

Cost of sepsis in Australia

September 2021

The
George
Institute
for Global Health



*Better treatments
Better care
Healthier societies*

Report prepared by
Health Technology Analysts Pty Ltd

Contents	Executive Summary	3
	Introduction	4
	Aim	4
	Methodology	4
	Direct Costs	4
	Indirect Cost	5
	Conclusion	6
List of Figures	Figure 1 Summary costs of sepsis	7
List of Tables	Table 1 Direct Cost of Sepsis	5
	Table 2 Indirect Cost of Sepsis	6

Acknowledgement of country

The George Institute acknowledges the Gadigal people of the Eora Nation as the First Custodians of the land on which our Australian office is situated. We pay our respect to Elders past, present and emerging.

© The George Institute for Global Health, 2021.

This work was commissioned by The George Institute for Global Health and was undertaken by HTAnalysts. Information contained in the report has been obtained from sources believed to be reliable; HTAnalysts has not sought to independently verify those sources unless otherwise noted within the paper. HTAnalysts is not accountable for information produced by any third party.

www.htanalysts.com.au

The George Institute for Global Health – global headquarters

ABN 90 085 953 331

Level 5,
1 King Street
Newtown, Sydney NSW 2042
Australia

T +61 2 8052 4300
info@georgeinstitute.org
www.georgeinstitute.org

We are a registered charity in Australia and the United Kingdom. All currency is in Australian dollars unless otherwise indicated.

Executive Summary

Sepsis is a potentially life-threatening condition that occurs when the body's response to an infection damages the tissues and organs (Singer et al., 2016). In 2017, the World Health Organization (WHO) recognised sepsis as a global health priority. One in five deaths worldwide are caused by sepsis, and the highest incidence of sepsis and sepsis-related mortality is found in low and middle sociodemographic index regions (Rudd et al., 2020).

Sepsis places a considerable burden on the health system and society. However, there is a lack of accurate recent estimates of sepsis-related costs in Australia. This report uses representative data from recent research by The George Institute for Global Health (Thompson et al., 2021) on the incidence and outcomes of sepsis hospitalisations among New South Wales (NSW) residents to estimate the national cost of treating sepsis.

The key findings of this research are as follows:

- The direct hospital cost of sepsis to the Australian healthcare system is estimated to be approximately \$700 million AUD per annum.
- Indirect costs due to premature deaths associated with sepsis exceed \$4 billion AUD.
- Direct hospital costs account for approximately 14% of the total cost of sepsis to society.
- A small reduction in sepsis cases would generate millions of dollars in savings—savings that could subsequently be used to reduce the rate of occurrence of sepsis in future through improved awareness and recognition, as well as to enhance clinical practice and treatments and provide post-sepsis support for survivors.

Introduction

In 2017, the World Health Organization (WHO) recognised sepsis, a potentially life-threatening condition that occurs when the body's response to an infection damages the tissues and organs (Singer et al., 2016), as a global health priority. One in five deaths worldwide is caused by sepsis, and the highest incidence of sepsis and sepsis-related mortality is found in low and middle sociodemographic index regions (Rudd et al., 2020).

Country-level data on the distribution of sepsis across all sociodemographic index regions are lacking. To address this, The George Institute for Global Health used representative data to estimate the incidence and outcomes of sepsis hospitalisations among New South Wales (NSW) residents. In the report, sepsis hospitalisations were estimated to be 6.24 per 1,000 person-years. Over 70% of participants were readmitted within one year (Thompson et al., 2021). Of those hospitalised, 16.2% (N=2089) were admitted to the intensive care unit (ICU).

Despite the considerable burden sepsis places on the health system and society, there is a lack of recent, accurate estimates of the cost of sepsis in Australia.

Aim

This analysis leverages recently completed research by The George Institute for Global Health to estimate the national cost of treating sepsis.

Methodology

Direct Costs

The direct hospital cost of sepsis was estimated using primary International Classification of Disease (ICD)-10 data from The George Institute for Global Health's Incidence and outcomes of sepsis in Aboriginal and Torres Strait Islander and non-Indigenous residents in New South Wales: population-based cohort study (Thompson et al., 2021). ICD-10 codes for the primary diagnosis were mapped to the Australian Refined Diagnosis Related Groups (AR-DRGs) to obtain the cost per episode. When an ICD-10 code included multiple relevant AR-DRG codes, an average across the AR-DRG codes was used. The cost of each AR-DRG was obtained from the Independent Hospital Pricing Authority (2021). When an ICD-10 code did not have a relevant DRG code, the DRG code was either inferred or, if no accurate prediction could be made, removed from the data set.

It was assumed patients admitted to the ICU had the highest-complexity variant of the AR-DRG, while patients not admitted to the ICU had the lowest-complexity variant. The cost of each patient was then calculated, and an average was obtained to determine the average cost of a hospitalisation episode.

The George Institute for Global Health report estimated the incidence rate of sepsis requiring hospitalisation for patients aged 45 years or older as 6.24 per 1,000 person-years. The report also estimated that 21.1% of patients who suffered from sepsis would be readmitted within one year as a result of a new/reoccurring sepsis case. Multiplying the incidence rate by the Australian population aged 45 years or older and accounting for the hospital readmission rate, the cost of hospital admissions for sepsis for the Australian population aged 45 years or older was estimated to be \$483,310,629 per annum.

A recent study conducted by Li et al. (2020) of Macquarie University, which provided an age-specific number of sepsis cases and incidence rates, was used to estimate the hospital cost of sepsis for the population aged under 45 years. A digitation method was used to obtain the incidence rates for each age group in tabular form. As the incidence rate was substantially higher than the incidence rate noted by The George Institute for Global Health (which was attributable to methodological differences), it was assumed that the age distribution of patients was representative of the

Australian population. A ratio of sepsis patients <45 years and ≥ 45 years of age, was approximated and applied to the incidence rate estimated by The George Institute for Global Health to obtain a relevant incidence rate of sepsis for the <45-year age group. The ratio for the <45-year age group relative to the ≥ 45 -year age group was calculated as 34.06% based on research by Li et al. (2020). This figure was multiplied by The George Institute for Global Health paper's incidence rate to yield an estimated incidence rate of sepsis in Australians younger than 45 years of 1.86 per 1,000 person-years. Therefore, the approximate total incidence of sepsis in Australia was estimated to be 3.64 per 1,000 person-years. Assuming the same hospital readmission rate, the cost of hospitalisations for sepsis for the Australian population under 45 was estimated to be \$211,726,599. Summing the two populations together, the total cost of hospitalisations for sepsis for the entire Australian population was estimated to be \$695,037,228 (see Table 1).

Table 1 Direct Cost of Sepsis

Cost Per Patient	\$6,143
Australian sepsis incidence (age <45)	0.186%
Direct cost of sepsis (age <45)	\$211,726,599
Australian sepsis incidence (age ≥ 45)	0.624%
Direct cost of sepsis (age ≥ 45)	\$483,310,629
Total Direct cost	\$695,037,228

Indirect Cost

Productivity Costs

In the present report, productivity costs were estimated both for in-hospital lost productivity to cover days lost while patients were hospitalised and lost productivity due to early mortality. The approach was aligned with a UK report by Hex et al. (2017).

In-Hospital Lost Productivity

Estimates for in-hospital lost productivity were generated by multiplying the incidence estimate of the number of adults of working age by the average length of stay (LOS) and average daily salary.

Applying the total labour force obtained from the Australian Bureau of Statistics (ABS) to the total incidence of sepsis among individuals aged 15 to 65 yielded a total figure of 41,334 working-age adults estimated to be hospitalised due to sepsis each year. Further, using the same method applied to calculate the direct costs, the incidence of sepsis for patients aged 15–65 was calculated as 3.00 per 1,000 person-years. The median LOS of 11.72 days was calculated based on research by Thompson et al. (2021) and assumed that the LOS for sepsis patients does not vary with age. The average daily salary of \$186.54 was calculated from the average weekly salary cited in the most recent ABS report (ABS, 2021). The costs of lost in-hospital productivity were, therefore, estimated to be \$90,367,558 (41,334 x 11.72 x \$186.54). This cost estimate is conservative, as it does not include lost productivity due to recovery and rehabilitation time at home following hospitalisation.

Mortality-Related Lost Productivity

Costs for lost productivity due to early mortality were summed for both working-age adults and children. For working-age adults, the cost was estimated by adding the number of in-hospital and post-discharge mortalities in the working-age population together and multiplying this figure by the average working years remaining and average yearly salary.

A total of 6,819 sepsis-related deaths were estimated to occur in hospital each year among working-age adults (aged 15–65 years). The mortality rate was calculated using a similar method to that used to calculate the incidence rate. The George Institute for Global Health estimated the relevant one-year mortality rate of sepsis for patients aged 45 years or older as 36.9% (Thompson et al., 2021). Figure 25 of Li et al.'s (2020) study was digitised into a table, and relevant ratios were calculated. The ratio of mortality for sepsis patients aged 15–65 years to patients 45 years or older was calculated as 44.71%. Multiplying this ratio by The George Institute for Global Health's estimated mortality rate of 36.9% yielded an estimated mortality rate of 16.5% for the working-age population.

The average number of working years remaining was calculated by finding the difference between the average age at death from sepsis within the working-age adult population and the retirement age. The average age at death within the working-age adult population was estimated to be 56.89 years based on the figure reported in Hex et al.'s (2017) UK study. An average of 9.11 working years remaining was estimated based on the Australian retirement age of 66, and an average yearly salary of \$67,902 was calculated based on ABS (2021) statistics.

It was assumed that a full lifetime of productivity would be lost for all children who died due to sepsis, which was estimated to be 48 years (i.e., the total number of years between ages 18 and 66). Therefore, the total number of paediatric in-hospital and post-discharge sepsis-related deaths were added together and multiplied by the average yearly salary over 48 years. A total of 555 children were estimated to die each year due to sepsis infection using the previously stated method. The ratio of mortality for sepsis patients under 15 to all patients over 45 was calculated as 22.50%. Multiplying this ratio by The George Institute for Global Health's estimated mortality rate of 36.9% led to an estimated mortality rate for the child population of 8.3%.

An annual discount rate of 5% was used to adjust figures to present values. Costs resulting from lost productivity relating to premature mortality were estimated to be \$3,322,980,782 for adults (6,819 x 9.11 x \$67,902) and \$680,875,857 for children (555 x 48 x \$67,902), totalling \$4,003,856,639. This figure was added to the previously calculated in-hospital lost productivity loss to yield a total indirect cost of sepsis of \$4,094,224,198 (see Table 2).

Table 2 Indirect Cost of Sepsis

Patient Types	Productivity lost	Estimated annual cost
Adults	In hospital	\$90,367,558
	Mortality	\$3,322,980,782
Children	Mortality	\$680,875,857
Overall Total	\$4,094,224,198	

Conclusion

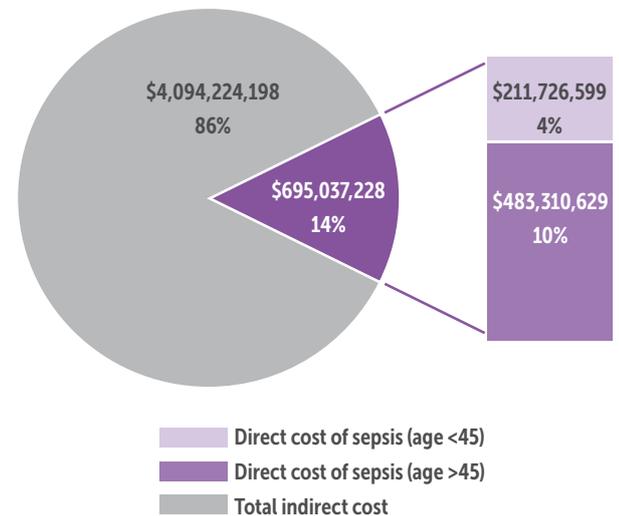
This report provides an estimate of the financial impact of sepsis, including the hospital costs and productivity losses associated with premature mortality. A snapshot of the findings is presented in Figure 1.

Figure 1 Summary costs of sepsis

Direct Costs	
Cost Per Patient	\$6,143
Australian sepsis incidence (age <45)	0.1863%
Direct cost of sepsis (age <45)	\$211,726,599
Australian sepsis incidence (age >45)	0.624%
Direct cost of sepsis (age >45)	\$483,310,629
Total Direct cost	\$695,037,228

Indirect Costs	
In-hospital lost productivity	\$90,367,558
Economic loss per adult	\$487,318
Number of adult deaths	6,819
Total adult productivity cost	\$3,322,980,782
Economic loss per child	\$1,227,468
Number of child deaths	555
Children	\$680,875,857
Mortality related lost productivity	\$4,003,856,639
Total Indirect cost	\$4,094,224,198

Total cost of sepsis in Australia	\$4,789,261,425
--	------------------------



The key findings were as follows:

- The direct hospital cost of sepsis to the Australian healthcare system is estimated to be approximately \$700 million AUD per annum.
- Indirect costs due to premature deaths associated with sepsis exceed \$4 billion AUD.
- Direct hospital costs account for approximately 14% of the total cost of sepsis to society.
- A small reduction in sepsis cases through prevention would generate millions of dollars in savings—savings that could be used to enhance clinical practice and design better treatments for sepsis patients.

This analysis had the following limitations:

- Hospital costs were estimated from primary diagnosis codes, which may not reflect the final AR-DRG assigned to patient episodes.
- National incidence figures were extrapolated from NSW data, which may not account for state-based variations.
- No data were available for patients under 45 years, and the estimates relied on other published figures that could not be verified.
- The mortality due to lost productivity estimate relied on national averages regarding workforce participation and wages, which may not be an accurate reflection of those who suffer from sepsis.

References

- Australian Bureau of Statistics. (2021, 19 August). Average weekly earnings, Australia. <https://www.abs.gov.au/statistics/labour/earnings-and-work-hours/average-weekly-earnings-australia/latest-release>
- Hex, N., Retzler, J. & Bartlett, C. (2017, 23 February). The cost of sepsis care in the UK. York Health Economics Consortium. <http://allcatsgrey.org.uk/wp/wpfb-file/yhec-sepsis-report-17-02-17-final-pdf/>
- Independent Hospital Pricing Authority. (2021, 16 February). National Hospital Cost Data Collection: Private hospital report round 23 (financial year 2018–19). <https://www.ihoa.gov.au/publications/national-hospital-cost-data-collection-report-public-sector-round-23-financial-year>
- Li, L., Sunderland, N., Rathnayake, K. & Westbrook, J. (2020, February). Epidemiology of sepsis in Australian public hospitals: A mixed methods, national longitudinal study (2013–2018). Australian Commission on Safety and Quality in Health Care. <https://www.safetyandquality.gov.au/publications-and-resources/resource-library/epidemiology-sepsis-australian-public-hospitals>
- Rudd, K. E., Johnson, S. C., Agesa, K. M., Shackelford, K. A., Tsoi, D., Kievlan, D. R., Colombara, D. V., Ikuta, K. S., Kissoon, N., Finfer, S., Fleischmann-Struzek, C., Machado, F. R., Reinhart, K. K., Rowan, K., Seymour, C. W., Watson, R. S., West, T. E., Marinho, F., Hay, S. I., Lozano, R., ... Naghavi, M. (2020). Global, regional, and national sepsis incidence and mortality, 1990–2017: Analysis for the Global Burden of Disease Study. *Lancet*, 395(10219), 200–211. [https://doi.org/10.1016/S0140-6736\(19\)32989-7](https://doi.org/10.1016/S0140-6736(19)32989-7)
- Singer, M., Deutschman, C. S., Seymour, C. W., Shankar-Hari, M., Annane, D., Bauer, M., Bellomo, R., Bernard, G. R., Chiche, J.-D., Coopersmith, C. M., Hotchkiss, R. S., Levy, M. M., Marshall, J. C., Martin, G. S., Opal, S. M., Rubenfeld, G. D., van der Poll, T., Vincent, J.-L. & Angus, D. C. (2016). The third international consensus definitions for sepsis and septic shock (sepsis-3). *JAMA*, 315(8), 801–810. <https://doi.org/10.1001/jama.2016.0287>
- Thompson, K. J., Finfer, S. R., Coombes, J., Eades, S., Hunter, K., Leong, R.N.F., Lewis, E., Liu, B., 'Incidence and outcomes of sepsis in Aboriginal and Torres Strait Islander and non-Indigenous residents of New South Wales: population-based cohort study' *Crit Care Resusc* 2021; 23 (3): 337-345 ; <https://doi.org/10.51893/2021.3.oa11>