Capstone Final Report

Temporal Trends and Cost Growth in Australian Healthcare Expenditure (2018–2023)

Project Lachesis – Redback
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Executive Summary

This report analyses five years (2018–2023) of Australian healthcare expenditure using datasets sourced from the Australian Institute of Health and Welfare (AIHW). The study, undertaken as part of the Lachesis project at Redback, aimed to uncover trends in cost growth, inflationary impacts, and sector-based (government vs non-government) differences in funding.

Key findings include,

- Total health expenditure consistently rose in both nominal and inflation-adjusted terms.
- The divergence between current and constant prices widened post-2019 due to inflation.
- Non-government sectors spent more than government across top health categories, but with higher year-on-year volatility.
- Hospitals remained the dominant funding category throughout, indicating an entrenched allocation pattern.
- COVID-19 caused sharp cost spikes, but post-pandemic expenditure remains elevated.

Recommendations include shifting from hospital-centric models to preventative care, accounting for real (inflation-adjusted) growth in planning, and preparing emergency fiscal buffers. The report reflects a three-month research cycle integrating data wrangling, visual analytics, and advanced interpretation for policy relevance.

Role Overview & Objective

In my role as the Temporal Trends & Cost Growth Analyst, I led the analytical component of the Capstone project. My primary objective was to investigate year-over-year expenditure patterns, distinguish nominal vs real growth, and identify category-wise and sectoral drivers of cost escalation.

This analysis focused on answering questions like,

- How much of healthcare growth is real vs inflation-driven?
- Which services or sectors drive the bulk of expenditure?
- How did the COVID-19 pandemic reshape spending patterns?
- What insights can we draw to improve resource allocation?

METHODOLOGY

1. Data Collection

- Source: AIHW official expenditure datasets (2018–19 to 2022–23).
- Only relevant sheets were extracted (Eg: government vs non-government splits, current vs constant prices, category-wise totals).

2. Preprocessing

- Power Query was used to align structural formats, headers, and clean merged cells.
- Python (Pandas) handled deeper wrangling,
    - Cleaned NA values, ellipses, and inconsistent monetary formats.
    - Transformed wide data into long format.
    - Added derived columns for year-over-year (YoY) growth rates and sector aggregations.

3. Version Control

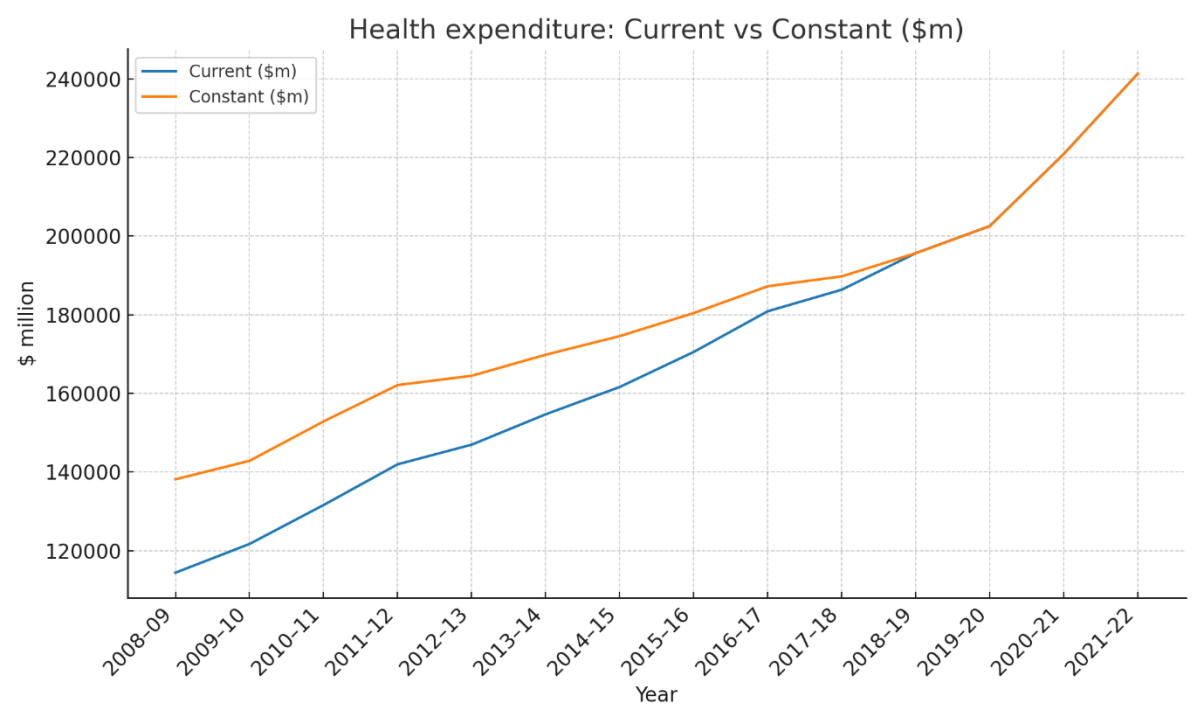
- GitHub repo structured as, /raw, /cleaned, /analysis, /outputs.
- Trello board tracked all tasks from acquisition → analysis → visualisation → insights & recommendations.

4. Data Visualisation

- Used **Matplotlib** and **Seaborn** to generate,
    - Line graphs for time series.
    - Heatmaps for category shares.
    - Stacked bars for growth decomposition.
    - Grouped bars for sectoral comparison.
    - Waterfall charts for YoY spending changes.

KEY FINDINGS & VISUAL INTERPRETATIONS

1. Current vs Constant Price Expenditure Trends (2008–2022)



The line chart above compares Australia's health expenditure over time using two distinct monetary concepts.

- Current Prices: The actual dollars spent in each year (not adjusted for inflation).
- Constant Prices: Spending values adjusted to a base-year dollar value (typically to remove the effects of inflation).

From 2008–09 to 2021–22

- Current price expenditure shows a steady upward trajectory, with a more pronounced surge after 2020.
- Constant price expenditure also rises but at a smoother, more gradual rate.

By 2021–22, the difference between the two curves is wider than at any point prior, revealing the growing influence of inflation on health spending figures.

Key Observations

- 2008–2018: The lines remain relatively close, suggesting inflation and real spending growth moved in tandem.
- Post-2019: A divergence begins to emerge. The gap expands dramatically between 2020–21 and 2021–22, aligning with,
    - The COVID-19 pandemic
    - Supply chain pressures, wage increases, and new service demands
- Current prices rose at a rate not matched by constant prices, indicating that a large share of increased spending was price-driven, not necessarily volume or quality-driven.

Insights

The Importance of Adjusting for Inflation in Health Expenditure Analysis

The observed divergence between current and constant price expenditure from 2008–09 to 2021–22 underscores a critical analytical and policy consideration. While current price expenditure rose sharply particularly in the post-2020 period this trend does not reflect an equivalent increase in the real quantity or quality of health services delivered. Much of this nominal growth can be attributed to inflationary pressures rather than genuine expansion in service provision.

This phenomenon poses a significant risk for policymakers and analysts who may base decisions solely on current dollar figures. Without adjusting for inflation, expenditure data can misrepresent progress, potentially leading to overoptimistic conclusions about funding effectiveness, system efficiency, and healthcare outcomes.

From a budgetary planning perspective, this insight highlights the need for constant price reporting as standard practice in public health expenditure analysis. By evaluating health spending in real terms, stakeholders can more accurately assess whether investments are keeping pace with population needs and cost pressures, or merely offsetting inflation.

Policy Relevance

- **Misaligned Planning**: Health departments may claim "record-breaking investment," but without adjusting for inflation, that claim is misleading in terms of service gains.
- **Budget Forecasting Errors**: Underestimating inflation leads to underfunding, forcing mid-year top-ups or cutting planned services.
- **False Efficiency Metrics**: Cost-efficiency ratios based on nominal growth create an illusion of reduced unit costs, which is inaccurate.

Failure to incorporate this adjustment can result in misallocated resources, unrealistic performance targets, and underfunded health initiatives. Therefore, it is recommended that all

future expenditure reviews, performance assessments, and strategic planning documents include inflation-adjusted financial metrics alongside nominal figures.

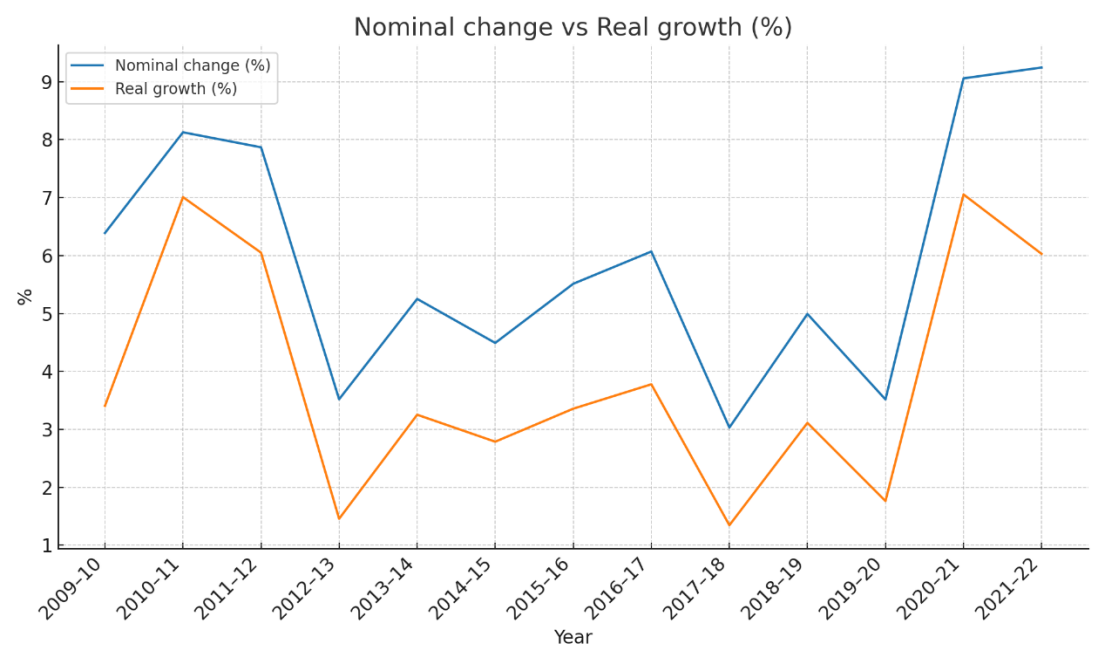
Strategic Recommendation

All future health budget reviews and policy documents should prioritise constant-price (real) analysis alongside nominal figures.

This includes,

- Tracking real per capita health spending for true comparison.
- Communicating inflation impacts to the public transparently.
- Incorporating price effect decomposition in annual budget reports.

2. Nominal vs Real Growth Bridge (2020–2023)



The above chart visualises the percentage change in Australia's health expenditure comparing,

- **Nominal Change (%):** The year-on-year percentage increase in current price (non-inflation-adjusted) spending.
- **Real Growth (%):** The same expenditure change but adjusted for inflation using constant prices.

By contrasting these two metrics, we can better understand whether expenditure growth reflects actual improvements in healthcare services or is largely driven by inflationary pressures.

Trends Observed (2009–10 to 2021–22)

- Nominal expenditure growth exhibits more volatility over time, peaking at over 9% during 2020–21, a period marked by emergency pandemic spending.
- Real expenditure growth, in contrast, remains consistently lower, fluctuating within a narrower range (mostly 2–6%), and never quite matching the nominal spikes.
- The largest divergence occurs in 2020–21 and 2021–22, when nominal increases outpaced real growth by over 2–3 percentage points, highlighting the sharp rise in healthcare costs.

Key Observations

- Early Years (2009–2015): Nominal and real growth generally track together, indicating limited inflation distortion.
- 2015–2019: Minor gaps emerge, suggesting that inflation began subtly contributing to nominal gains.
- 2020–2022 (Pandemic Period),
    - Emergency response funding, vaccine rollouts, PPE procurement, and hospital surges led to rapid spending growth.
    - However, inflation driven by global economic disruptions eroded the purchasing power of that spending.
    - Real growth increased but not proportionately meaning service delivery may not have expanded as much as the budgets suggest.

Insights

This chart highlights the "price effect" the portion of spending growth attributable to rising prices rather than increased healthcare activity or improved outcomes.

Without adjusting for this, budget growth can be overstated leading to,

- Misinterpretation of system performance
- Unrealistic expectations from policymakers and the public
- Potential overestimation of efficiency gains

For instance, a 9% increase in health spending with only 6% real growth implies that one-third of the increase was purely inflationary, offering no tangible service improvements.

Policy Relevance

- **Inflation-aware budgeting -** Governments must explicitly factor in inflation forecasts to avoid underestimating the real funding required to maintain or expand service levels.

- **Performance measurement distortion -** Using only nominal growth can falsely suggest system productivity improvements when unit costs may be rising.
- **Strategic misalignment -** Funding commitments based on nominal increases might fail to meet actual operational needs, especially during economic shocks or global crises.

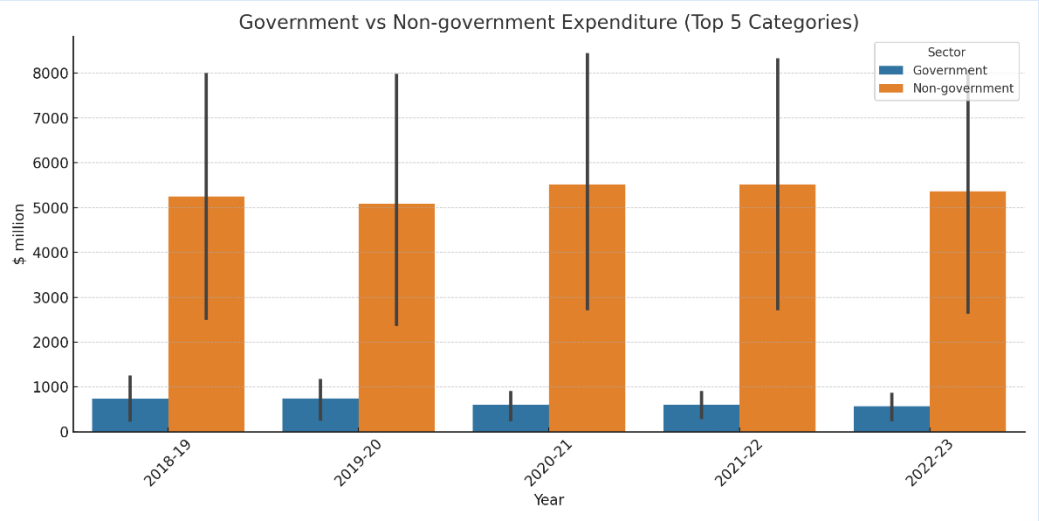
Strategic Recommendation

To enhance fiscal transparency and avoid misrepresentation,

- All budgetary planning and review processes must distinguish between real and nominal growth.
- Price effect decompositions should be included in Treasury and health department reporting.
- Health efficiency KPIs must be adjusted to reflect real, not nominal, expenditure growth.
- Post-COVID budget evaluations should especially emphasise how much of spending was inflation-driven versus service-driven.

3. Government vs Non-Government Expenditure

Top 5 Expenditure Categories (2018–19 to 2022–23)



Overview

This analysis compares healthcare spending patterns across government and non-government sectors within the top five expenditure categories over the five-year period from 2018–19 to 2022–23. The chart illustrates consistently higher spending by non-government sources in every year and category assessed.

Observations

- **Dominance of Non-Government Funding**
  Non-government entities including private health insurers and out-of-pocket consumer payments contributed significantly more than the government across all top five categories. This trend persisted throughout the five-year period.
- **Greater Variability in Non-Government Spending**
  The vertical error bars (standard deviation or range) show that non-government expenditure exhibited higher year-on-year volatility. In contrast, government spending was more stable and predictable, indicating insulation from short-term market or policy shifts.
- **Government Stability vs Non-Government Elasticity**
  The relatively flat and lower bars for government suggest a steadier allocation of resources. In contrast, non-government spending appeared more reactive, likely driven by macroeconomic factors like household income levels, insurance coverage trends and external shocks like COVID-19.

Key Insights

Implications of Non-Government Spending Dominance

- **Equity Challenges**
  A health system overly reliant on non-government financing risks amplifying inequality. When out-of-pocket spending or private insurance becomes the primary source of funding, lower-income populations may face access barriers to essential health services.
- **Exposure to Economic Downturns**
  Since non-government spending is more sensitive to economic cycles, periods of recession or financial strain may lead to sharp drops in healthcare utilization, especially in elective or specialist services not covered by public programs.
- **Policy Dependence on Consumer Behaviour**
  With non-government sectors playing a leading role, health policy becomes more vulnerable to market dynamics rather than being steered by national health objectives or equity-driven principles.

Strategic Recommendation

To strengthen the equity and resilience of Australia's healthcare system,

- **Rebalance Funding Sources**
  Gradually increase government contributions in key service categories, particularly those with large non-government shares and high patient cost burdens (Eg: dental care, allied health, pharmaceuticals).

- **Introduce Safety Nets**
  Enhance policy frameworks like the Medicare Safety Net or private insurance rebates to mitigate the effects of high out-of-pocket costs on vulnerable groups.
- **Stabilize Non-Government Inputs**
  Consider regulatory interventions to reduce price shocks in privately funded sectors, including price caps on key services or negotiated fees with private insurers.
- **Improve Forecasting Models**
  Given the variability in non-government trends, integrate macroeconomic forecasting into annual health budget planning to better predict potential spending gaps or service demand shifts.

4. Heatmap Analysis - Healthcare Expenditure Shares by Sector

Overview

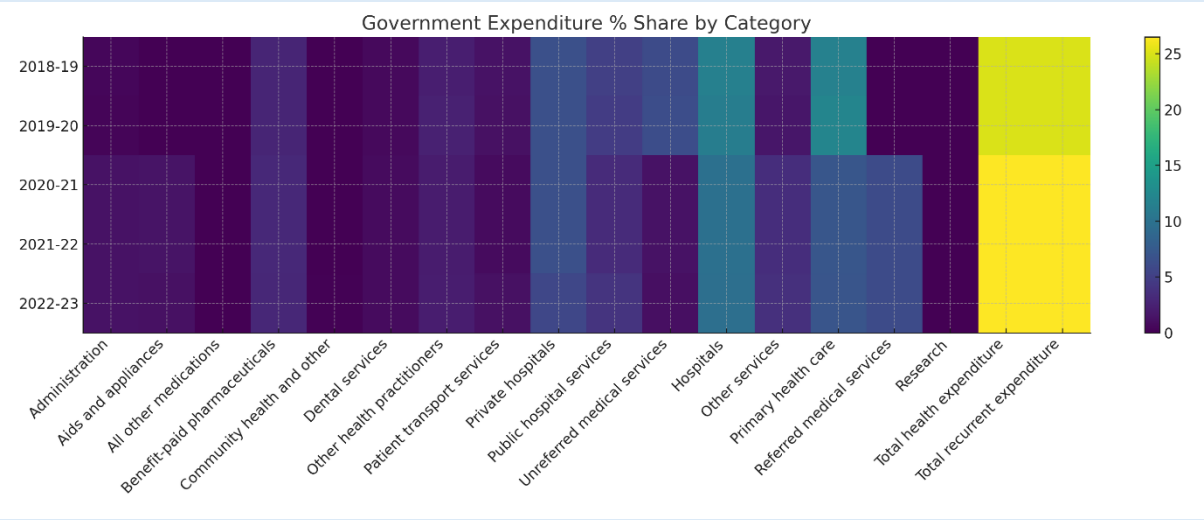
This section presents two heatmaps comparing the percentage share of expenditure across healthcare service categories for government and non-government sectors over five years (2018–19 to 2022–23). These heatmaps help identify concentration zones, funding gaps, and sectoral differences in how healthcare dollars are distributed.

- Figure 1: Government Expenditure % Share by Category (Heatmap)
- Figure 2: Non-Government Expenditure % Share by Category (Heatmap)

Key Observations

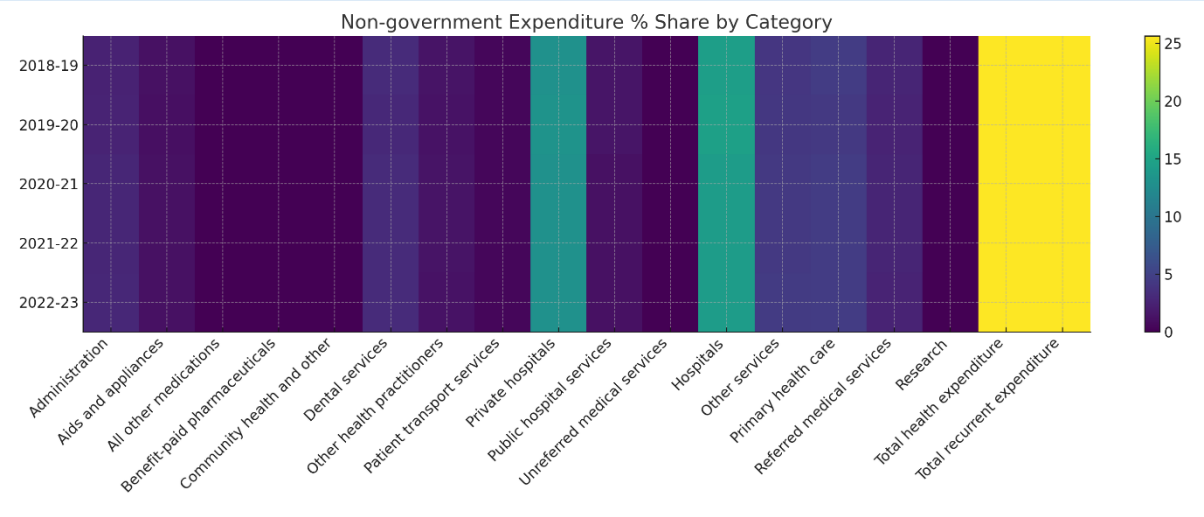
A. Government Sector: Hospital-Centric Investment

- The government sector displays a consistent concentration of funds towards hospital services, especially public hospitals and general hospital care, dominating over 20–25% of total yearly expenditure.
- Categories like research, administration, benefit-paid pharmaceuticals, and community health receive a relatively smaller allocation and show minimal year-on-year variation.
- Some underfunded areas such as aged care, mental health, or preventive health are not prominently highlighted, pointing to potential systemic neglect or lack of prioritisation.



B. Non-Government Sector: Distributed & Private-Care Focused

- In contrast, non-government expenditure is more diversified across several services.
- Higher allocation is consistently seen in private hospitals, referred medical services, and pharmaceuticals especially out-of-pocket purchases.
- Dental services, primary care, and mental health practitioners also receive relatively more attention in non-government funding than in government budgets.
- This diversification may reflect the out-of-pocket burden faced by consumers and the market-driven nature of private health sectors.



Insights

1. Funding Prioritisation Differences

- Government prioritises infrastructure-heavy and system-level services, often centralised and universally accessible (Eg: public hospitals).
- Non-government sources show flexibility, focusing on individual services, choice-based care, and supplementary medical support, such as specialists and prescriptions.

2. Implications for Health Equity

- The stark differences suggest that certain services like dental, mental health, or prescription medications may rely heavily on non-government (private) sources.
- This leads to inequities in access, especially among low-income or rural populations who may struggle to afford non-subsidised care.

3. Budget Planning Risks

- Heavy reliance on government funding for hospitals makes the system vulnerable during emergencies like pandemics, when diversified care models become essential.
- On the other hand, the volatility of non-government spending, influenced by economic downturns or insurance premiums, poses a sustainability challenge.

Policy Implications

1. Equity Rebalancing Needed
   Introduce targeted government subsidies for underfunded categories like mental health, referred services, and pharmaceuticals, which currently depend on non-government funding.
2. Holistic Investment Strategy
   A move beyond hospital-centric planning is required. Funding models should adopt a population health approach, increasing investment in primary care, preventive services, and community-based interventions.
3. Improve Transparency & Reporting
   Sectoral expenditure breakdowns like these heatmaps should be published annually to visually highlight systemic imbalances and inform evidence-based policymaking.

Strategic Recommendation

To optimise sectoral equity and maximise system-wide efficiency in health expenditure

• Diversify Government Investment Across Services

Redirect a portion of concentrated hospital funding towards underfunded but essential categories like mental health, aged care, and primary healthcare, as highlighted in the

government heatmap. This would balance system load and promote upstream interventions that reduce hospital admissions.

• Recalibrate Subsidies for High-Burden Private Categories

Provide targeted subsidies or rebates in sectors where non-government spending dominates, such as referred services, dental care, and pharmaceuticals. This could involve expanding Medicare item numbers or reducing co-payment thresholds.

• Use Heatmap Trends for Annual Budget Adjustments

Incorporate visual analytics into AIHW's budgeting process to identify funding stagnation or overconcentration. Heatmaps should serve as an early warning system for misalignment between funding and service demand.

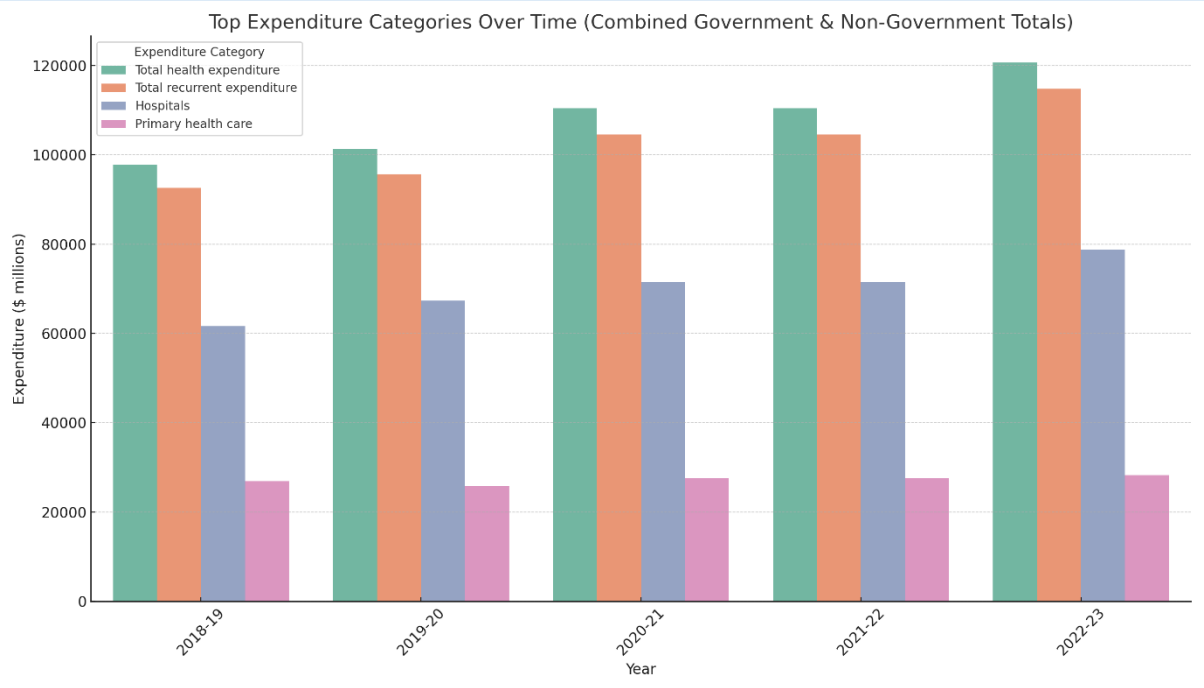
• Formalise Public–Private Co-Investment Models

Where private expenditure shows consistent dominance, encourage blended funding schemes through public–private partnerships (PPPs). This would share cost risks and improve long-term investment in chronic care services.

• Mandate Annual Heatmap Disclosure for Transparency

AIHW should release public-facing sectoral heatmaps annually to reveal allocation trends and gaps. This transparency can empower citizen advocacy, support evidence-based policymaking, and increase pressure for equity-based reforms.

5.Analysis of Top 3 Expenditure Categories (Combined View: 2018–2023)



Overview

The stacked bar chart visualises aggregate health spending across Australia's key service categories like Hospitals, Primary Health Care, and Other Services from 2018–19 to 2022–23. These are measured in millions of dollars, combining both government and non-government contributions.

This chart highlights a consistent dominance of these three categories over a five-year period, demonstrating the structural backbone of Australia's healthcare spending priorities. All categories show uninterrupted year-over-year growth, even during periods marked by global health and economic disruptions like the COVID-19 pandemic.

Key Observations

1. Hospitals

- Most funded category overall, accounting for the largest share of combined expenditure.
- Spending grew from ~$62 billion in 2018–19 to over $78 billion by 2022–23, showing steady, linear expansion.
- This reinforces the sector's role as the central node in health service delivery, encompassing public, private, and emergency care systems.

2. Total Recurrent and Health Expenditure

- Total Health Expenditure and Total Recurrent Expenditure serve as cumulative financial benchmarks and consistently top the chart.
- Their growth reflects both inflation-adjusted increases and real expansion of the health system's scale and scope.

3. Primary Health Care

- Although funded at lower absolute levels than hospitals, Primary Health Care exhibits remarkable resilience.
- Expenditure rose from ~$27 billion in 2018–19 to nearly $29 billion by 2022–23, with minimal fluctuation, even amid the pandemic.
- Reflects the systemic reliance on GP services, community clinics, immunisation, and preventive care programs as frontline services.

4. Other Services

- This catch-all category also remained consistently among the top three, growing steadily year-on-year.
- Represents supportive and peripheral services such as health administration, outreach programs, research, and auxiliary health workforce roles.

Interpretation

The persistent growth and dominance of Hospitals, Primary Health Care, and Other Services indicate long-term structural dependencies in Australia's health expenditure model. This reflects,

- **Entrenched funding patterns**: Public and private health strategies continue to prioritise acute and primary care over innovation or long-term reforms.
- **Reactive vs. proactive investment**: Heavy investment in hospitals suggests a reactive model (treating illness), whereas growth in primary care hints at preventive intent.
- **Pandemic resilience**: Despite COVID-19's systemic strain, none of the top categories showed contraction highlighting the system's adaptive financial planning.

Policy Relevance

Failure to adjust spending patterns may,

- **Entrench inefficiencies**, with hospitals remaining overloaded while upstream services remain underfunded.
- **Skew workforce planning**, causing oversupply in hospital staffing while neglecting primary or allied health roles.
- **Reduce system adaptability**, especially in responding to future pandemics, aging demographics, and chronic disease burdens.

Strategic Recommendation

To foster a more sustainable and equitable future healthcare model, policymakers should consider the following actions.

• Encourage Preventive over Curative Funding

- While hospital care is essential, greater investment in primary and community care can reduce long-term system strain and costs.
- Introduce value-based care incentives to shift focus from reactive treatment to early intervention and chronic disease management.

• Diversify "Other Services" Spending

- Disaggregate the "Other Services" category for clearer visibility into where resources are being allocated.
- Invest in underrepresented yet critical services like digital health infrastructure, rural telemedicine, and aged care transformation.

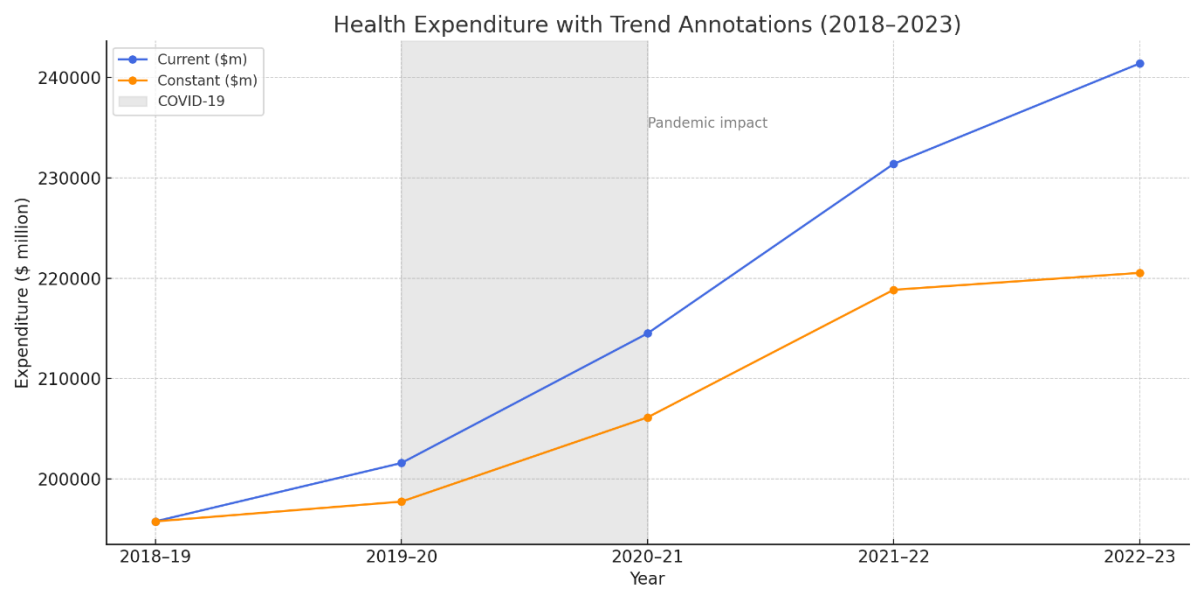
• Address Over-Reliance on Top Categories

- Review health budget allocations to identify and fund emerging or underfunded categories, such as mental health, Indigenous health, and preventive health campaigns.
- Pilot funding reallocation models that test the effectiveness of category rebalancing without compromising service delivery quality.

• Innovation in Financing Models

- Explore blended payment models across categories that reward outcomes rather than inputs (Eg: bundled payments, risk-adjusted capitation).
- Integrate public-private partnerships for technology and infrastructure in hospital care to reduce government load.

6. Annotated Trend Line Analysis: Structural Growth in the Wake of COVID-19



Overview

This annotated line graph illustrates Australia's total health expenditure in both current dollars and inflation-adjusted (constant) dollars between 2018–19 and 2022–23, with the COVID-19 pandemic period (2019–20 to 2020–21) visually highlighted. The dual-line format distinguishes between nominal growth and real expenditure trends, allowing for clearer identification of pandemic-related spending impacts versus structural financial shifts.

The annotation clearly marks a significant upward trend starting around 2019–20, with no post-pandemic reversion, implying a permanent shift in the healthcare expenditure baseline.

Key Observations

1. Sudden Surge During COVID-19 (2019–2021)

- Both current and constant dollar expenditures surged significantly between 2019–20 and 2020–21, coinciding with the initial years of the COVID-19 pandemic.
- This increase was not transient it exceeded typical year-on-year increments observed prior to 2019.
- The real (constant $) expenditure increased from $197 billion (2018–19) to $205 billion (2019–20) and then further to $206 billion (2020–21), indicating tangible scale expansion even after adjusting for inflation.

2. Structural Baseline Shift

- Post-COVID, both lines continued upward, with no regression to pre-pandemic levels. This contradicts the assumption that heightened spending was merely an emergency response.
- By 2022–23, current expenditure crossed $241 billion, while constant expenditure held above $220 billion, maintaining the elevated trajectory.
- The absence of a plateau or dip after 2021 confirms that temporary stimulus measures evolved into permanent funding pathways.

3. Inflation-Adjusted vs. Nominal Growth Gap

- The growing gap between current and constant dollar trends implies price-level increases, cost inflation, or elevated service charges not just an increase in service quantity.
- This highlights the need to distinguish between volume-driven and price-driven growth, especially when planning future budget allocations.

Interpretation

This trendline analysis confirms a pandemic-induced structural transformation in Australia's health spending.

- COVID-19 accelerated long-term cost growth, creating a new "normal" for health system expenditure rather than a temporary spike.
- Expenditure commitments made during the crisis such as telehealth rollout, vaccine logistics, health workforce expansion, and emergency preparedness have become ingrained components of the budget.
- The data implies that Australia did not just weather the crisis but evolved structurally in response, with fiscal adjustments cementing higher baseline costs across the board.

Strategic Recommendation

To manage this new baseline responsibly, policymakers and health economists should pursue future-facing financial planning strategies

• Institutionalise Pandemic-Era Reforms

- Evaluate and formally embed high-impact services like telehealth, pandemic logistics and remote diagnostics into long-term health policy.
- Transition temporary contracts, services, and infrastructure into permanent budget lines with ongoing performance monitoring.

• Mitigate Inflationary Pressure

- Establish cost containment mechanisms to manage growing nominal expenditures, particularly in sectors where price increases outpace volume growth.
- Introduce fee schedules, pharmaceutical price caps, or procurement reforms to control supplier-induced inflation in public healthcare services.

• Forecasting and Risk Modelling

- Enhance fiscal planning models to incorporate external shocks, including climate risks, demographic shifts, and zoonotic disease threats.
- Implement scenario-based budgeting to test resilience against future surges (Eg: pandemics, refugee health crises, health security breaches).

Policy Relevance

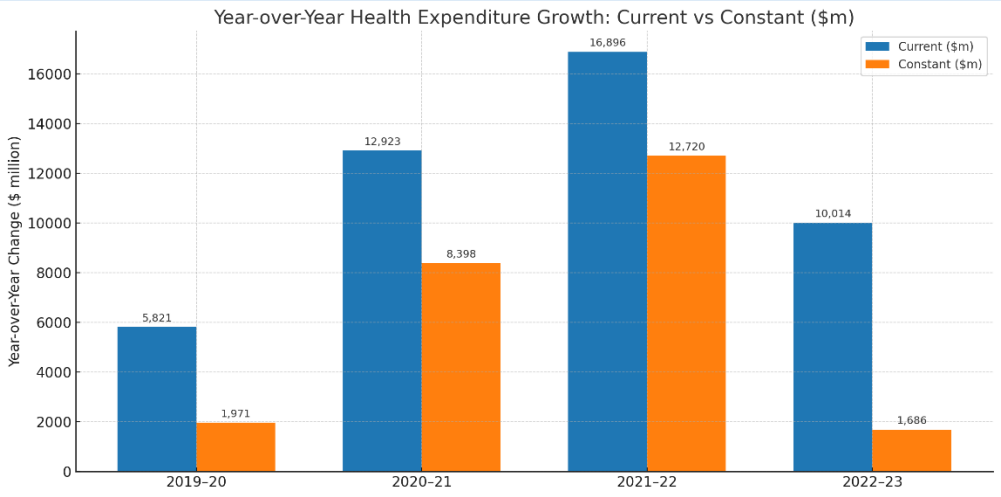
Neglecting to act on this structural shift could result in,

- **Budget strain and sustainability risks**, as spending outpaces economic growth or tax revenue.
- **Distorted expectations**, with temporary crisis services becoming the public's new standard of care.
- **Overextended health infrastructure**, especially if long-term demand projections aren't re-aligned with baseline changes.

The pandemic did more than temporarily spike expenditure it redefined Australia's health system economics. The challenge moving forward lies not in returning to a previous state, but in strategically managing a permanently expanded healthcare economy.

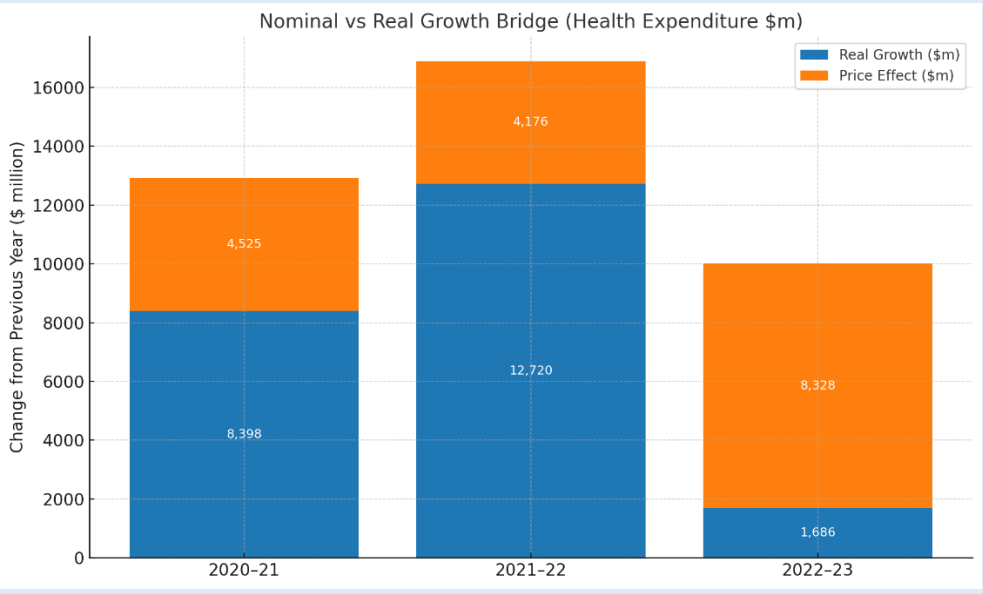
6.

Year-over-Year Growth: Current vs Constant Dollars



- 2020–21 and 2021–22 show exceptionally high growth, with increases of $12.9b and $16.9b in current dollars respectively.
- When adjusted for inflation, real growth was $8.4b and $12.7b, indicating substantial expansion in actual services delivered.
- 2022–23 saw a sharp decline in real growth to just $1.7b, while current dollar growth still appeared strong ($10b), suggesting that inflation, not service expansion, was the key driver.
- 2019–20 reflects moderate real and nominal growth, likely due to early-stage pandemic responses.

Nominal vs Real Growth Bridge



- In 2022–23, almost the entire nominal increase ($10b) was due to price effects ($8.3b), while real growth accounted for only $1.7b.
- In contrast, 2020–21 and 2021–22 show strong real growth, with services expanding significantly, aligned with COVID-19 response strategies.
- The gap between nominal and real growth widened sharply in the final year, confirming a shift from structural expansion to inflation-driven budget strain.

Interpretation

These charts clearly illustrate a structural shift in the nature of health expenditure growth.

- COVID-19 triggered real increases in health services funding (Eg: new programs, expanded ICU capacity, vaccination rollout).
- Post-pandemic (2022–23), although spending remained high, the bulk of the increase was inflation-related, not service-driven.
- This implies a saturation point in real service expansion, with budget increases now primarily compensating for rising costs (Eg: wages, supply chains, equipment).

Strategic Recommendations

To ensure long-term financial sustainability and maintain service delivery standards,

• Strengthen Value-for-Money in Health Spending

- Introduce cost-efficiency audits across departments that experienced real growth during the pandemic.
- Avoid locking in temporary surge spending into permanent baselines unless justified by outcome data.

• Contain Inflationary Pressures

- Negotiate bulk procurement contracts and long-term supplier agreements to reduce price volatility.
- Expand use of technology like telehealth and AI diagnostics to offset rising labour costs.

• Shift from Volume to Outcome-Based Funding

- Instead of rewarding spending increases, tie future allocations to measurable health outcomes and productivity gains.
- Consider bundling payments or risk-adjusted capitation in chronic disease management to avoid unnecessary cost escalations.

• Use Real Growth as a Benchmark for Capacity Planning

- In future budgeting, distinguish between inflation-adjusted growth and real expansion to guide infrastructure, workforce, and service planning more accurately.

Policy Relevance

- 2022–23's inflation-led growth is unsustainable if not matched with real improvements in care delivery or health outcomes.
- Without reform, Australia risks a scenario where more money buys the same or fewer services, reducing system efficiency.
- These insights call for clear policy differentiation between cost-driven increases and investment-led growth, especially in an environment of fiscal tightening and rising public debt.

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