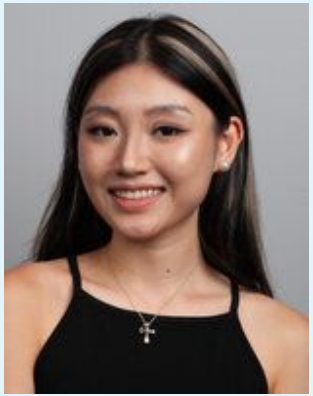
Analyzing the Impact:

How Expanding CMS Coverage Affects Health Outcomes Across the U.S

TEAM 41: Communicable disease



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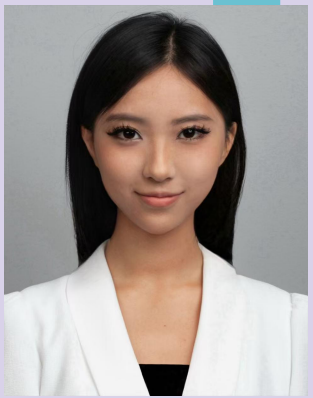

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01

Introduction

02

Literature Review

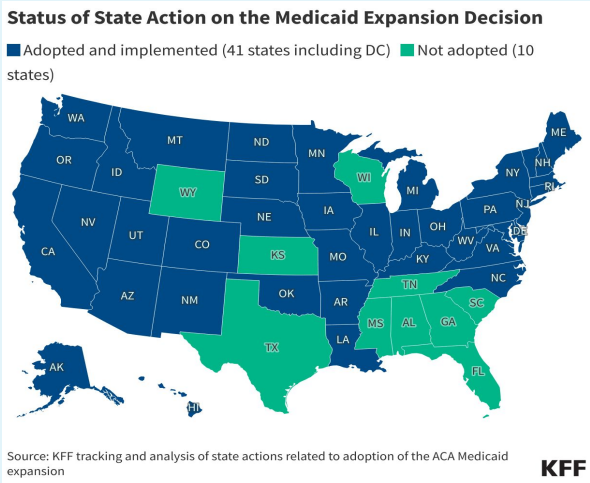
Why this study matters

Research Motivation:

- Medicaid expansion greatly changed healthcare access in the U.S.
- States expanded at different times—or not at all—creating a natural experiment.
- Communicable diseases like HIV, TB, and STIs remain a serious public health burden.
- Prior MQM research was limited to two states; we broaden the scope nationwide.

Why It Matters:

- Policy Impact: Informs Medicaid design and timing for better outcomes.
- Equity Focus: Helps reduce disparities for vulnerable populations.
- Economic Relevance: Impacts hospital stability and cost effectiveness.
- Academic Value: Provides causal evidence for future healthcare strategy.



Literature Review

HIV

Medicaid expansions were associated with an increase in HIV diagnoses of 0.508 per 100,000 population, or 13.9% (p=0.037)

Tuberculosis (TB)

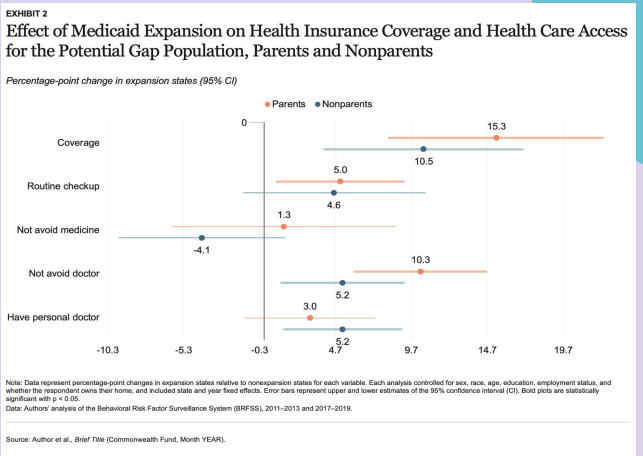
Three in-depth case studies were conducted to explore the impact Medicaid managed care…Overall, study results indicated that there has been a minimal impact on TB prevention and control services

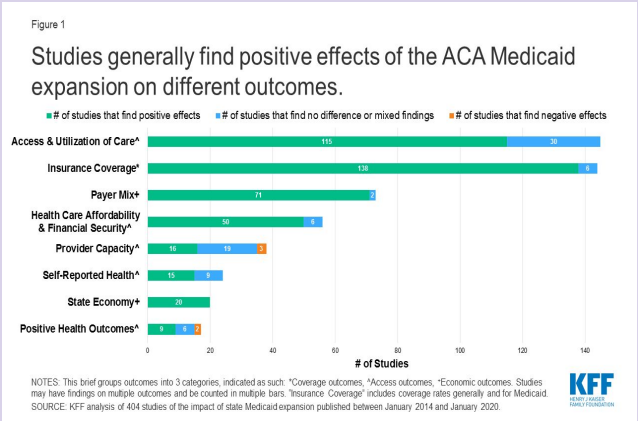
Sexually Transmitted Infections (STIs)

By 3 years post-expansion, expansion states had increased STI testing by 12.7 percentage points more than non expansion states (95% confidence interval [CI] [2.5, 23.0], p = .016).

Literature Review

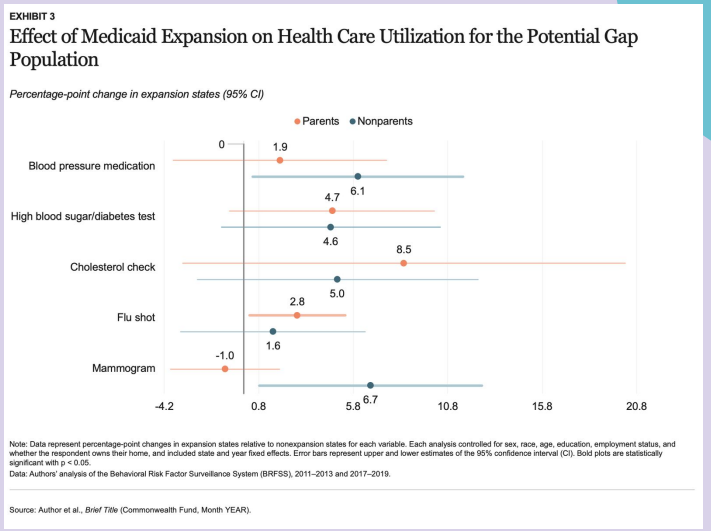
- Medicaid expansion under the ACA significantly increased coverage for low-income adults.
- In expansion states, coverage increased by **15.3 percentage points** for parents and **10.5 points** for non parents *(Commonwealth Fund, 2023)*.
- Studies show improved **self-reported health status** and **early diagnosis / treatment** in expansion states *(PMC4225799)*.
- Some evidence links expansion to **reduced mortality**, though findings are mixed *(NBER Working Paper 30818)*.
- Medicaid expansion narrowed racial/ethnic gaps in health coverage and care access.
- Black and Hispanic adults saw **notable improvements** in insurance rates and routine care access *(Commonwealth Fund, 2023)*.

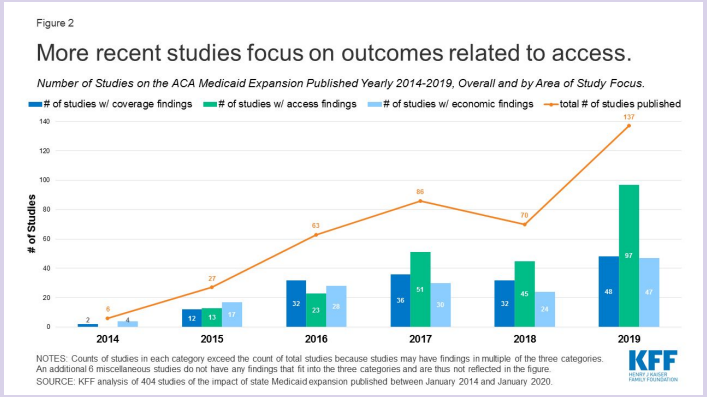




Literature Review

- Hospitals in expansion states experienced **lower uncompensated care costs** and **improved financial health** *(KFF, 2020)*.
- No negative effect on state budgets; in some cases, expansion led to **net savings** via federal funding.
- **Neutral or positive effects** on state economies and job markets.
- Medicaid expansion drove **cross-sector participation** in population health initiatives *(PMC10154156)*.
- Supported **community-based care coordination** and long-term health improvements.





Conclusion

The expansion of Medicaid under the ACA has led to significant improvements in insurance coverage, access to care, and certain health outcomes. While the impact on mortality rates is mixed, the economic benefits for providers and states are evident. Moreover, expansion has contributed to reducing health disparities and enhancing population health initiatives. Continued efforts to expand Medicaid in remaining states could further these gains and promote health equity across the U.S.

03

EDA & Trend Analysis –Communicable

Data

Dataset Overview: This dataset is a panel dataset tracking disease burden across U.S. states over time, used to evaluate the impact of **Medicaid expansion policies** on population health outcomes.

Years Covered: The dataset spans multiple years (2010-2019), allowing for pre- and post-policy comparison.

Key Columns

- year: Year of observation
- location_name: U.S. state
- cause_name: Specific disease
- val: Value of the health outcome (DALYs / Prevalence / Deaths/Incidence)
- sex_name: Gender (Male/Female)
- age_name: Age group (e.g., 25–29, 60–64)
- expansion_group: Medicaid expansion status (Early, Mid, Late, Never)
- post: Indicates if observation is from post-expansion period
- treat_group: Treatment assignment dummy for DiD analysis

Data

Category	
HIV/AIDS	Maternal sepsis and other maternal infections
Neonatal sepsis and other neonatal infections	Invasive Non-typhoidal Salmonella(iNTS)
Sexually transmitted infections excluding HIV	Typhoid and paratyphoid
Tuberculosis	Maternal deaths aggravated by HIV/AIDS
Acute hepatitis (A/B/C/E)	

Core Measures for Analysis and Modeling

Deaths

- **Definition:** Number of deaths occurring in a population during a given time period
- **Why it matters**: Represents the **most severe failure** of health interventions

DALYs (Disability-Adjusted Life Years)

- **Definition**: Sum of years lost due to premature death (YLLs) and years lived with disability (YLDs)
- **Why it matters**: Widely used by policymakers for comparing cross-state, cross-disease data

Core Measures for Analysis and Modeling

Prevalence

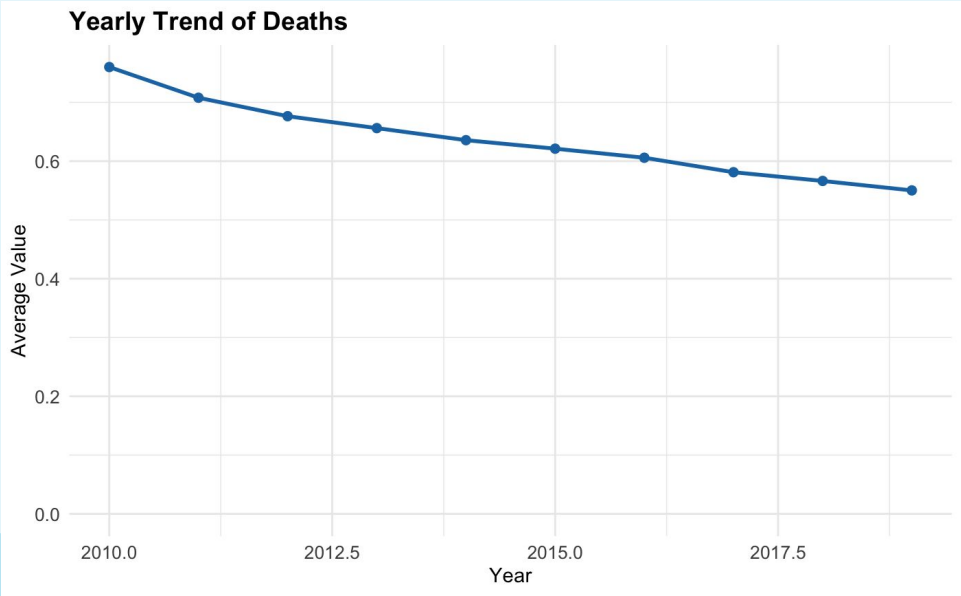
- **Definition**: The proportion of people in a population with a disease, injury, or condition at a specific point in time
- **Why it matters**: Closely linked to healthcare service demand and cost for long-term care

Incidence

- **Definition**: The number of **new cases** of a disease or condition occurring in a population within a specific time period.
- **Why it matters**: Reflects the **rate of disease spread** and helps identify **emerging public health threats** or outbreaks.

Group-level Summary Analysis

🧩 Section 1: Yearly Trend by Measure(Deaths)



Key Observations:

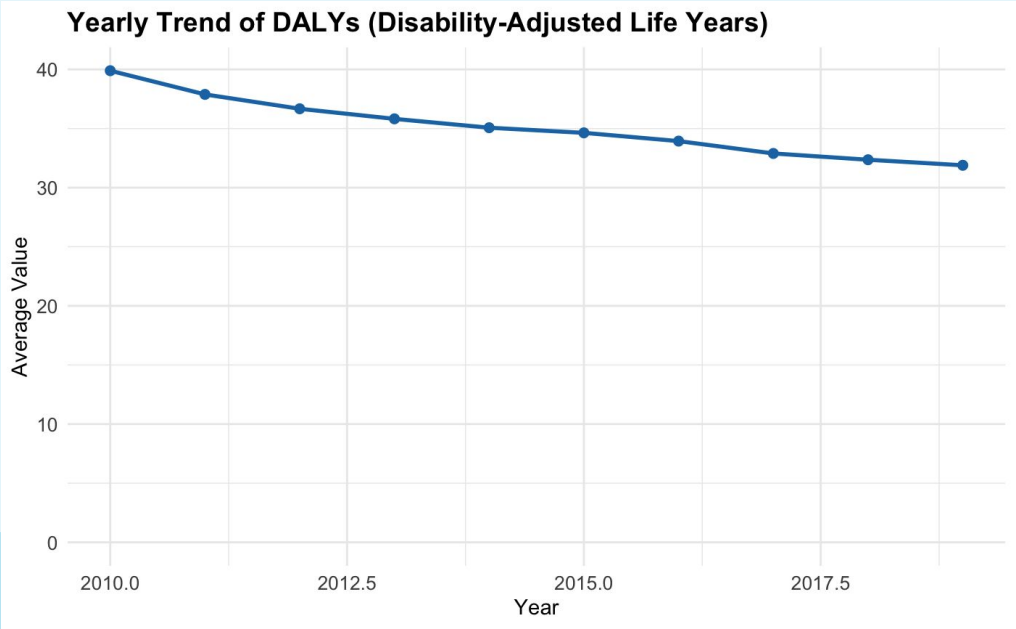
- **Consistent Decline** in Death Rates Over Time

Insights:

- The declining trend may reflect the **positive effects** of **health policies, medical advancements, or expanded healthcare coverage** (e.g., Medicaid expansion).

Group-level Summary Analysis

🧩 Section 1: Yearly Trend by Measure(DALYs)



Key Observations:

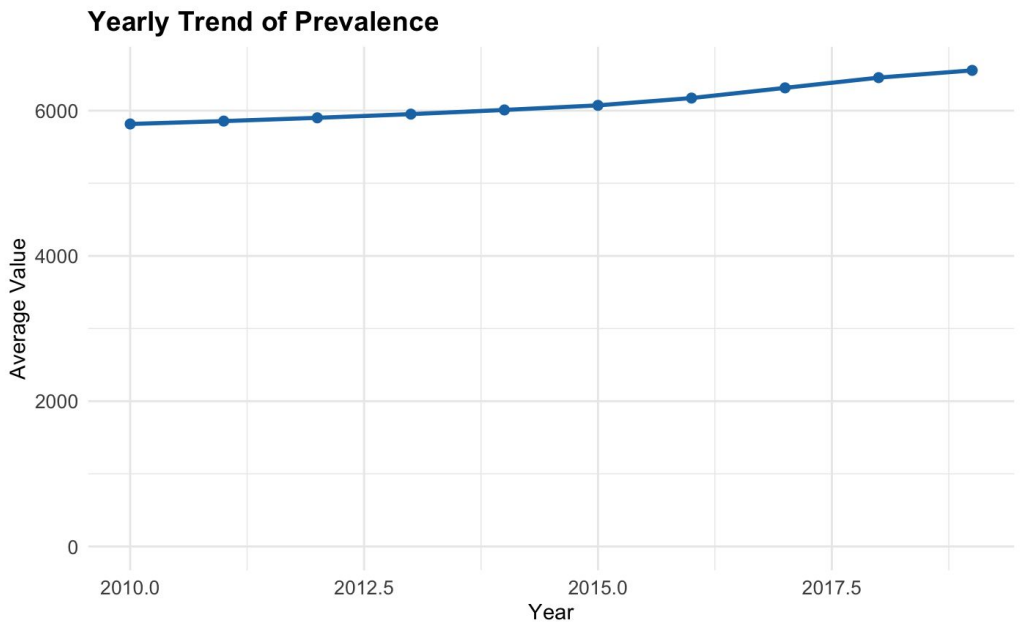
- **Steady Decrease** in DALYs Over Time

Insights:

- The downward trend suggests **positive progress** in **population health**.
- The **long-term impact of health interventions and policy reforms.**

Group-level Summary Analysis

🧩 Section 1: Yearly Trend by Measure(Prevalence)



Key Observations:

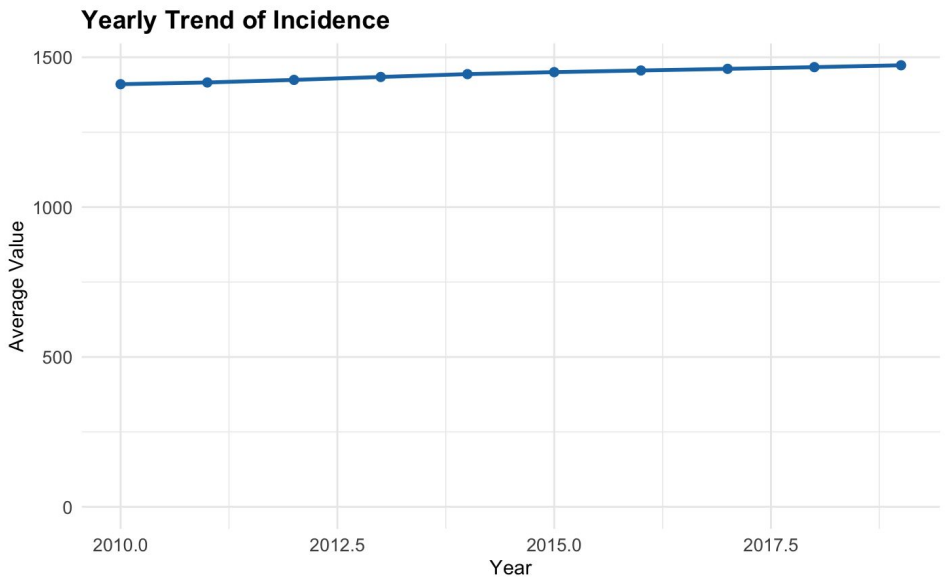
- Prevalence Rates **Rising Steadily Over Time**

Insights:

- The improvements in **survival and diagnosis**.
- **A growing burden of communicable conditions**.
- The need for **stronger preventive care, long-term disease management, and healthcare system capacity planning.**

Group-level Summary Analysis

🧩 Section 1: Yearly Trend by Measure(Incidence)



Key Observations:

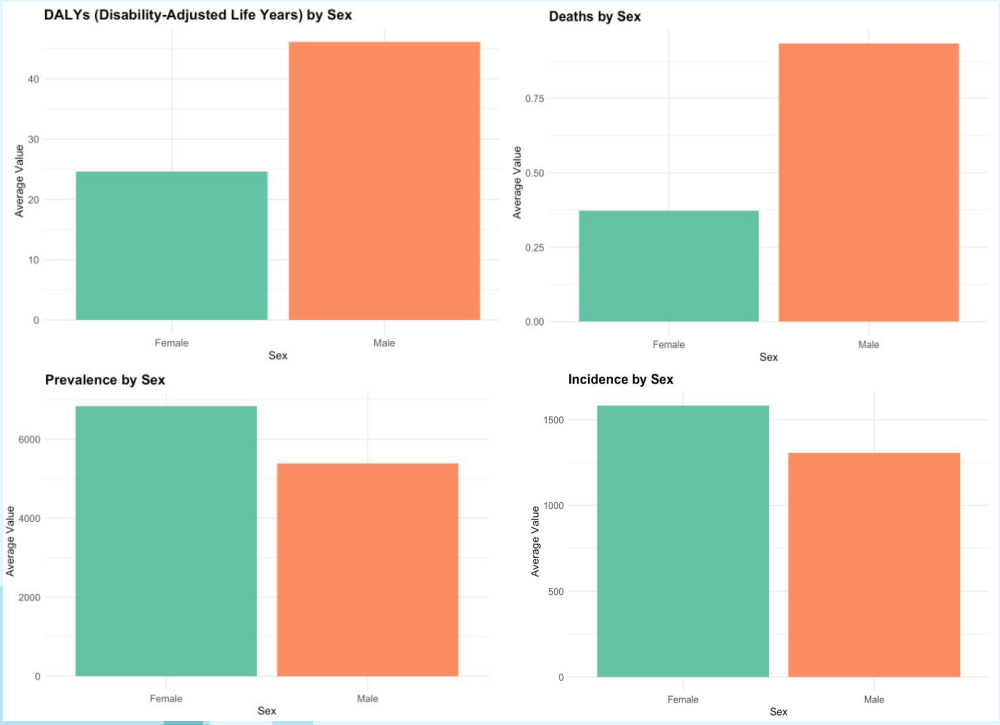
- Average incidence has shown a **steady year-over-year increase** from 2010 to 2019.
- The growth appears **linear and consistent**, with no significant drops or plateaus.

Insights:

- The **persistent upward trend** suggests increasing transmission, improved reporting, or rising population risk factors.
- **Calls** for continued **public health investment and intervention.**

Group-level Summary Analysis

🧩 Section 2: Distribution by Sex



Key Observations:

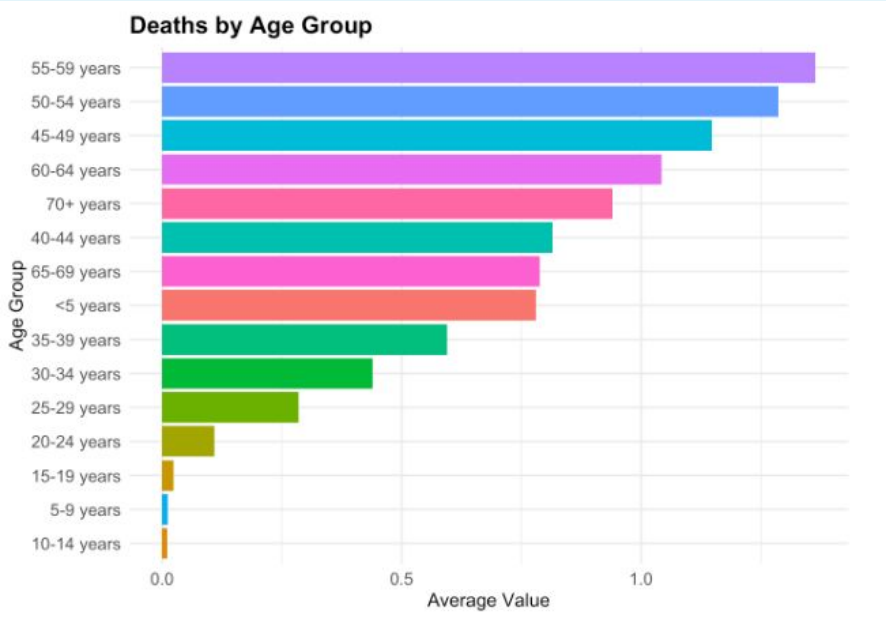
- **Clear Gender Disparities Across All Metrics**
- **Males** show significantly higher average death rates and DALYs than females.
- **Females** have a notably higher **prevalence and incidence rates**, suggesting more new cases are diagnosed among women.

Insights:

- The need for **gender-tailored interventions**:
- For **males**, greater focus on mortality prevention and early intervention is essential.
- For **females**, strategies should target **managing communicable conditions** and improving quality of life

Group-level Summary Analysis

🧩 Section 3: Distribution by Age Group(Death)



Key Observations:

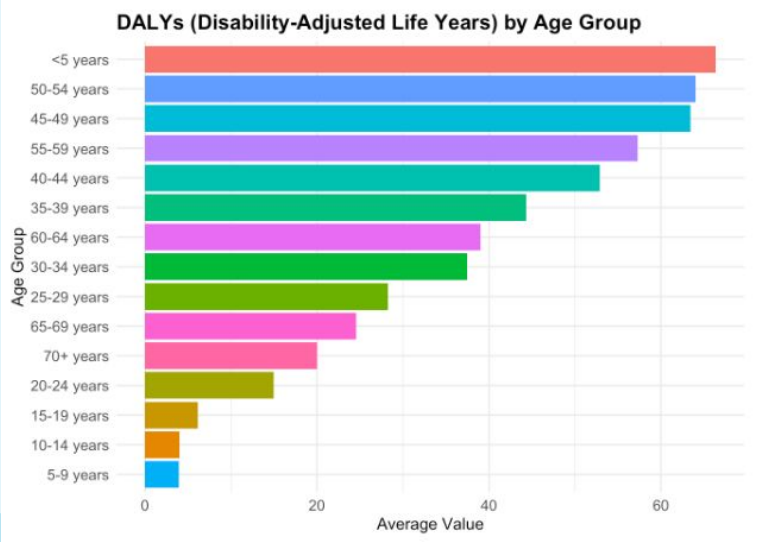
- **Deaths drop sharply** in younger age groups.

Insights:

- **Lower** mortality among children and adolescents.
- **Older adults (70+ years)** still account for significant deaths, but slightly less than late middle-aged groups.

Group-level Summary Analysis

🧩 Section 3: Distribution by Age Group(DALYs)



Key Observations:

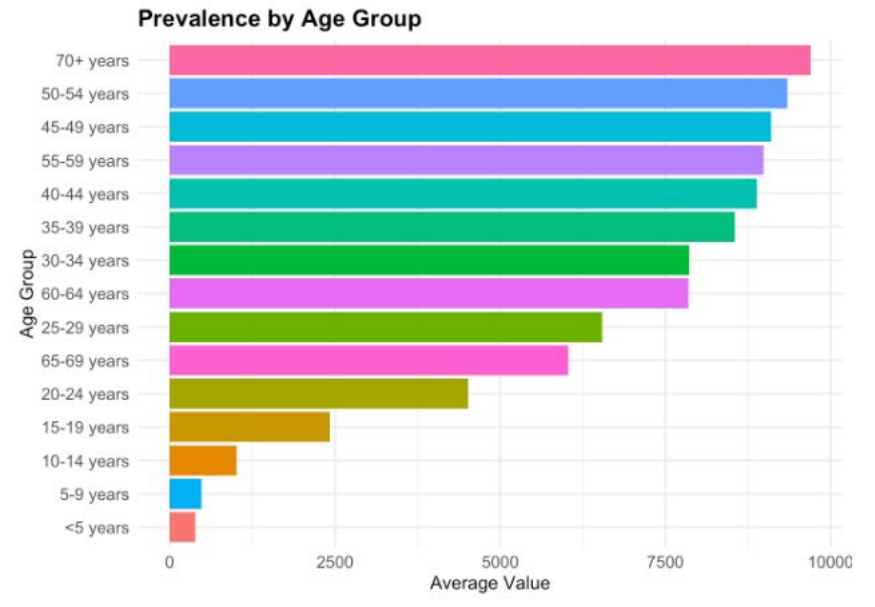
- The **<5 years** age group has the **highest DALYs.**
- **Deaths drop sharply** in younger age groups.
- **Middle-aged groups (50–59 years)** also show high DALY values
- DALYs decline in **older adults (70+ years)**

Insights:

- Early childhood mortality and severe health issues.
- Children and adolescents (5–19 years) have the **lowest DALYs**, indicating relatively low mortality and disability.
- DALYs decline in **older adults (70+ years)** due to fewer years lost from early death.

Group-level Summary Analysis

🧩 Section 3: Distribution by Age Group(Prevalence)



Key Observations:

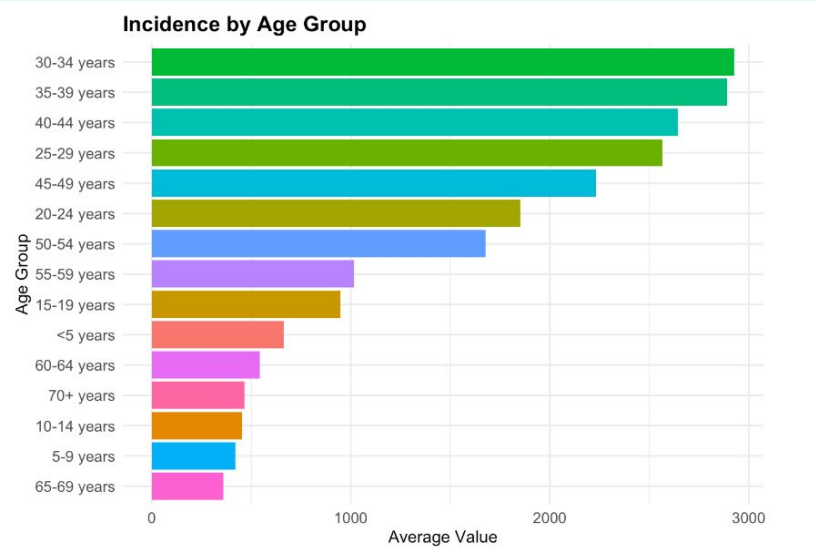
- The **70+ age group** has the **highest prevalence**, followed closely by adults aged **50–69**.
- Prevalence remains **consistently high** across **middle-aged groups (40–59)**
- The **<5 age group** has the **lowest prevalence**, as expected for this population.

Insights:

- A **significant** communicable disease **burden**, especially among **older adults**.
- **High prevalence** in **ages 40–69** highlights the need for targeted prevention in **middle-aged and older populations.**

Group-level Summary Analysis

🧩 Section 3 : Distribution by Age Group(Incidence)



Key Observations:

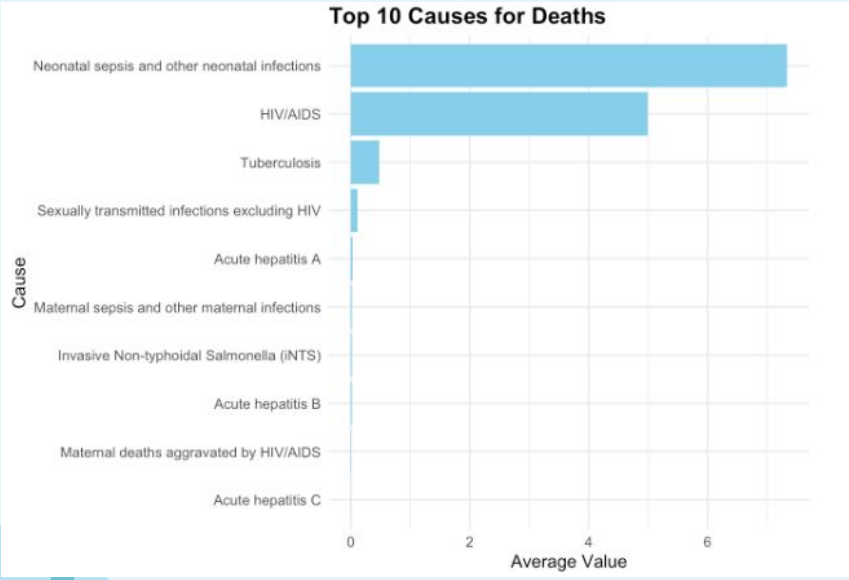
- Incidence is **highest among adults aged 25–44**, peaking in the 30–34 age group.
- Incidence **declines sharply** after age 55, and is **lowest** among children (5–14 years) and the elderly (65+).

Insights:

- The burden of new infections is **concentrated in young to middle-aged adults**, suggesting high exposure or transmission risk during economically active years.
- Public health efforts should **prioritize prevention, screening, and education** for adults aged 20–54 to reduce new cases.
- Moderate incidence in the <5 age group highlights the need for **early-life protective measures**.

Group-level Summary Analysis

🧩 Section 4: Top 10 Diseases by Average Value(Deaths)



Key Observations:

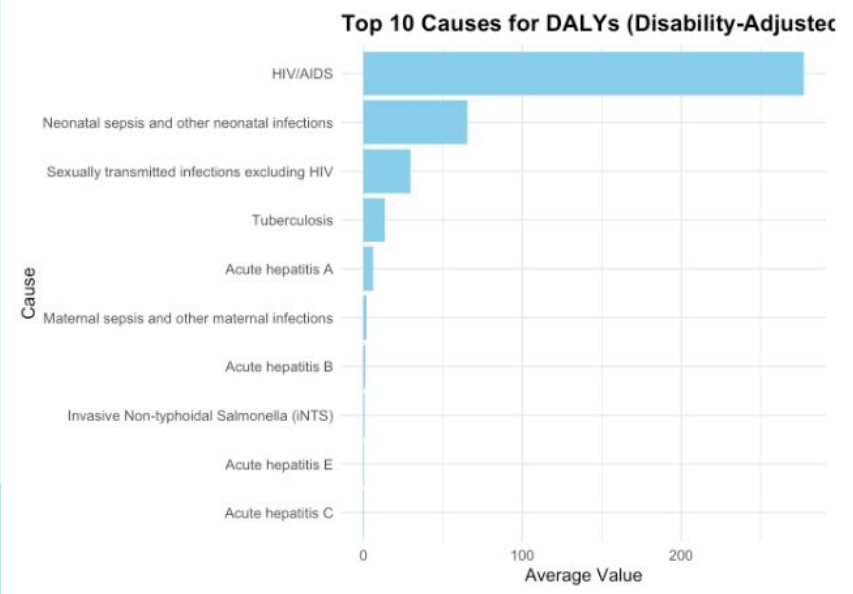
- **Neonatal infections** lead in **average mortality**.
- **HIV/AIDS** ranks **second**, still high.
- **TB** is **third** but significantly lower.

Insights:

- Mortality is **concentrated** in **neonatal infections and HIV/AIDS.**
- Targeted interventions in these areas could have the **biggest impact**.
- **Sharp drop** after top two suggests priority areas for public health efforts.

Group-level Summary Analysis

🧩 Section 4: Top 10 Diseases by Average Value(DALYs)



Key Observations:

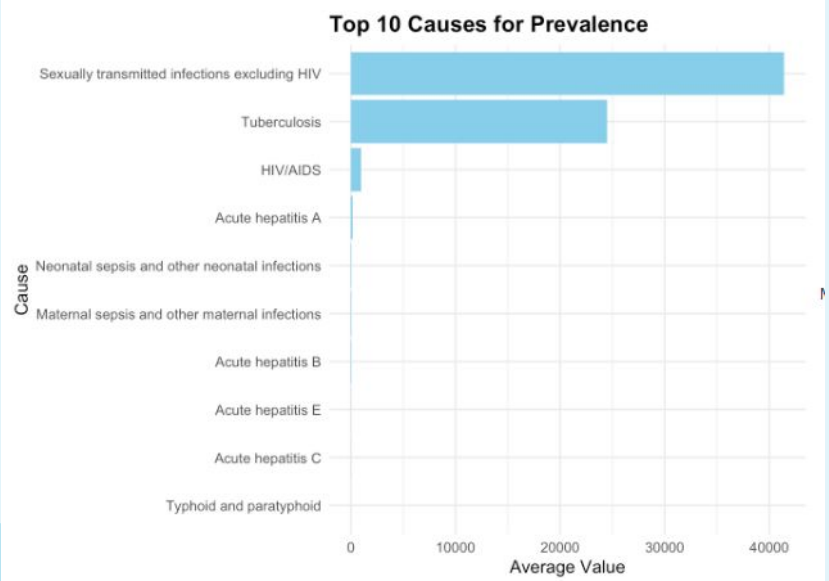
- **HIV/AIDS** has the **highest DALY burden**, far surpassing other conditions.
- **Neonatal infections** rank **second**, with strong **early-age impact**.
- **STIs (excluding HIV)** and **TB** are also **high** on the DALY list.

Insights:

- **HIV/AIDS** leads due to its **combined fatal and communicable effects.**
- **Neonatal care** remains a critical area for **DALY reduction**.
- **Infectious diseases** broadly dominate **DALY rankings**, highlighting continued global health challenges.

Group-level Summary Analysis

🧩 Section 4: Top 10 Diseases by Average Value(Prevalence)



Key Observations:

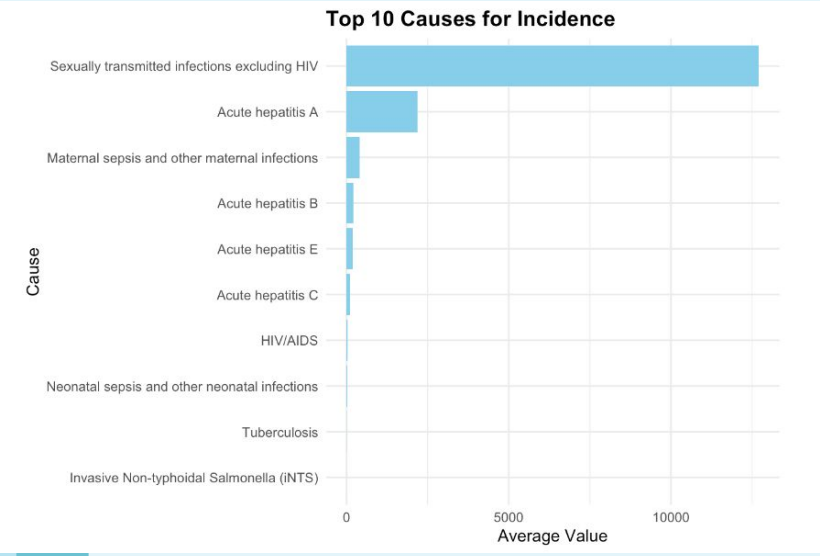
- **STIs (excluding HIV)** have the **highest average prevalence**.
- Tuberculosis follows as the second most prevalent condition.

Insights:

- **A few conditions (STIs and TB) dominate** overall prevalence, indicating where most cases are concentrated.
- The **steep drop** after **the top two** suggests focused interventions could **address** the majority of disease burden.
- **Lower-prevalence conditions** still affect **specific at-risk groups** and shouldn't be overlooked in policy planning.

Group-level Summary Analysis

🧩 Section 4: Top 10 Diseases by Average Value(Incidence)



Key Observations:

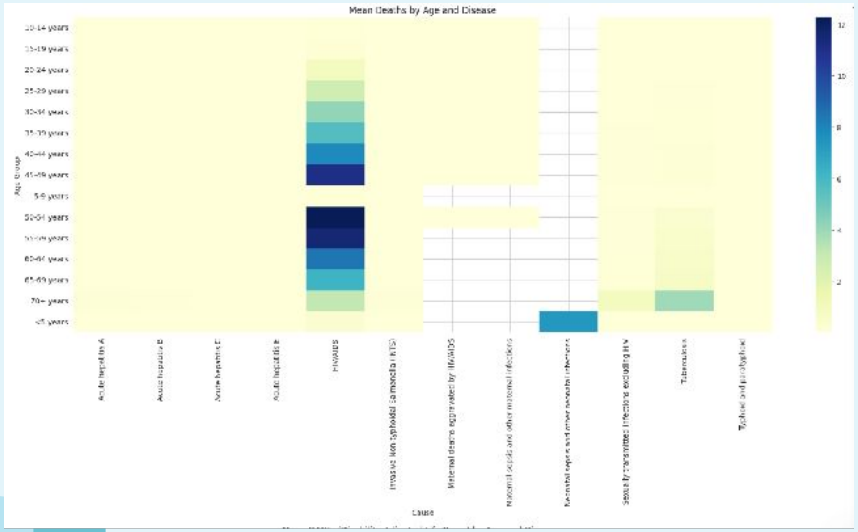
- **STIs (excluding HIV)** overwhelmingly top the list, with average incidence far higher than any other condition.
- **Acute hepatitis A** ranks second but lags far behind STIs in terms of case numbers.

Insights:

- **STIs dominate new case counts**, highlighting an urgent need for **prevention, education, and screening** in sexual health.
- The sharp drop-off after the top two causes suggests **targeted interventions** for high-incidence diseases could have **outsized impact**.

Group-level Summary Analysis

🧩 Section 5: Heatmap: Age & Disease(Deaths)



Key Observations:

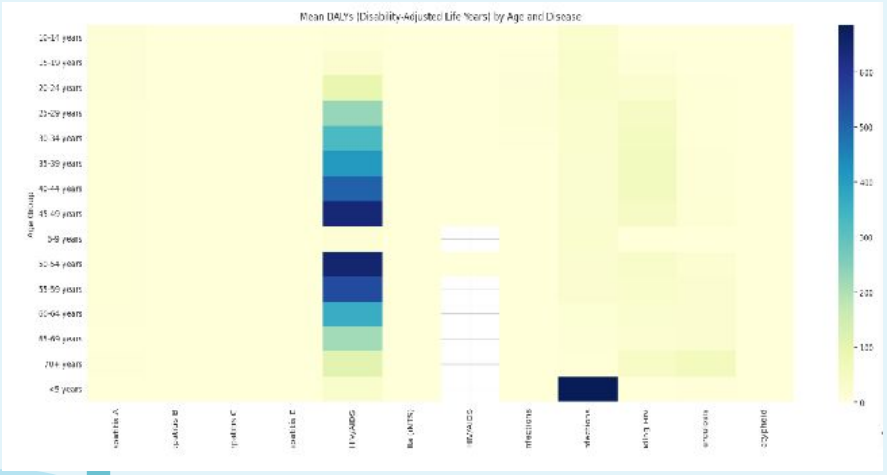
- **HIV/AIDS** has the highest mortality, especially in ages **40–54**, showing **strong mid-life impact**.
- **Hepatitis B and E** show moderate mortality in **middle-aged adults**.
- **Neonatal infections** are concentrated **in the <5 age group.**
- **TB** spans **multiple age groups** but with **moderate mortality.**

Insights:

- **Mid-life adults** bear a **disproportionate HIV/AIDS mortality burden.**
- **Neonatal deaths** highlight urgent **early-life health risks**.
- Broader age spread of TB suggests need for **lifelong surveillance and intervention.**

Group-level Summary Analysis

🧩 Section 5: Heatmap: Age & Disease(DALYs)



Key Observations:

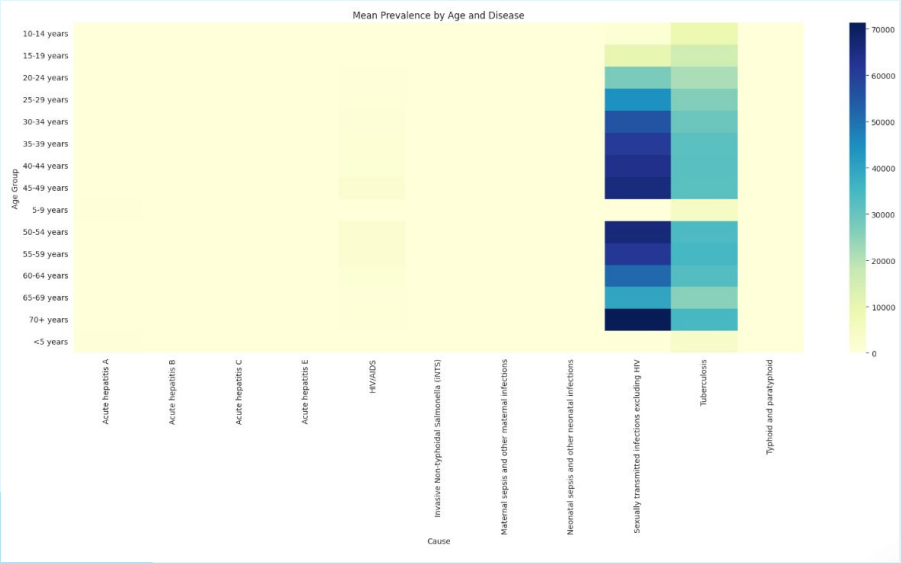
- **HIV/AIDS** shows the **highest DALY burden** in ages **30–59,** peaking at **40–44.**
- **Neonatal infections** drive **high DALYs** in the **<5 age group**.
- **STIs (excluding HIV)** and **TB** show moderate **DALYs** in **young to mid-life adults**.
- **Hepatitis B/C/E** and **typhoid** present **lower** but more **evenly spread DALYs across age groups.**

Insights:

- **HIV/AIDS** causes both **early death** and l**ong-term disability** during **peak working years**.
- **Neonatal DALYs** highlight **critical early-life health challenges**.
- **Moderate but widespread DALY patterns** in other infections suggest a need for **broad, age-inclusive public health strategies**.

Group-level Summary Analysis

🧩 Section 5: Heatmap: Age & Disease(Prevalence)



Key Observations:

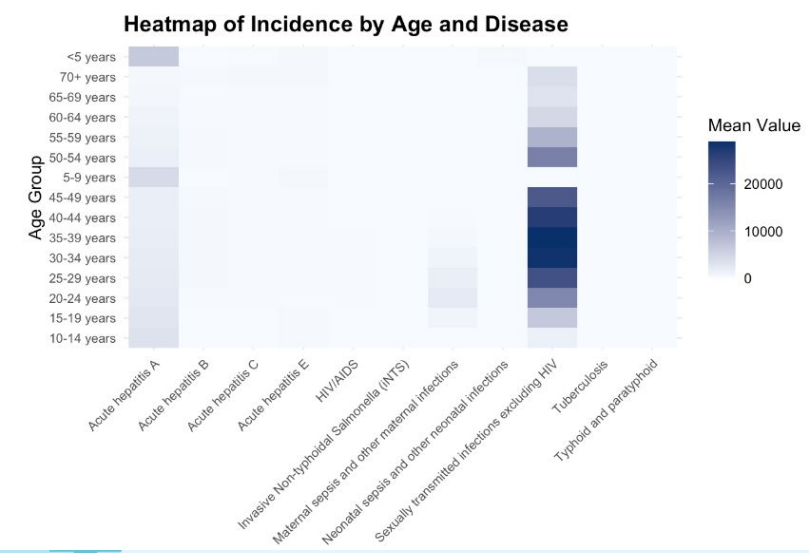
- **Tuberculosis and STIs** (excluding HIV) have the **highest prevalence.**
- **Highest prevalence** occurs in **ages 25–54**, especially **young to mid-life** adults.

Insights:

- **TB and STIs** are widespread in the **working-age population**, suggesting **high transmission potential**.
- **Lower prevalence of HIV/AIDS** and **hepatitis** may **mask their severity**, as seen in DALY and death burdens.

Group-level Summary Analysis

🧩 Section 5: Heatmap: Age & Disease(Incidence)



Key Observations:

- **Sexually transmitted infections (excluding HIV)** dominate across most age groups, especially ages **20–54**, with the **highest incidence density**.
- **Neonatal sepsis and other neonatal infections** are concentrated in the **<5 years** group.

Insights:

- **Young to middle-aged adults (20–54 years)** are the primary drivers of incidence for many infectious diseases, especially STIs.
- Age-specific targeting is essential: early-life interventions for **neonatal infections**, and prevention strategies for **STIs in working-age adults.**

Diseases Selection & EDA & Trend Analysis –Non Communicable

Data - Non Communicable

📊 Dataset Overview

The dataset we were using included **every non-communicable disease** from the data website IHME: Global Health Data Exchange.

🗓️ Years Covered

- The dataset spans multiple years(2010-2019), allowing for pre- and post-policy comparison.

🧩 Key Columns

- `year`: Year of observation
- `location_name`: U.S. state
- `cause_name`: Specific disease
- `val`: Value of the health outcome (DALYs / Prevalence / Deaths/Incidence)
- `sex_name`: Gender (Male/Female)
- `age_name`: Age group (from <5 to 70+ years old)
- `expansion_group`: Medicaid expansion status (Early, Mid, Late, Never)
- `post`: Indicates if observation is from post-expansion period
- `treat_group`: Treatment assignment dummy for DiD analysis

Disease Selection Methodology

Non - Communicable

$$\begin{cases} \text{Mean\_Post}_{\text{Deaths, D}} < \text{Mean\_Pre}_{\text{Deaths, D}} \\ \text{Mean\_Post}_{\text{DALYs, D}} < \text{Mean\_Pre}_{\text{DALYs, D}} \\ \text{Mean\_Post}_{\text{Prevalence, D}} > \text{Mean\_Pre}_{\text{Prevalence, D}} \\ \text{(and thresholds applied to filter out low-burden diseases)} \end{cases}$$

A **two-sample t-test** was conducted to compare the **mean value** for the **pre-expansion vs. post-expansion** for each disease.

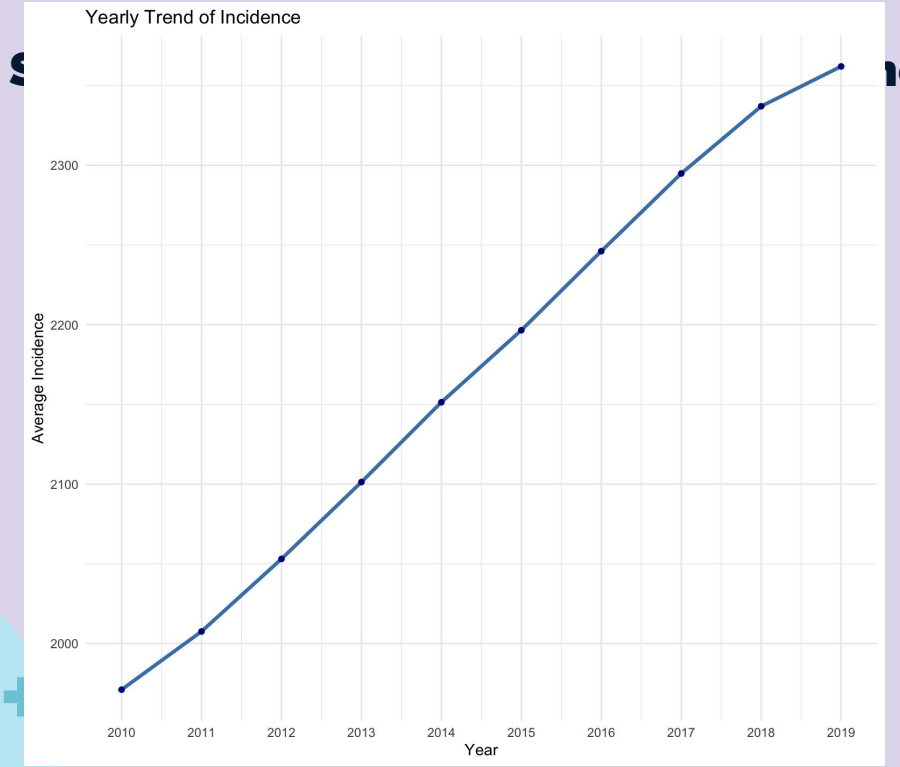
This statistical test assessed whether observed changes were **statistically meaningful and unlikely to occur by chance**.

- Lower post-expansion means for **Deaths and DALYs** (i.e., Mean_Post < Mean_Pre)
- **Higher post-expansion means for Prevalence** (i.e., Mean_Post > Mean_Pre)
- Exclusion of conditions with **very low absolute burden**

10 Selected Non - Comm Diseases

1. Substance use disorder
2. Drug use disorders
3. Opioid use disorders
4. Diabetes and kidney diseases
5. Chronic kidney disease
6. CKD due to diabetes mellitus type 2
7. Alzheimer's disease and other dementias
8. Alcohol use disorders
9. CKD due to hypertension
10. Uterine cancer

Summary Analysis - Non Communicable



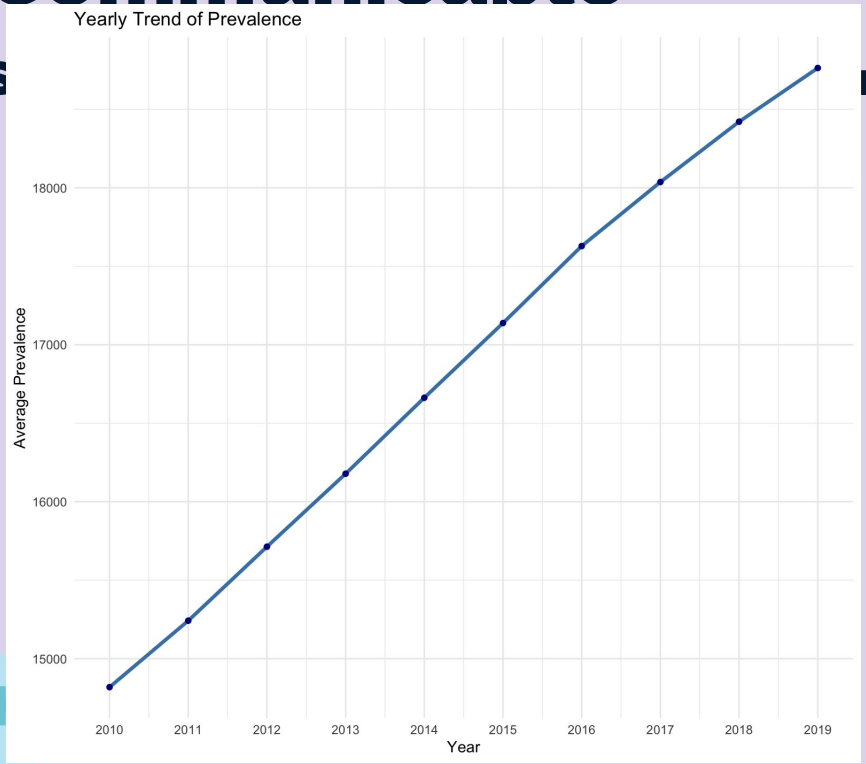
Key Observations:

From 2010 to 2019, the average incidence of the 10 selected diseases steadily increased each year, indicating a persistent rise in the number of new cases diagnosed annually across states.

Insights:

- May reflect improved disease detection and reporting over time.
- Could be driven by population growth or demographic shifts.
- Highlights a need for enhanced prevention strategies and early intervention policies

Summary Analysis - Non Communicable



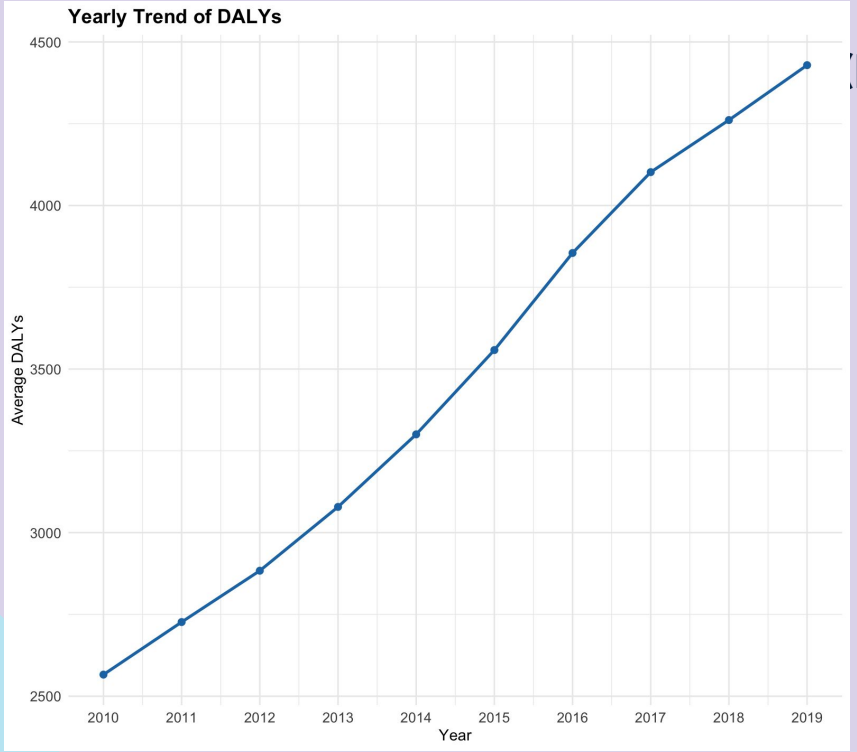
Key Observations:

Prevalence has steadily increased from 2010 to 2019 across the 10 selected diseases.

Insights:

- More people are living with chronic conditions year over year.
- Better diagnosis/reporting.
- Improved survival, leading to more people living longer with disease.
- Expanding population also contributes to higher case numbers.

Summary Analysis - Non Communicable



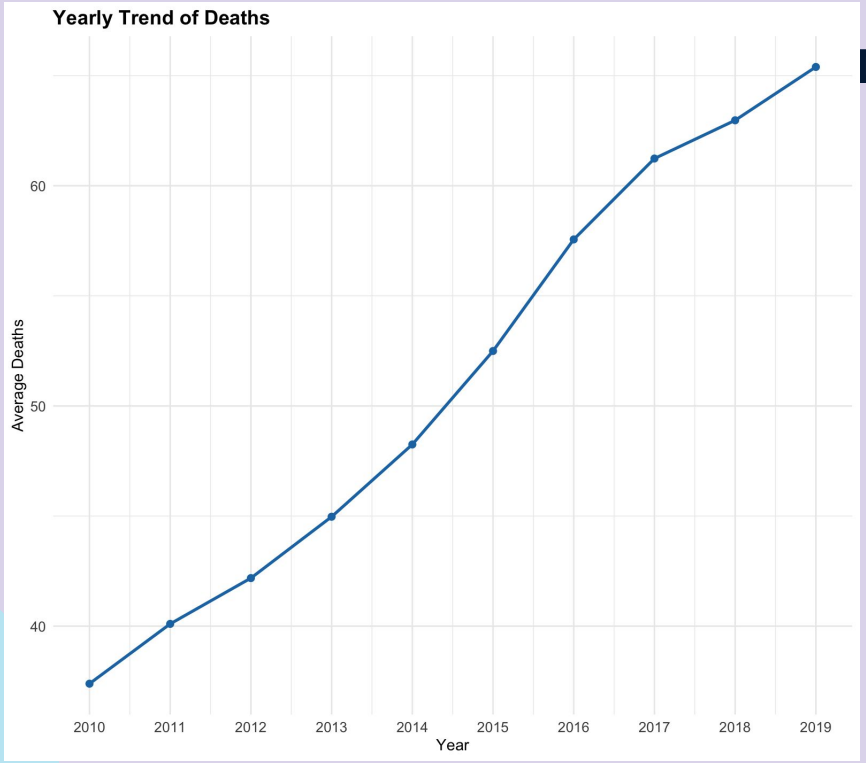
Key Observations:

DALYs increased over time as rising prevalence and better diagnosis led to more cases being tracked. Although average DALYs declined post-expansion, total burden grew due to **expanded access and national chronic disease trends.**

Insights:

- Indicates not just more deaths, but also more people living with disease-related disabilities.
- The growth in DALYs underscores:
- Higher disease burden.
- Possibly longer durations of illness before death.
- Increasing impact on quality of life and productivity.

Summary Analysis - Non Communicable Deaths)



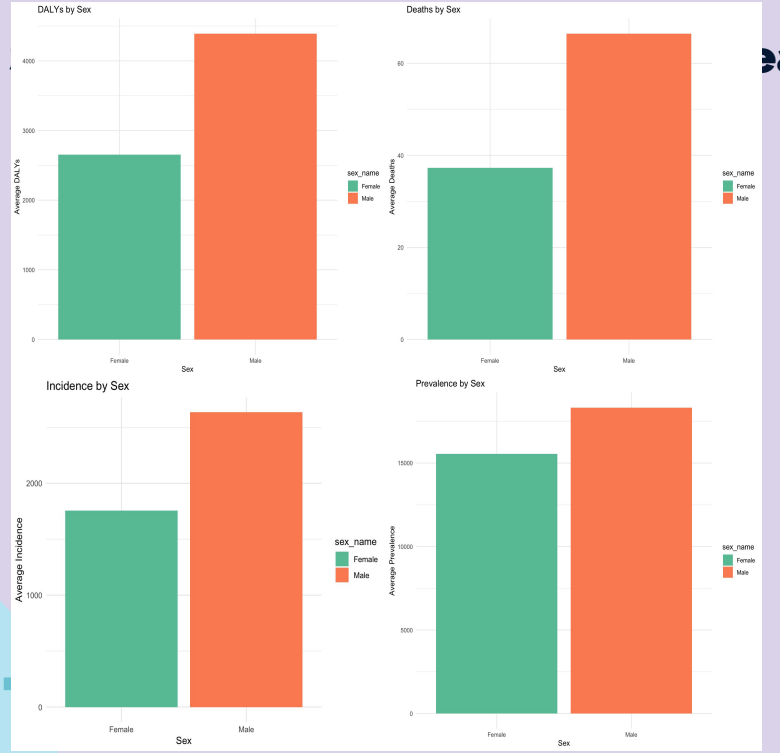
Key Observations:

The yearly trend of average deaths is increasing from 2010 to 2019 likely due to population growth, aging demographics, and the rising burden of chronic diseases. The averaging reflects the mean number of deaths per year across all states and demographic groups for the 10 selected diseases.

Insights:

The graph shows a steady increase in the average number of deaths from 2010 to 2019 for the 10 selected diseases. This rising trend likely reflects broader factors such as population growth, aging demographics, and the escalating impact of chronic illnesses.

Summary Analysis - Non Communicable



eaths & DALYs & Prevalence)

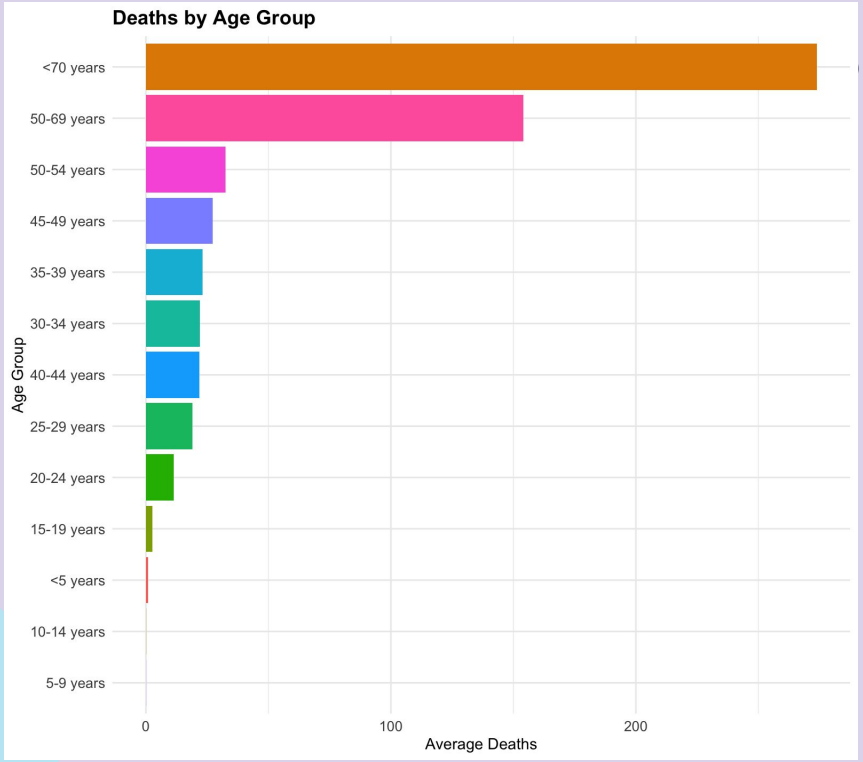
Key Observations:

- Across all four measures (Deaths, DALYs, Incidence, Prevalence), **males consistently exhibit higher average values than females**.
- The most significant disparities are observed in **DALYs and Deaths**, indicating worse health outcomes for men.

Insights:

- Males show consistently higher rates across all measures, especially in deaths and DALYs, suggesting the need for focused **prevention in high-risk areas** like substance use, kidney disease, and alcohol use.
- Females, while having lower rates, may **benefit from better chronic disease management**, particularly for conditions like Alzheimer's and uterine cancer.

Summary Analysis - Non Communicable (Death)



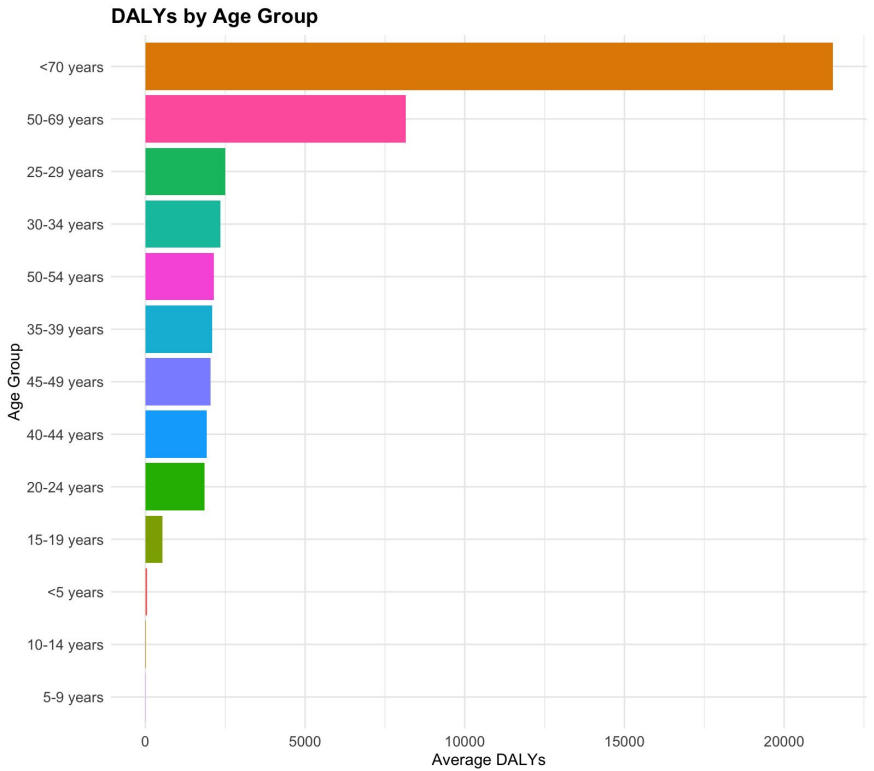
Key Observations:

- The **<70 years** group records the highest average number of deaths, followed by the 50–69 years bracket.
- Mortality decreases dramatically with **younger age groups,** becoming **minimal** in children and adolescents.

Insights:

- **Older adults are significantly more vulnerable to death** from the 10 selected diseases.
- Preventive and chronic care strategies should **target the 50+ population**, with special emphasis on those approaching or surpassing retirement age.

Summary Analysis - Non Communicable



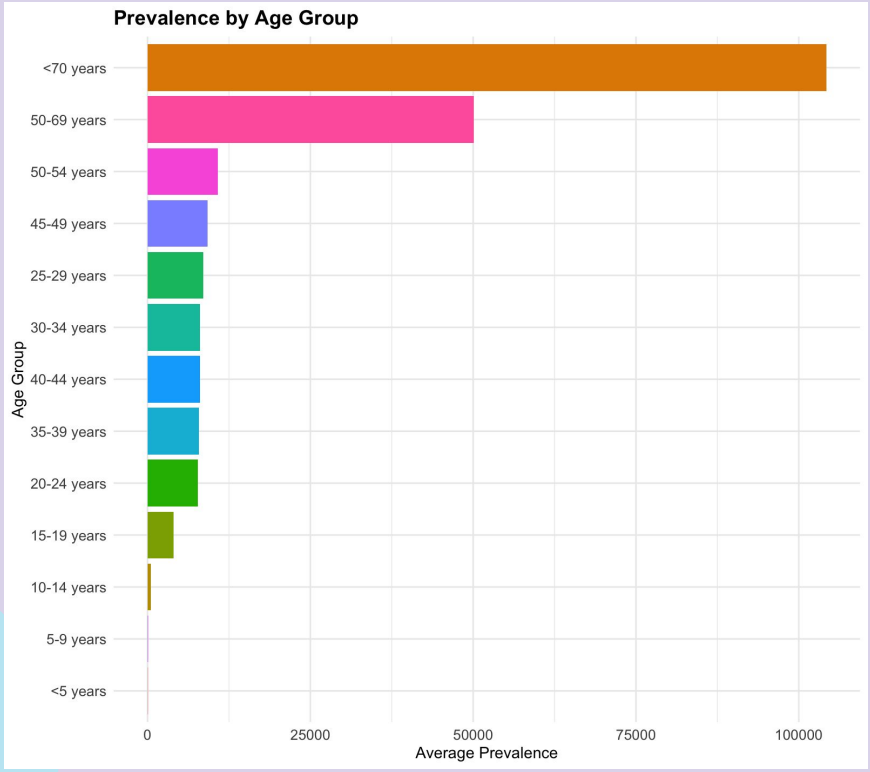
Key Observations:

- The **<70 years and 50–69 years** age groups again dominate in average DALYs.
- DALYs are distributed across several young adult groups **(25–49)**, indicating **significant years lost to disability** even when death does not occur.

Insights:

- While deaths are concentrated in older adults, younger adults are living with disease burdens—implying the importance of long-term management, early detection, and support services for working-age populations.
- DALY distribution also reflects the economic burden of disease among people in their productive years.

Summary Analysis - Non Communicable (Prevalence)



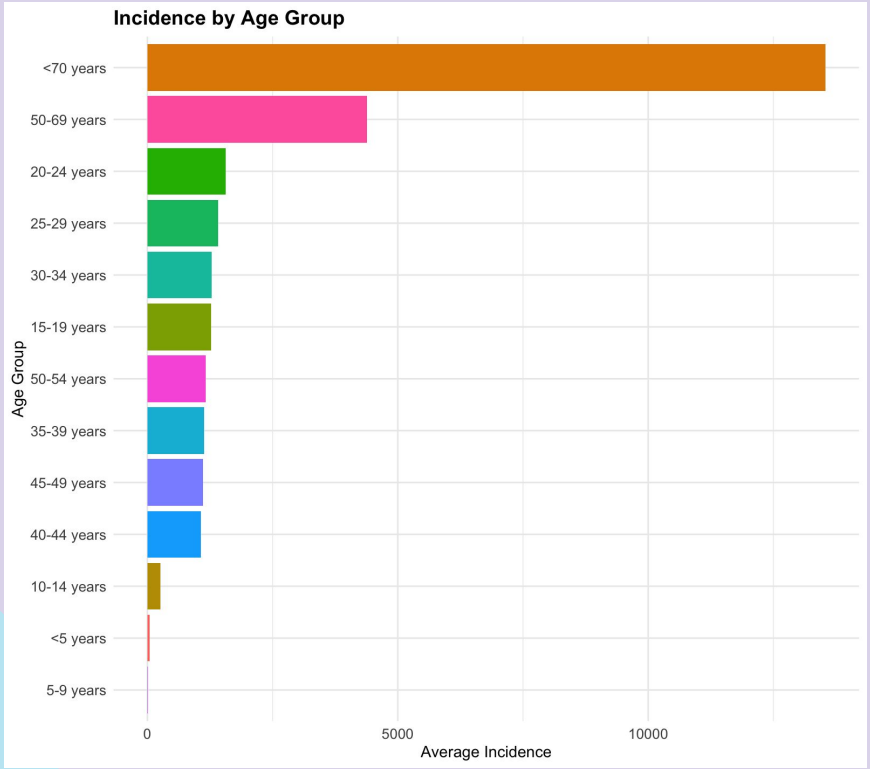
Key Observations:

- **<70 years age** group shows the highest disease prevalence, followed by 50–69 years.
- Disease prevalence is l**ower in younger groups,** but **not negligible**, with early adulthood (**20–44 years) showing moderate levels.**

Insights:

- Chronic conditions become increasingly common with age, but are present and growing in younger adults.
- Programs focused on early lifestyle interventions (e.g., nutrition, smoking cessation, exercise) can reduce progression into later-life disease burden.

Summary Analysis - Non Communicable (Incidence)



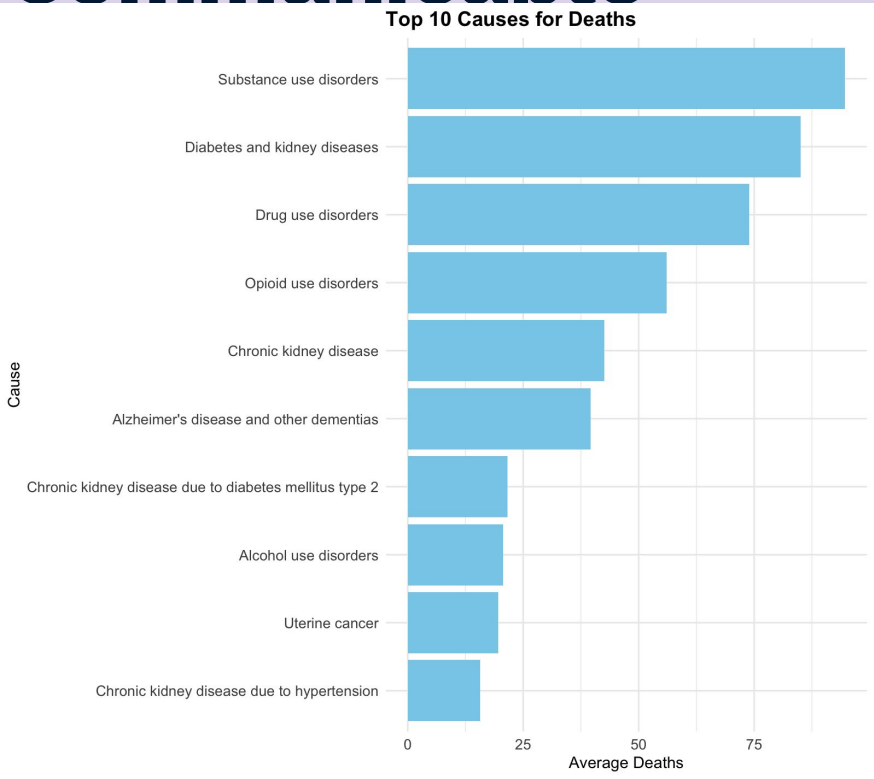
Key Observations:

- The <70 years category dominates in incidence, followed by the 50–69 and 20–24 age groups.
- Younger adults (ages 15–34) show moderate levels of incidence.
- Children under 10 have minimal incidence rates.

Insights:

- Adults under 70, especially those between 20 and 69, are driving new case counts for the selected diseases.
- Rising incidence in young adults (15–34) suggests a need for earlier health interventions, particularly around substance use and chronic disease onset.

Summary Analysis - Non Communicable



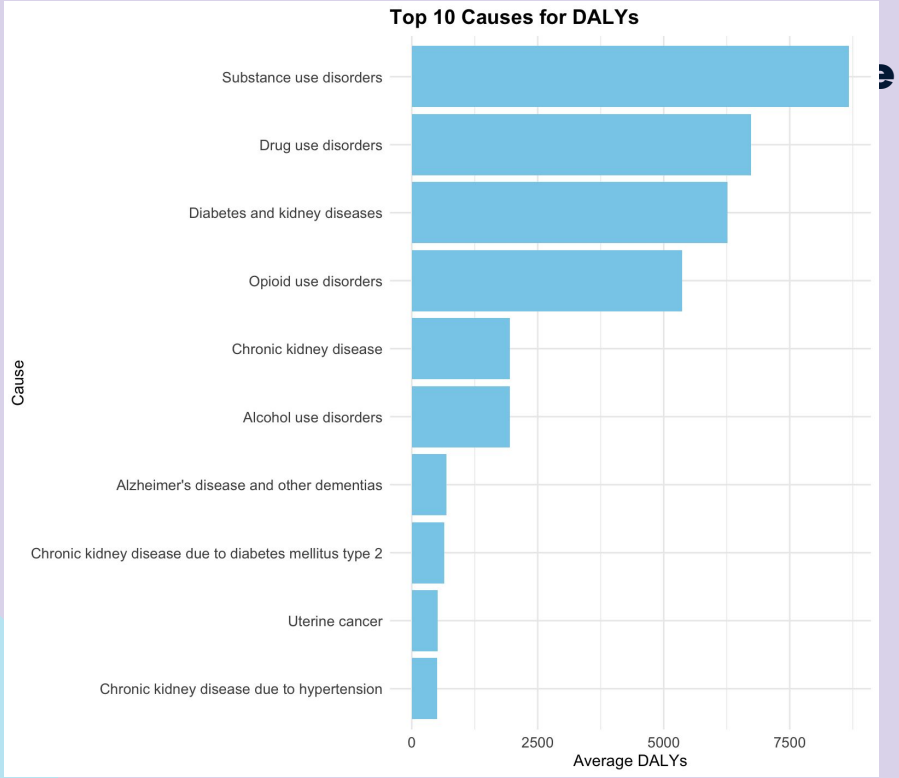
Key Observations:

- **Substance use disorders** are the leading cause of average deaths, followed by diabetes and kidney diseases, and drug use disorders.
- The chart highlights a strong impact from **addiction-related conditions—including drugs, alcohol, and opioids**.
- Chronic diseases such as **Alzheimer's, chronic kidney disease, and uterine cancer** also contribute substantially.

Insights:

- Behavioral and preventable causes like substance abuse dominate the mortality burden.
- Comorbidities involving diabetes and kidney function are also key contributors.
- There's a critical need for addiction treatment programs, and early screening strategies.

Summary Analysis - Non Communicable



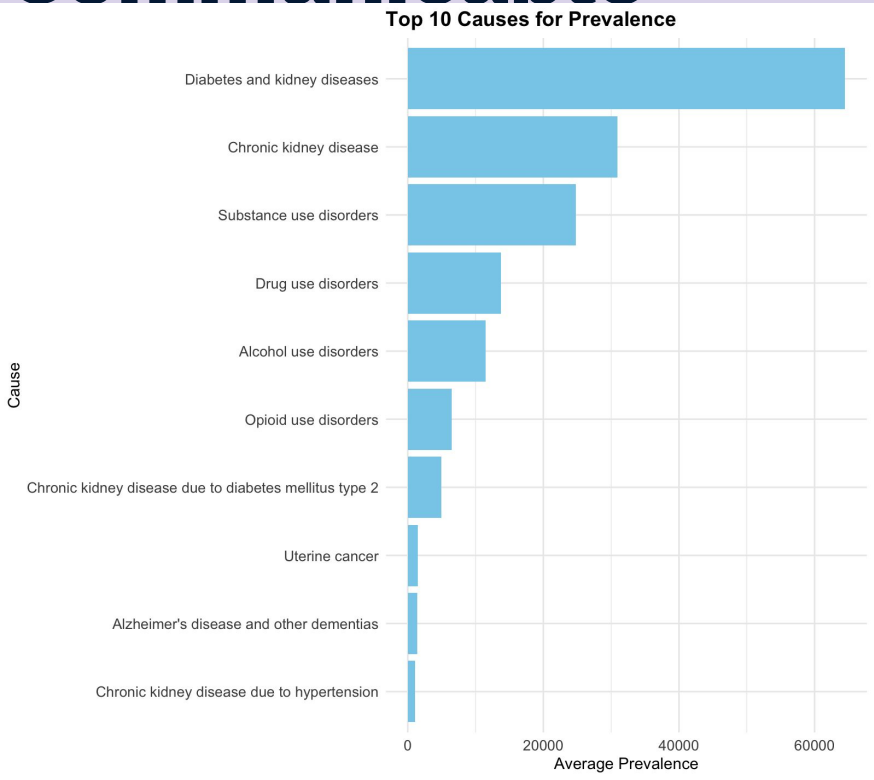
Key Observations:

- **Substance use disorders** are again the leading cause of DALYs, followed by drug use, diabetes and kidney diseases, and opioid use disorders.
- The **high DALY values** for these causes reflect **significant disability years lost**, not just mortality.
- Conditions like **Alzheimer's disease and chronic kidney disease** due to diabetes or hypertension r**ank lower for DALYs.**

Insights:

- DALY-focused causes point to long-term disability and quality of life loss, not just fatal outcomes.
- The overlap between substance use, chronic illness, and mental health should be central to policy and healthcare planning.

Summary Analysis - Non Communicable



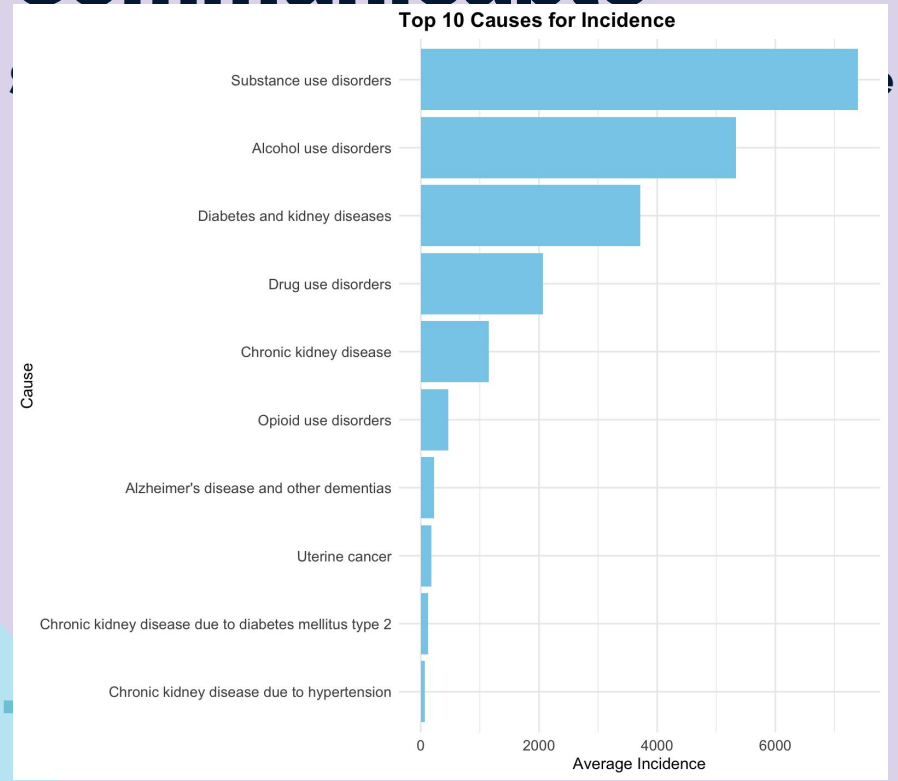
Key Observations:

- **Diabetes and kidney diseases top the chart in average prevalence,** followed closely by chronic kidney disease and substance use disorders.
- Unlike the deaths/DALYs charts, here we see broader conditions with **longer lifespans, such as alcohol use, Alzheimer's, and uterine cancer.**
- **Chronic diseases** clearly dominate **long-term health management burdens.**

Insights:

- High prevalence doesn't always mean high mortality but often translates to sustained healthcare needs.
- Disease management programs targeting lifestyle and renal function can significantly reduce prevalence and downstream mortality.

Summary Analysis - Non Communicable



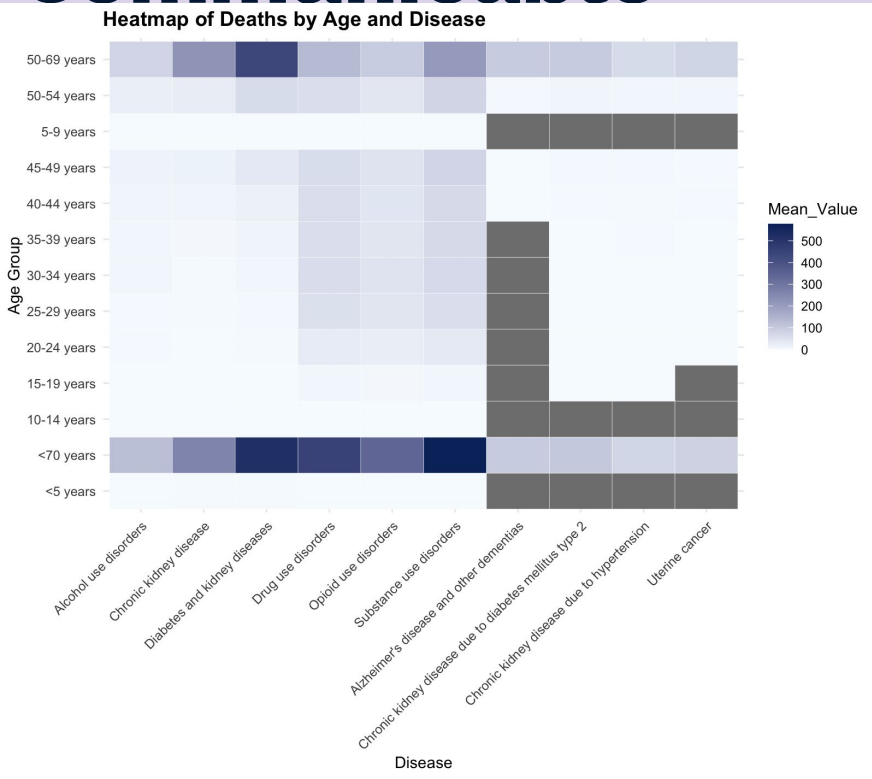
Key Observations:

- **Substance use disorders** show the highest average incidence by a significant margin.
- Alcohol use and diabetes-related diseases follow, contributing notably to the overall disease burden.
- More specific causes like opioid use and chronic kidney disease subtypes show lower incidence but remain relevant.

Insights:

- **Behavioral health issues** (substance and alcohol use) dominate incidence rates, suggesting an urgent need for preventive and treatment strategies in addiction services.
- Chronic diseases like diabetes and kidney conditions **highlight long-term health management challenges**.

Summary Analysis - Non Communicable



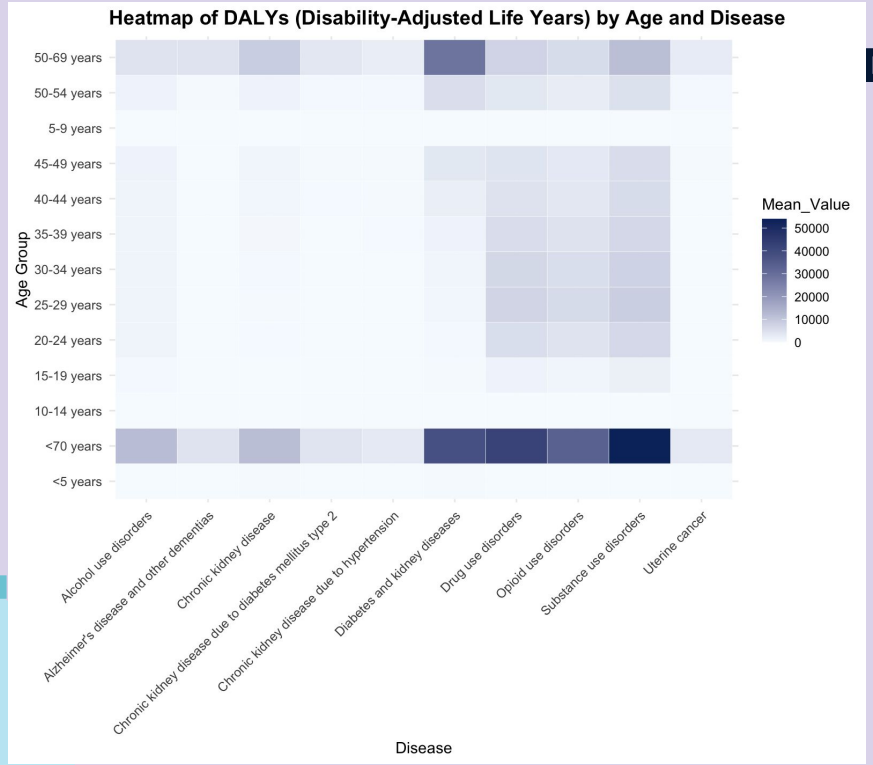
Key Observations:

- The **<70 years age** group shows the **darkest shades** across nearly all diseases, especially for: **Substance use disorders; Diabetes and kidney diseases; Drug use disorders**.
- **Aging-related diseases** like Alzheimer's and hypertension-related kidney disease are more visible in the **50+ brackets**.
- **Minimal death burden** appears for **younger age groups (under 25).**

Insights:

- Mortality sharply increases with age and is heavily driven by preventable conditions in working-age adults.
- There's a critical need for preventive programs for substance use and chronic disease management before age 70.

Summary Analysis - Non Communicable DALYs)



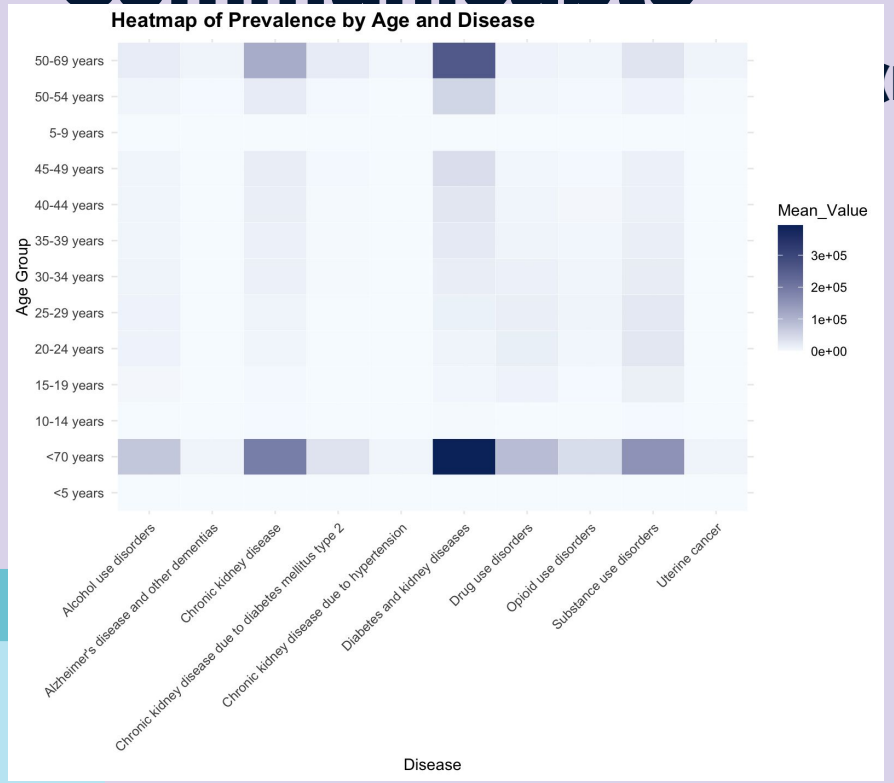
Key Observations:

- **The <70 years** group again has the **highest DALYs**, especially from: **substance use disorders; Drug and opioid use disorders, diabetes and kidney diseases**
- The **25–50 year** range also **contributes heavily to DALYs** from **substance-related and chronic** conditions.
- Even **age groups 15–29 reflect moderate DALYs from drug and alcohol disorders.**

Insights:

- Many diseases start years before death, affecting long-term quality of life.
- This highlights the importance of early detection, particularly for substance use, which imposes high DALYs across multiple age groups.

Summary Analysis - Non Communicable (Prevalence)



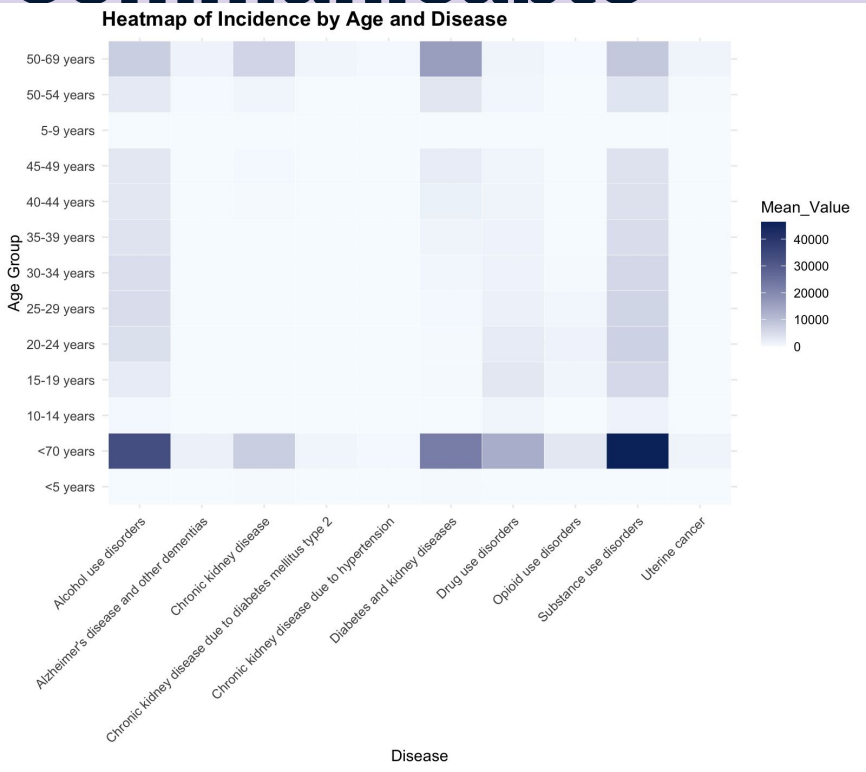
Key Observations:

- The **<70 years** population again leads in prevalence for most diseases, particularly **diabetes and kidney diseases, chronic kidney disease, and substance use disorders; some chronic diseases** are more concentrated in **older adults**, though **less prevalent** overall.
- **Youth age** groups show l**ow but non-zero prevalence**, especially for behavioral disorders.

Insights:

- **Chronic and behavioral diseases are highly prevalent and sustained across age ranges**, with most cases concentrated in **late-middle age**.
- Emphasizes the growing population living with chronic illness, requiring continuous care, not just acute intervention.

Summary Analysis - Non Communicable



ncidence)

Key Observations:

- <70 years age group shows the highest incidence, especially for substance use, alcohol use, and diabetes-related diseases.
- Moderate incidence persists across working-age groups (25–54 years).
- Some diseases like uterine cancer and dementia show low incidence across all ages.

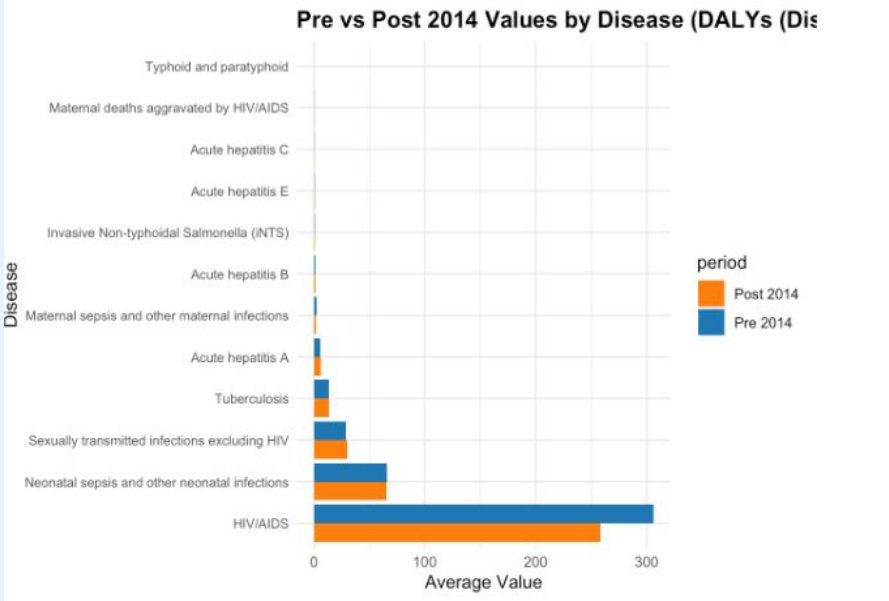
Insights:

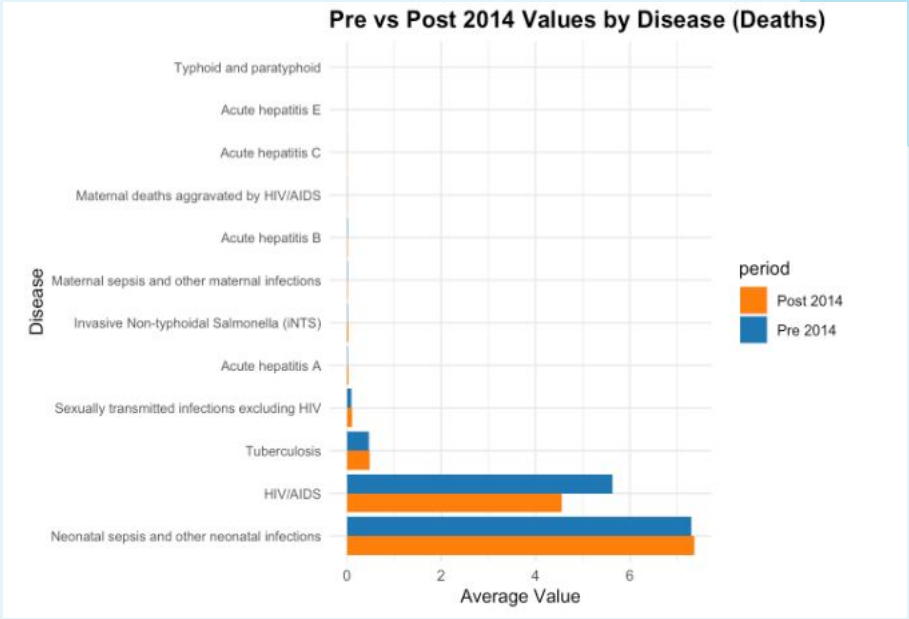
- Target middle-aged and younger populations for early intervention on substance and chronic conditions.
- Even low-incidence diseases warrant attention due to long-term impact—focus on screening and awareness.

04

Statistical Modeling & Insights

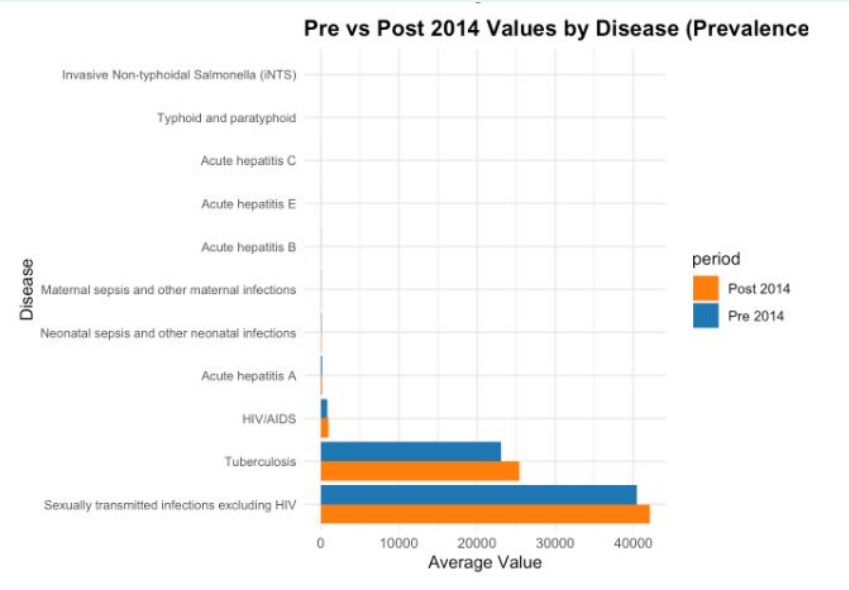
Comparing pre-2014 vs post-2014 average values for each disease under different measures

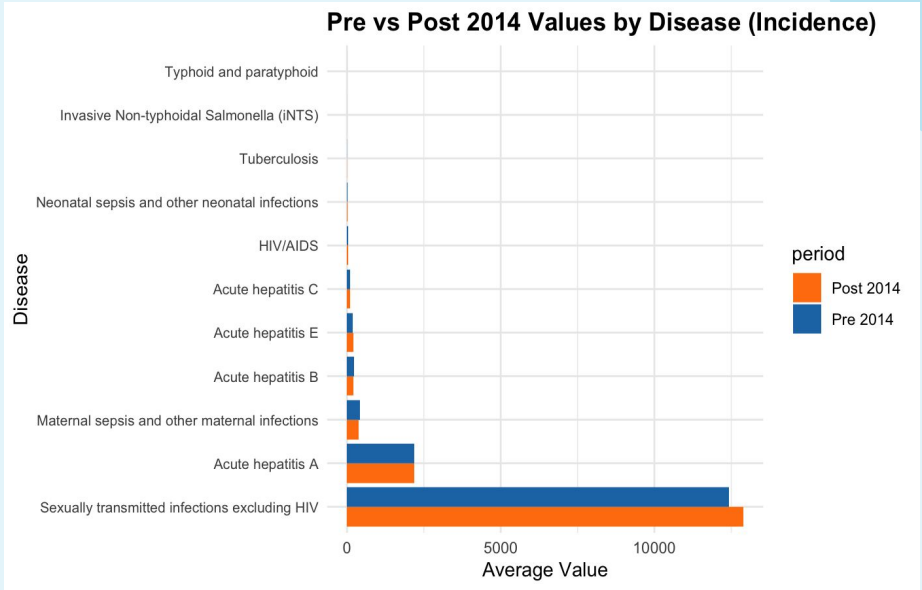




There is a modest decline in DALYs and death rates for several communicable diseases after 2014, including HIV/AIDS and tuberculosis. This suggests potential health improvements, but visual differences alone are not sufficient to confirm policy effects.

Comparing pre-2014 vs post-2014 average values for each disease under different measures





Prevalence and incidence values appear to shift in both directions across diseases, with some conditions like STIs and hepatitis showing post-2014 increases. This suggests a potential rise in disease detection, but whether this change is causally linked to Medicaid expansion remains unclear.

Methodology: Model Overview

But are these observed changes truly caused by Medicaid expansion, or are they simply trends driven by other factors

Causal Inference Methods:

- **Difference-in-Differences (DiD)**
  → Measures the *causal impact* of Medicaid expansion by comparing **treated** vs **untreated** states *before and after* implementation.
- **Fixed Effects (FE)**
  → Controls for **unobserved heterogeneity** at the state and year levels (e.g., policy climate, macroeconomic shocks).

Methodology: Model Formula

DID Model

$$\text{val}_{ist} = \beta_0 + \beta_1(\text{Treatment}_s \times \text{Post}_t) + \gamma \mathbf{X}_{ist} + \varepsilon_{ist}$$

Fixed Effect Model

$$\text{val}_{ist} = \beta_0 + \beta_1(\text{Treatment}_s \times \text{Post}_t) + \gamma \mathbf{X}_{ist} + \delta_s + \varepsilon_{ist}$$

$$\text{val}_{ist} = \beta_0 + \beta_1(\text{Treatment}_s \times \text{Post}_t) + \gamma \mathbf{X}_{ist} + \lambda_t + \varepsilon_{ist}$$

- val_ist: Health outcome for individual/group i, in state s, at year t
- Treatment_s: 1 if state s implemented Medicaid expansion
- Post_t: 1 if year t is after expansion
- Treatment × Post: DiD interaction term (causal effect β_1)
- X_ist: Confounders (e.g., age, sex)
- δ_s: State fixed effects
- λ_t: Year fixed effects
- ε_ist: Error term

Methodology: State Groupings

Grouping Strategy Based on Expansion Year:

Group	Definition	Count	Example States
Early	Expansion in **2014**	**25**	California, New York, Texas, Illinois, etc.
Mid	Expansion in **2015–2016**	**4**	Indiana, Pennsylvania, Louisiana, Montana
Late	Expansion in **2017–2019**	**2**	Maine, Virginia
Never	Expansion in **2020–2023**	**6**	Idaho, Nebraska, Missouri, Oklahoma, North Carolina, South Dakota
Never	**No expansion by end of 2023**	**13**	Florida, Georgia, Wisconsin, etc.

Methodology: Control Group and Confounder Strategy

❑ **Who is the Control Group?**

- **Definition:** States that did **not expand Medicaid** during the analysis window (2010–2019) serve as the **control group**.
- **Why?** These states provide a baseline for comparison to evaluate the causal impact of Medicaid expansion.
- **Examples:** Florida, Georgia, North Carolina, Wisconsin, Kansas.

❑ **What are the Key Confounders?**

- **Sex**: Health outcome trends differ by gender (e.g., maternal health vs. male HIV rates).
- **Age**: Disease prevalence and mortality rates vary significantly across age groups.

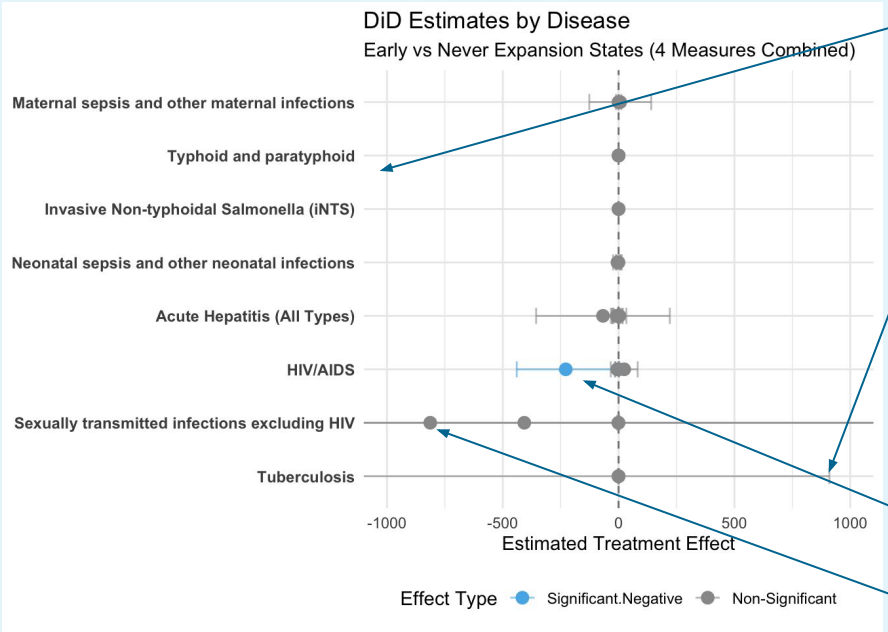
Why We Do It (the Benefits)

- **Causal clarity**: By comparing changes over time and across similar groups, DiD helps rule out spurious correlations (we're not just seeing general downward trends in HIV incidence, but the extra drop tied to Medicaid).
- **Transparency**: Policymakers can see a single number—"Medicaid expansion lowered mortality by X deaths per 100 000"—that's easy to communicate.
- **Robustness**: State fixed effects and demographic controls guard against hidden biases from, for example, richer states both expanding earlier and having better hospitals.

What it tells us?

1. **Identify diseases with statistically significant effects ($p < 0.05$),** indicating that the observed differences are unlikely to be due to random chance.
2. Interpret the **direction of the treatment effect** based on the **treat_group:post** coefficient of those significant communicable disease
    - **Negative coefficients on Deaths or DALYs** → Larger reductions in mortality or health loss → **Potential effect** of Medicaid expansion on population health
    - **Positive coefficients on Incidence or Prevalence** → Higher reported cases→ **Better access to healthcare**, **more screening**, or **improved disease reporting** following Medicaid expansion, rather than a real rise in disease burden.

Early Expansion VS Never Expansion



Y-axis (Diseases)

Lists each disease category

X-axis (Estimated Treatment Effect)

How much the outcome changed in early-expansion vs. never-expansion states (in natural units of cases, deaths, DALYs, etc.).

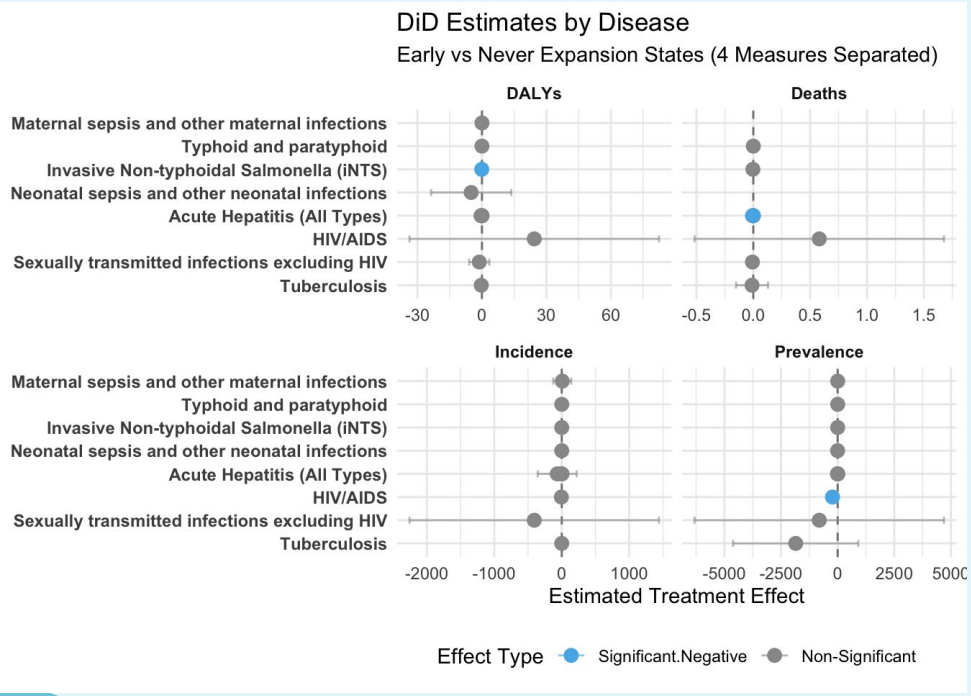
Points & horizontal error bars

- **Point** = the DiD estimate (difference-in-differences).
- **Bar** = 95% confidence interval around that estimate.

Color = statistical significance

- **Blue** points are *significant negative(*$p < 0.05$).
- **Yellow** points are *significant positive (*$p < 0.05$).
- **Gray** points are *non-significant*

DID Model - Early VS Never



DALYs & Deaths

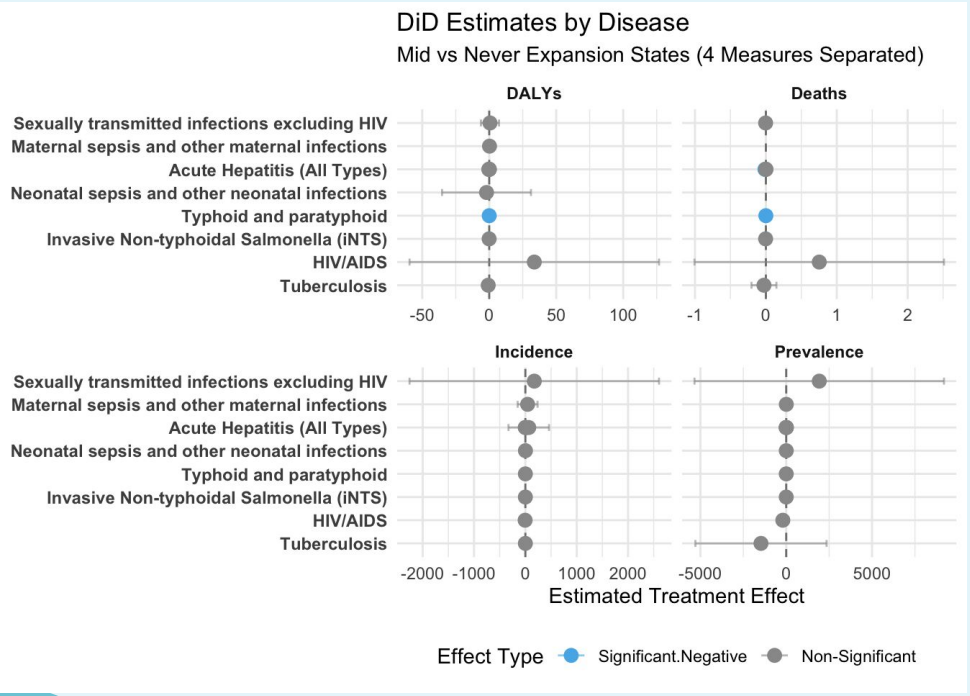
- **Invasive Non-typhoidal Salmonella (iNTS) DALYs** fell by **9.15 per 100,000,000**
- **Acute Hepatitis deaths** dropped by **0.000365 per capita**

Incidence & Prevalence

- **HIV/AIDS prevalence** fell sharply—**228 fewer cases per 100,000**
- **Acute Hepatitis incidence** decreased by **0.00737 per capita** (significant), pointing to fewer new infections.

- **Significant Decreases** (blue): **HIV/AIDS, iNTS, Acute Hepatitis**

DID Model - Mid VS Never



DALYs & Deaths

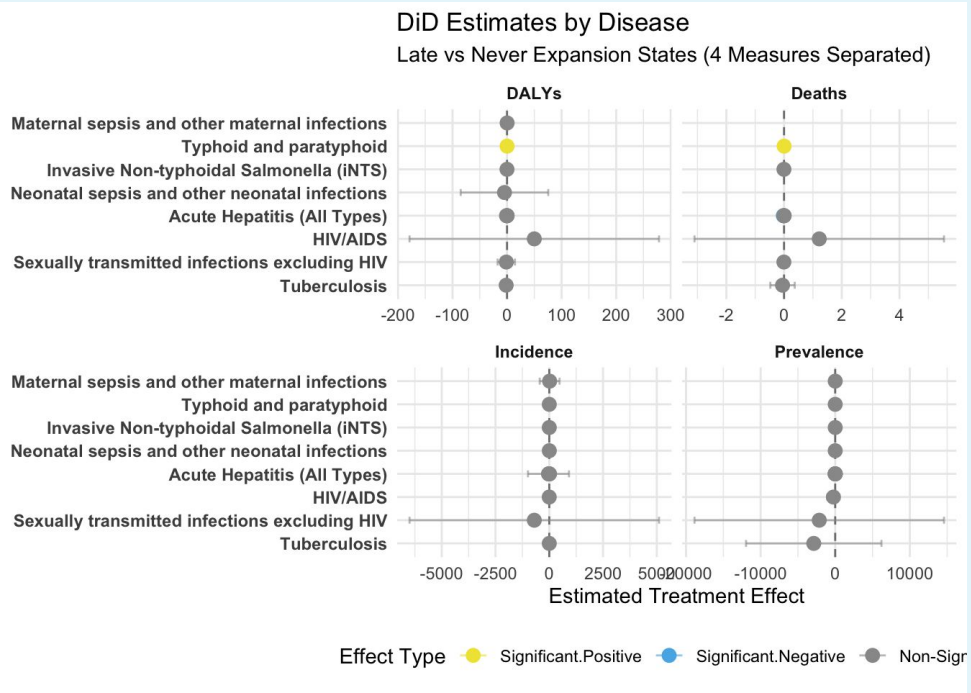
- **Typhoid and Paratyphoid** saw small but significant dropped by **9.15 per 100,000,000**
- **Acute Hepatitis (All Types)** experienced a significant reduction in deaths by **12.9 per 100,000,000**

Incidence & Prevalence

- **No significant changes detected.**

- **Significant Decreases** (blue): **Typhoid and paratyphoid**

DID Model - Late VS Never



DALYs & Deaths

- **Typhoid and Paratyphoid** saw small but significant increase by **56.1 per 100,000,000**
- **Acute Hepatitis (All Types)** experienced a reduction in deaths by **26.1 per 100,000,000**

Incidence & Prevalence

- **No significant changes detected.**

- **Significant Increases** (yellow): **Typhoid and paratyphoid**

Why We Introduce Fixed Effect

1. **Shortcoming of the “bare” DiD**

   Few significant results, small-magnitude effects and is vulnerable to omitted-variable bias from unobserved, time-invariant state differences and common time shocks.

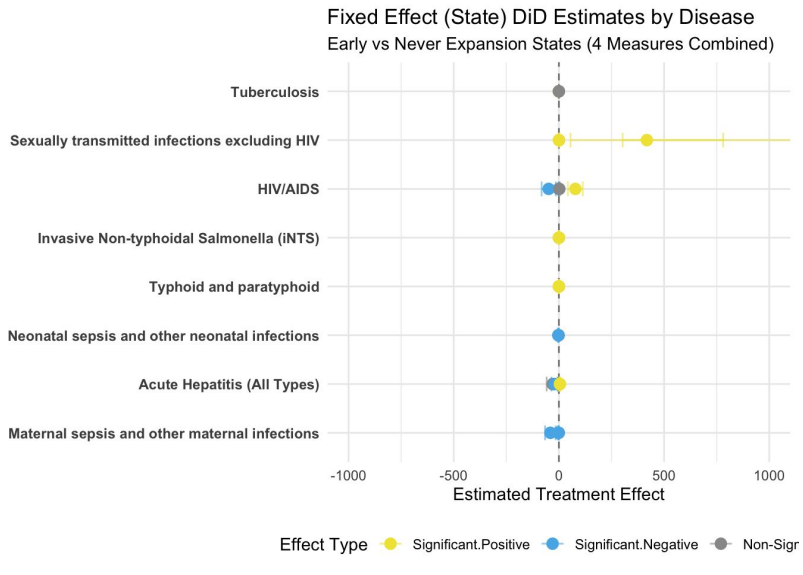
2. **+ State Fixed Effects**

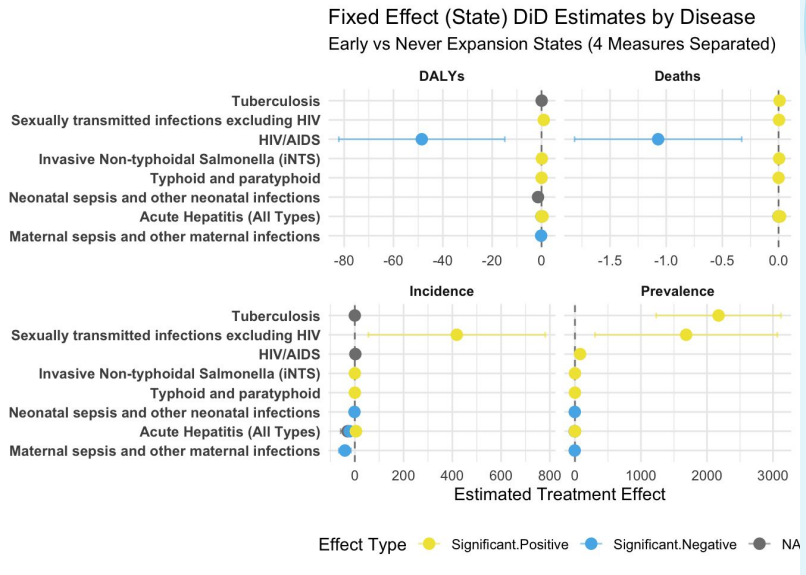
   Remove each state’s constant character—age structure, public-health capacity, reporting practices (e.g. Florida’s older population vs. New York’s testing infrastructure)—so we isolate the true effect of expansion.

3. **+ Year Fixed Effects**

   Remove nationwide temporal shifts—new guidelines, vaccine rollouts, treatment advances—so changes reflect Medicaid timing rather than broad secular trends.

Fixed State(Early vs Never)

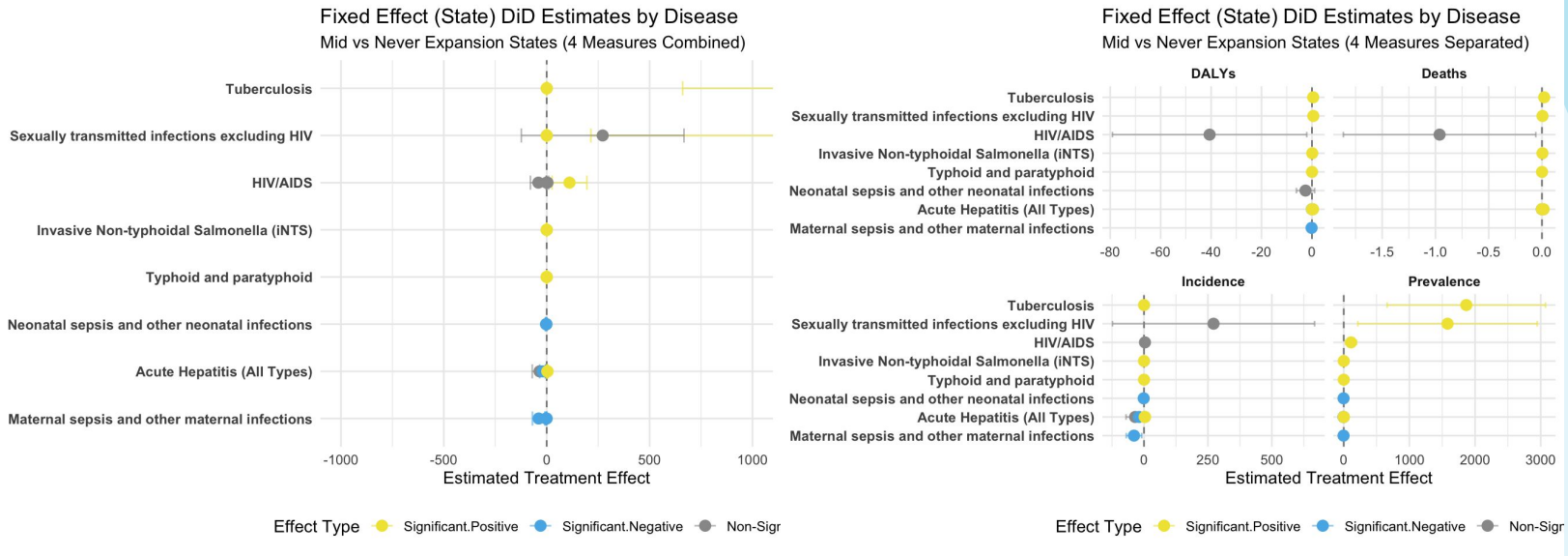




Result

- **Significant Decreases** (blue): **HIV/AIDS, Neonatal sepsis, Maternal sepsis**
- **Significant Increases** (yellow): **Sexually transmitted infections (excluding HIV)**

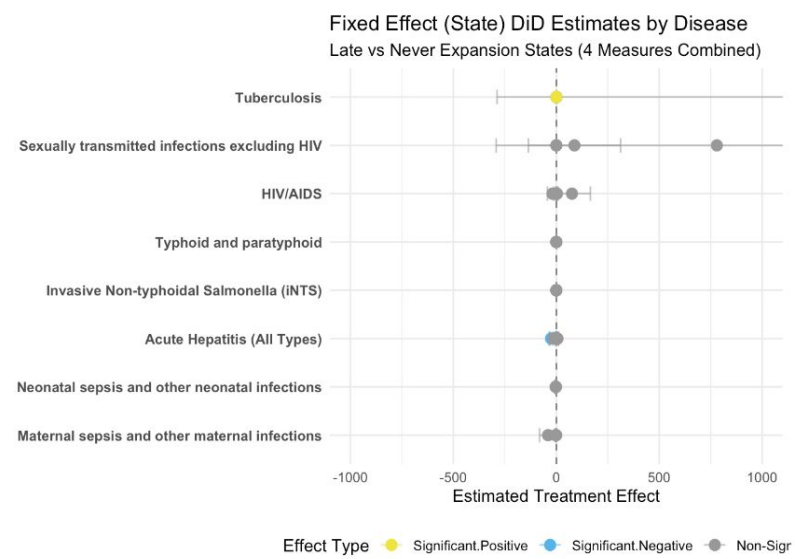
Fixed State(Mid vs Never)

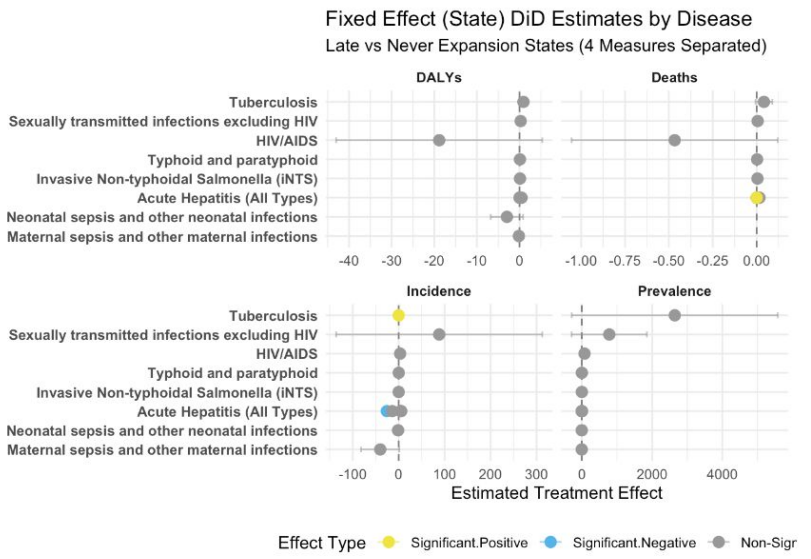


Result

- **Significant Decreases** (blue): **Acute Hepatitis, neonatal and maternal sepsis**
- **Significant Increases** (yellow): **HIV/AIDS, TB, non-HIV STIs,and typhoid**

Fixed State(Late vs Never)

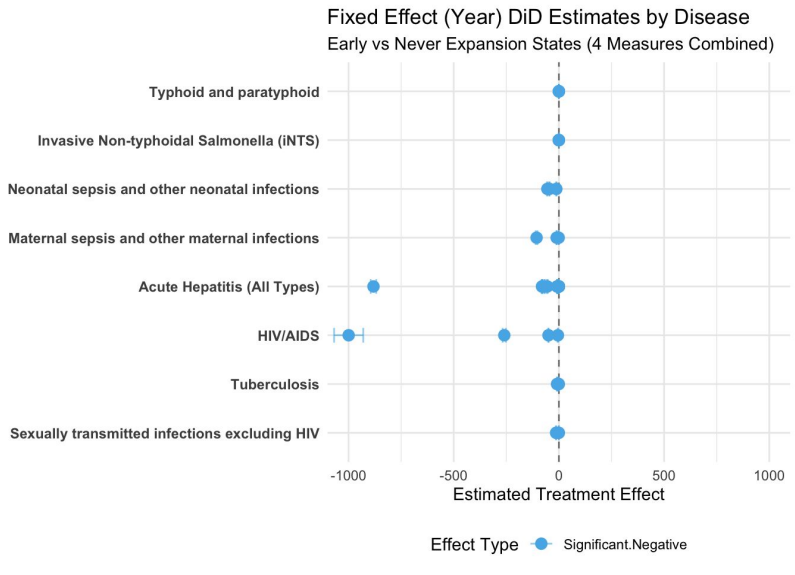


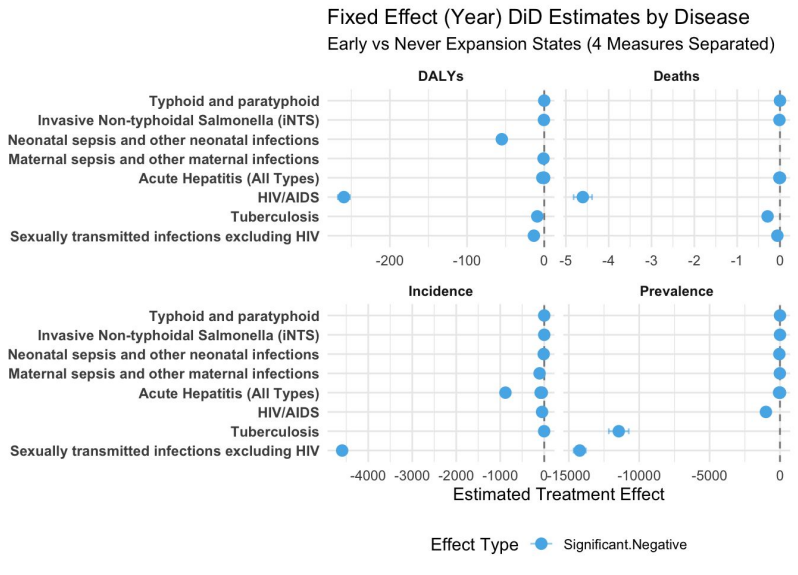


Result

- **Significant Decreases** (blue): **Acute Hepatitis**
- **Significant Increases** (yellow): **TB**

Fixed Year(Early vs Never)

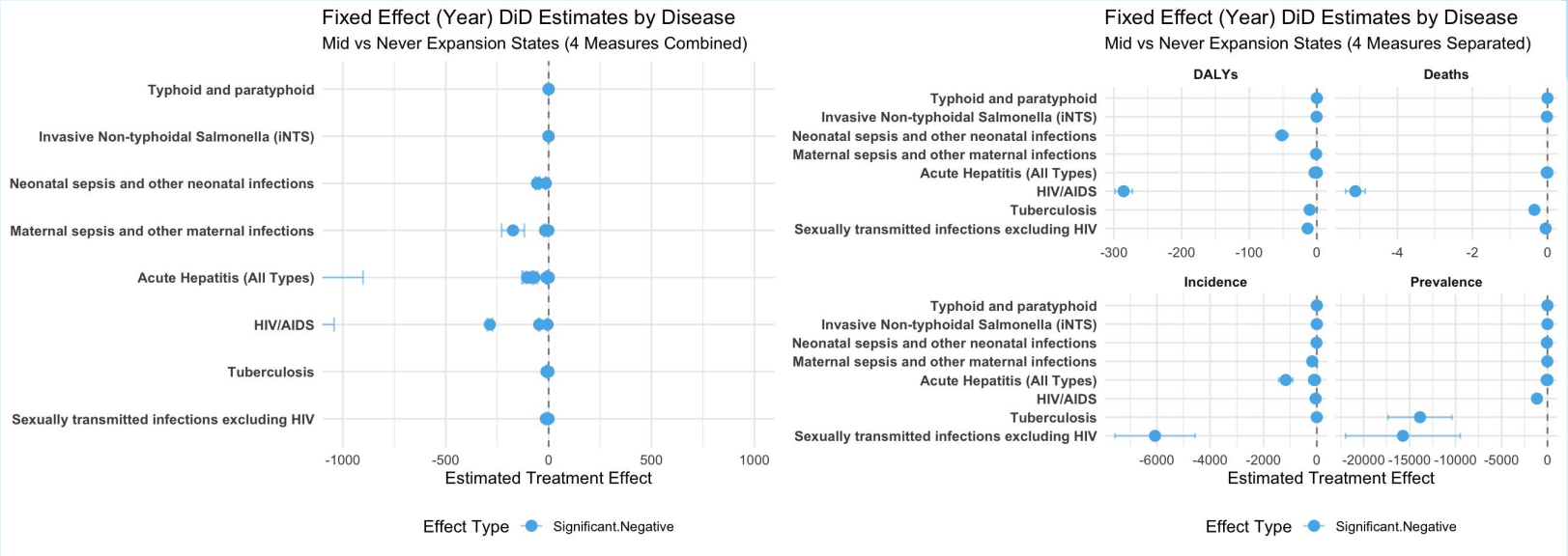




Result

- Among early-expansion states (e.g. California, New York, Texas, Illinois), each **additional year** after 2014 was linked to **steady, significant declines** in almost every infectious-disease measure—especially for:
- **HIV/AIDS, Acute hepatitis, Typhoid & paratyphoid, Neonatal & maternal sepsis**

Fixed Year(Mid vs Never)

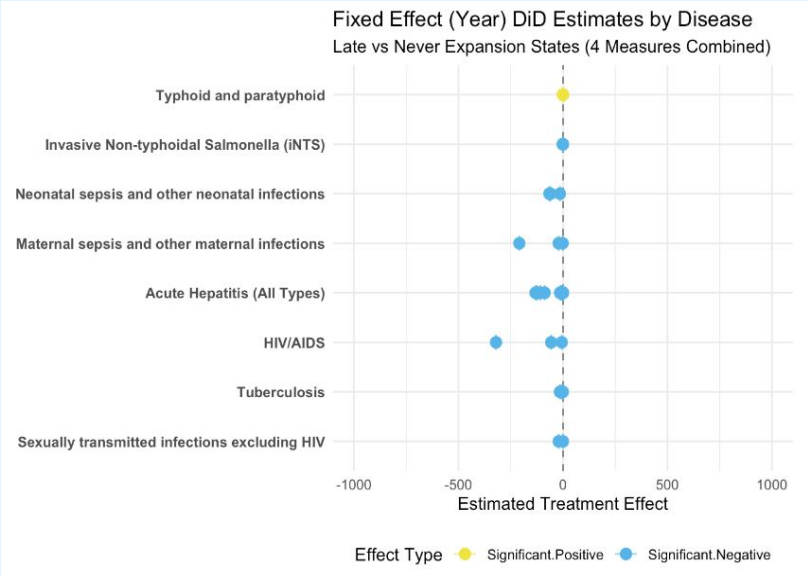


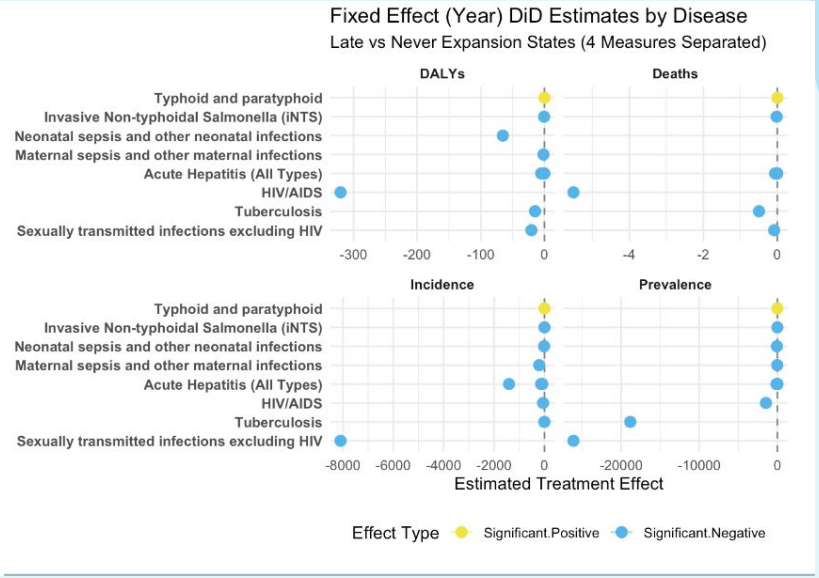
Result

- Among mid-expansion states, each **additional year** after 2015 was linked to **steady, significant declines** in almost every infectious-disease measure—especially for:
- **HIV/AIDS, Neonatal & maternal sepsis, Acute hepatitis**

- However, the coefficient is **smaller that Early vs Never**

Fixed Year(Late vs Never)





Result

- Among late-expansion states, each **additional year** after 2017 was linked to **significant declines** in almost every infectious-disease measure—especially for:
- **HIV/AIDS, Neonatal & maternal sepsis, Acute hepatitis**

- **Except typhoid/paratyphoid,** which showed a small but significant rise.

05

Conclusion

Conclusion

Group	Model	Significant Decreases	Significant Increases
Early	DiD	Acute Hepatitis, HIV/AIDS, iNTS	—
	FE – State	HIV/AIDS, Neonatal Sepsis, Maternal Sepsis	STIs (excluding HIV)
	FE – Year	**All**	—
Mid	DiD	Typhoid & Paratyphoid	—
	FE – State	Acute Hepatitis, Neonatal & Maternal Sepsis	TB, HIV/AIDS, STIs, Typhoid & Paratyphoid, INTS
	FE – Year	**All**	—
Late	DiD	—	Typhoid & Paratyphoid
	FE – State	Acute Hepatitis	TB
	FE – Year	**All** except Typhoid & Paratyphoid	Typhoid & Paratyphoid

Conclusion

1. Disease Burden Decreased Most in Early States

- **Early vs Never:** Clear and significant **negative effects** (blue dots) on:
  - **HIV/AIDS**
  - **Neonatal and maternal sepsis**
  - **Acute Hepatitis**
  - These declines appear across multiple outcome types (DALYs, incidence, prevalence), indicating **broad improvements in both mortality and morbidity.**
- Early expansion led to **earlier diagnosis, treatment access, and possibly better care coordination**, which prevented complications and reduced disease severity.

2. Mid-Expansion States Show Conflicting Effects

- Significant **reductions** in sepsis and hepatitis.
- But **increases** (yellow) in:
  - **TB**
  - **Typhoid and paratyphoid**
  - **STIs**
- These increases might reflect **improved surveillance or delayed care-seeking behavior** catching up post-expansion—but **could also signal treatment capacity issues** or **higher disease transmission**.

Conclusion

Group	Model	Significant Decreases	Significant Increases
Late	DiD	—	Typhoid & Paratyphoid (DALYs and Death)
	FE – State	Acute Hepatitis	TB
	FE – Year	All except Typhoid & Paratyphoid	Typhoid & Paratyphoid

Conclusion

1. Disease Burden Decreased Most in Early States

- **Early vs Never:** Clear and significant **negative effects** (blue dots) on:
    - **HIV/AIDS**
    - **Neonatal and maternal sepsis**
    - **Acute Hepatitis**
    - These declines appear across multiple outcome types (DALYs, incidence, prevalence), indicating **broad improvements in both mortality and morbidity.**
- Interpretation: Early expansion led to **earlier diagnosis, treatment access, and possibly better care coordination**, which prevented complications and reduced disease severity.
    -

Conclusion

DiD only – limited wins:

Only the most coverage-sensitive conditions (HIV/AIDS, hepatitis, iNTS, typhoid) and severe sepsis syndromes show significant declines, reflecting the immediate boost in testing and emergency treatment access when new patients gain insurance.

+ State FE – broader benefits revealed:

Once we hold constant each state's unique factors (age mix, clinic availability, Medicare use), additional declines emerge in STIs (beyond HIV), TB, and maternal/neonatal sepsis—clinically showing that expansion's gains really span both routine screening and complex infectious threats.

+ Year FE – nearly universal impact:

After filtering out nationwide trends (e.g., new diagnostics, reporting changes, general healthcare advances), almost every disease shows significant decline across all expansion groups. However, the effects are **clearest and strongest in early-expansion states**, indicating that **longer exposure to Medicaid expansion amplifies improvements** in prevention, early detection, and disease control.

06

Limitation & Future Potential

Limitations

- Lack of within-state heterogeneity after grouping—unable to capture state-specific effects.
- Endogeneity between Prevalence and Deaths—metrics may be causally intertwined. (*High prevalence can increase deaths, but deaths may also affect reported prevalence—like a "chicken-and-egg" problem.)*
- The parallel trends assumption may be violated. *(We assume states had the same intervention trend, but they start from different baselines—like runners on unequal starting lines.)*

Future Potential

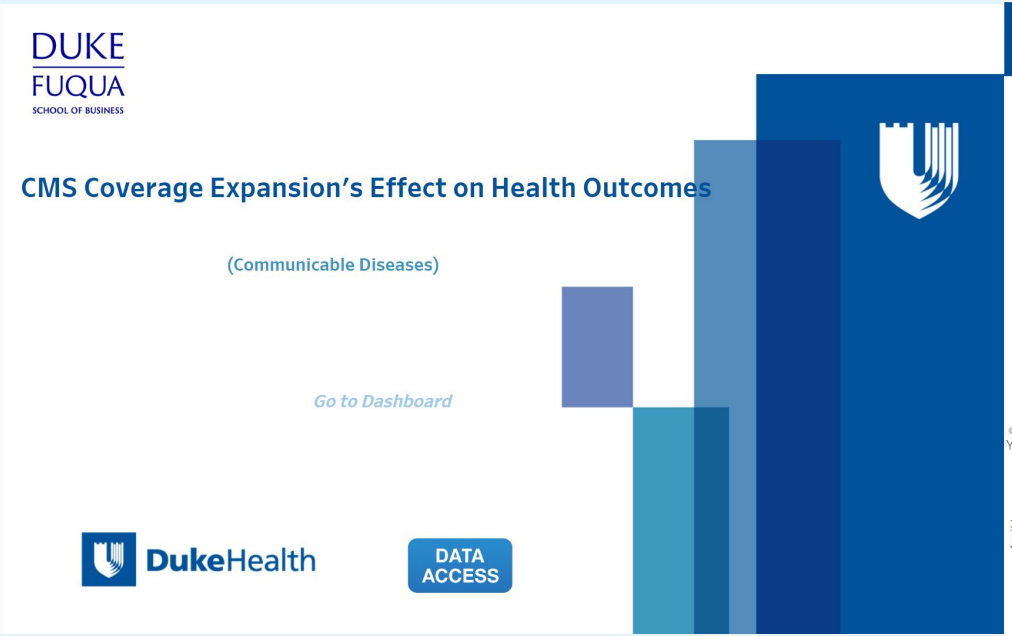
- Include state dummy variables or fixed effects in the model
  (Assigning IDs to track each state's performance separately, capturing each state's unique trajectory.)
- Using IV or system GMM separates intertwined metrics, clarifying which one drives the other.
- Synthetic control creates a "mirror" control for each state, and causal forests use AI to uncover hidden causal links, enhancing reliability.

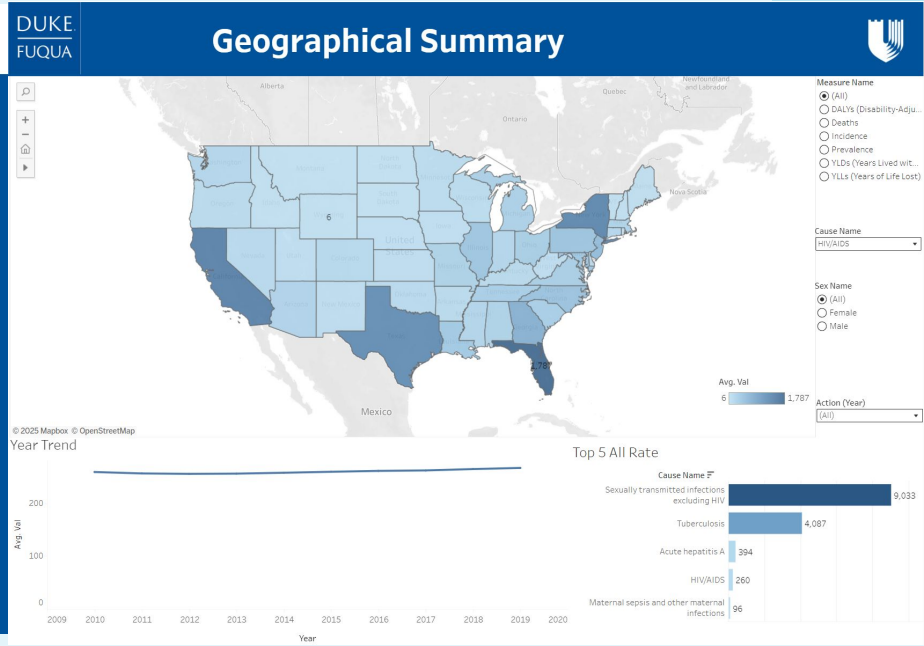
07

Appendix

Tableau Dashboard Preview

Click on the image to navigate to dashboard





Reference

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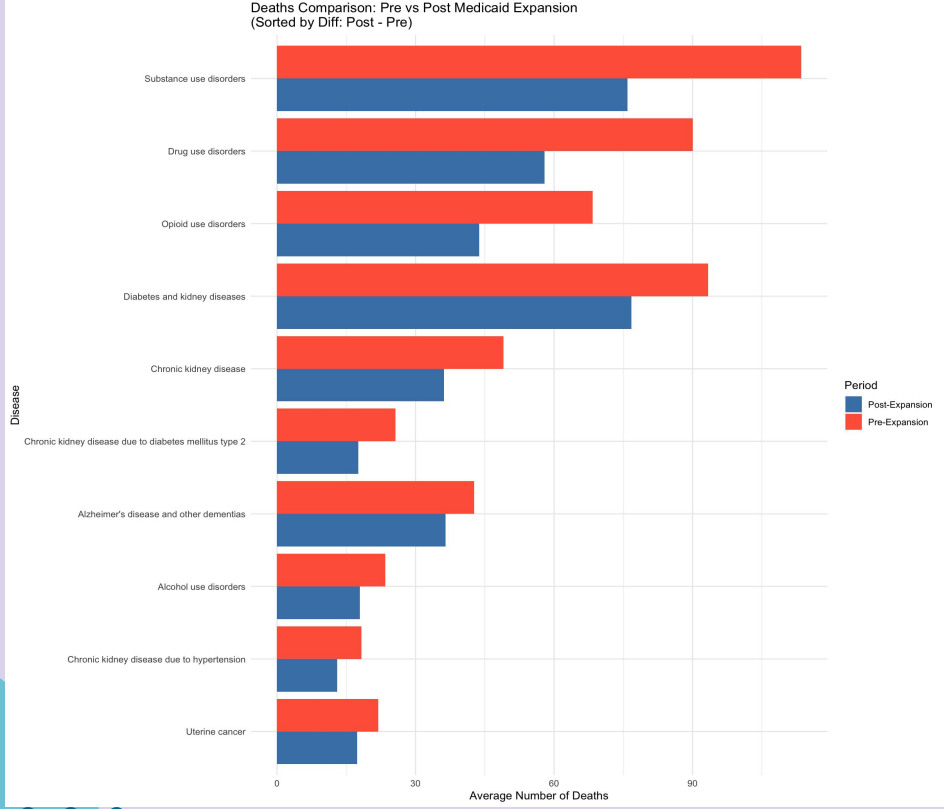
Impact of CMS Expansion on Health Outcome Across the U.S

- Non Communicable

Statistical Modeling & Insights -Non Communicable

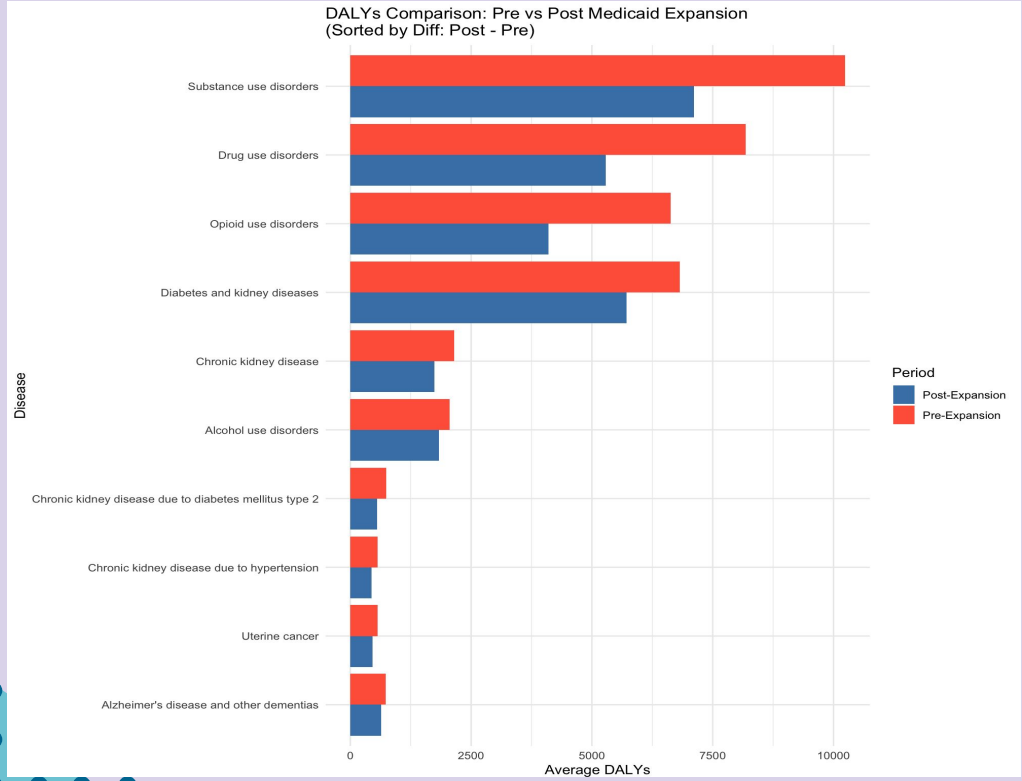
Non-Communicable
Pre-2014 vs Post-2014 average values for each disease - Deaths



- For **most diseases**, **bars post-2014** are **shorter** than the **bars pre-2014**. This is especially visible for **Chronic kidney disease due to hypertension, Opioid, drug and substance use disorders.**
- Indicates a **reduction in mortality** post-2014 in several key NCDs.
- Suggests Medicaid expansion **helped reduce fatal outcomes**, especially in **treatable or manageable chronic diseases**.
- Likely due to **better access to ongoing care**, earlier diagnosis, and **intervention pathways** for addiction.

The reduction in death rates post-expansion—particularly for kidney disease and substance use—shows Medicaid's **life-saving potential**, especially when implemented early and with behavioral health support.

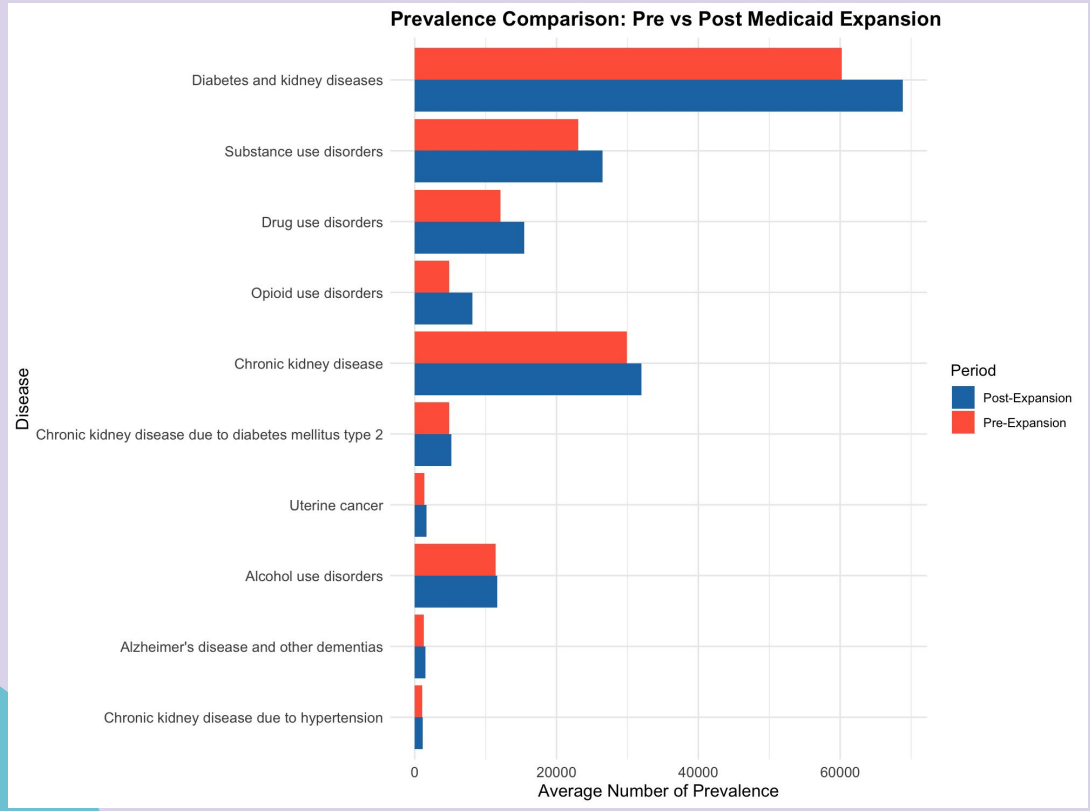
Non-Communicable
Pre-2014 vs Post-2014 average values for each disease - DALYs



- Blue bars are **shorter** for most conditions. Significant drops seen in **Substance and drug use disorders**, **Diabetes and kidneys-related DALYs.**
- DALY reductions imply people are either: **Dying later**, or **Living with fewer years of disability.**
- Suggests **not just survival**, but **better quality of life** through managed care.

Post-2014 DALY declines signal that Medicaid expansion improved **chronic condition management**, reducing the years lost to poor health and disability—especially in renal, diabetic, and substance use populations.

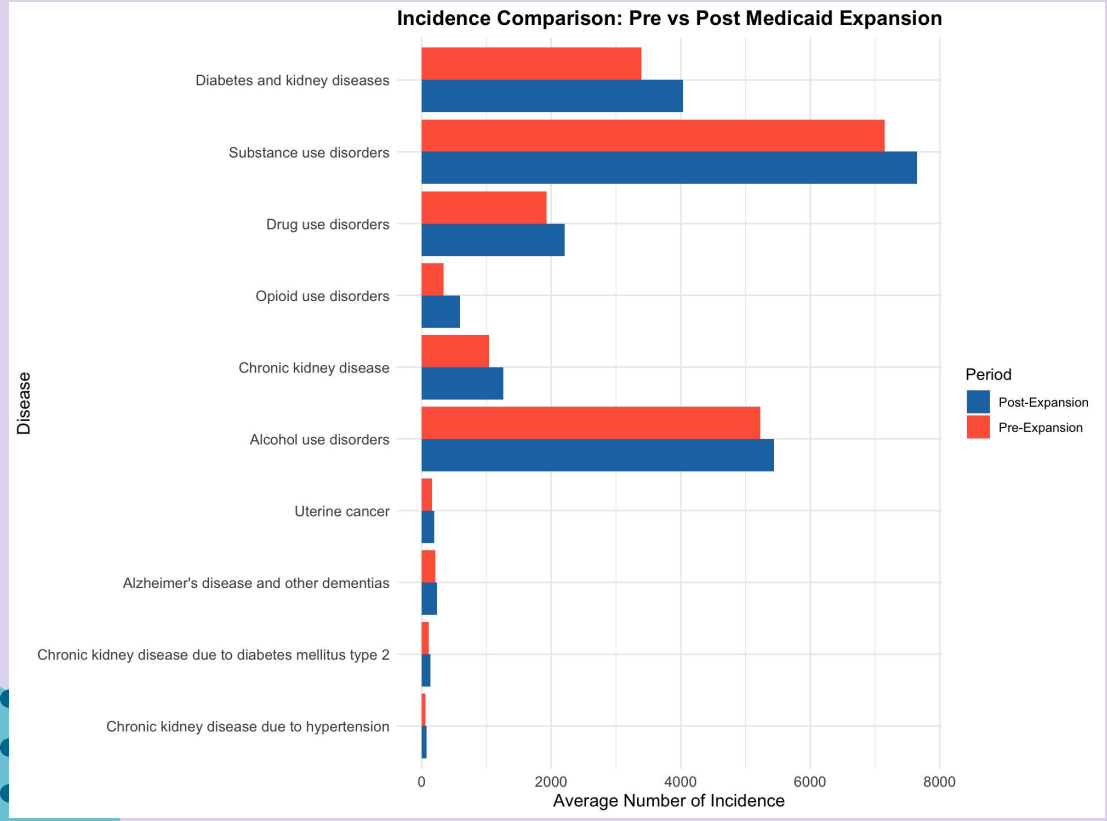
Non-Communicable
Pre-2014 vs Post-2014 average values for each disease - Prevalence



- **Prevalence increased** across all conditions post-expansion.
- This likely reflects **better diagnosis/reporting, screening**, and **survival** rather than worsening health. (more people accessing care)
- Suggests **Medicaid improved detection** but also revealed a larger burden of chronic disease.
- High post-expansion prevalence in early states supports the idea of **earlier diagnosis**.

Prevalence doesn't necessarily mean new disease; it could mean people are living longer with illness due to better treatment and access. Medicaid helped identify these patients.

Non-Communicable
Pre-2014 vs Post-2014 average values for each disease - Incidence

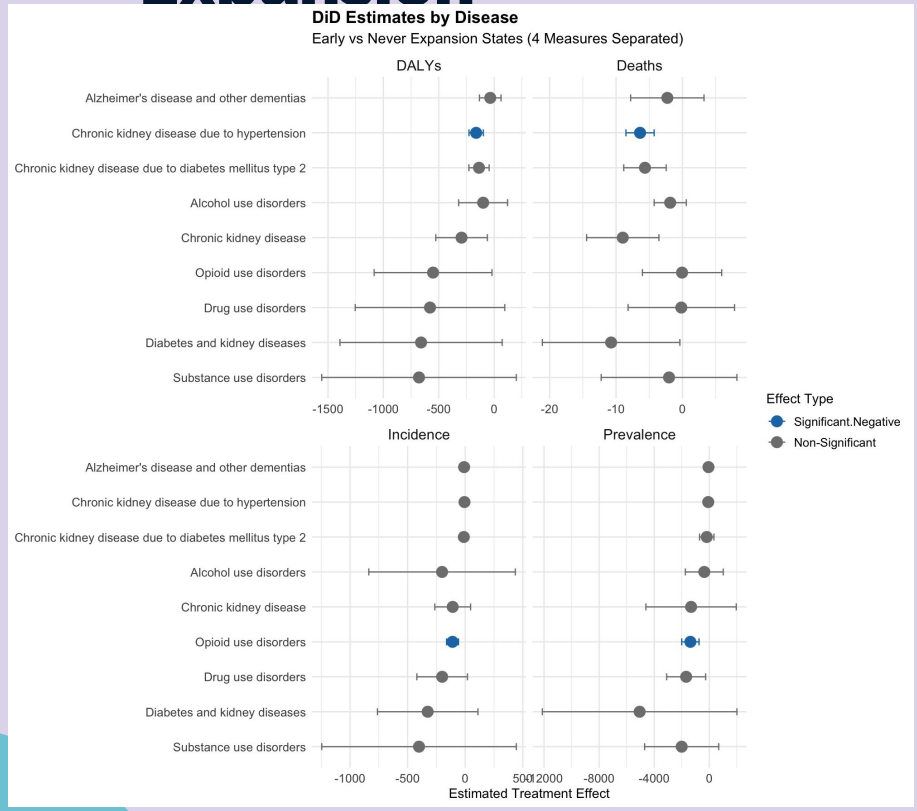


- Most conditions show an **uptick in incidence**, though modest.
- **Substance use disorder incidence** rose the most reflecting either:
  More people becoming addicted, or
  Better identification of cases through expanded health services.
- CKD and diabetes also show rises, hinting at earlier-stage detection.

Incidence of major NCDs rose modestly post-expansion, likely driven by **early-stage detection**/screening due to improved primary care. This reflects a **front-loaded burden** on healthcare services but may **prevent late-stage costs** later.

Incidence is highly sensitive to **diagnostic trends**. An increase could mean more new cases—or just better detection. Without controlling for

DID Model: Early Expansion VS Never Expansion



DALYs & Deaths

- **Chronic kidney disease due to hypertension** saw a significant reduction in DALYs (~500 fewer years lost), indicating improved management and treatment in early-expansion states.
- **Chronic kidney disease due to hypertension deaths** also declined significantly (~10 fewer deaths per capita), reinforcing the impact of early intervention.

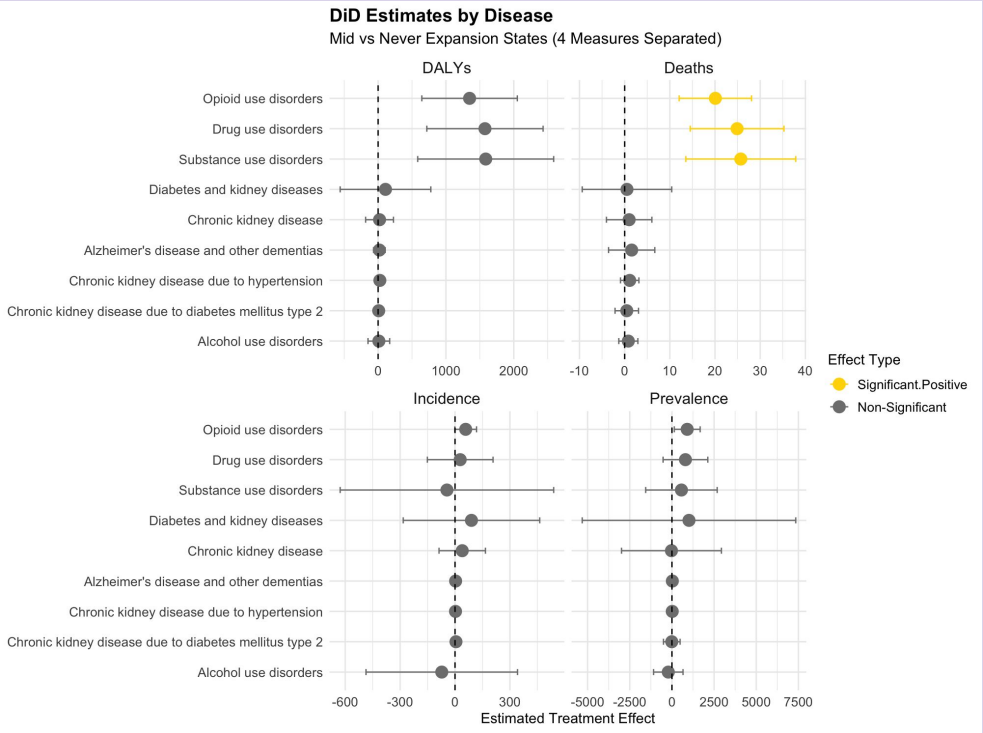
Incidence & Prevalence

- **Opioid use disorders incidence** dropped significantly, pointing to fewer new addiction cases, likely due to early intervention programs in expansion states.
- **Substance use disorder prevalence** decreased by ~4,000 cases on average, reflecting better access to behavioral health services post-expansion.

Insights

- Early expansion states saw clear benefits in reducing addiction-related burdens, especially for opioids and substance use.
- Effects on chronic diseases were less immediate, suggesting longer timelines or the need for targeted strategies.
- Not all conditions responded equally, highlighting the importance of disease-specific Medicaid interventions.

DID Model: Mid Expansion VS Never Expansion



DALYs & Deaths

- **Opioid, drug, and substance use disorders** showed increased deaths post-expansion, with **significant positive effects** (20–30 more deaths per unit observed). This signals worsening mortality outcomes in mid-expansion states.
- **DALYs** rose across several chronic disease categories (e.g., diabetes and substance use), but none reached statistical significance, indicating inconclusive evidence on disability burden changes.

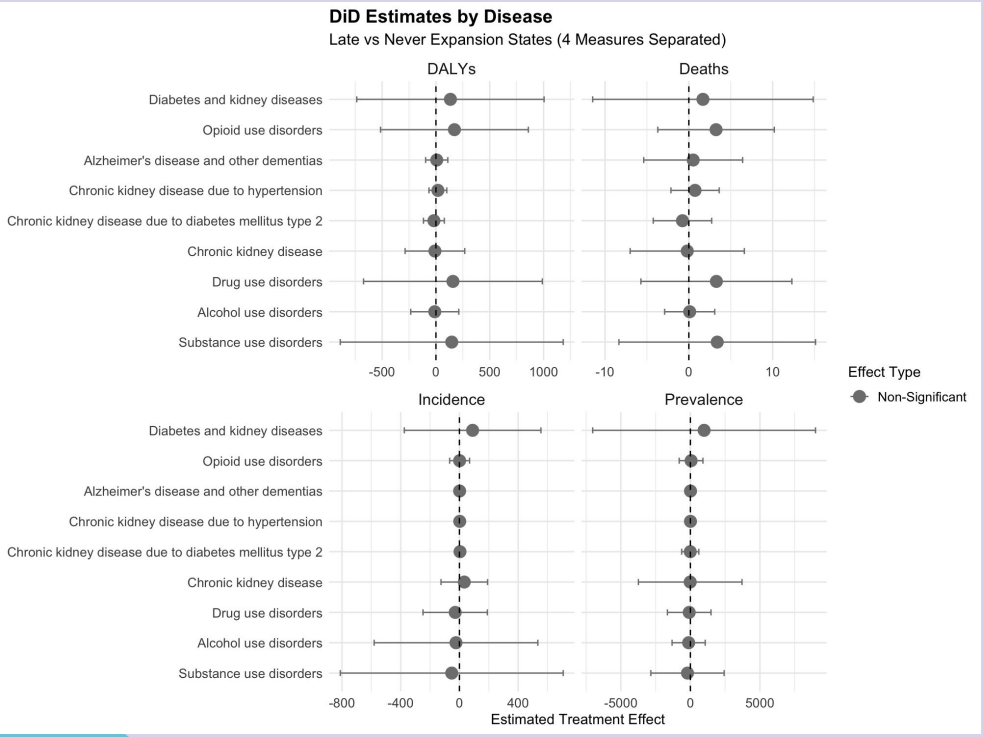
Incidence & Prevalence

- Across all 10 diseases, **no statistically significant changes** were detected in incidence or prevalence. However, point estimates suggest rising burden in substance-related and chronic kidney disease areas.

Insights

- **Mid-expansion states** may have faced lacked immediate capacity to mitigate mortality, especially for addiction-related illnesses.
- These results warrant deeper investigation into **opioid-related mortality** in mid-expansion regions and whether healthcare access improvements came too late to prevent fatal outcomes.

DID Model: Late Expansion VS Never Expansion



Key Observations

- No statistically significant effects were observed across any disease-measure pair.
- All estimates—whether for DALYs, Deaths, Incidence, or Prevalence—have confidence intervals that cross zero. Diseases like **diabetes and kidney diseases** or **opioid use disorders** show moderate estimated effects, but not with enough certainty to conclude a true treatment effect.

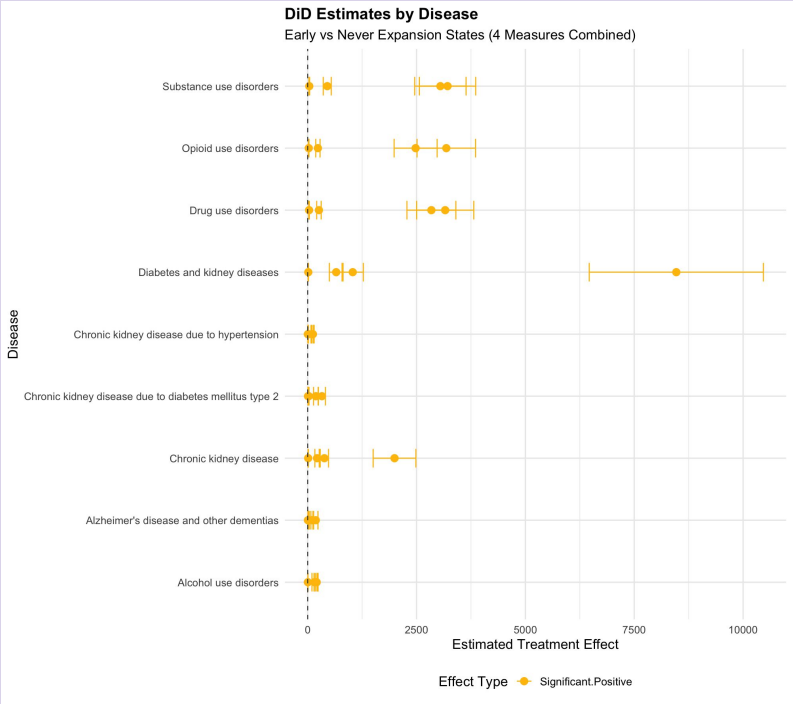
Insights

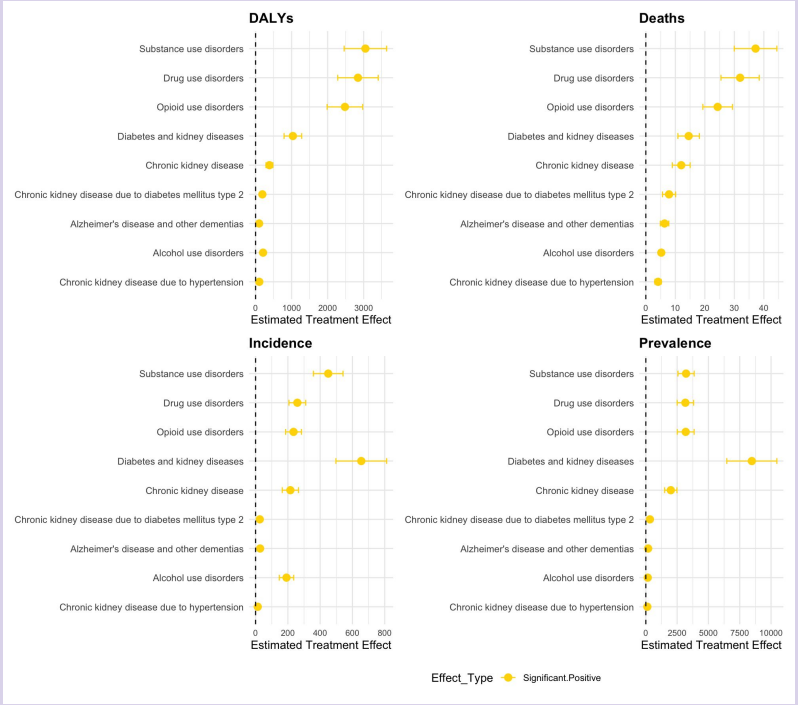
- The lack of significant results may reflect the **limited time window** for post-expansion impact to materialize in late-adopting states (2017–2019).
- It's possible that **health infrastructure or enrollment lag** diluted the observable benefits in the short term.
- Further research should examine **longer post-treatment periods** or consider **subgroup analyses** (e.g., high-burden states) to uncover latent effects.

Rationale for Transition to Fixed Effects Modeling

Due to **limited significant findings in the DiD comparisons** across expansion groups—largely driven by **unbalanced group sizes**, **limited post-expansion periods**, and **potential heterogeneity** in state-level baseline trends—the analysis proceeds with **fixed effects modeling**. This method **better controls** for unobserved, state-specific differences and i**mproves within-state comparisons** over time.

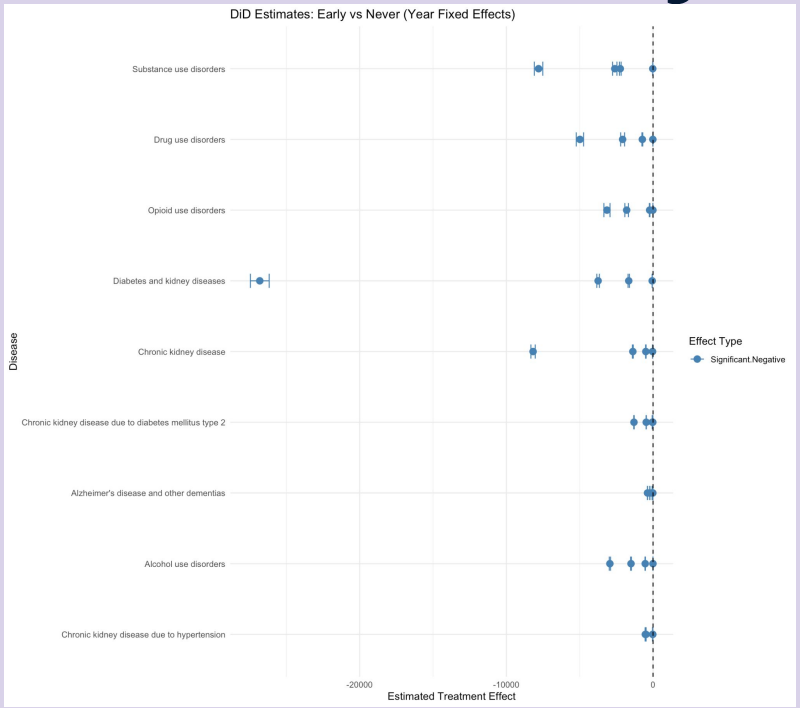
Fixed State (Early vs Never)

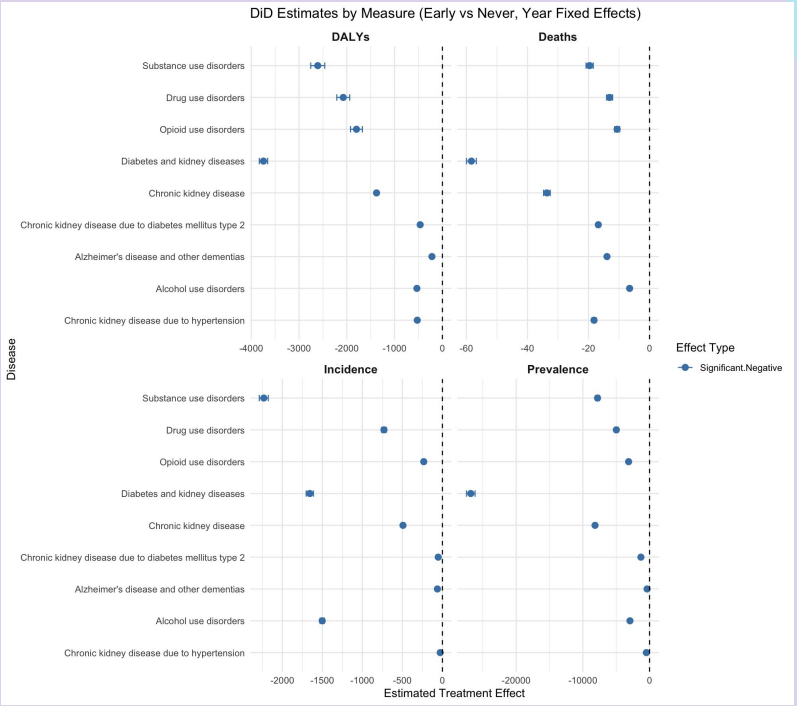




- **Significant increases across all measures suggest rising disease burden in early expansion states.**
- **These trends may reflect improved detection and access to care post-expansion, not necessarily worsening health.**

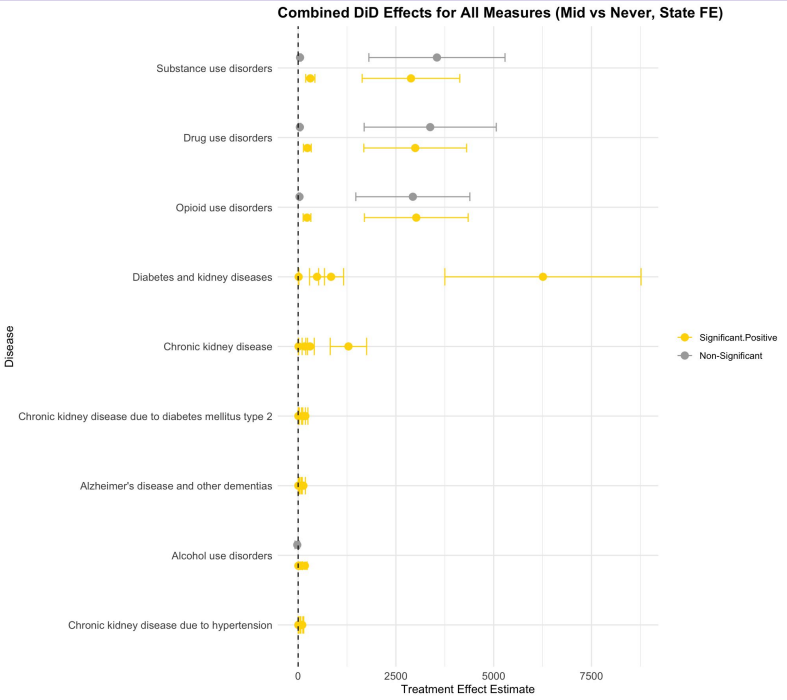
Fixed Year (Early vs Never)

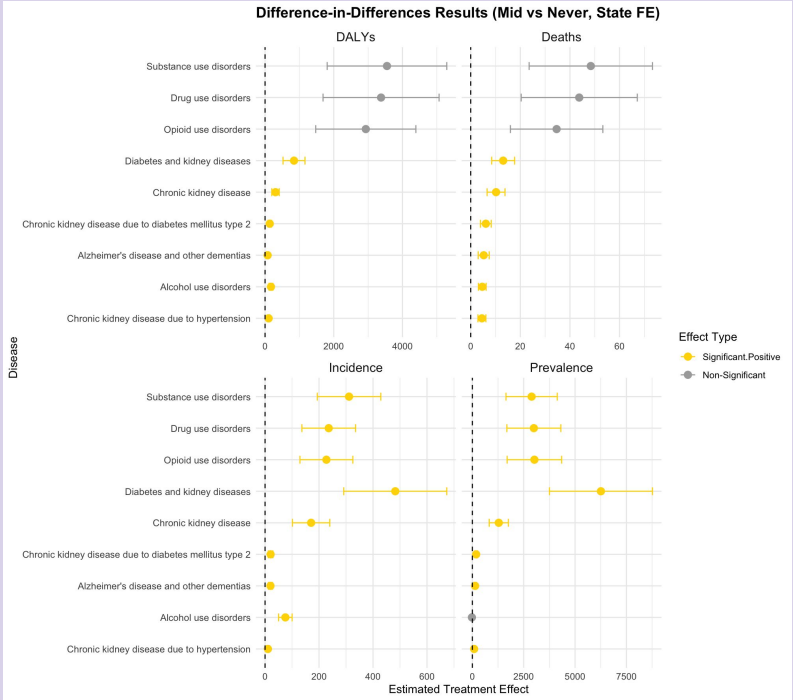




- **Significant decreases in disease burden observed across most conditions.**
- **Year fixed effects enhance confidence by controlling for national time trends.**

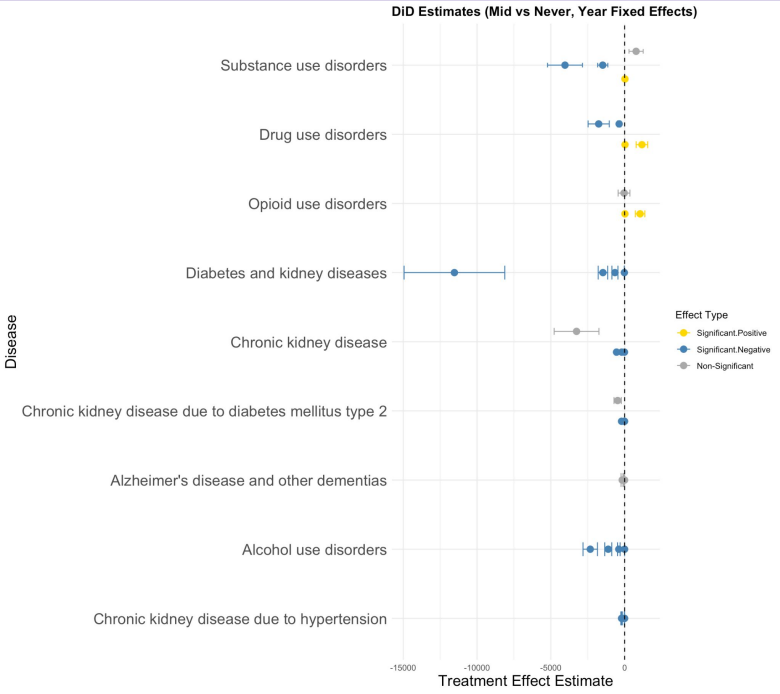
Fixed State (Mid vs Never)

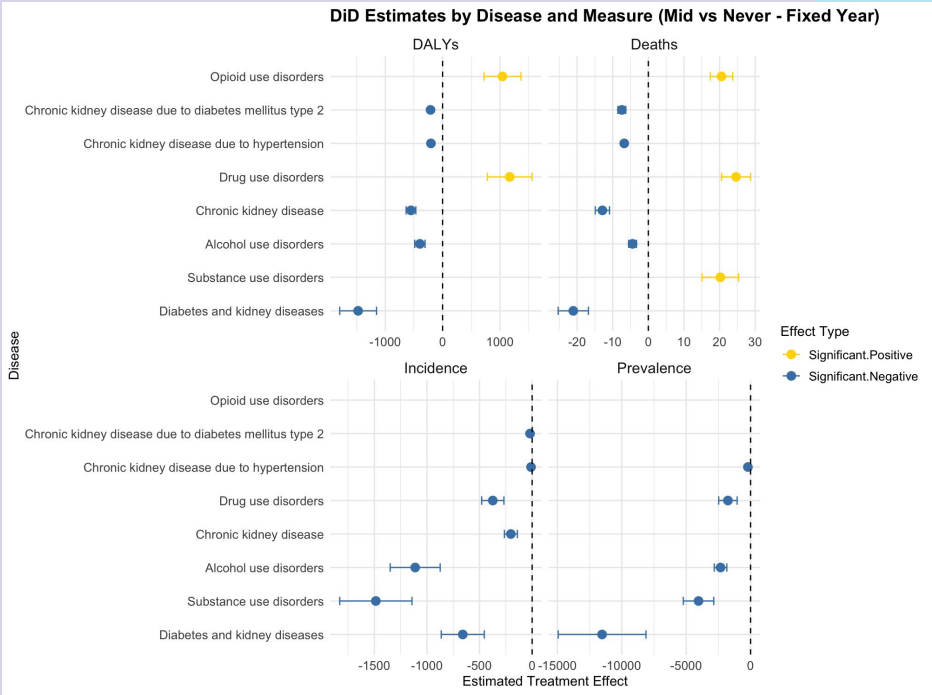




- Most selected diseases show **statistically significant increases**, especially in incidence and prevalence.
- **Substance, drug, and opioid use disorders** exhibit sharp rises in incidence.
- **Diabetes and kidney diseases** show the **largest positive shift**, especially in prevalence

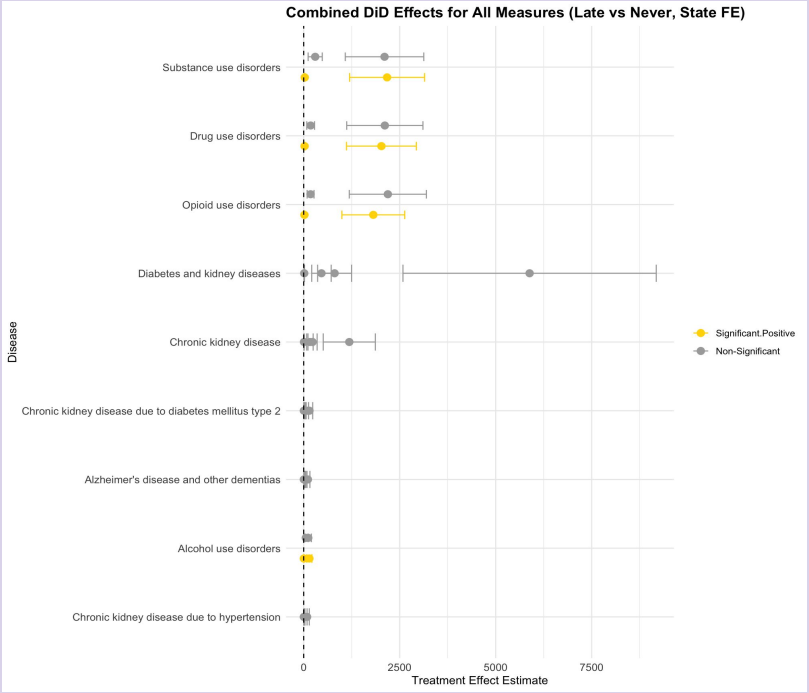
Fixed Year (Mid vs Never)

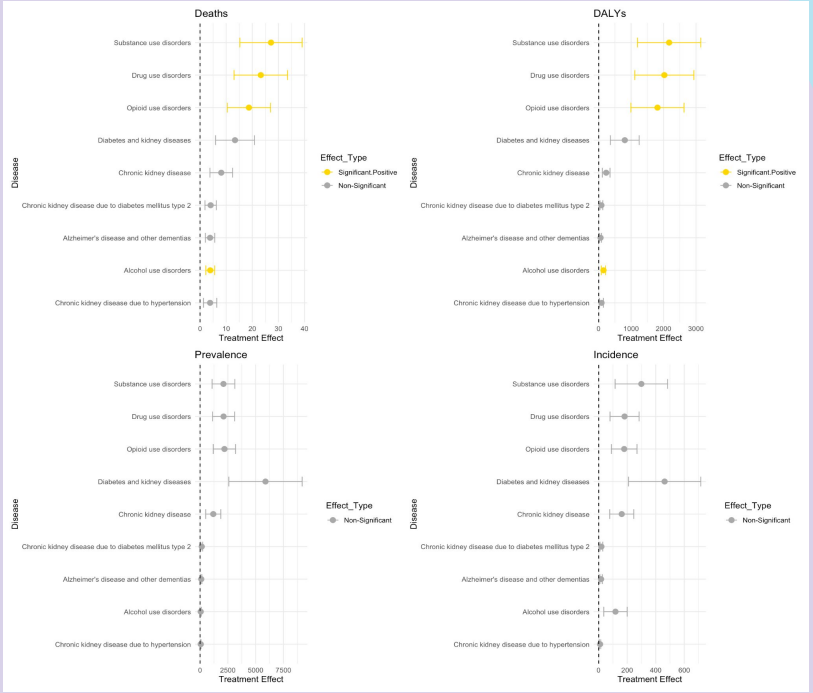




- **Strong declines were observed across all four measures, especially for chronic kidney-related diseases and substance use disorders.**
- **Notably, incidence and prevalence dropped significantly for *diabetes and kidney diseases*, reinforcing the policy's effectiveness in slowing new cases.**

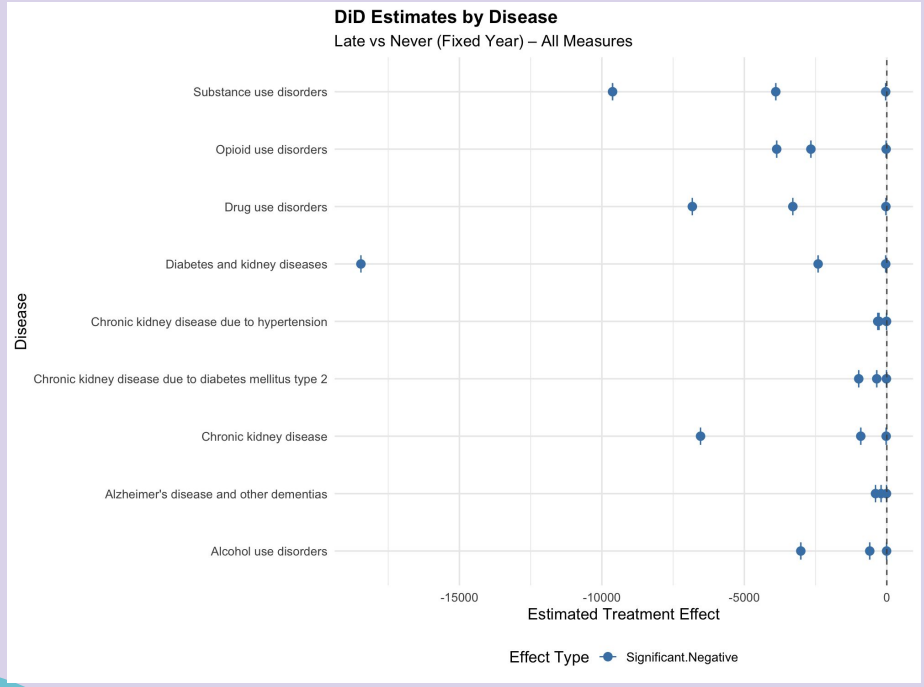
Fixed State (Late vs Never)

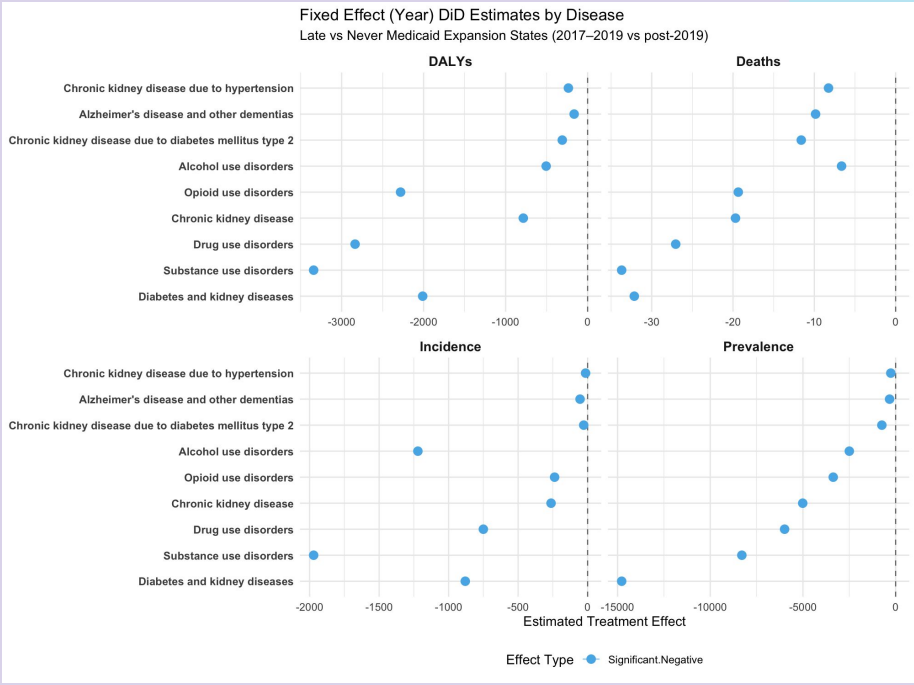




- Most effects for Late expansion states are **positive but statistically insignificant**, suggesting delayed Medicaid expansion showed **limited measurable impact** across the four health burden measures.
- A few **significant increases** were found, notably in **DALYs and Deaths** for *substance use disorders* and *opioid use disorders*, which may reflect **underlying crisis trends** rather than policy effectiveness.

Fixed Year (Late vs Never)





- **Consistent and significant reductions** were found in DALYs, Deaths, Prevalence, and even Incidence across multiple diseases following Medicaid expansion in Late states (2017–2019), compared to Never-expanded states

Conclusion

- When controlling for national time trends using year fixed effects, states that expanded Medicaid—especially in the Early group—experienced **significant reductions in disease burden**, including deaths, DALYs, and prevalence. In contrast, models with state fixed effects often showed positive or non-significant results. These findings highlight both the **causal impact of Medicaid expansion** and the importance of accounting for time trends to uncover its true effects.

- These findings highlight both the **causal impact of Medicaid expansion** and the importance of accounting for time trends to uncover its true effects.

Limitation & Future Potential

Limitations

- **Time Lag in Outcomes:** Some NCD improvements (e.g., reduced mortality or complications) require long-term observation.
- **Policy Complexity:** Medicaid expansion implementation varies across states, influencing outcome measurement.
- **Data Variability:** Inconsistencies in how states report health outcomes, especially for NCDs, may affect comparability.
- **Causal Attribution:** Difficulty in isolating Medicaid expansion effects from other policy or socioeconomic influences.
- **Confounding Variables:** Factors like race, rural access, and healthcare infrastructure may bias results if not adequately controlled.

Future Potential

- **Integration with Cost Data:** Analyze how improved NCD outcomes translate into system-wide cost savings.
- **Policy Simulation Models:** Use statistical models to forecast impacts of future expansions or rollbacks.
- **Hospital and Provider Behavior:** Study how Medicaid expansion affects **provider capacity, hospital revenue stability, and care delivery models**.
- **Subpopulation Studies:** Deeper focus on vulnerable groups (e.g., rural residents, racial minorities, elderly).

Appendix

https://www.commonwealthfund.org/publications/issue-briefs/2023/sep/impact-medicaid-coverage-gap-comparing-states-have-and-have-not

Status of State Medicaid Expansion Decisions | KFF

https://pmc.ncbi.nlm.nih.gov/articles/PMC4225799/

https://www.kff.org/affordable-care-act/report/the-effects-of-medicaid-expansion-under-the-aca-updated-findings-from-a-literature-review/

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10154156/

https://www.nber.org/system/files/working_papers/w30818/w30818.pdf

https://academic.oup.com/qje/article/136/3/1783/6124639?login=false

https://www.rwjf.org/en/insights/our-research/2025/02/reducing-federal-support-for-medicaid-expansion-would-shift-costs-to-states-and-likely-result-in-coverage-losses.html?utm_source=chatgpt.com

https://jamanetwork.com/journals/jama/article-abstract/2749799?utm_source=chatgpt.com#google_vignette

Q & A