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Cost Analysis of COVID-19 in Australia

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Abstract

Access to accurate and reliable information on the cost of COVID-19 is essential for informed socio-economic policy decisions. This paper analyses the economic costs associated with the COVID-19/SARS-CoV-2 pandemic, with a particular focus on Australia. This study examined both the macroeconomic costs measured as the foregone gross domestic product attributable to the pandemic and the direct and indirect costs to society. Using a bottom-up costing approach and the WHO-CHOICE model, this study estimates the direct and indirect economic impacts of COVID-19 on the Australian economy. The analysis draws on quarterly and fortnightly data from 2020 to 2022, the period during which the pandemic exerted its most severe economic effects. The results indicate that the per-day inpatient unit cost is estimated at AUD 836, representing the minimum benchmark for direct health costs. The WHO-CHOICE model identifies key determinants of inpatient hospital costs, including hospital bed occupancy, GDP per capita, and hospital admissions, which are found to be highly responsive to changes in inpatient costs. In terms of indirect effects, GDP fell by 1.9 percent below its projected no-COVID level in the first quarter of 2021. Based on these empirical findings, this study proposes several important policy recommendations to enhance economic resilience and healthcare preparedness in future public health crises.

Keywords: COVID-19; inpatient direct cost; macroeconomy; economic cost

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1. Introduction

The COVID-19 pandemic has affected households, industries, and governments around the globe and has resulted in an unprecedented increase in costs to the economy. In advanced and emerging economies, the escalated pandemic resulted in strict lockdowns and massive disruptions in economic activity (Baldwin & Mauro, 2020). This study is motivated by the ongoing coronavirus pandemic and its impact on economies worldwide. In particular, the direct costs of the COVID-19 pandemic to the Australian economy are examined, and policy directions are suggested to mitigate their magnitude.

The economic impacts of COVID-19 can be broadly classified as demand and supply shocks (Boissay & Rungcharoenkitkul, 2020). The pandemic affects the economy through the following channels: (1) the direct effect of a reduction in the workforce; (2) the increase in the cost of global trade; (3) the sudden decline in travel and transportation due to local and international border restrictions; (4) the decline in demand for services sector activities (Maliszewska et al., 2020; Pearson et al., 2021). Besides the impact through these channels, there existed a decline in consumer demand as millions of people stayed at home and postponed non-essential expenses, a contraction in foreign direct investment, and an expansion in government expenses with growing healthcare expenditure widening the economic costs associated with COVID-19 (Ajmal et al., 2021; World Health Organisation, 2021). Therefore, it is crucial to identify country-specific economic cost factors to ensure stability and defend the economy from major breakdowns.

Based on the situation stated above, the research objectives are to (1) estimate the direct health costs of the COVID-19 pandemic, (2) identify country-specific cost factors, and (3) analyse the macroeconomic impacts due to this pandemic in Australia.

However, estimating costs per patient is challenging in hospitals due to complex and insufficient data. There is no publicly available information on the input costs of testing and treatments for COVID-19 in Australia. Therefore, it is necessary to estimate the approximate direct health cost expenditure by government funding, public or private health insurance, patient out-of-pocket expenses, or a combination of all. This is because estimations of the cost of coronavirus disease in a country may not only support policymakers in effectively allocating resources and prioritising disease control activities, but it is also paramount to the long-term planning for sustainable financing in similar future conditions.

Although the previous literature estimated the unit cost of specific health interventions, the transferability of such findings from one setting to another is limited (Beck et al., 2012; Adam et al., 2003). This study contributes to the literature in the following ways. First, it is one of the first attempts to assess the direct health cost of the COVID-19 pandemic in Australia. Second, the impact of indirect cost factors is identified to determine the inpatient per-day cost of COVID-19 in Australia. Third, this study can be used as a guide for a comprehensive policy direction in response to COVID-19 by emphasising unprecedented macroeconomic changes.

This article is organised as follows. Section 2 presents the public health responses to COVID-19 in Australia. Sections 3 and 4 indicate empirical evidence on the cost of COVID-19 and the methodology for this study. Sections 5 and 6 provides the estimated daily cost of inpatient of COVID-19 per person and the macroeconomic impact of COVID-19. Finally, Section 7 concludes the study. It includes policy recommendations, the limitations of the existing literature, and future research directions.

2. Public Health Responses to COVID-19 in Australia

Australia is a country with a population of 25.77 million people (2021). The population aged 65 and above is 16.21 percent of the total population. GDP per capita is estimated at USD 55,807. Total health spending in 2021–2022 is USD 98.3 billion, accounting for 16.7 percent of total Australian government spending (Commonwealth of Australia, 2022).

Since the start of the pandemic in 2020, Australia has experienced multiple waves of COVID-19 (Figure 1). The first wave occurred between March and April, with most Australian states recording active infected cases and deaths. The second wave began in June 2020, with the most active infections and deaths. Then, with the spread of the Delta variant, a third wave began in June 2021 and reached its peak in October. The Omicron variant was revealed in Australia in November 2021 and quickly spread throughout the country, resulting in a fourth wave that lasted till the first quarter of 2022.

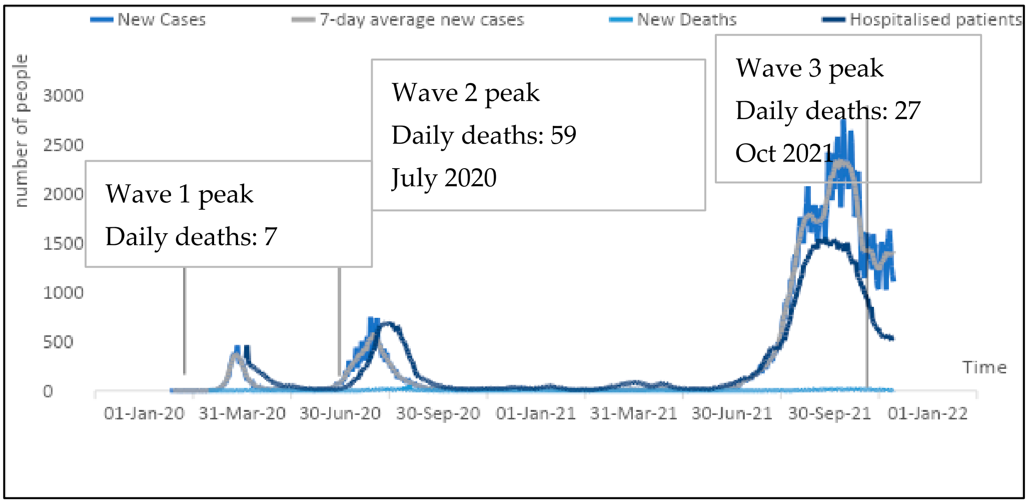

Figure 1. Waves 1–3: daily cases, hospitalisations, and peak deaths. Source: Department of Health and Aged Care (2022a).

Most COVID-19 patients can have mild to moderate symptoms and recover without treatment or hospitalisation. However, some people become severely ill and need medical attention. Since the outbreak of COVID-19, various countries have responded to the pandemic using different strategies. Australia has also followed several policies to suppress COVID-19 infection (Table 1). The Australian government attempted to lessen the pressure on health services by reducing the number of illnesses and fatalities through shutdown procedures. It introduced voluntary mitigation restrictions such as self-isolation for those with symptoms and social distancing advice for those most at risk.

Table 1. Hierarchy of control for the COVID-19 pandemic in Australia.

	Hierarchy of Control Ranking	**Examples of Control Measures to Prevent Transmission**
Most Effective	Elimination Decrease the opportunities for the virus to spread	Vaccination Testing and quarantine at borders Travel restrictions
	Substitution Find different approaches to provide care that minimise the risk of transmission.	Physical distancing Symptomatic health workers and agency groups to stay home and not come to work, remote working, telehealth
Less Effective	Engineering controls Use physical barriers and other forms of hazard reduction	Ventilation and improved air changes Registration of all people entering the facility (symptom check, QR code), negative pressure rooms, single room with ensuite, isolation of patients
	Administrative controls Implement effective and consistent policies and protocols	Audit and feedback, hand hygiene, cleaning and disinfection, signs, posters, information sheets, infection prevention and control guidance documents, training, and education of health workers
	Personal protective equipment	Symptomatic patients to wear surgical masks, correct transmission-based precautions, personal protective equipment worn when in contact with infectious patients

Source: Department of Health and Aged Care (2022b).

The Australian government enforced local and international border restrictions to control the immediate spread of the coronavirus (SARS-CoV-2) in Australia before the World Health Organisation (2020) declared a Public Health Emergency in 2020. Therefore, the Australian economy recovered from COVID-19-related lockdowns from 2020 to 2021, completing the calendar year with successful and effective controls.

3. Literature Review

There is a growing body of empirical literature on the COVID-19 pandemic. This section is a review of past studies related to the cost of COVID-19 and includes macroeconomic factors such as GDP during the COVID-19 pandemic. The COVID-19 pandemic is inflicting high and rising human costs worldwide, and the necessary protection measures are severely impacting economic activity. As a result of the pandemic, the global economy is projected to contract sharply by 3 percent in 2020, much worse than during the 2008–2009 financial crisis (Mishra, 2020). According to Boissay and Rungcharoenkitkul (2020) the economic cost of the COVID-19 pandemic can be proxied by GDP forgone, namely, the difference between current forecasts and pre-COVID-19 outlook. The annual output loss ranges between 5 and 9 percent of pre-COVID-19 estimates for the US, and between 4 and 4.5 percent for the global economy by the end of 2020. In the meantime, Ghaffari Darab et al. (2021) stated that the high prevalence rate of COVID-19 has been imposing a heavy economic burden on the country and health system directly, which may result in rationing or painful cost-control approaches. High healthcare costs could also threaten the health of patients infected with COVID-19. Fourteen percent of Americans said they would avoid medical care due to cost if they developed symptoms consistent with COVID-19 (Debata et al., 2020).

Eichenbaum et al. (2021) investigate the equilibrium interactions between economic decisions and epidemic dynamics using the SIR model. Their findings imply that, while containment policies and agents' decisions to lower work and consumption mitigate the severity of the pandemic based on the total deaths, the size of the ensuing recession is exacerbated. According to Jin et al. (2021), COVID-19 control measures prevented the spread of disease and resulted in substantial costs from productivity losses amounting to 2.7 percent of China's annual gross domestic product during 1 January–31 March 2020. The total monthly economic losses during the lockdown reached CNY 177 billion. However, the lockdown policy has been considered to reduce COVID-19 infections by 180,000, which saved about 20,000 lives, as well as nearly CNY 30 billion in medical costs in China (Debata et al., 2020). Therefore, the total GDP decreased 37 percent in 2020. The private components of GDP, investment, consumption, export, and import lost 82 percent, 30 percent, 36 percent, and 25 percent of their respective counterfactual values (Debata et al., 2020). Another part of the literature is devoted to the measurement of the macroeconomic impact of COVID-19. Marcolino et al. (2021) stated that there is a significant variability in acquisition costs and investments by institutions responding to the COVID-19 pandemic. On the other hand, Mckibbin and Fernando (2020) mentioned that the COVID-19 pandemic caused a sharp drop in both consumption and investment.

The above literature review demonstrates that COVID-19 has created financial and economic costs of many kinds. Even though there are limited studies about direct health cost estimates per day at the hospital for a COVID-19-infected patient, based in a single country or a group of countries, it is difficult to compare across the literature due to differences in methodology, population, and healthcare costs. Therefore, our contribution to the literature is precisely to evaluate the cost of COVID-19 in Australia and identify its macroeconomic impact, because such a research study is absent in Australia.

4. Data and Methodology

Data Collection

For this study, we use data from the Australian Bureau of Statistics (ABS), the Australian Institute of Health and Welfare (AIHW) database, the European Centre for Disease Prevention and Control Statistics, and WHO Coronavirus Data from 2020 to 2022 to evaluate the cost of the COVID-19 pandemic in Australia. For the direct health cost estimation, we follow the framework of bottom-up costing, for which we gather data from the ABS and AIHW. To identify the determinants of the cost of COVID-19 in six states of Australia, we use the WHO-CHOICE[1] model and collect data from the AIHW database. "EVIEWS-09" econometric software is used for estimation purposes.

5. Methodology

One of the objectives of this study is to estimate the direct and indirect costs of COVID-19. The direct cost includes the medical expenditure for diagnosis, treatment, and rehabilitation. Indirect costs include lost production due to premature deaths and missed workdays.

The direct health costs can vary with the number of infected patients, the severity of the illness, the mean length of stay in the hospital, and other variables (Warren et al., 2003). We estimate the direct health cost of a COVID-19 patient using the bottom-up approach. It is a method of economic evaluation in which individual resource inputs used in delivering a health service (e.g., staff time, consumables, equipment, and overheads) are identified, measured, and valued separately. The total cost is then obtained by aggregating these resource-specific costs (Ghaffari Darab et al., 2021). Here, we prospectively include consecutive patients diagnosed with COVID-19 who were admitted to public or private hospitals in 2021.

The cost included human resources (medical, nursing, allied health, and support staff), consumables (medications, personal protective equipment, including masks, gloves, head covers, etc., and oxygen therapy), diagnostic services (PCR testing, radiology, and laboratory investigations), and overheads (utilities and administrative services). All prices were obtained primarily from the Australian Institute of Health and Welfare (2020–2021), Medicare Benefits Schedule (MBS) fee schedules, and hospital finance records. All prices were converted to 2021 Australian dollars using the consumer price index (CPI). A detailed breakdown of inputs, unit costs, and data sources is provided in Appendices A and B.

WHO-CHOICE offers prediction models that describe cost estimation for all states of Australia. Furthermore, the WHO-CHOICE model is used to identify the factors that influence the cost of inpatient health services per day (World Health Organisation, 2021). This study uses state-specific values where possible and other independent variables based on the representative "average values", which can be converted to normative values. All COVID-19 patients who had been referred to a primary referral medical facility in all states of Australia by July 2022 made up the research population.

The relationship between the inpatient unit cost and explanatory variables is explored using multiple regression analysis using the ordinary least squares method (Warren et al., 2003). Natural logarithms are used to transform dependent and explanatory variables to make the coefficients interpretable as elasticities. The functional specification is formulated as follows (Stenberg et al., 2018):

$$\ln \mathrm{UIC_i} = \beta_0 + \beta_i \sum_{i=1}^{n} \ln \mathrm{X_i} + \varepsilon_i$$

$$\ln \mathrm{UIC_i} = \beta_0 + \beta_i \ln \mathrm{gdp_i} + \ln \mathrm{occ_i} + \ln \mathrm{alos_i} + \ln \mathrm{admin_i} + \ln \mathrm{dumH1_i} + \ln \mathrm{dumH2_i} + \varepsilon_i$$

where ln UICi is the natural log (Ghaffari Darab et al., 2021) of unit cost per inpatient day in Australian dollars in the ith facility; β_0 and β_(i. . .. . .n) are the estimated parameters; Xi are the set of explanatory variables transformed into natural logarithms for continuous variables GDP per capita in 2021 (gdp), bed occupancy rate (occ), ALOS (also), total inpatient admissions (admin), and a dummy variable for public hospitals and dummy variable for private hospitals); and ε_i represents the error term.

As in the WHO-CHOICE model, hospital bed cost per day does not include expenses for medications, medical supplies, caregiving appliances, and laboratory research. These are considered separately and factored into the treatment plan since a detailed vector of input prices is not available.

Furthermore, GDP per capita serves as a proxy for the level of technology (Adam et al., 2003). In terms of the output indicators that such models typically use, occupancy rate, total inpatient admissions, and ALOS provide a measure of capacity utilisation while controlling for facility size. An indicator of the level of the facility and of whether the hospital is a public or private hospital has been considered for this study. Furthermore, we gather sector-by-sector percentage change estimates of COVID-19's economic impact based on data from the ABS to examine the indirect cost of COVID-19 on the Australian economy from mid-March 2020 to June 2022.

Finally, to detect the changes in GDP due to COVID-19 in Australia, we use the Keynesian expenditure output method. Due to the expected short-term nature of the COVID-19 shock and the likelihood that the economy will return to "business as usual" once the crisis has passed, the Keynesian expenditure output framework is a better tool for analysing one-time unanticipated shocks.

6. Results

6.1. Direct Cost

The average inpatient cost of COVID-19 is used to determine the mean value of total direct health costs for each patient with COVID-19. According to the initial guidelines, the average expenses per patient, per day, and per stay can be determined based on the risk type of the illness (Table 2).

Table 2. Risk type of COVID-19.

Risk Category	Treatment Method
Mild symptoms	Rest and recover at home.
Worsening symptoms	Contact a general practitioner (GP), GP respiratory clinic, or the National Coronavirus Helpline.
Severe symptoms	Immediate hospitalisation Authorise a drug, supplemental oxygen, or mechanical ventilation as needed.

Source: Department of Health and Aged Care (2022b).

Unit cost estimates are sensitive to the method used for cost allocation. The direct health costs of COVID-19 can be calculated separately for each of the three types of risks. These costs vary according to the treatment procedure, direct and indirect labour, types of medical consumables, COVID-19 test kits, laboratory tests, radiological examination costs, and accommodation. In this study, we only estimate the minimum daily healthcare cost of a hospital-admitted patient based on possible assumptions and calculations.

The direct costs of a COVID-19-infected inpatient in hospital wards are shown in Table 3. An inpatient's per-day unit cost is estimated to be AUD 836. This is the minimum per-day cost that is compensated for COVID-19 inpatients by government funding, public or private health insurance, patient out-of-pocket expenses, or a mix of all to cover the cost of treatments in Australia. The total cost is thought to constitute 40 percent of medicinal consumable expenditure and 26 percent of radiological examination expenditure. The estimated total cost of inpatients is AUD 3.7 million for 2021 in Australia.

Table 3. Estimated daily cost of inpatient of COVID-19 per person (without ICU admission).

Cost Categories	Amount (Australian Dollars)	Percentage of Total Cost per COVID-19-Infected Patient
Human capital cost (International Labour Organization, 2021)	122	14.61
Medicinal consumables	343	40.92
Diagnostic test (Polymerase Chain Reaction (PCR))	100	11.94
Laboratory tests	50	5.97
Radiological examinations (Computed Tomography scans)	222	26.52
Total cost per COVID-19-infected patient	836	
Total inpatient cost of COVID-19 (TC * No. of patients for a year) in 2021 (based on 4473 patients)	3,738,974.089	

Source: Author's construction based on Australian Bureau of Statistics (2022a).

Human capital and medical consumables are more expensive for inpatients than for other cost categories. We divide the total salary and wage expenditure per day for medical and supportive staff by the total number of admitted COVID-19 patients to calculate the direct human capital cost per day. The cost of medicinal consumables is calculated based on several COVID-19 treatments that people with COVID-19 may be eligible for if they are in a healthcare facility. There are two types of COVID-19 treatment options in Australia. First, antiviral treatments help to prevent viruses from infecting healthy cells. The second type of treatment is monoclonal antibody therapy, which works by attaching to the virus and preventing it from entering human cells. This facilitates the fight against the threatening virus (Australian Institute of Health and Welfare, 2021). Therefore, we include both the COVID-19 antiviral treatment cost and the monoclonal antibody treatment cost to calculate the cost of medicinal consumables. Furthermore, radiology is identified as an indispensable part of COVID-19 inpatient primary care. It is essential to diagnose, manage, and treat many common conditions. Then, we include the average upfront cost of radiology for this calculation.

The estimated per-day cost of AUD 836 represents the minimum baseline cost of hospital admission for a COVID-19 inpatient without ICU admission. This value was derived using conservative assumptions and cost components obtained from authoritative national sources, including the Australian Institute of Health and Welfare (AIHW). The purpose of using the minimum cost estimate was to establish a lower bound of expenditure that captures the essential and unavoidable direct healthcare costs, namely, labour, medical consumables, diagnostics, and radiology, while excluding overheads and complications that vary widely across institutions.

Although patient-level cost data were not available to construct a statistical distribution, the reported estimate aligns with the WHO-CHOICE methodology, which recommends the use of standardised cost inputs for international comparability. Therefore, the figure of AUD 836 can be interpreted as the minimum representative cost of all hospitalised patients.

Therefore, the per-day cost is adjusted after episode allocation. Treating PCR (AUD 100) and radiology (AUD 222) as one-off episode costs and allocating them across the ALOS materially reduces the per-day estimate. However, using an ALOS of 7 days (example/median from sample), recurring daily costs (personnel, medicines, and routine labs) sum to AUD 560.00, a 33% reduction from the raw summed value of AUD 836.83.

In the original calculation above, the per-day inpatient cost (AUD 836.83) was derived by summing all daily cost components. However, certain components, namely, the PCR test (AUD 100) and radiological examination (AUD 222) represent time costs rather than daily recurring expenditures. Therefore, we allocated these costs evenly across ALOS instead of attributing them as daily costs (Table 4). The recurring daily costs (human capital, medicinal consumables, and laboratory tests) remain constant per day:

Table 4. Adjusted daily inpatient cost after allocating one-off episode costs across average length of stay (ALOS).

Cost Component	Nature of Cost	Amount (AUD)	Allocation Method
Human capital cost	Daily recurring	122.33	Per day
Medicinal consumables	Daily recurring	342.50	Per day
Diagnostic test (Polymerase Chain Reaction (PCR))	Daily recurring	50.00	Per day
Laboratory tests	One-off episode	100.00	spread over ALOS
Radiological examinations	One-off episode	222.00	spread over ALOS

Source: Author's construction based on Australian Bureau of Statistics (2022a).

Using an average ALOS of 7 days, the recalculated daily cost is as follows:

$$\text{Adjusted daily cost} = 122.33 + 342.50 + 50 + (100 + 222)/7) = 560.00 \text{ AUD per day}$$

On the other hand, ALOS varies significantly across states, ranging from 1 day (South Australia) to 25 days (Tasmania) as reported in Appendix A. Accordingly, we calculated state-specific total inpatient costs using the following formula:

$$\text{Total Cost} = \text{Adjusted Daily Cost} \times \text{ALOS}_{\text{state}} \times \text{No of Patients}$$

As patient counts were not disaggregated by state, we assumed proportional distribution to derive indicative uncertainty bands.

Table 5 presents the state-specific average length of stay (ALOS) and the corresponding adjusted total inpatient costs for COVID-19 hospital admissions in Australia. The adjustment accounts for one of the episode's costs distributed across the respective ALOS in each state.

Table 5. State-specific average length of stay (ALOS) and corresponding adjusted total inpatient cost.

State	ALOS (Days)	Total Inpatient Admissions	Adjusted Total Cost (AUD)
South Australia	1	246	137,753.00
Victoria	8	737	3,301,583.00
New South Wales	8	2049	9,179,028.00
Queensland	10	860	4,815,742.00
Tasmania	25	100	1,399,925
Western Australia	4	297	665,244.4
Northern Territory	13	39	665,244.36
Australian Capital Territory	2	140	283,904.79

Source: Author's construction based on Australian Bureau of Statistics (2022a).

A notable variation in ALOS is observed across stages, ranging from 1 day in South Australia to 25 days in Tasmania. This variation significantly influences the total cost estimates, highlighting the sensitivity of inpatient expenditure to hospitalisation duration. States with a higher ALOS, such as Tasmania (25 days) and Northern Territory (13 days), record comparatively higher cost per patient, despite having smaller patient counts, due to longer hospital stay. Conversely, South Australia shows the lowest total inpatient cost (AUD 137,753), primarily driven by its short ALOS of 1 day, even though its number of admissions (246) is moderate.

New South Wales reports the highest aggregate cost (AUD 9.18 million) owing to its large number of inpatient admissions (2049), combined with an ALOS of 8 days. Similarly, Victoria (AUD 3.30 million) and Queensland (AUD 4.82 million) all contribute substantially to national inpatient expenditure because of relatively high admission volumes and ALOS values ranging 8–10 days. Overall, these findings demonstrate that variation in hospitalisation duration rather than per-day cost differentials drives the observed disparities in total inpatient expenditure across Australian states.

6.2. WHO-CHOICE Specific Cost Factors for Inpatient Health Service Delivery

Furthermore, we attempt to identify the factors of country-specific costs related to health service utilisation with estimates for cost per inpatient per day using the WHO-CHOICE model. To account for potential heteroskedasticity in inpatient costs, robust standard errors (Huber–White) were estimated. These robust standard errors are reported in parentheses below each coefficient in Table 6. Diagnostic tests confirmed that heteroskedasticity was present and corrected.

Table 6. Regression coefficient: natural log of cost per inpatient bed day.

Variable	Regression Coefficient	*p* Value
Ln GDP per capita	0.2786 (0.0941)	0.0042
Ln occupancy rate	1.0506 (0.1173)	0.0010
Ln ALOS	−0.0422 (0.0046)	0.0017
Ln admissions	0.0140 (0.0017)	0.0290
Dummy H1—public hospital	−0.1125 (0.0507)	0.1490
Dummy H2—private hospital	0.1101 (0.0756)	0.0010
R^2		0.6980
Adjusted R^2		0.6850
F-stat	251.0800 (0.0040)	
Durbin–Watson stat		1.5650

Source: Authors' estimation based on Australian Institute of Health and Welfare (2021).

The final regression models for inpatient unit costs are shown in Table 6.

This analysis is based on 4473 inpatient COVID-19 cases admitted to public and private hospitals in Australia during 2021. The unit of observation is the per-day cost of an inpatient bed. This study conducts multiple regression analyses.

Most of these are statistically significant under the probability value ($p < 0.05$). The inpatient cost model performs marginally better, with an adjusted R-squared of 0.698. In this model, the hospital bed occupancy rate is a highly significant proxy for the price level or cost of a COVID-19 patient. When there is an increase in the bed occupancy rate of 1 percent, this directly increases the cost of inpatient care by 1.05 percent. This confirms the measure of capacity utilisation as one of the important independent variables of cost analysis. In the model, GDP per capita is a significant proxy for price level and level of technology. A 1 percent increase in GDP per capita increases the inpatient per-day cost by 0.2 percent.

Furthermore, higher admissions have a significant and very small positive effect on cost. This small effect on cost can be said to result from mixed effects exerted on the cost. Higher admissions could lead to lower overhead costs per patient and greater efficiency. On the other hand, a greater size could also indicate more specialist care, with a large proportion of complicated cases with a higher unit cost. Furthermore, there is a negative relationship between the cost of inpatients and the length of stay. A 1 percent increase in hospital stay time increases the inpatient cost by only 0.01 percent per day. When increasing the length of the hospital stay, the fixed costs per patient are spread over the days. Therefore, more hospital days lower the per-day cost per inpatient.

Inpatient unit cost per day is predicted to be lower in public hospitals. However, the results show that cost is higher in a private hospital, but this relationship has an insignificant impact on the COVID-19 inpatient cost.

The regression results in Table 4 indicate that hospital bed occupancy rate, GDP per capita, and average length of stay (ALOS) are significant determinants of inpatient costs. The elasticity of inpatient cost with respect to the occupancy rate (1.05) reveals that a 1% increase in hospital occupancy leads to a 1.05% increase in per-day inpatient cost. This is positive and more than a proportional relationship, and it suggests that higher capacity utilisation may lead to congestion effects, additional staff hours, and resource constraints. Conversely, the elasticity of inpatient cost with respect to ALOS (−0.04) indicates that a 1% increase in average hospital stay is associated with respected with a 0.04% decrease in per-day cost, consistent with economic scale at the patient level. Longer stays spread fixed admission and administrative costs over more bed days, reducing the daily average cost. GDP per capita, a proxy for the technological and price level of inputs, exhibits a positive elasticity of 0.28%. The table and the text now align numerically and conceptually, emphasising how both capacity utilisation and scale effects influence hospital cost structures.

According to Stock and Watson (2018), all the above coefficients are zero with the exception of the intercept. The regression coefficients are stored in a vector c(1) to c(k + 1), where the number in parentheses indicates the order of appearance in the regression output. Therefore, Wald test results indicate the F-statistic of 209.1 and the Chi-square value of 1045.57.

The regression model explains 69.8% of the variation in patient costs (adjusted R^2 = 0.685). The F-statistic of 251.08 indicates the model is jointly significant. The Durbin–Watson statistics (1.565) suggest mild positive autocorrelation, which is acceptable for cross-sectional data.

Two variables, Ln occupancy rate and Ln admissions, have a nearly moderate threshold, indicating little multicollinearity impact. This is expected since both variables reflect similar dimensions; however, they remain within acceptable limits (Table 7).

Table 7. Variance inflation factor (VIF) diagnostics.

Variable	Coefficient Variance	Uncentered VIF	Centred VIF
Ln GDP per capita	0.0089	3.25	1.85
Ln occupancy rate	0.0138	4.10	2.10
Ln ALOS	0.0001	2.50	1.65
Ln admissions	0.0001	4.55	2.25
public hospital	0.0026	1.20	1.15
private hospital	0.0057	1.15	1.10

The Breusch–Pagan–Godfrey test was conducted to assess the presence of heteroskedasticity in the regression model (Table 8). The F-statistics, the Obs*R-squared statistics, and the scaled explained sum of squares all have *p*-values greater than 0.05. Therefore, this study fails to reject the null hypothesis of homoskedasticity, indicating that the variance of the residuals is constant. This suggests that the standard errors, t-values, and *p*-values reported in the regression are reliable.

Table 8. Breusch–Pagan–Godfrey heteroskedasticity test.

Heteroskedasticity Test: Breusch–Pagan–Godfrey			
F-statistic	1.2700	Prob. F(6,2)	0.2740
Obs*R-squared	8.7200	Prob. Chi-Square(6)	0.1930
Scaled explained SS	0.7980	Prob. Chi-Square(6)	0.2450

6.3. Indirect Cost

COVID-19 has had a significant impact on the Australian economy since its arrival. Steps to reduce the spread of the virus have had various impacts on economic activity. This section is a discussion of the changes in sectoral contributions to the Australian economy due to the COVID-19 pandemic. It comprises two parts. First, the initial effects of COVID-19's containment from 2020 Quarter 1 to 2022 Quarter 2 across all economic sectors are described. The second part consists of a closer examination of the main macroeconomic variables using consumption, investment, government expenditure, exports, imports, and their effects with the COVID-19 scenario and without it (No-COVID).

Australia is a world-class provider of education and tourism, professional services, financial services, energy and mining-related services, and environmental services. Australia prioritises these industries to improve access to foreign markets.

In Figure 2, the blue bars represent observed quarterly GDP from ABS data (seasonally adjusted, real terms), and the green line represents the IMF's No-COVID projection. The consistent units (AUD billions, seasonally adjusted) and rebased indices allow for replication of this analysis using publicly available ABS and IMF datasets. The green columns represent the IMF's predicted GDP values. The GDP value is closely related to demand shocks caused by physical distance and slowing international trade. In 2021 Quarter 1, GDP fell significantly to 1.9 percent below its No-COVID level. The reduction continued to −1.8 percent by the 3rd quarter of 2021. The L-strain and Delta outbreaks of COVID-19 had a massive impact on Australian GDP, resulting in two declines in GDP during the peak of restrictions across Australia. As the population emerged from lockdowns, there was a strong rebound in growth. While growth is returning to pre-pandemic levels, GDP is estimated to have suffered an AUD 158 billion cumulative loss, compared to its pre-pandemic trajectory (Australian Bureau of Statistics, 2022a).

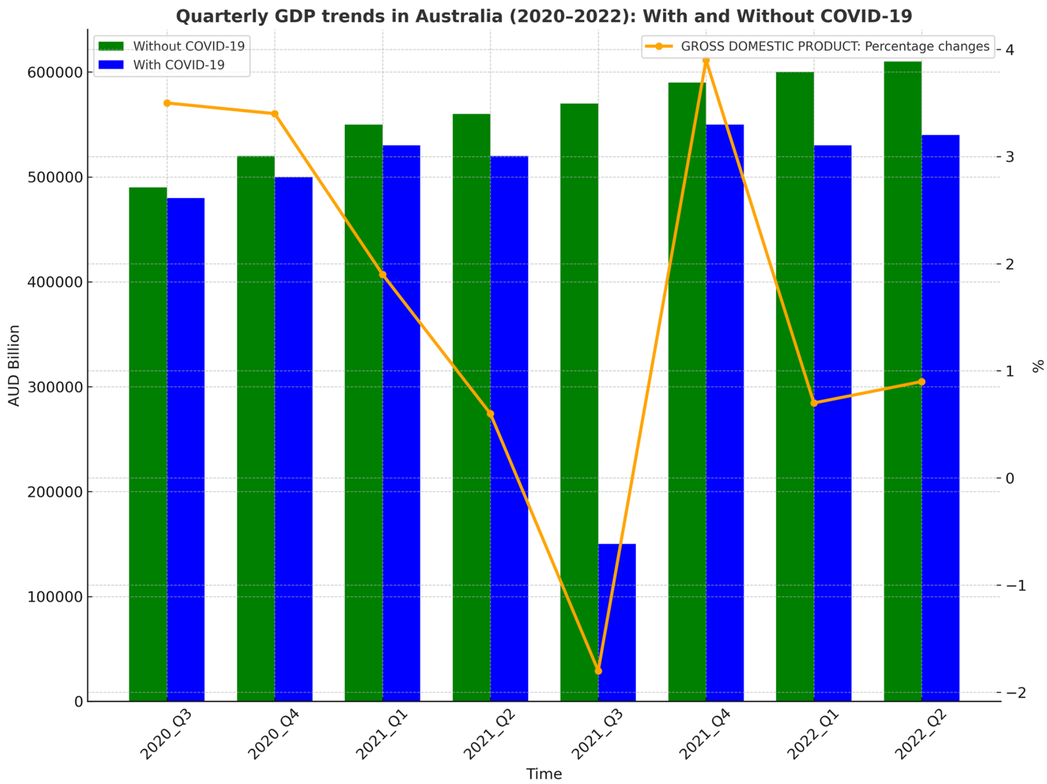

Figure 2. GDP changes due to the COVID-19 pandemic. Source: International Monetary Fund (2020) and Australian Bureau of Statistics (2022b).

COVID-19 has had a substantial impact on Australia's economic performance. To ensure analytical transparency, quarterly real GDP data (seasonally adjusted, chain volume measures) were obtained from the Australian Bureau of Statistics (2022a), while the counterfactual No-COVID trajectory was constructed using pre-pandemic GDP projections from the IMF World Economic Outlook (WEO, October 2019). These series were rebased to

2019 Q4 = 100 to ensure comparability with observed quarterly GDP data. The GDP gap represents the deviation between observed and projected (No-COVID) levels, expressed in billion AUD. The deviation shown in Figure 2 represents the percentage difference between observed GDP and the No-COVID trend.

The agriculture sector, which was exempt from most social distancing restrictions, experienced a relatively small contraction (between 20 percent and 1 percent). As a result of the knock-on effects of social distancing on forestry and fishing, the agri-food system contracted by 40 percent in the 4th quarter of 2020. All these downstream agri-food sectors have been suffering significant losses and contribute significantly to GDP. During the observed period, agriculture, forestry, and fishing fell in 2020 Q2 relative to No-COVID levels, reflecting the general downturn in world demand. Over time, the agriculture sector recovered after the 3rd quarter of 2020 and was back to No-COVID levels by 2021 (Figure 3).

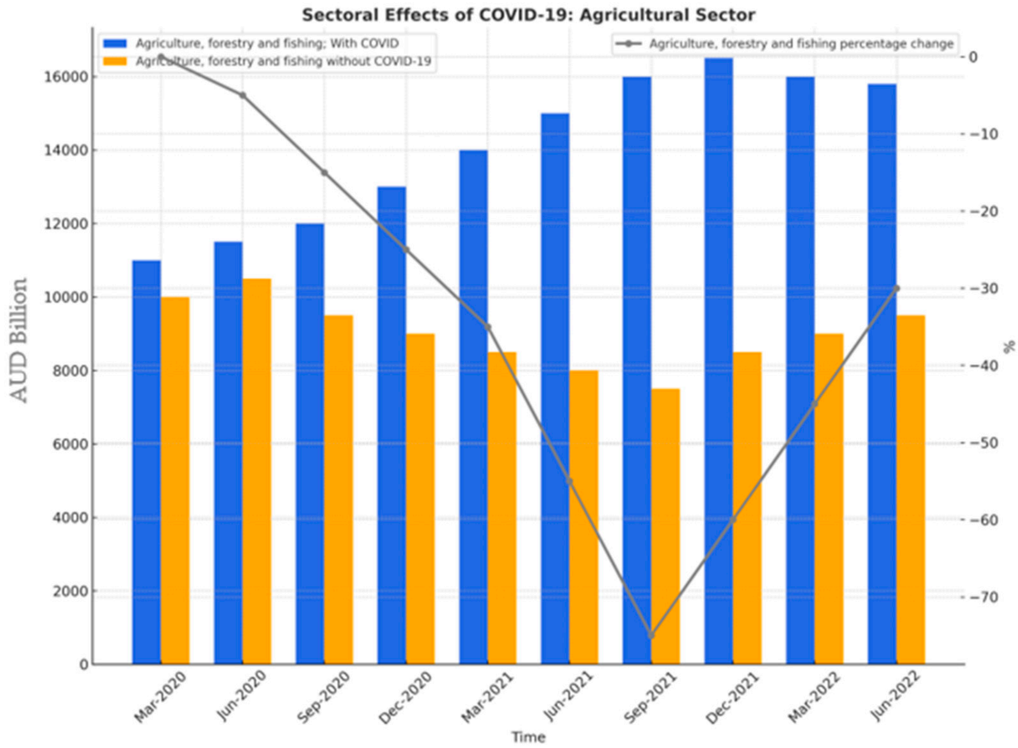

Figure 3. Sectoral effects of COVID-19: Agricultural sector. Source: Australian Bureau of Statistics (2022b) and International Monetary Fund (2020).

The initial effects of COVID-19 containment across all industries peaked in 2020 Q4. Most industries were the most negatively impacted in 2020 Q4. Both internal physical barriers and global travel restrictions have an impact on these sectors. The deviations show a different outline to those for mining (Figure 4). The Australian mining sector is unlikely to return to a No-COVID situation. It is significantly below the No-COVID scenario compared to other industrial activities. Recovery in electricity, gas, water, and waste services production starts to rise at the end of 2021, with output back to No-COVID values by the start of 2022.

The Australian services sector has grown at a 3.3 percent annual rate. This means that the services sector's growth continues to outpace that of the goods sector. The information, media, and telecommunications sector grew the fastest, with a compound annual growth rate of 5.8 percent in June 2021 before beginning to decline. Professional, scientific, and technical services grew after the 2nd quarter of 2021, while healthcare and social assistance fluctuated from −8.8 percent to 9.5 percent. Business activities in industries like hospitality, tourism, elective medicine, personal care services, and public entertainment experienced an unprecedented decline due to the demand shock brought on by the Australian government's social distancing policies and other measures (Australian Bureau of Statistics, 2022b).

The most impacted sectors in 2020 Q2 are accommodation and food services, arts and recreation services, transportation, postal services, and warehousing, owing to domestic physical barriers and international travel restrictions. Rental, hiring, and real estate services, administrative and support services, and other services declined due to the travel bans and mobility restrictions. Rental, hiring, and real estate services were reduced directly by physical distancing restrictions and indirectly through being connected to the construction sector, travelling, and dwelling investment. The decline in healthcare and social assistance is relatively small in 2020, Quarter 2. Overall, service sectors have recovered since the 3rd quarter of 2021, with the exception of a few minor drops. However, this only makes up a small proportion of the services sector.

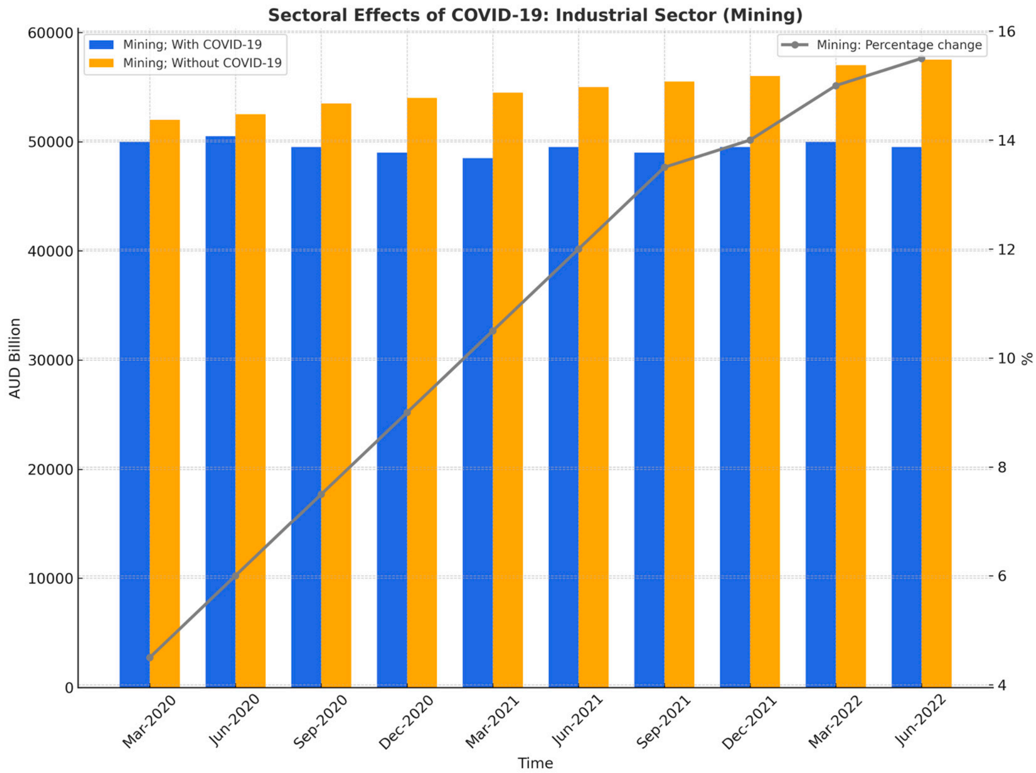

Figure 4. Sectoral effects of COVID-19: industrial sector (mining). Source: Australian Bureau of Statistics (2022b) and International Monetary Fund (2020).

7. Conclusions and Policy Recommendations

The economic toll of the COVID-19 pandemic is incalculable. However, estimates and evaluations would indicate how global GDP might have evolved if COVID-19 had been absent. The COVID-19 pandemic had a significant impact on the Australian economy. At the same time, economic activities have been affected differently by measures to reduce the spread, such as social distancing, commercial trading restrictions, and stay-at-home orders. Therefore, in this article, we have aimed to evaluate the direct and indirect costs of the COVID-19 pandemic on the Australian economy from 2020 to 2022, a time when the pandemic hit the economy the hardest. Such an evaluation of economic costs and the burden of a pandemic is crucial in developing resource allocation and prioritisation strategies for public health and economic resilience.

According to our findings, the unit cost of inpatients per day is estimated to be AUD 836, and 40 percent of the total cost is for medicinal consumables. The estimated total inpatient cost of COVID-19 in 2021, based on 4473 patients, is AUD 3.7 million for 2021 in Australia.

Moreover, the relationship between the inpatient unit cost per day and explanatory variables is explored using multiple regression analysis using the ordinary least squares method (Warren et al., 2003) based on the WHO-CHOICE model. Inpatient costs across six states of Australia are significantly associated with the type of hospital, gross domestic product, bed occupancy rate, average length of stay, and total number of inpatient admissions. The hospital bed occupancy rate is a highly significant proxy for the cost of a COVID-19 patient. A 1 percent change in GDP per capita for a state increases the inpatient costs by 0.24 percent. The higher number of admissions has a significant but minor cost-saving effect on per-day hospital costs. Furthermore, the direct cost of inpatient units per day in public hospitals is expected to be lower than in private hospitals. The magnitude of costs necessitates health policy coordination to respond to the pandemic.

This study has several policy recommendations. Indeed, the efficient use of resources decreases costs, which reduces the economic burden of health, which, in turn, leads to higher health security. The government and policymakers should consider the current macroeconomic transmission channels and causalities to monitor the impact of the macroeconomy by using available policy instruments, such as monetary and fiscal policies. According to the study findings, the hospital bed occupancy rate is a highly significant proxy for the cost of COVID-19 patients. Higher occupancy rates correlate with increased per-day costs due to the resource strain. Therefore, implementing surge staffing models and adaptable bed capacity, such as flexible ward allocation and temporary staffing pools, can mitigate cost pressure during peak admission periods. This directly addresses the findings that inpatient costs are sensitive to the admission periods. This directly addresses the findings that inpatient costs are sensitive to the number of admissions and occupancy levels. Furthermore, medicinal consumables account for 40% of total inpatient costs. By adopting targeted procurement strategies such as bulk purchasing, supplier diversification, and inventory optimisation, hospitals can reduce unit costs and minimise stockouts. In the meantime, this study's findings show that direct inpatient cost per day varies by hospital and resource use. To reduce avoidable costs, hospitals could implement triage protocols and telehealth consultations that determine the necessity of expecting other intensive resource procedures. Such measures would reduce unnecessary expenditure, aligning with our findings that per-day costs are driven by service intensity and hospital type. Therefore, this study concludes that the accurate estimation of health costs is a necessity to boost policy responses to COVID-19. In the context of cost minimisation efforts at the national level, health policy coordination among all states could also effectively reduce the economic effects of COVID-19.

Finally, this study focuses solely on the direct inpatient medical costs of non-ICU COVID-19 cases and, therefore, excludes intensive care unit (ICU), outpatient, and post-acute care costs. These exclusions limit the generalisability of the AIHW and OECD data. ICU treatment costs are approximately three to five times higher than those of standard inpatient care. Consequently, the estimated AUD 836 per inpatient per day likely represents a minimum or lower bound estimate, covering roughly 40% to 55% of total COVID-19-related health expenditure within the Australian health system. Additionally, this study does not include outpatient consultations, pharmaceutical care, or post-COVID rehabilitation costs, primarily due to data limitations and interstate variations in reporting. Macroeconomic factors such as inflation, unemployment, international trade flows, and fiscal adjustments were also beyond this study's analytical scope. Despite these constraints, this study offers a transparent and conservative benchmark for understanding inpatient cost structures. It provides a basis for future research to incorporate a comprehensive estimation of healthcare costs across all levels of care.

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Data Availability Statement: The data that support the findings of this study are available from the websites of the International Monetary Fund, the Australian Bureau of Statistics, and the Australian Institute of Health and Welfare. The data used in this study can be downloaded from https://docs.google.com/spreadsheets/d/1nNEbUQOqHLF4NWZsoRZVQatrNphnMdcb/edit?usp=drive_link&ouid=109457436135769460793&rtpof=true&sd=true (accessed on 15 October 2025).

Conflicts of Interest: The authors have no affiliations with or involvement in any organisation or entity with any financial or non-financial interest in the subject focus or materials discussed in this study.

Appendix A

State	Gross State Product per Capita: 2020	Total Confirmed Cases 2020	Natural log of Total Inpatient Admissions	Bed Occupancy Rate	Public Patients [a]	Private Health Insurance	Self-Funded	Workers Compensation	Motor Vehicle Third Party Personal Claim	Department of Veterans' Affairs	Other [b]	Median Length of Stay for Separations with a COVID-19 Diagnosis 2020–2021
NSW	76,760	4923	2049	20.72	5,260,917	3,829,711	249,509	95,888	60,770	211,794	89,866	8
VIC	70,571	20,368	737	14.95	4,557,914	2,724,248	161,449	44,637	50,818	127,182	56,030	8
QLD	70,416	1253	860	12.89	3,796,869	2,639,012	110,933	44,213	25,842	252,390	25,588	10
SA	62,821	576	246	4.53	1,264,535	745,464	26,863	11,162	15,076	51,464	18,615	1
WA	118,108	861	297	5.83	1,755,640	1,069,941	24,654	14,173	18,679	58,889	21,721	4
TAS	61,011	234	100	1.47	0	0	0	0	0	0	0	25
NT	107,412	75	39	0.98	0	0	0	0	0	0	0	13
ACT	98,513	118	140	1.15	0	0	0	0	0	0	0	2

[a] Public hospitals include separations at public psychiatric hospitals. [b] Excludes separation for which the care type was. Notes: Appendix information with notes on definitions and data limitations is available to download at the link below: https://www.aihw.gov.au/reports-data/myhospitals/content/about-the-data (accessed on 12 January 2023).

Appendix B

Funding Source	Public Hospitals [a]	Private Hospitals	Total
Public patients [b]	2,336,476	42,969	2,379,445
Private health insurance	378,652	1,005,473	1,384,125
Self-funded	19,728	48,596	68,324
Workers' compensation	10,792	27,071	37,863
Motor vehicle third-party personal claim	17,842	2880	20,722
Department of Veterans' Affairs	26,850	44,340	71,190
Other [c]	15,339	10,410	25,749
Total	**2,805,679**	**1,181,739**	**3,987,418**

[a] Public hospitals include separations at public psychiatric hospitals. [b] *Public patients* include separations with a funding source of health service budget, other hospital or public authority (with a public patient election status), health service budget (due to eligibility for reciprocal health care agreements), and health service budget—no charge raised due to hospital decision (in public hospitals). [c] *Other* includes separations with a funding source of other compensation, Department of Defence, correctional facilities, other hospital or public authority (without a public patient election status), other, and health service budget—no charge raised due to hospital decision (in private hospitals) and not reported. Notes: Appendix information with notes on definitions and data limitations is available to download at the link below: https://www.aihw.gov.au/reports-data/myhospitals/content/about-the-data (accessed on 12 January 2023).

Note

1 WHO-CHOICE (Choosing Interventions that are Cost-Effective) is an initiative started by the World Health Organisation in 1998 to help countries choose their healthcare priorities.

References

Adam, T., Evans, D. B., & Murray, C. J. (2003). Econometric estimation of country-specific hospital costs. *Cost Effectiveness and Resource Allocation*, *1*, 3. [CrossRef] [PubMed]

Ajmal, M. M., Khan, M., & Shad, M. K. (2021). The global economic cost of coronavirus pandemic: Current and future implications. *Public Administration and Policy*, *24*(3), 290–305. [CrossRef]

Australian Bureau of Statistics. (2022a). *Australian national accounts: National income, expenditure and product*. Available online: https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-national-income-expenditure-and-product/jun-2022 (accessed on 15 October 2025).

Australian Bureau of Statistics. (2022b). *Statistics*. Australia's National Statistical Agency. Available online: https://www.abs.gov.au/ (accessed on 15 October 2025).

Australian Institute of Health and Welfare. (2021). *Health expenditure Australia 2019–20*. Available online: https://www.aihw.gov.au/reports/health-welfare-expenditure/health-expenditure-australia-2019-20/contents/summary (accessed on 15 October 2025).

Baldwin, R., & Mauro, B. W. D. (2020). *Mitigating the COVID economic crisis: Act fast and do whatever it takes*. Centre for Economic Policy Research. ISBN 978-1-912179-29-9.

Beck, E. J., Avila, C., Gerbase, S., Harling, G., & De Lay, P. (2012). Counting the cost of not costing HIV health facilities accurately: Pay now, or pay more later. *Pharmacoeconomics*, *30*(10), 887–902. [CrossRef] [PubMed]

Boissay, F., & Rungcharoenkitkul, P. (2020). *Macroeconomic effects of COVID-19: An early review* (No. 7). Bank for International Settlements.

Commonwealth of Australia. (2022). *Budget strategy and outlook*. Commonwealth of Australia.

Debata, B., Patnaik, P., & Mishra, A. (2020). COVID-19 pandemic! It's impact on people, economy, and environment. *Journal of Public Affairs*, *20*(4), e2372. [CrossRef]

Department of Health and Aged Care. (2022a). *Coronavirus (COVID-19) case numbers and statistics*. Department of Health and Aged Care. Available online: https://www.health.gov.au/health-alerts/covid-19/case-numbers-and-statistics (accessed on 1 January 2022).

Department of Health and Aged Care. (2022b). *The hierarchy of controls for minimising the risk of COVID-19 transmission*. Department of Health and Aged Care. Available online: https://www.health.gov.au/resources/publications/the-hierarchy-of-controls-for-minimising-the-risk-of-covid-19-transmission (accessed on 14 December 2022).

Eichenbaum, M. S., Rebelo, S., & Trabandt, M. (2021). The macroeconomics of epidemics. *The Review of Financial Studies*, *34*(11), 5149–5187. [CrossRef]

Ghaffari Darab, M., Keshavarz, K., Sadeghi, E., Shahmohamadi, J., & Kavosi, Z. (2021). The economic burden of coronavirus disease 2019 (COVID-19): Evidence from Iran. *BMC Health Services Research*, *21*, 132. [CrossRef] [PubMed]

International Labour Organization. (2021). *The impact of the COVID-19 pandemic on jobs and incomes in G20 economies*. Available online: https://www.ilo.org/publications/impact-covid-19-pandemic-jobs-and-incomes-g20-economies-0 (accessed on 30 March 2023).

International Monetary Fund. (2020). *Macroeconomic and financial data*. International Monetary Fund. Available online: https://www.imf.org/en/Data (accessed on 30 March 2023).

Jin, H., Wang, H., Li, X., Zheng, W., Ye, S., Zhang, S., Zhou, J., & Pennington, M. (2021). Economic burden of COVID-19, China, January–March 2020: A cost-of-illness study. *Bull World Health Organ*, *99*, 112–124. [CrossRef] [PubMed]

Maliszewska, M., Mattoo, A., & Van Der Mensbrugghe, D. (2020). *The potential impact of COVID-19 on GDP and trade: A preliminary assessment (*Policy Research Working Paper; No. 9211*)*. World Bank.

Marcolino, M. S., Ziegelmann, P. K., Souza-Silva, M. V., Nascimento, I. J. B. D., Oliveira, L. M., Monteiro, L. S., Sales, T. L., Ruschel, K. B., Martins, K. P., & Etges, A. P. B. (2021). Clinical characteristics and outcomes of patients hospitalized with COVID-19 in Brazil: Results from the Brazilian COVID-19 registry. *International Journal of Infectious Diseases*, *107*, 300–310. [CrossRef] [PubMed]

Mckibbin, W., & Fernando, R. (2020). The global macroeconomic impacts of COVID-19: Seven scenarios. *Asian Economic Papers*, *20*, 1–30. [CrossRef]

Mishra, M. K. (2020). *The world after COVID-19 and its impact on global economy*. ZBW—Leibniz Information Centre for Economics. Available online: http://hdl.handle.net/10419/215931 (accessed on 2 February 2023).

Pearson, C. A. B., Bozzani, F., Procter, S. R., Davies, N. G., Huda, M., Jensen, H. T., Keogh-Brown, M., Khalid, M., Sweeney, S., Torres-Rueda, S., Group, C. H. C.-W., Group, C. C.-W., Eggo, R. M., Vassall, A., & Jit, M. (2021). COVID-19 vaccination in Sindh Province, Pakistan: A modelling study of health impact and cost-effectiveness. *PLoS Medicine*, *18*, e1003815. [CrossRef] [PubMed]

Stenberg, K., Lauer, J. A., Gkountouras, G., Fitzpatrick, C., & Stanciole, A. (2018). Econometric estimation of WHO-CHOICE country-specific costs for inpatient and outpatient health service delivery. *Cost Effectiveness and Resource Allocation*, *16*(1), 11. [CrossRef] [PubMed]

Stock, J. H., & Watson, M. W. (2018). Identification and estimation of dynamic causal effects in macroeconomics using external instruments. *The Economic Journal*, *128*(610), 917–948. [CrossRef]

Warren, D. K., Shukla, S. J., Olsen, M. A., Kollef, M. H., Hollenbeak, C. S., Cox, M. J., Cohen, M. M., & Fraser, V. J. (2003). Outcome and attributable cost of ventilator-associated pneumonia among intensive care unit patients in a suburban medical centre. *Critical Care Medicine*, *31*, 1312–1317. [CrossRef] [PubMed]

World Health Organisation. (2020). *WHO COVID-19 preparedness and response progress report—1 February to 30 June 2020*. Available online: https://www.who.int/publications/m/item/who-covid-19-preparedness-and-response-progress-report{-}{-}-1-february-to-30-june-2020 (accessed on 1 January 2022).

World Health Organisation. (2021). *WHO COVID-19 dashboard*. World Health Organisation. Available online: https://covid19.who.int/ (accessed on 12 December 2021).