	1105.3	710.0	1051.8	1796.9	1427.5	1037.4	**1492.9**
DRG-standardised	1950.4	1000.4	517.1	836.2	1424.2	1311.9	1207.2	**1401.3**

* Simplified CHADx excludes conditional diagnoses for CHADx classifications 2 and 3

Sources: SA Health Admitted Patient Care data domain. CHADx codes provided by Terri Jackson, PhD, Adjunct Associate Professor, School of Population and Global Health, University of Melbourne

47. Further, an overnight patient who has at least one CHADx complication stayed about three times longer than a patient who had none (see table 4). Of course, there is a circularity here: a CHADx complication is also likely to lead to a longer stay but a patient is more exposed to the risk of a CHADx complication the longer they stay in hospital. Older patients (75 years of age and older) are more likely to have a hospitalisation with a non-maternity CHADx complication (18.2%) than other patients (13.8%) (see Table A.4).

Table 4: DRG-standardised ALOS (days) for acute overnight hospitalisations by CHADx-defined (simplified) complications, 2021-22*

Hospitalisation type	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
At least one non-maternity CHADx complication	11.4	9.9	3.2	2.7	11.6	9.7	8.7	10.8
No CHADx complications (excluding maternity)	3.5	3.8	2.3	2.3	3.9	3.6	2.2	3.6
All non-maternity	**4.9**	**4.7**	**2.5**	**2.6**	**5.1**	**4.6**	**3.6**	**4.7**

* Simplified CHADx excludes conditional diagnoses for CHADx classifications 2 and 3

Sources: SA Health Admitted Patient Care data domain. CHADx codes provided by Terri Jackson, PhD, Adjunct Associate Professor, School of Population and Global Health, University of Melbourne

48. **If RAH had the same DRG-standardised ALOS of hospitalisations with complications as other hospitals,[11] then almost 5,500 inpatient days could be saved, equivalent to 15 beds. Given the analyses earlier that suggests RAH's higher ALOS was equivalent to 40 beds per annum, RAH's complication rate represents a sizable share of that total.**

49. Local health networks would benefit from examining where higher rates of complications occur and engage clinicians to develop strategies to reduce these rates.

Long-stay patients

50. The Commonwealth-state hospital payment system provides additional payments for unusual patients, defined for this purpose as patients who stay more than three times the national ALOS for their DRG. The 3X threshold is called the 'upper trim point', or the 'upper bound'. We use the latter term.[12]

51. As we know that patients with a CHADx complication stay longer than other patients, patients without complications are assessed to determine whether they stayed longer than the Independent Health and Aged Care Pricing Authority (IHACPA) defined Diagnosis Related Group (DRG) upper bound.

[11] Defined as at least one CHADx occurrence.

[12] For most DRGs there is a corresponding lower threshold at one third ALOS.

Table 5: Long-stay acute overnight hospitalisations, DRG-standardised ALOS (days) and percent exceeding upper bound, 2021-22— No non-maternity CHADx complications*

Age of patient	Long stay**	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
<=75 years	Non-long-stay ALOS	2.8	2.7	1.5	1.3	3.1	2.7	2.0	2.8
	Long stay ALOS	11.7	12.4	2.7	2.5	12.7	8.6	4.8	11.1
	Long stay %	3.3%	2.8%	2.2%	2.0%	3.7%	3.8%	1.7%	3.0%
>75 years	Non-long-stay ALOS	3.6	4.2	2.8	2.6	4.0	3.7	-	3.8
	Long stay ALOS	11.1	12.9	6.7	5.5	13.6	10.7	-	11.8
	Long stay %	3.7%	5.1%	3.8%	5.2%	5.0%	5.2%		4.6%
All ages	Non-long-stay ALOS	3.1	3.2	2.0	1.9	3.4	3.0	2.0	3.1
	Long stay ALOS	13.0	13.6	5.7	5.0	14.0	10.6	4.3	12.4
	Long stay %	3.4%	3.3%	2.9%	3.1%	4.1%	4.3%	1.7%	3.4%

* Simplified CHADx excludes conditional diagnoses for CHADx classifications 2 and 3

** Long stay hospitalisations are acute overnight hospitalisations where the actual length of the inpatient's stay exceeded the DRG three times ALOS upper bound for the DRG from table Appendix H – Price weights for admitted acute patients – AR-DRG V10.0, National Efficient Price Determination tables, Independent Health and Aged Care Pricing Authority

ALOS figures reported in this table are DRG-standardised

Sources: SA Health Admitted Patient Care data domain. ALOS upper bound limits from National Efficient Price Determination tables, Independent Health and Aged Care Pricing Authority. CHADx codes provided by Terri Jackson, PhD, Adjunct Associate Professor, School of Population and Global Health, University of Melbourne

52. RAH has a higher rate (4.1%) of patients without non-maternity complications who stay longer compared to the metropolitan hospital average (3.4%) (see Table 5). Reducing the RAH rate to the metropolitan average would save about seven beds of the 40 beds previously identified.

53. Examining these long-stay patients with targeted early interventions could provide opportunities for improvement. For example, older patients who stay more than two days might be flagged for an initial geriatric assessment to assess the risk of their having a prolonged stay.[13]

54. Table 5 above analyses patients classed as acute overnight patients. In addition, all hospitals in Australia have patients who are still in hospital even though they no longer need acute treatment, these patients are called 'maintenance care patients'. These patients may be in hospital due to failures in getting more appropriate care funded by the National Disability Insurance Scheme (NDIS), or in arranging aged care in a residential aged care facility or aged care support at home.

[13] Gray, Leonard C, et al. (2018), 'Development and testing of the interRAI acute care: a standardized assessment administered by nurses for patients admitted to acute care', Health Services Insights, 11, 1-7.
Peel, Nancye M, et al. (2021), 'Implementation and evaluation of a standardized nurse-administered assessment of functional and psychosocial issues for patients in acute care', Worldviews on Evidence-Based Nursing, 18 (3), 161-69.

Table 6: Maintenance care beddays and average length of stay by hospital, 2021-22

	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
Maintenance Care beddays (no.)	14,367	9,477	6,249	1,430	11,163	3,887	-	**46,573**
Total inpatient beddays (no.)	344,793	191,180	85,183	41,956	320,128	133,483	93,366	**1,210,089**
Maintenance Care beddays (%)	4.2%	5.0%	7.3%	3.4%	3.5%	2.9%	0.0%	**3.8%**
Maintenance Care ALOS (days)	21.4	16.5	14.2	14.7	12.7	8.7	-	**15.0**
Total *overnight* inpatient ALOS (days)	6.5	5.0	8.4	6.7	6.3	6.5	3.8	**6.0**

Source: SA Health Admitted Patient Care data domain

55. Although the RAH rate of maintenance care beddays (3.5%) (see Table 6) is below the major metropolitan acute public hospital average (3.8%), this still represents the equivalent of over 30 beds are being occupied by patients who no longer need the acute care RAH provides. This highlights the importance for all local health networks to maximise efforts to manage these patients in appropriately staffed wards and promote more off-site care.

56. *These 30 beds are in addition to the potential 40 bed which might be freed up as identified in our analyses of acute patients.*

Short-stay patients — Day-only stays and single-night stays

57. The proportion of strictly sameday acute inpatients (acute episodes of care admitted and discharged on the same day, without an overnight stay) is fairly even across the larger hospitals (FMC, LMH, RAH, TQEH and WCH) once relative clinical complexity is accounted for via DRG-standardisation and by removal of high-volume-low-acuity activity such as haemodialysis (see Table 7).

58. The 2021-22 DRG-standardised acute sameday hospitalisation rate for RAH (43.1%) is slightly above the metropolitan average (40.3%)—not including hospitalisations for haemodialysis, chemotherapy and scopes[14].

Table 7: Percent of acute hospitalisations where inpatient was admitted and discharged on the same day, actual and DRG-standardised percent, 2021-22

Acute sameday hospitalisations as a percent of all acute hospitalisations	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
Actual, *including* haemo-dialysis, chemotherapy & scopes*	48.3%	44.4%	57.6%	81.3%	59.0%	62.1%	47.2%	**54.3%**
Actual, *excluding* haemo-dialysis, chemotherapy & scopes*	35.4%	35.7%	57.3%	68.8%	42.2%	47.1%	43.2%	**41.8%**
DRG-standardised, *including* haemodialysis, chemotherapy & scopes*	51.1%	51.7%	33.8%	61.2%	55.3%	54.8%	55.7%	**53.1%**
DRG-standardised, *excluding* haemodialysis, chemotherapy & scopes*	36.7%	36.5%	45.0%	49.5%	43.1%	41.4%	41.3%	**40.3%**

* 'scopes' in this analysis consists of arthroscopies, bronchoscopies, colonoscopies, endoscopies, and gastroscopies

Sources: SA Health Admitted Patient Care data domain

[14] 'Scopes' are defined in this analysis as arthroscopies, bronchoscopies, colonoscopies, endoscopies, and gastroscopies.

59. Another way to look at short-stay activity is to consider acute overnight hospitalisations of a single overnight stay.

60. In 2021-22, RAH recorded the lowest rate of acute hospitalisations of a single overnight stay (27.6%) amongst the seven major metropolitan Adelaide public hospitals (average 34.9%) (see Table 8).

61. Accounting for relative clinical complexity via DRG-standardisation, RAH still records the lowest rate of single overnight stay acute hospitalisations (30.9% vs 33.6% average).

Table 8: Percent of acute overnight hospitalisations where recorded length of stay is single night, actual and DRG-standardised percent, 2021-22

Acute overnight hospitalisations of single night as a percent of all acute overnight hospitalisations	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
Actual	32.7%	36.7%	56.2%	55.4%	27.6%	33.7%	43.9%	**34.9%**
DRG-standardised	32.8%	34.1%	44.4%	40.6%	30.9%	32.5%	38.8%	**33.6%**

Sources: SA Health Admitted Patient Care data domain

62. Finally, looking specifically at acute hospitalisations where no non-maternity complication was recorded, RAH again has the lowest rate amongst the major metropolitan Adelaide public hospitals where the overnight stay was a single night (36.8% vs an average 43.2% for inpatients aged 75 years or under, and 22.8% vs an average 29.5% for inpatients aged over 75 years) (see Table 9).

63. **If RAH increased its percentage of acute overnight stays of a single night (without complications) from the current 32.7% to the average of 39.8% about 5,000 beddays per year (over 1,000 additional inpatients at a metropolitan hospital average of 4.7 days' ALOS) would be freed up. This is the equivalent of about 14 beds of the 40 beds previously identified.**

Table 9: Acute overnight hospitalisations by recorded length of stay cohort (single night stay / multiple-night stay), 2021-22— No non-maternity CHADx complications*

Age of inpatient	Length of overnight stay	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
<=75 years	Single night	9,811	9,155	1,757	1,217	8,141	3,212	6,931	**40,224**
	Multiple nights	14,183	11,401	798	567	14,002	4,423	7,575	**52,949**
	Total	23,994	20,556	2,555	1,784	22,143	7,635	14,506	**93,173**
	% Single night	**40.9%**	**44.5%**	**68.8%**	**68.2%**	**36.8%**	**42.1%**	**47.8%**	**43.2%**
>75 years	Single night	2,542	1,555	1,086	450	2,057	1,303		**8,993**
	Multiple nights	5,275	4,525	1,213	565	6,958	2,916		**21,452**
	Total	7,817	6,080	2,299	1,015	9,015	4,219		**30,445**
	% Single night	**32.5%**	**25.6%**	**47.2%**	**44.3%**	**22.8%**	**30.9%**		**29.5%**
All ages	Single night	12,353	10,710	2,843	1,667	10,198	4,515	6,931	**49,217**
	Multiple nights	19,458	15,926	2,011	1,132	20,960	7,339	7,575	**74,401**
	Total	31,811	26,636	4,854	2,799	31,158	11,854	14,506	**123,618**
	% Single night	**38.8%**	**40.2%**	**58.6%**	**59.6%**	**32.7%**	**38.1%**	**47.8%**	**39.8%**

* Simplified CHADx excludes conditional diagnoses for CHADx classifications 2 and 3; Maternity complications removed to aid comparison

Sources: SA Health Admitted Patient Care data domain. CHADx codes provided by Terri Jackson, PhD, Adjunct Associate Professor, School of Population and Global Health, University of Melbourne

Conclusion

64. This follow-up report has taken a deep dive into the efficiency variations we identified in our four-yearly Report released last year. We have identified that there are significant opportunities for RAH to lift its game to bring its ALOS to that seen in other metropolitan Adelaide hospitals for similar patients.

65. We identified that, just looking at acute overnight patients, about 40 beds could be freed up if RAH addressed its excess ALOS. We have shown change of this magnitude has been achieved by RAH in the past. We have also identified factors – such as higher rates of complications and very long stays, and lower rates of single day admissions – which contribute to this total.

66. This is not just a theoretical exercise. Every bed taken up by a patient staying too long in hospital, is a bed not available for another patient. This inefficiency therefore contributes to unnecessary ramping and longer wait times for planned procedures.

67. Our aim with this report is to identify potential areas for improvement. Improving efficiency is an important way in which access can be improved. We will therefore revisit this analysis in a further report in the future when data from later periods become available. This will allow us to highlight if and by how much RAH has been able to address the issues we have identified.

Appendix

Table A.1: Acute overnight hospitalisations by metro hospital and inpatient cohort, 2021-22

Patient cohort	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
				number of separations				
ATSI metro residents	703	1,031	79	54	1,089	392	584	3,932
ATSI country residents	199	217	10	7	529	89	300	1,351
All ATSI	**1,074**	**1,283**	**94**	**62**	**2,051**	**523**	**997**	**6,084**
Non-ATSI metro residents	30,297	22,391	4,598	2,716	26,044	11,116	11,693	108,855
Non-ATSI country residents	6,142	5,220	312	266	7,407	1,426	2,651	23,424
All non-ATSI	**36,708**	**27,822**	**4,932**	**3,005**	**34,409**	**12,652**	**14,570**	**134,098**
All metro residents	31,719	23,940	4,846	2,821	28,102	12,019	12,646	116,093
All country residents	6,798	5,738	345	282	8,339	1,621	3,161	26,284
Elective admissions	8,340	2,486	1,128	982	6,603	3,120	2,790	25,449
Emergency admissions	28,001	23,382	3,931	1,821	28,520	9,901	8,429	103,985
Ages 0-34 years	9,861	8,757	495	280	4,419	1,334	14,309	39,455
Ages 35-64 years	11,790	9,360	1,368	948	14,170	4,670	1,871	44,177
Ages 65+ years	17,366	11,829	3,362	1,900	19,394	7,824	5	61,680
DRGs with extreme complexity	9	27	-	-	-	-	29	65
DRGs with major complexity	12,574	10,760	1,661	827	15,697	5,079	4,122	50,720
DRGs with intermediate complexity	4,921	3,668	260	124	3,864	1,027	3,032	16,896
DRGs with minor complexity	20,221	14,708	2,918	1,987	15,806	6,933	7,918	70,491
DRGs with no defined complexity	1,292	783	386	190	2,616	789	1,084	7,140
TOTAL	**39,017**	**29,946**	**5,225**	**3,128**	**37,983**	**13,828**	**16,185**	**145,312**

Source: SA Health Admitted Patient Care data domain

Table A.2: Separations (acute overnight inpatient hospitalisations), comorbidities (MACSS-defined) present at time of admission, length of stay (LOS) and coefficients of determination (R-squared) by select Diagnosis Related Group (DRG) — RAH vs metropolitan Adelaide public acute hospital counterparts, 2021-22

	RAH Diagnosis Related Groups (DRGs) with more than 30 hospitalisations (excl. haemodialysis), 2021-22	RAH			Other metro. public hospitals			RAH MACSS vs ALOS R-squared
		no. seps.	avg. no. MACSS	ALOS (days)	no. seps.	avg. no. MACSS	ALOS (days)	
1	E62B RESPIR INFECTN/INFLAMM, MINC	429	1.7	3.6	1,497	1.2	2.5	6% *
2	E67A RESP SIGNS & SYMPTOMS, MAJC	328	3.7	5.8	324	2.9	4.5	15% *
3	G67A OESOPHS & GASTROENTS, MAJC	308	3.3	4.9	1,240	2.5	4.0	23% *
4	B02C CRANIAL INTERVTN, MINC	305	1.2	4.7	143	0.7	4.8	9% *
5	E65B CHORNIC OBSTR AIRWAY DIS, MINC	266	1.2	3.5	936	1.0	2.9	3% *
6	G70C OTHER DIGESTIVE SYS DIS, MINC	253	1.0	1.7	1,354	0.8	1.8	2% *
7	F62B HEART FAILURE & SHOCK, MINC	250	2.6	4.0	785	2.2	3.8	6% *
8	B02B CRANIAL INTERVTN, INTC	228	2.9	8.8	81	1.2	9.9	2% *
9	Q60A RETICLENDO&IMMUNITY DIS, MAJC	225	3.8	9.2	326	3.0	5.3	20% *
10	E67B RESP SIGNS & SYMPTOMS, MINC	212	2.1	3.3	494	0.7	1.5	14% *
11	T63B VIRAL ILLNESS, MINC	212	1.5	3.8	609	0.7	2.1	20% *
12	F76A ARRHY,CARD ARRST&COND DIS, MAJC	182	3.2	4.4	569	2.6	3.6	10% *
13	B76A SEIZURES, MAJC	178	2.5	6.1	325	2.1	5.2	10% *
14	X06C OTH INTERVTN FOR OTH INJURIES, MINC	156	0.4	2.0	397	0.2	2.0	31% *
15	K60B DIABETES, MINC	155	2.2	3.9	525	1.5	3.0	20% *
16	H62B PANCREAS DIS -MALIG, MINC	153	1.3	3.2	502	1.0	3.2	0%
17	E41B RESP SYS DIS,NON-INV VENT, MINC	148	3.0	9.1	263	2.6	6.7	3% *
18	D63B OTITIS MEDIA&UPP RESP INF, MINC	147	1.2	2.1	722	0.6	1.5	21% *
19	F75B OTHER CIRCULATORY DIS, MINC	138	1.4	2.6	334	1.0	2.5	7% *
20	B76B SEIZURES, MINC	136	1.0	2.2	548	0.6	1.7	3% *
21	D63A OTITIS MEDIA&UPP RESP INF, MAJC	129	2.8	4.4	304	1.5	2.9	11% *
22	B77B HEADACHES, MINC	128	0.6	1.6	360	0.5	1.3	1%
23	I12C MISC INTERVTN INFC/INFM BNE/JN, MINC	123	2.0	5.3	118	1.4	7.5	2% *
24	E61A PULMONARY EMBOLISM, MAJC	122	3.7	6.7	216	3.0	6.4	18% *
25	F76B ARRHY,CARD ARRST&COND DIS, MINC	119	0.9	1.9	510	0.7	1.6	4% *
26	T62B FEVER OF UNKNOWN ORIGIN, MINC	119	2.1	3.1	379	1.7	2.1	2%
27	T63A VIRAL ILLNESS, MAJC	112	3.6	9.9	174	2.4	5.7	18% *
28	L04C KDY,URT&MJR BLDR INTERVT N-NPM, MINC	110	0.5	2.3	249	0.3	1.5	8% *
29	R60A ACUTE LEUKAEMIA, MAJC	109	3.9	22.6	51	2.2	13.5	2%
30	T62A FEVER OF UNKNOWN ORIGIN, MAJC	107	3.4	5.9	198	3.0	4.9	1%
31	G66A ABDMNL PAIN/MESENT ADNTS, MAJC	99	2.4	3.1	362	1.8	2.9	11% *
32	B02A CRANIAL INTERVTN, MAJC	95	5.0	22.5	28	2.9	22.5	11% *
33	L65B KDNY&UNRY TR SGNS&SYMPS, MINC	92	1.9	2.3	284	1.3	1.9	4% *
34	F06B CRNRY BYPSS-INV INVES, INTC	91	2.9	9.5	37	2.0	11.7	3% *
35	E61B PULMONARY EMBOLISM, MINC	72	1.2	2.7	303	0.9	2.9	17% *
36	B66A NERVOUS SYSTEM NEOPLASM, MAJC	70	3.9	9.0	48	2.8	7.9	20% *
37	E69B BRONCHITIS & ASTHMA, MINC	70	0.8	2.3	558	0.3	1.4	14% *
38	E69A BRONCHITIS & ASTHMA, MAJC	68	2.2	4.3	302	1.1	2.7	8% *
39	Z61B SIGNS & SYMPTOMS, MINC	68	2.1	2.5	305	1.3	1.9	12% *
40	B80B OTHER HEAD INJURIES, MINC	67	0.5	1.3	239	0.3	1.1	0%
41	D14A MOUTH&SALIVRY GLAND INTERVTN, MAJC	65	1.0	4.2	22	0.5	2.5	7% *
42	R60B ACUTE LEUKAEMIA, INTC	65	1.9	6.0	67	1.0	4.0	3%
43	F06C CRNRY BYPSS-INV INVES, MINC	62	1.6	8.1	38	1.0	8.7	2%
44	E75B OTHER RESP SYS DIS, MINC	61	1.5	4.0	251	0.8	1.8	13% *
45	X06B OTH INTERVTN FOR OTH INJURIES, INTC	60	1.3	3.7	128	0.9	4.3	5%
46	D12B OTH EAR,NOSE,MTH&THRT INTERVTN, MINC	52	0.4	1.7	138	0.1	1.3	20% *
47	F05A CRNRY BYPSS+INV INVES, MAJC	52	5.9	19.2	18	3.9	17.4	28% *
48	I12B MISC INTERVTN INFC/INFM BNE/JN, INTC	51	3.0	8.9	54	1.8	12.9	1%
49	F04A CRD VLV INTERVTN+PMP-INV INVES, MAJC	50	5.2	22.0	9	2.3	20.1	13% *
50	K62C MISC METABOLIC DISORDERS, MINC	50	1.8	2.4	297	1.3	2.5	0%
51	I66A INFLAM MUSCULOSK DIS, MAJC	46	3.3	9.0	88	2.4	6.4	18% *

52	I69B BONE DISEASES & ARTHROP, MINC	46	1.2	3.3	141	0.7	2.4	33% *
53	F05B CRNRY BYPSS+INV INVES, MINC	45	2.6	11.9	32	2.0	12.2	0%
54	T64C OTH INFECT&PARASITIC DIS, MINC	44	2.0	6.4	90	1.3	7.1	13% *
55	Y02A SKIN GRAFT OTHER BURNS, MAJC	40	2.9	18.1	9	1.3	14.4	0%
56	B72A NRVS SYS INF EX VRL MNGTS, MAJC	39	3.9	16.2	68	2.8	13.9	46% *
57	I65B MUSCULOSK MALIG NEOPLASM, MINC	39	2.9	5.0	229	1.2	3.5	0%
58	T61B POSTOP INFECT, MINC	35	1.0	2.7	117	0.7	3.6	20% *
59	E60A CYSTIC FIBROSIS, MAJC	32	5.1	12.4	80	3.6	11.8	9% *

* = statistically significant (α=.05) positive correlation between RAH non-hospital acquired MACSS-defined comorbidities and RAH length of stay

Source: SA Health Admitted Patient Care data domain; MACSS defined using Toson, B., Harvey, L. A.; Close, J. C. T. (2016). 'New ICD-10 version of the multipurpose Australian comorbidity scoring system outperformed Charlson and Elixhauser Comorbidities in an older population'. Journal of Clinical Epidemiology, 79, 62–69 https://doi.org/10.1016/j.jclinepi.2016.04.004

Table A.3: CHADx-defined (simplified) complications by metro hospital and CHADx type, acute overnight hospitalisations in 2021-22*

Hosp name	FMC	LMH	Mod-bury	Noar-lunga	RAH	TQEH	WCH	MAJOR METRO
Seps (no.)	*39,017*	*29,946*	*5,225*	*3,128*	*37,983*	*13,828*	*16,185*	*145,312*
CHADx* occurrences (no.)								
CHADx 1 Postprocedural complications	1,569	894	64	38	**1,924**	550	223	5,262
CHADx 2 Adverse drug events	2,983	1,177	129	133	2,669	692	367	8,150
CHADx 3 Accidental injuries	279	170	34	17	201	116	7	824
CHADx 4 Infections	1,797	621	38	40	**1,981**	525	466	5,468
CHADx 5 Cardiovascular complications	1,172	439	47	33	**1,373**	244	167	3,475
CHADX 6 Respiratory complications	954	331	66	23	**1,003**	288	163	2,828
CHADx 7 Gastrointestinal complications	921	332	23	40	**1,097**	290	153	2,856
CHADx 8 Skin conditions	213	82	-	17	115	57	79	563
CHADx 9 Genitourinary complications	885	404	40	31	**977**	214	152	2,703
CHADx 10 Hospital-acquired psychiatric states	107	37	5	3	94	19	27	292
CHADx 11 Early pregnancy complications	4	-	-	-	-	-	6	10
CHADx 12 Labour, delivery & postpartum complications	2,966	2,756	-	-	-	1	3,844	9,567
CHADx 13 Perinatal complications	2	19	-	-	-	-	25	46
CHADx 14 Haematological disorders	549	160	11	11	**786**	133	151	1,801
CHADx 15 Metabolic disorders	3,474	301	45	81	2,442	646	297	7,286
CHADx 16 Nervous system complications	137	42	6	3	**152**	26	30	396
CHADx 17 Other complications.	1,584	648	72	61	1,392	382	509	4,648
***TOTAL* CHADx OCCURRENCES**	**19,596**	**8,413**	**580**	**531**	**16,206**	**4,183**	**6,666**	**56,175**
***AT LEAST ONE* CHADx OCCURRENCE**	**8,765**	**4,781**	**371**	**329**	**6,825**	**1,975**	**3,777**	**26,823**

* Simplified CHADx excludes conditional diagnoses for CHADx classifications 2 and 3

Sources: SA Health Admitted Patient Care data domain. CHADx codes provided by Terri Jackson, PhD, Adjunct Associate Professor, School of Population and Global Health, University of Melbourne

Table A.4: Hospitalisations with a CHADx occurrence by age total and percentages, acute overnight hospitalisations in 2021-22

CHADx occurrence	Inpatients aged <=75 years	Inpatients aged >75 years	Total
No non-maternity CHADx occurrences (no CHADx occurrence or CHADx is pregnancy, childbirth or perinatal related)	93,173	30,445	123,618
At least one CHADx occurrence, EXCLUDING pregnancy, childbirth and perinatal complications (CHADx codes 11, 12 & 13)	14,905	6,789	21,694
Total	**108,078**	**37,234**	**145,312**
No non-maternity CHADx occurrences (no CHADx occurrence or CHADx is pregnancy, childbirth or perinatal related)	86.2%	81.8%	85.1%
At least one CHADx occurrence, EXCLUDING pregnancy, childbirth and perinatal complications (CHADx codes 11, 12 & 13)	13.8%	18.2%	14.9%
Total	**100%**	**100%**	**1,311**

* Simplified CHADx excludes conditional diagnoses for CHADx classifications 2 and 3

Sources: SA Health Admitted Patient Care data domain. CHADx codes provided by Terri Jackson, PhD, Adjunct Associate Professor, School of Population and Global Health, University of Melbourne