



The Macquarie Indexes of Healthcare Productivity

A SET OF NATIONALLY CONSISTENT AND DISAGGREGATED
INDEXES OF HOSPITAL SERVICES DELIVERY FOR STATES
AND TERRITORIES IN AUSTRALIA

AN INITIATIVE OF



**AUSTRALIAN INSTITUTE
OF HEALTH INNOVATION**
*Faculty of Medicine, Health
and Human Sciences*

**CENTRE FOR THE
HEALTH ECONOMY**



ABOUT THE NHMRC PARTNERSHIP CENTRE FOR HEALTH SYSTEM SUSTAINABILITY

The Australian Institute of Health Innovation (AIHI) at Macquarie University is the home of the NHMRC Partnership Centre for Health System Sustainability (PCHSS), a research network of 17 lead investigators, 20 expert advisors, and over 40 system implementation partners from across Australia that have come together to develop and evaluate interventions to improve the sustainability of the country's health system.

Funded by a five-year NHMRC grant in 2017, the Centre is led by Professor Jeffrey Braithwaite, Founding Director of AIHI. Professor Braithwaite leads a highly experienced research team to explore the issues impacting healthcare system sustainability, while developing and evaluating interventions that are appropriate from a clinical, patient, and economic perspective.

PCHSS researchers conduct sustainability analyses of health systems and assess models for conceptualising and creating sustainable organisations to deliver healthcare in the 21st century. We contribute to national and international models for health system sustainability. Our researchers are committed to seeing health systems improvement move from a localised, small-scale empirical endeavour, to one that is theoretically sound, efficient and cost-effective when performed at scale, and with the ability to be widely deployed and to have sustainable results.

AN OPEN INVITATION TO LEARN MORE ABOUT & USE THE MACQUARIE INDEXES

To learn more about the Macquarie Indexes or to discuss how you can use them in your setting, please get in touch. We look forward to hearing from you.

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FUNDING STATEMENT

This research is conducted for the NHMRC Partnership Centre for Health System Sustainability (Grant ID #: 9100002) administered by the Australian Institute of Health Innovation, Macquarie University. Along with the NHMRC, the funding partners in this research collaboration are: The Bupa Health Foundation; NSW Ministry of Health; Department of Health, WA; and The University of Notre Dame Australia. Their generous support is gratefully acknowledged. While the NHMRC, The Bupa Health Foundation, NSW Ministry of Health, Department of Health, WA and The University of Notre Dame Australia, have provided in-kind and financial support for this research, they have not reviewed the content and are not responsible for any injury, loss or damage however arising from the use of, or reliance on, the information provided herein. The published material is solely the responsibility of the authors and does not reflect the views of the NHMRC or its funding partners.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support provided by the team at the Australian Institute of Health Innovation (AIHI), Macquarie University, with special thanks to Ms Jackie Mullins, Ms Sue Christian-Hayes, Dr K-lynn Smith and Ms Joanna Holt.

ADVISORY PANEL

The support of the following experts from the Project Advisory Panel is gratefully acknowledged: Professor Christine Bennett AO (University of Notre Dame), Adjunct Associate Professor Annette Schmiede (Bupa Health Foundation), Professor Anthony Scott (University of Melbourne) and Associate Professor Jongsay Yong (University of Melbourne).

RECOMMENDED CITATION

Yeend, T. Cutler, H. Partington, A. Braithwaite, J. Zurynski, Y. 2021. The Macquarie Indexes of Healthcare Productivity: A Set of Nationally Consistent and Disaggregated Indexes of Hospital Service Delivery for States and Territories in Australia. The NHMRC Partnership Centre for Health System Sustainability, Sydney, Australia.

ISBN: 978-1-74138-479-6

THE MACQUARIE INDEXES OF HEALTHCARE PRODUCTIVITY

A SET OF NATIONALLY CONSISTENT AND DISAGGREGATED INDEXES OF HOSPITAL SERVICES DELIVERY FOR STATES AND TERRITORIES IN AUSTRALIA

Presented is an introduction to a set of new indexes that describe the quantity, price and combined expenditure on hospital services delivery by the states and territories in Australia. These indexes provide a consistent account of healthcare productivity, which can be disaggregated into sub-indexes that map directly to the underlying activity and cost-structures of health sector providers and their payers.

These indexes result from a body of work produced within the National Health and Medical Research Council (NHMRC) Partnership Centre for Health System Sustainability, at the Australian Institute of Health Innovation (AIHI) at Macquarie University, in collaboration with the Independent Hospitals Pricing Authority (IHPA) and the Macquarie University Centre for the Health Economy (MUCHE).

Contained within this introductory report are the following sections:

1. Operations & Policy Context
2. The Macquarie Indexes
3. Examples of Insights from the Indexes
4. Our Approach to Indexing
5. Immediate Impact & Future Directions

OPERATIONS & POLICY CONTEXT

Healthcare systems across the world experience financial, organisational, and social pressures due to demographic change, the development of new technologies, and increasing expectations of effectiveness and experience. As a result, these systems continually need to adapt to provide high quality and

sustainable care, whilst also ensuring equitable access for their populations, particularly those with chronic and complex conditions [1].

As part of the health system, Australian public hospitals are supported by over \$50 billion in government and non-government recurrent expenditure, which is delivered through a complex arrangement of funding and payment mechanisms. Commonwealth, state, and territory governments account for around 92 per cent of this expenditure, with the remaining eight per cent accounted for by non-government sources such as health insurance funds and individual out-of-pocket payments [2].

Expenditure for public hospital services doubled in nominal terms over the ten years to 2015-16, from \$25.4 billion to \$51.1 billion [2]. This nominal increase represents the combined effect of price inflation within the public hospital sector, together with changes in the composition, quantity, and quality of the public hospital services. Understanding the relative effect of these factors is critical to forming a meaningful understanding of the value of the sector within the broader healthcare system.

In 2012-13, a national activity-based funding (ABF) system was established as the primary mechanism for government funding of public hospital services. The ABF system creates line-of-sight funding arrangements from governments to collections of public hospitals referred to as Local Hospital Networks (LHNs).

In 2015-16, \$35.7 billion in government payments were made to LHNs under the ABF system, representing 70 per cent of that year's total expenditure on public hospital services. These ABF payments comprised 58.6 per cent (\$20.9 billion)

state and territory government funding and 41.4 per cent (\$14.8 billion) Commonwealth government funding [3].

The ABF system is underpinned by an annual determination of prices for public hospital services, set by the Independent Hospital Pricing Authority (IHPA). Payments made under the ABF system are based on these prices together with the activity undertaken by LHNs. To support the determination of prices and the operation of the ABF system, IHPA collects data from state and territory health authorities on public hospital activity and costs.

These national public hospital data collections contain detailed information on the demographic characteristics of the patients receiving care; the clinical, service, and administrative characteristics of the care provided; and the financial characteristics associated with the services delivered.

Not only do these data collections provide a crucial evidence base for the national ABF system, but they are also a highly valuable resource for improving our understanding of Australia's public hospital system. In fact, they constitute the only national collection of data directly linking the care provided in Australia's public hospitals with the services delivered, costs incurred, and revenue received.

Government treasuries and health agencies require economic information that summarise their systems and practices, with accurate estimates of the productivity of the public hospital sector. Simply, productivity is the relationship between inputs and outputs of the system and provides insight into whether the quantum of inputs is producing the amount and type of outputs that are expected. They also require the ability to track how these estimates of productivity change over time given different stressors or interventions, and to be able to do so in ways that can be used to draw comparisons to different benchmarks. For this, data is required on the inputs and outputs to the system, namely prices, quantities, and quality.

Through index number methods for hospital prices, expenditure, and the quantity and quality of care provided, the effectiveness and value of policies and

operational decisions can be observed and assessed. Indexes also provide the potential for inferences to be drawn on the underlying dynamics within the system, that drive productivity.

The Australian Bureau of Statistics (ABS) produce the Government Final Consumption Expenditure (GFCE), which is used by the Australian Institute of Health and Welfare (AIHW) in their estimates of inflation-adjusted real expenditure. The ABS measures of price inflation and the AIHW's 'top-down' calculation of expenditure is helpful economic information for health system managers and providers. However, because the GFCE is a broad index that includes non-ABF care, it is non-specific to hospital care and cannot be disaggregated into different types of services and their associated quantities. Specific measures are needed that directly link to the care that is provided.

Since March 2018, the National Health & Medical Research Council (NHMRC) National Partnership Centre of Health System Sustainability have worked with the Independent Hospital Pricing Authority (IHPA) and the Australian Institute of Health Innovation (AIHI) and Centre for the Health Economy (MUCHE) at Macquarie University, to understand and profile the pressures faced by Australia's public hospitals. Together they have sought to use the activity and funding data held by IHPA and explore how this may be turned into more accurate economic information to support evidence-based decision-making within the hospital sector.

THE MACQUARIE INDEXES

The culmination of multiple projects conducted within the NHMRC Partnership Centre for Health System Sustainability has been the construction of a set of nationally consistent and disaggregated indexes of hospital service delivery for the states and territories in Australia.

The **Macquarie Indexes of Healthcare Productivity** currently comprise the three interrelated indexes:

1. The Macquarie Index of **Expenditure** on Hospital Service Delivery
2. The Macquarie Index of **Price** of Hospital Services Delivered
3. The Macquarie Index of **Quantity** of Hospital Services Delivered

The aim of the indexes is to enable the consistent measurement of the components of productivity across time and physical geographies, through routinely collected data that accurately reflects the care that is delivered.

Each index retains the dimensions of the underlying IHPA activity and costing data. As a result, each of the Macquarie Indexes can be further broken-down or disaggregated into sub-indexes that reflect combinations of these dimensions e.g., a price index for the salaries and wages of allied health (a specific budget Line Item), for publicly funded patients within the state of Victoria.

To date, the existing indexes provide metrics that quantify drivers of expenditure across the public hospital system over the period from 2006-07 to 2016-17. These outputs require further detailed examination to gain meaningful and reliable insights. As the metrics span the years prior to and since the introduction of ABF, ongoing work includes the consideration of the metrics in this context.

Further work is planned to extend the existing indexing methods to develop additional **indexes of quality** metrics and an **index of funding**, which will enable greater analysis of productivity and its underlying drivers. The construction of quality indexes for hospital outputs, to compare and balance against quantity, is

particularly important for understanding the nature of the outputs from the health system.

The Macquarie Indexes establish a broad foundation for understanding the pressures faced by Australian public hospitals. Through this, the economic evidence-base for policy development and evaluation, strategic planning and system management will be improved.

EXAMPLES OF INSIGHTS FROM THE INDEXES

Over the period from 2012-13 to 2016-17, total recurrent expenditure on acute admitted public hospital services grew an average of 6.2 per cent per annum. As highlighted within *Figure 1*, this growth was the combined effect of 3.7 per cent annual inflation in prices and 2.4 per cent annual growth in the quantity of services.

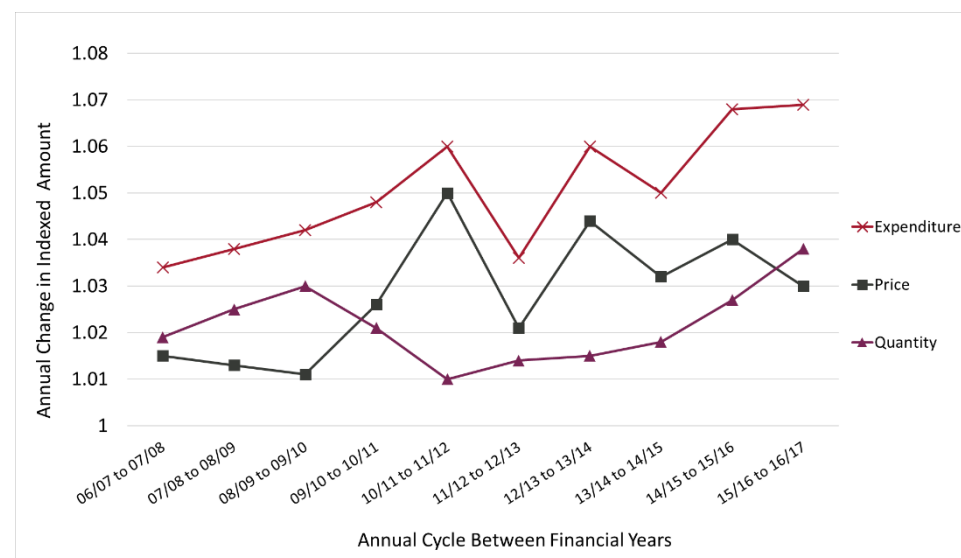


FIGURE 1 - TRENDS FOR ANNUAL CHANGES IN TOTAL RECURRENT EXPENDITURE, SERVICE PRICE AND QUANTITY INDICES, FROM 2006/07 TO 2016/17

At a state and territory level, average annual growth in expenditure ranged from 2.6 per cent in State H to 9.4 per cent in State A, with annual inflation rates ranging from 1.7 per cent in State F to 6.1 per cent in State H. Underlying State H's relatively low expenditure growth and high inflation rate was a negative annual growth of -3.5 per cent in volume of services. The highest annual growth in volume of services was seen in State A with 5.2 per cent. *Figure 2* illustrates these average annual expenditure, price and quantity growth in acute admitted public hospital services by state and territory.

Salaries and wages make up 61.7 per cent of total recurrent expenditure on acute admitted services, so overall price inflation is largely affected by the underlying price growth of labour market services. The sub-index for salaries and wages estimates that that prices for labour market services grew on average 3.1 per cent over the period from 2012-13 to 2016-17.

As shown in *Figure 3*, State E, State F and State G saw their annual growth in underlying labour market prices exceed their growth in prices of acute admitted services. State A, State C, State D, and State G all saw a relatively low annual price growth in underlying labour market services of around 2.3 per cent.

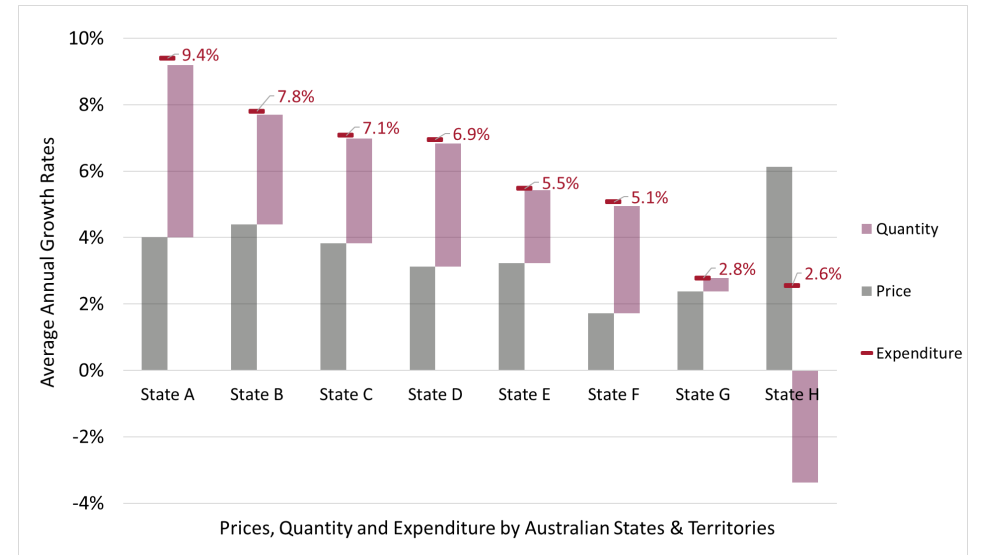


FIGURE 2 - AVERAGE ANNUAL GROWTH IN EXPENDITURE, PRICE AND QUANTITY OF ACUTE ADMITTED PUBLIC HOSPITALS SERVICES, FROM 2012/13 TO 2016/17

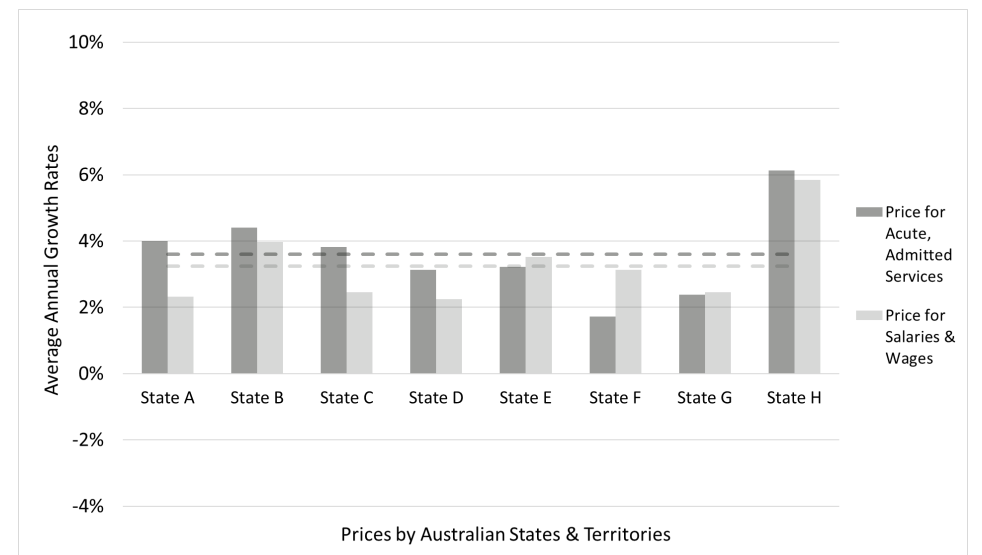


FIGURE 3 - AVERAGE ANNUAL GROWTH IN PRICES FOR TOTAL ACUTE ADMITTED SERVICES, COMPARED WITH PRICES FOR RELATED SALARIES & WAGES, FROM 2012/13 TO 2016/17

OUR APPROACH TO INDEXING

To compile the Macquarie Indexes a **National Public Hospital Database** has been curated. The routinely collected, but previously disparate, patient-level data collated by IHPA can now be used for the construction of indexes and sub-indexes that reflect the unique features of the IHPA data collections.

CORE CONCEPTS

Relative Changes

The indexes profile the relative changes in expenditure, price, and quantity over time. These changes can either be expressed as ‘deflators’ or proportions of a total in a reference year (e.g., the most recent or final year); or as ‘annual change estimates’ that profile the shifts between years, on a rolling basis.

These relative changes in the indexes provide a normalised measure for each index that ensures that trends from one year to the next are not artificially driven by artefacts within the data, and how it is collected, rather than what it is that we seek to measure.

Interdependent Partitions

The health service activities that are represented within the indexes have been grouped into common partitions across all the years for each index. The partitions are collectively exhaustive, but mutually exclusive groupings of all the dimensions that constitute the activity that is captured within an index.

This enables the indexes to be broken-down and analysed consistently over time and allows for the underlying drivers of any index to be investigated. For example, the expenditure index can be broken-down into the partitions for salaries and wages of allied health, where the information captured in that specific Line Item is

consistent from one year to the next. *Table 1 - The Dimensions* details the Index Level and Expenditure Scope partitions, by which the indexes can be broken-down.

The grouping of partitions also means that any sub-group of the total national activity (e.g., that of an individual hospital, LHN, or state) can be expressed relative to a national profile that is standardised for variation in case-mix, clinical complexity, length of stay and cost. Likewise, any break-down can be summed together and ‘rolled-back up’ into consistent aggregate figures.

DATA SOURCES

The Macquarie Indexes utilise national public hospital data collections held by IHPA. These data sources span 12 years of public hospital activity from 2006-07 to 2017-18 and constitute one of the most comprehensive single collections of information on the Australian public hospital system, directly linking the care provided with the services delivered, costs incurred, and revenue received.

The specific data sources include:

- a. The ABF Activity Data Collection (ADC), which contains patient characteristics together with clinical service and administrative descriptors.
- b. The Admitted Patient Care (APC) and the Non-admitted Patient Emergency Department (NAPED) National Minimum Data Sets (NMDSs), which also include activity attributes for years prior to the establishment of the IHPA ADC
- c. The National Hospital Cost Data Collection (NHCDC), which contains attributes related to costs incurred by LHNs and collates their spending into categories related to common service-lines within an LHN and whether is directly or indirectly attributable to a patient episode; and
- d. The Hospital Casemix Protocol (HCP) Data Collection, which contains private health insurance attributes.

Further details will be published on the incorporation of mental health care data & unqualified newborn activity. Efforts were also undertaken to recalibrate earlier 2006-07 and 2007-08 indexes, to account for breaks within the time series of the

collections. Activities that make use of IHPA data collections are undertaken on purpose-built Secure Data Management System, which includes a virtual desktop environment.

EMPIRICAL METHODS

Derivation of Three Indexes

Index number methods were used to derive the three interrelated indexes.

1. Firstly, models for expenditure incurred by LHNs were constructed, across the dimensions related to their scope of ABF operations.
2. From total expenditure, a casemix and complexity adjusted cost per care-day was inferred. This represents the price at which services are procured or commissioned by the states and territories in Australia, as the system managers of ABF.
3. Finally, the quantity is derived as the quotient of expenditure and price.

Within the construction of the Macquarie Indexes, different approaches were tested, and compared against the existing price deflators for Government Final Consumption Expenditure, developed by the ABS [4]; the Health Expenditure reports, which are based on the ABS deflators [2]; and the public hospital costs per National Weighted Activity Unit (NWAU) used by IHPA.

IMMEDIATE IMPACT & FUTURE DIRECTIONS

The work that has gone into the production of the National Public Hospitals Database and the Macquarie Indexes provide immediate impact through their use within operational and policy contexts; the further development of indexing methods; and in applied research that can utilise the indexes.

There are also some clear directions that can be taken within the indexes, into the future. These include how they can be embedded within the operations of IHPA and broader policy context. The approach may also be expanded to include other sectors within the health system for which similar data may be available.

These immediate impacts and future directions are outlined below and listed in *Table 2 – Applications of the Macquarie Indexes of Healthcare Productivity*.

A main priority is the extension of the methods employed within the existing Macquarie Indexes, towards additional indexes for quality, funding, and other spatial breakdowns. Quality will take specific consideration, given there are a range of technical components (e.g., comparison of outcomes to best practice) and interpersonal components (e.g., patient experience), [5] and may require value judgements and consideration of public attitudes and expectations [6].

The applications outlined in *Table 2* increase the value that can be realised from national hospital datasets. The Macquarie Indexes and resulting outputs should be viewed as a return on the investments and effort of IHPA that go into the generation of these enduring resources, every year.

TABLE 1 - THE DIMENSIONS OF THE INDEXES

The Dimensions of the Indexes							
Index Level			Expenditure Scope				
National	State & Territory	Intra-State Locality	Funding Source	Activity Stream	Cost Centre	Line Items	Cost Buckets
AUS	NSW	Local Hospital Network*	Public	Emergency Department	Allied	Salaries & Wages - Nursing	Allied Health
	VIC		Private	Acute, Admitted	Clinical	Salaries & Wages - Allied Health	Critical Care
	QLD		DVA	Subacute and Non-Acute, Admitted	Imaging	Salaries & Wages - Other	Depreciation
	WA			Non-Admitted	Pathology	Salaries & Wages - Medical	Emergency Department
	SA				Critical	Salaries & Wages - Visiting Medical	Excluded
	TAS				Operating Room	Other Goods & Services	Hotel
	ACT				Pharmacy	Medical & Surgical Supplies	Imaging
	NT				Emergency	Corporate	Non Clinical
					Special Procedure Suites	Imaging Goods & Services	On Costs
					Non-allocated Overheads	Pathology Goods & Services	Operating Room
				Other - Non-Patient	Blood Products	Patient Travel	
					Non PBS Pharmacy	Pathology	
					Pharmacy PBS	Pharmacy	
					Staffing Oncosts	Prostheses	
					Prostheses	Special Procedure Suites	
					Hotel	Ward Medical	
					Building Depreciation	Ward Nursing	
					Equipment Depreciation	Ward Supplies	
					Leasing Costs		
					Capital Works		
					Excluded		
					Patient Travel		

The Macquarie Indexes of Healthcare Productivity	The Macquarie Index of <i>Expenditure</i> on Health Services Delivery
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* Local Health District (NSW); Hospital and Health Service (QLD); Local Health Network (SA); Tasmanian Health Organisation (TAS)

TABLE 2 – APPLICATIONS OF THE MACQUARIE INDEXES OF HEALTHCARE PRODUCTIVITY

Applications of the Macquarie Indexes			
	Operational & Policy Uses	Methodological Developments	Applied Research with Indexes
Immediate Impact	<ol style="list-style-type: none"> 1. The Macquarie Indexes can be used to inform and evaluate policies and interventions within healthcare delivery, that aim to improve productivity. 2. The Macquarie Indexes can be used to inform and evaluate Activity Based Funding and other financing models for hospital and health care services. 	<ol style="list-style-type: none"> 3. The Macquarie Indexes can be used to inform other indexes of price and quantity, that are currently under development by the Australian Bureau of Statistics (ABS) 4. The Macquarie Indexes can be used to inform new methodologies for transforming and using Australian public hospital administrative data, in ways that account for definitional changes and data-linkage errors. 	<ol style="list-style-type: none"> 5. The Macquarie Indexes can be used within existing and ongoing research into hospital sector performance, including: <ul style="list-style-type: none"> • The NHMRC Partnership Centre for Health System Sustainability • The Medical Research Future Fund (MRFF) <i>Keeping Australians Out of Hospital</i> initiative • The MRFF <i>Preventive and Public Health</i> initiative • The National Prescribing Service (NPS) <i>MedicineWise Choosing Wisely Australia</i> initiative

Applications of the Macquarie Indexes

	Operational & Policy Uses	Methodological Developments	Applied Research with Indexes
Future Directions	<ol style="list-style-type: none"> 6. Embed the Macquarie Indexes and their methods within online, national performance benchmarking portals and reports produced by IHPA. 7. Use the Macquarie Indexes to routinely monitor and report on healthcare productivity. 8. Extend access to the curated National Public Hospitals Database and Macquarie Indexes to enable the forecasting of quality improvement and intervention budgets. 9. Expand the scope of indexes to include activity in other sectors of the health system that are or may be funded through the ABF or other bundled payment approaches, such as aged care. 	<ol style="list-style-type: none"> 10. Extend methods to develop a Macquarie Index of Quality and Safety in Hospital Service Delivery, using health outcomes and patient-reported experience measures e.g., <ul style="list-style-type: none"> • Indexes for Hospital Acquired Complications (HACs) and Potential Avoidable Hospitalisations/Admissions (PPHs/PPAs) 11. Extend methods to develop a Macquarie Index of Funding for Hospital Services Delivery, using funding data published by the Administrator of the National Health Funding Pool, as a set of Activity Based Funding. 12. Extend methods to develop a set of Spatial Indexes as an extension of the existing temporal indexes, which will measure differences across the public hospital sector (i.e., between states or networks of hospitals) within a given time-period. 13. Extend methods to specialised and targeted index development e.g., <ul style="list-style-type: none"> • Index for restricted scopes of activity, such as for neonatal ventilatory support 	<ol style="list-style-type: none"> 14. Extend access to the Macquarie Indexes and underlying National Public Hospitals Database, to facilitate comparative studies using Real-world evidence (RWE), and enable natural experiments and prospective observational studies.

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