Tracking Measles Outbreaks in Ontario: Identifying Zero-Dose Populations and Strengthening Public Health Interventions

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Background

Measles is a highly contagious viral disease that poses a serious risk to communities with low vaccination coverage. In Canada, 2025 marked the largest national resurgence of measles cases in 20+ years - most notably in Ontario.

- To address this growing public health threat, we developed **EpiScan -** interactive geospatial dashboard and winner of the 2025 Health GIS App Challenge (Esri Canada) - to supports outbreak monitoring, public engagement, and targeted public health response

EpiScan aims to:

- Visualize vaccination coverage and measles case trends across Ontario's Public Health Units (PHUs).
- Identify social and demographic predictors of outbreaks.
- Estimate the burden of preventable cases among unvaccinated populations.

Methodology

Developed using ArcGIS StoryMaps and Dashboards, integrating data from: **1)** Public Health Ontario's Measles Surveillance Reports (latest: May 1, 2025); **2)** Ontario's iPHIS (integrated Public Health Information System); **3)** Statistics Canada Census Profiles; and **4)** Public Health Ontario's Immunization Data Tool

Dashboard features include:

- Weekly measles case counts by PHU (Oct 2024–Apr 2025)
- Immunization coverage by dose (0, 1, or 2+)
- Demographic overlays: education level, religious group, visible minority status, and income
- Custom filtering by case burden and vaccination status

Analytic methods:

- Descriptive epidemiology to map spatial-temporal trends
- Correlational analysis of social predictors and case rates
- Zero-dose modeling to estimate avoidable cases under a universal 1-dose MMR coverage scenario

Results

1. Measles Case Rates (per 100,000) by PHU and Predictors

- Highest rate in Southwestern Public Health (181) and Chatham-Kent (120.3)
- PHUs with lower educational attainment, higher proportions of Anabaptist Christian groups, and moderate visible minority representation showed higher measles rates.
- PHUs with high case counts often had moderate-to-high socioeconomic indicators, suggesting education and cultural factors may play a stronger role than income alone.

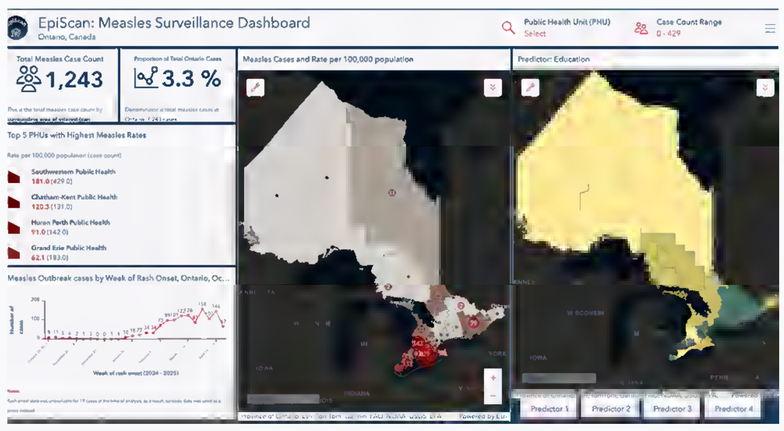


Figure 1: Measles Surveillance Dashboard

2. Measles Cases by PHU and Immunization Status of 7 Year-Olds

- PHUs such as Huron Perth (with 142 cases) had the highest proportion of unvaccinated children (41.6%).
- While many high-burden PHUs had large unvaccinated populations, this was not always the case - indicating other drivers such as community beliefs or access barriers.

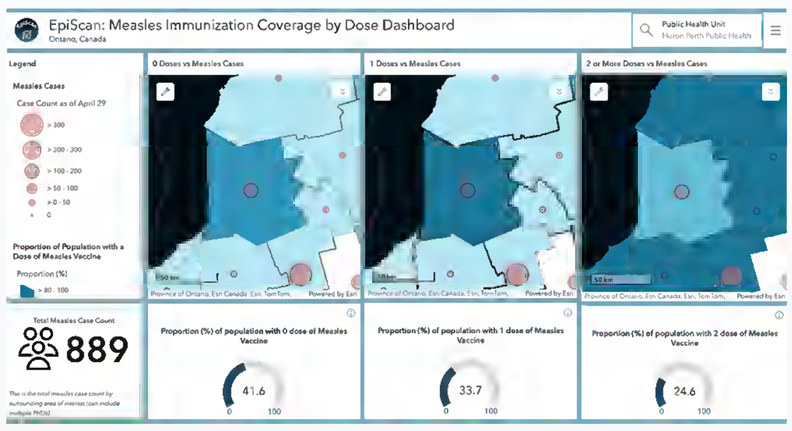


Figure 2: Measles Immunization Coverage by Dose Dashboard

3. Estimating Avoidable Cases Under a No-Zero-Dose Scenario

- Using a proportional model, we estimated that 86.8% of measles cases occur in unvaccinated individuals, with 1-dose vaccine effectiveness at 90%.
- Applying this to Ontario PHUs from Oct 2024–Apr 2025, over 950 cases were potentially avoidable.
  - Southwestern Public Health: 333 out of 429 cases (77.6%) were estimated to be preventable.
  - Grand Erie: 144 avoidable cases.
- A swipe map visualized changes in case rates, showing that all PHUs could be brought below 45 cases per 100,000 under a 1-dose scenario.

Legend: Cases per 100,000 residents

> 135 - 181 | > 90 - 135 | ≥ 45 - 90 | >0 - 45

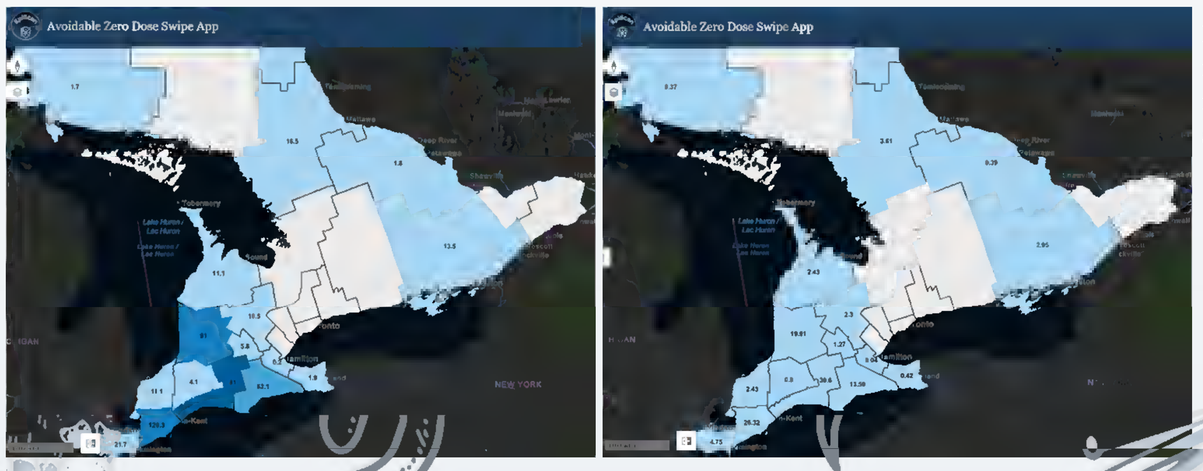


Figure 3: Comparing actual measles rate (cases per 100,000) (left) to measles rate in No-Zero-Dose scenario (right)

Scan to view dashboard

Conclusion

EpiScan demonstrates the critical role of geospatial tools in infectious disease surveillance and public health response. By integrating outbreak data, immunization coverage, and demographic predictors, we:

- Identified high-risk regions and vulnerable populations in Ontario
- Estimated the impact of vaccine hesitancy through a zero-dose modeling tool
- Provided interactive, actionable tools for both the public and public health professionals

These findings reinforce the need for targeted outreach, community-driven messaging, and accessible vaccination services to curb measles resurgence and protect population health.

Vaccine sentiment heterogeneity & gonorrhoea vaccination:
a modelling analysis of impact & cost-effectiveness

George Young, Trystan Leng, Dariya Nikitin, Lilith K. Whittles, Peter J. White

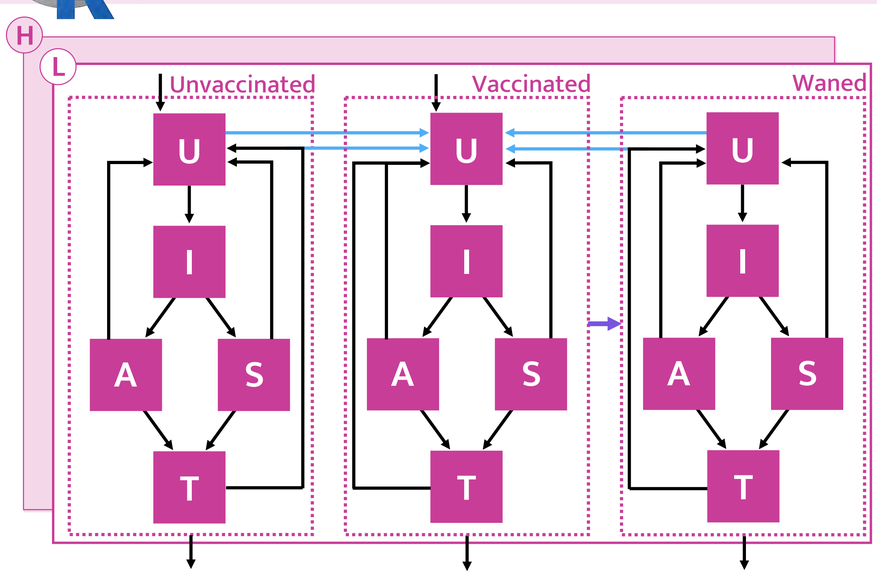
Context & Previous Work

70–80,000 annual cases of gonorrhoea in the UK, mostly in men who have sex with men (MSM).[1]

UK government began vaccinating high-risk MSM in England against gonorrhoea in **August 2025** using **4CMenB** based on evidence of 20-40% efficacy from observational studies.[2-4]

Health-economic modelling informed the 4CMenB programme.[5-7] ***gonovax***, a transmission-dynamic compartment model, was at the centre of this work.

gonovax model:



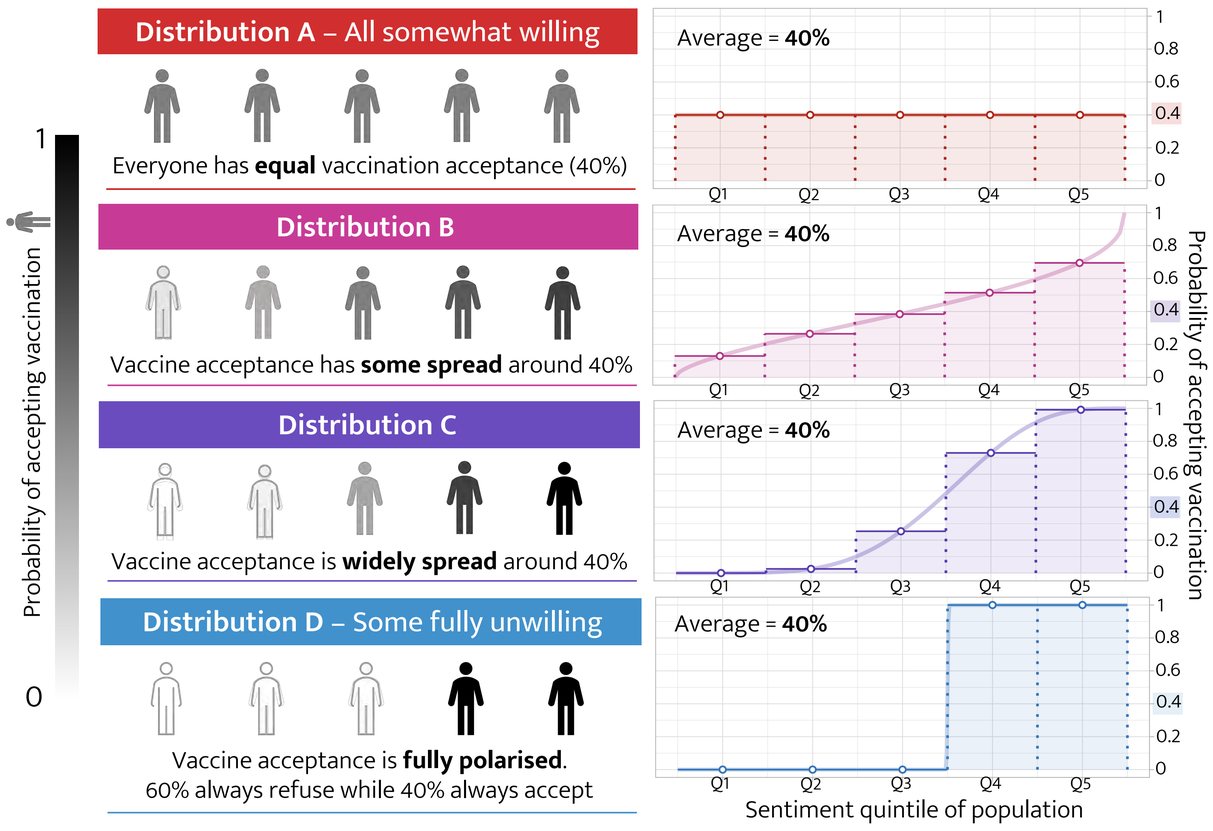
Government planned vaccination eligibility based on ***gonovax***[7]:
- ≥5 sexual partners in last 3 months
- Bacterial STI diagnosed in last year

Research Gap

Does it matter whether vaccine sentiment (probability of accepting vaccination) is uniformly distributed or concentrated in subgroups? Does this change the value of a vaccination strategy?

Objectives & Methods

Aim: To explore how heterogeneity in vaccine sentiment influences the disease & health economic outcomes of modelling gonorrhoea vaccination amongst MSM in the UK.



We produced four **vaccine sentiment distributions (A-D)**. Each had an average population-level vaccine acceptance probability of **40%** but differed in how this was distributed.

We explored impact with **proportionate** mixing (random sexual partnerships across the population) and **assortative** mixing (partnerships formed within vaccine sentiment quintiles).

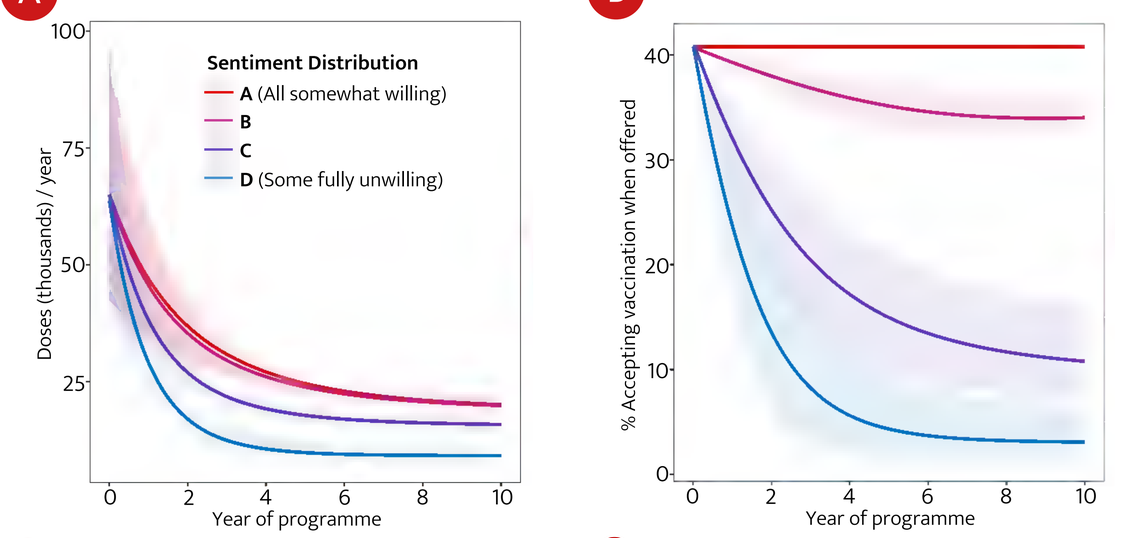
We compared how this affected the disease & health economic outputs of the ***gonovax*** model:

Doses Given | **Cases Averted** | **Vaccine Value**

Results

Vaccine Uptake by Sentiment Distribution

Figure 1 – Doses given



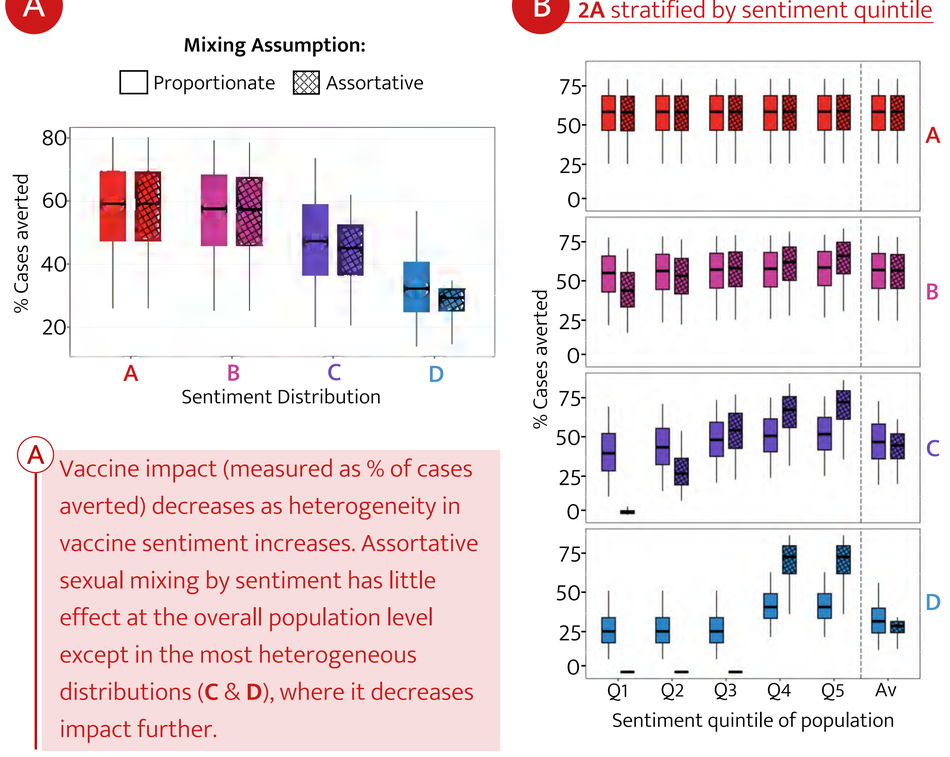
A Number of doses given out decreases as vaccine sentiment is distributed more heterogeneously.

B Much of the effect seen in (**1A**) is due to a lower proportion accepting vaccines when offered.

Figure 1 shows that doses vary substantially between sentiment distributions, but how does this translate to vaccine impact? See **Figure 2**.

Vaccine Impact & Value by Sentiment Distribution

Figure 2 – Vaccine Impact



A Vaccine impact (measured as % of cases averted) decreases as heterogeneity in vaccine sentiment increases. Assortative sexual mixing by sentiment has little effect at the overall population level except in the most heterogeneous distributions (**C** & **D**), where it decreases impact further.

B Stratifying results from (**2A**) by quintile shows that heterogeneity in sentiment leads to two distinct impact patterns when assuming proportionate or assortative mixing

Vaccine Value

The lower impact in heterogeneous distributions (**C** & **D**) is largely due to fewer doses given. Cases averted per dose (how we measure **vaccine value**) remains very similar (not shown).

Summary & Interpretation

Decreases doses given and therefore programme impact.

High heterogeneity in vaccine sentiment

= £ Has little impact on vaccine value.

Take-home messages

A model which assumes homogeneous vaccine sentiment limits accuracy of impact estimates but is useful to predict vaccine value.

Be careful assuming initial uptake of a vaccine after programme implementation is representative of uptake going forward.

Future Work

Survey to link **vaccine sentiment** and **sexual behaviour** and explore correlation between likelihood of accepting vaccination and risk of infection.

Survey would also reveal the **true vaccine sentiment distribution** in the MSM population of the UK, allowing higher accuracy for STI disease models.

Repeating the above for other high-risk groups like **sex-workers**.

References

1 | UKHSA. Sexually transmitted infections (STIs): annual data (2025).
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3 | Bruxvoort, K. J. et al. Clinical Infectious Diseases 76, e1341-e1349 (2023).
4 | Wang, B. et al. The Lancet Infectious Diseases 22, 1011-1020 (2022).
5 | Whittles, L. K. et al. The Lancet Infectious Diseases 22, 1030-1041 (2022).
6 | Nikitin, D. et al. The Journal of infectious diseases 231, 71-83 (2025).
7 | Leng, T. Vaccines 10, 128 (2025).
8 | UKHSA. 4CMenB vaccine for prevention of gonorrhoea: information for healthcare practitioners (2025).

IMPERIAL Department of Infectious Disease Epidemiology

NIHR | National Institute for Health and Care Research

Estimating the Causal Effect of Vaccine Allocation on State-Level COVID-19 Outcomes in the United States

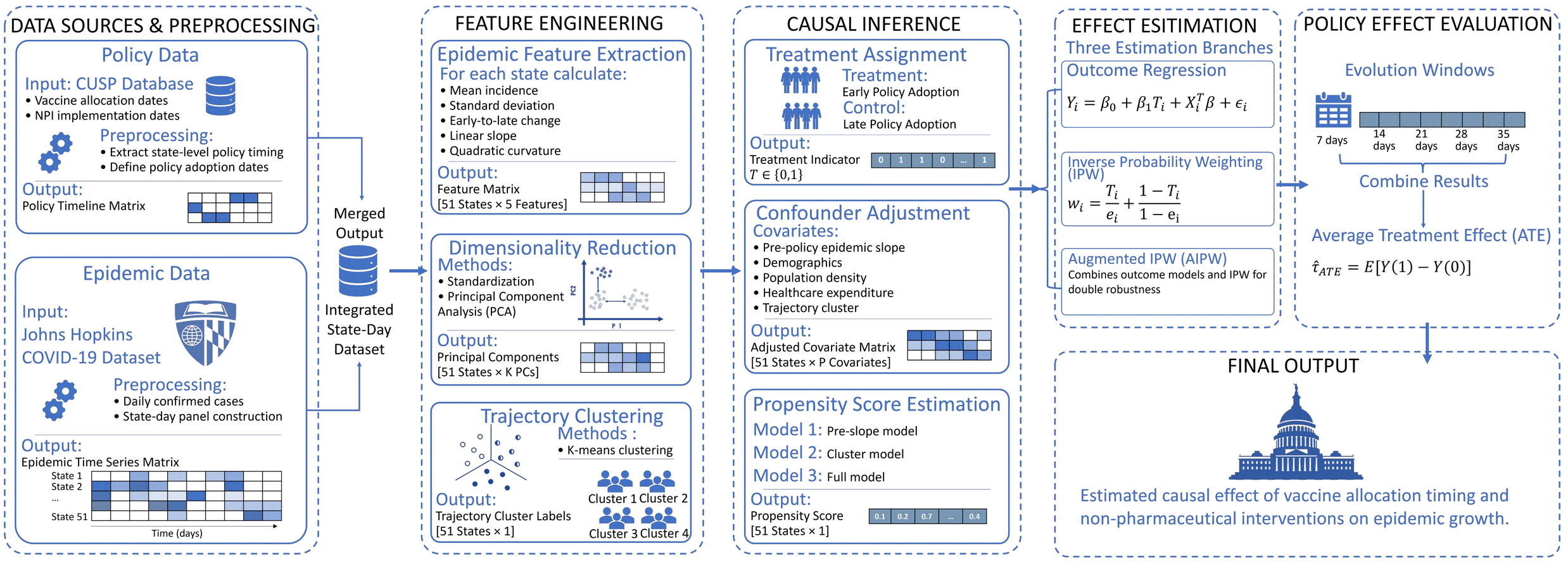
Hanzhi CHEN[1]

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Abstract:

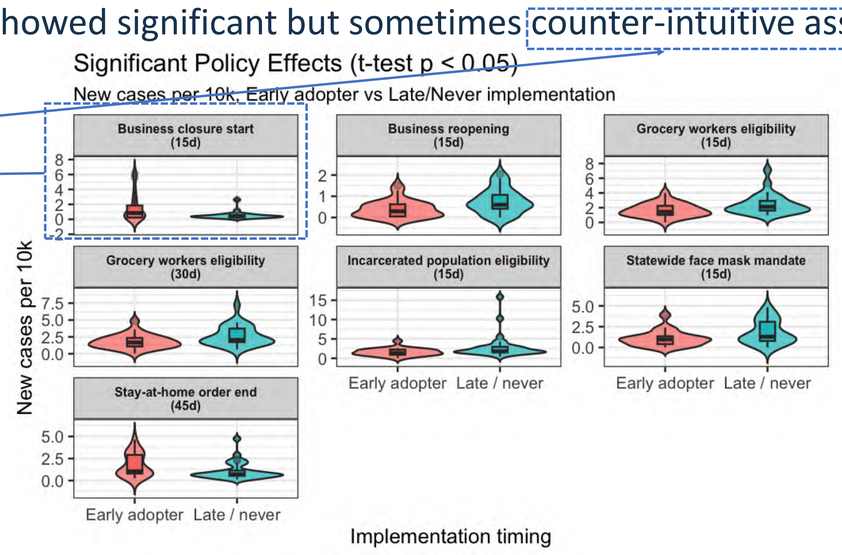
Objectives: Evaluating the real-world impact of staggered U.S. state-level COVID-19 vaccine allocations is essential for future pandemic planning. However, simple cross-sectional policy evaluations are heavily confounded by endogeneity, as governments typically implement interventions when local infection numbers are already escalating. **Methods:** We established a robust causal inference framework combining the COVID-19 US State Policy (CUSP) database with Johns Hopkins University daily case records. To rigorously block backdoor confounding paths driven by latent epidemic severity, we developed a feature-engineering pipeline that summarized each state's epidemic curve using key metrics (e.g., mean incidence, slope, curvature), reduced them via Principal Component Analysis (PCA), and classified states into distinct severity clusters using K-means clustering. The average treatment effect (ATE) was measured by the post-policy epidemic slope difference across rolling 7- to 35-day windows. Confounder adjustment was cross-validated using three statistical methods: Outcome Regression, Inverse Probability Weighting (IPW), and Augmented IPW (AIPW). **Results:** Doubly robust AIPW and IPW estimations revealed consistent short-term dynamics. Early vaccine allocation for the 65+ population and stay-at-home orders both achieved modest reductions in epidemic growth rates within 14–21 days, which later attenuated as states re-synchronized with national transmission cycles. Statewide mask mandates yielded the most rapid and pronounced suppression within a 7-day window, whereas the causal effects of lifting stay-at-home orders were highly variable and context-dependent across models.

Methods:



Results:

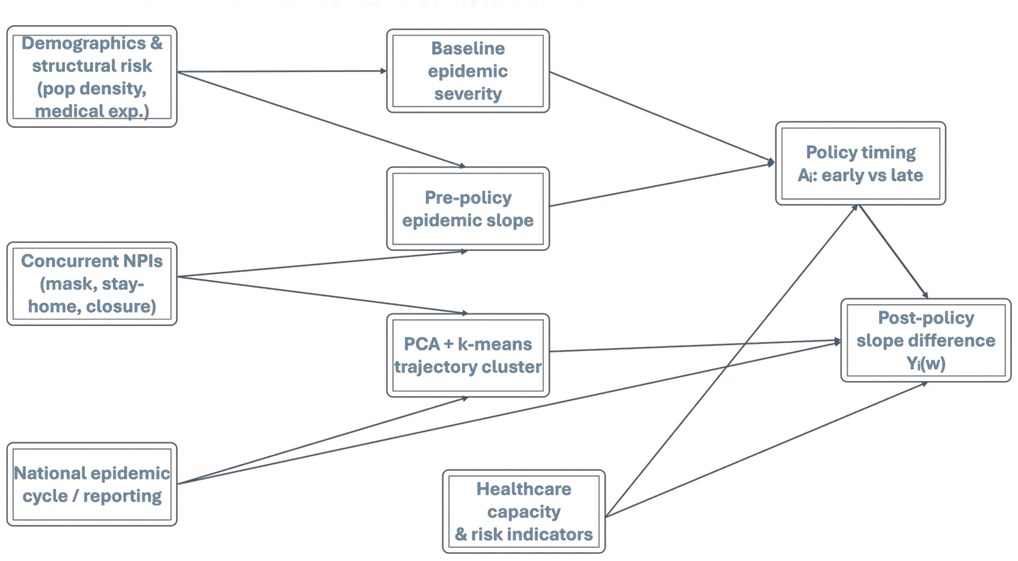
Naive t-tests showed significant but sometimes counter-intuitive associations.



association between early closure and higher case counts.

1. policy timing is often endogenous because governments tend to adopt interventions when cases are already rising.

2. short evaluation windows rarely capture the true effect of a policy, since behavioral responses and reporting delays introduce time lags.

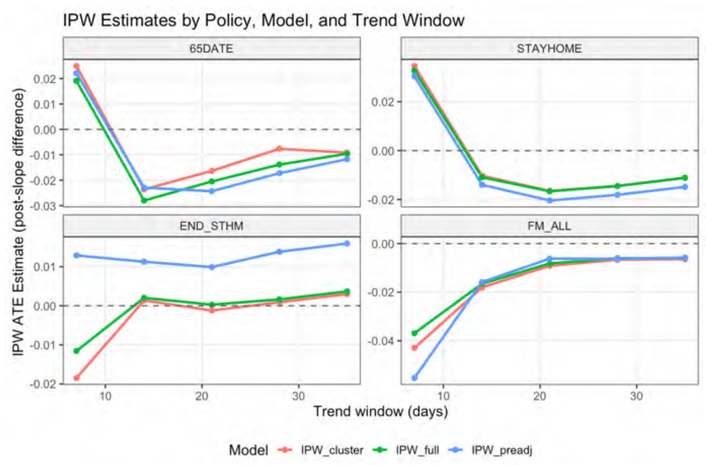


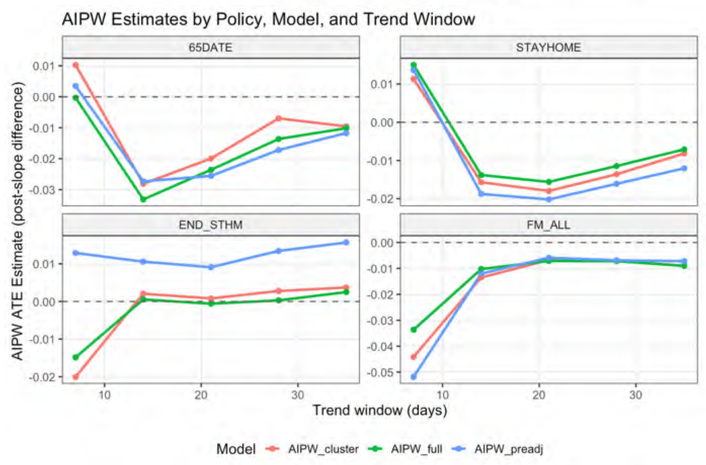
Why the DAG matters?

Without adjustment: early policy states may appear worse simply because they were hit earlier/harder.

With adjustment: compare states with similar pre-policy trends, demographic/structural risk, and latent epidemic trajectory cluster.

Practical message: future policy evaluations should encode epidemic phase before estimating policy effects.





Key takeaways

1. Early 65+ allocation and stay-at-home start show modest reductions at 14-21 days.

2. Mask mandates show the clearest immediate response, strongest at 7 days.

3. Ending stay-at-home orders is unstable across models, suggesting strong context dependence.

Policy	7d	14d	21d	28d	35d	Interpretation
65+ allocation	↓	↓ modest	↓ modest	atten.	atten.	Short-term flattening
Stay-home start	mixed	↓ modest	↓ modest	atten.	atten.	Benefit strongest at 14-21d
Mask mandate	↓ strong	↓	atten.	atten.	atten.	Fastest suppression
Stay-home end	variable	variable	mixed	mixed	mixed	Context-dependent

↓ = estimated reduction in epidemic slope; atten. = attenuation with longer windows

Conclusion:

Early vaccine rollout and timely mask mandates effectively flattened short-term epidemic trajectories. Integrating machine-learning trajectory clustering into standardized causal inference pipelines successfully addresses policy endogeneity, offering a powerful methodological blueprint for evaluating future public health interventions.

Development and Evaluation of a Digital Decision-Support Tool to Improve Pneumococcal Vaccination Uptake in Adults with Chronic Diseases in China

Background

- **High-risk population:** Over 400 million Chinese adults live with chronic diseases.
- **Severe consequences:**
Pneumococcal Infection→ Pneumonia Hospitalization ICU admission ⚠ Mortality
- **Vaccination is effective and recommended:** Pneumococcal vaccination effectively prevents pneumococcal disease and is recommended by both WHO and the Chinese CDC for adults with chronic conditions.
- **Vaccination uptake remains low:** Pneumococcal vaccination coverage among Chinese
- adults with chronic conditions remains suboptimal, with rates below 5% in some regions.
- **Decision-making barriers exist:**
Limited physician recommendation Poor awareness Financial barriers Limited access
- **Research Gap:** Community health center physicians in China manage large numbers of adults with chronic conditions, yet practical tools to support personalized pneumococcal vaccination decisions remain limited.

Research Questions

RQ1. Tool Development
Can a practical, physician-facing personalized decision-support tool be developed to support pneumococcal vaccination decisions for adults with chronic conditions in China?

RQ2. Effectiveness Evaluation
Does the intervention, combined with reminder and appointment-scheduling functions, improve pneumococcal vaccination uptake and long-term health outcomes?

RQ3. Implementation Evaluation
What are the reach, effectiveness, adoption, implementation, and maintenance of the intervention in real-world Chinese settings?

Methods

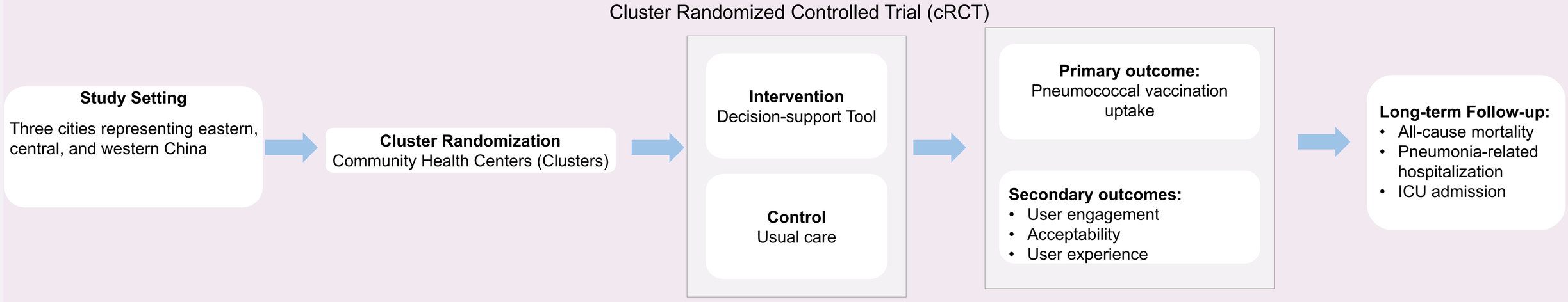
Step 1. Tool Development

A physician-facing decision-support tool will be developed to support pneumococcal vaccination among adults with chronic conditions in China.

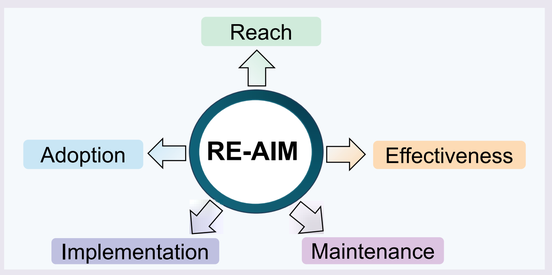


Step 2. Effectiveness Evaluation

Cluster Randomized Controlled Trial (cRCT)



Step 3. Implementation Evaluation



Reach
- Recruitment rate
- Coverage of eligible patients
- Representativeness

Effectiveness
- Vaccination uptake

Adoption
- Physician adoption rate
- Institutional willingness for future use
- Recommendation intention

Implementation
- Fidelity
- User engagement
- Barriers and facilitators

Maintenance
- Continued use
- Routine practice integration
- Scalability

Expected Outcomes

Validated Decision-Support Tool
Development and validation of a physician-facing decision-support tool for pneumococcal vaccination among adults with chronic conditions.

Improved Vaccination Uptake
Increased pneumococcal vaccination rate and adherence among high-risk adults.

Real-World Health Evidence
Evidence on the real-world effectiveness of pneumococcal vaccination in reducing key long-term outcomes, including all-cause mortality, hospitalization, and ICU admission.

Implementation Evidence
Comprehensive evaluation of the intervention's acceptability, feasibility, and scalability in routine clinical practice using the RE-AIM framework.

Implications

Clinical Practice
Strengthen standardized yet personalized pneumococcal vaccination recommendations for adults with chronic conditions.

Public Health
Boost vaccination coverage in high-risk populations and reduce the overall burden of pneumococcal disease.

Health System & Policy
Implement digital tools to support physician-led adult vaccination programs and improve service delivery in China.

Digital Health
Provide a scalable, evidence-based model for leveraging digital health technologies in adult immunization and preventive care.

Gendered Narratives of HPV Vaccination on Weibo and WeChat: A Pilot Content Analysis

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[1] Center for Social Media Research, School of New Media, Peking University, Beijing, China

Background

HPV vaccination is a highly effective intervention for preventing cervical cancer and other HPV-related diseases. The World Health Organization (WHO) recommends HPV vaccination as a key strategy for cervical cancer elimination.

In Mainland China, HPV vaccine communication increasingly takes place on social media platforms. However, discussions around HPV vaccination are strongly shaped by gender norms, sexuality-related stigma, and social expectations. These narratives may influence public perceptions of HPV vaccination and contribute to vaccine hesitancy.

Despite growing public attention, little research has systematically examined HPV vaccine discourse from a gender perspective in Chinese social media environments.

Research Objectives

1. Examine how women and men are represented in HPV vaccine-related social media content.
2. Identify gender-related narratives, stereotypes, and stigma.
3. Explore how these narratives may affect HPV vaccine acceptance and communication.
4. Assess the feasibility of combining manual coding and AI-assisted text analysis for large-scale social media research.

Methods

Data were collected from two major Chinese social media platforms, Weibo and WeChat Official Accounts, covering the period from February to April 2024. The initial dataset included 35,481 Weibo posts and 20,514 WeChat posts. After machine-based filtering and manual cleaning to remove irrelevant and duplicate content, 12,884 valid HPV-related texts containing gender-related content were retained for analysis. For this pilot study, a random sample of 100 HPV vaccine-related texts was selected for detailed examination. A content analysis approach was employed using a gender-sensitive coding framework. Three trained coders conducted the coding to ensure consistency and reliability in the interpretation of the data.

Key Findings

1. Women are highly visible but often portrayed as recipients of protection and care, Although some women also appear as roles such as health educator(10%), experience sharers (20%), advocates (12%), and individuals seeking medical help (19%), the frequency remains far lower than their representation as communication targets. Men are largely invisible in HPV vaccine discourse and were more often associated with HPV transmission, while only 5% of the samples proposed strategies for addressing HPV infection among men. A sexual scandal involving a male celebrity drew public attention to HPV and its vaccine, while simultaneously intensifying the moralization of HPV discourse and reinforcing stigma against men.

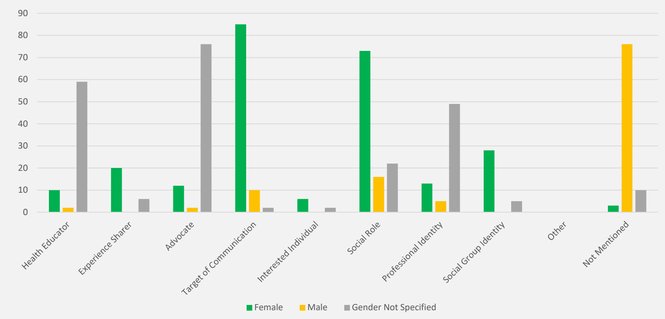


Figure1. Roles and Identities of Individuals Mentioned in HPV-Related Content (N=100)

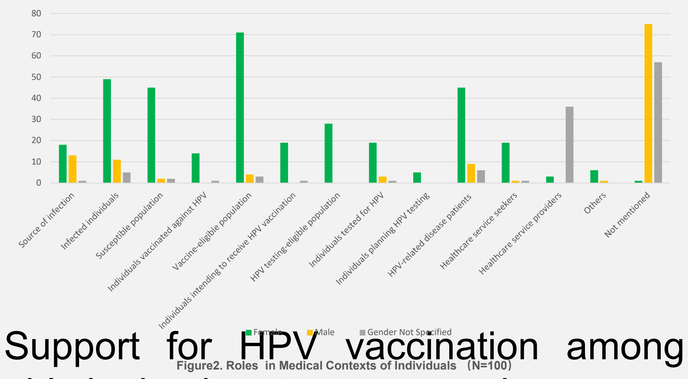


Figure2. Roles in Medical Contexts of Individuals (N=100)

2. Support for HPV vaccination among girls is dominant across gender groups, while opposition or hesitation is limited (< 5%) and mainly driven by perceived medical risks and moralized beliefs about sexual behavior, reflecting underlying gendered norms and stereotypes.

3. Vaccination is primarily framed as a mother's responsibility, with 45% of the samples mentioning mothers, compared with only 5% mentioning fathers.

4. Although 26% recognized girls aged 9–14 years as the primary target population for vaccination, 0 samples captured their voices. Although schools play an important role in advocating for and organizing HPV vaccination among 9-14years girls, but only 2 included school-based sources.

Conclusion

Our findings suggest that HPV vaccine communication remains strongly gendered in mainland China:

1. little evidence of explicitly gender-equal communication. Women are central to HPV vaccine discussions but are primarily framed as recipients of care rather than active participants. Men remain largely absent from HPV prevention narratives while being more often emphasized in relation to HPV transmission.
2. HPV infection continues to be associated with moral judgments about sexuality, potentially discouraging vaccination and screening behaviors.
3. More gender-sensitive and stigma-reducing HPV communication is needed to improve vaccine uptake and support cervical cancer elimination in mainland China. Some narratives emphasized that individuals with "orderly private lives" or even no sexual experience could still get infected with HPV. Although intended to counter the stereotype that HPV infection results from promiscuity, these accounts continue to rely on moralized assumptions about sexuality and thus fall short of promoting gender-equitable discourse.

Challenges&Future Directions

1. Social media data are generated at a scale that makes traditional manual coding increasingly difficult. To address this challenge, we explored the use of large language models (ChatGPT) for automated coding in this pilot study. Preliminary testing showed that AI-generated coding did not yet achieve the level of accuracy and consistency required for research-quality analysis. Therefore, all findings presented in this study are based on human-coded data. Nevertheless, AI-assisted text analysis remains a promising approach for future large-scale social media research. Further work will focus on Improving agreement between AI and human coders .
2. As the data were collected before the approval of male HPV vaccination in mainland China (January 2025), this study serves as a baseline for future comparisons of HPV vaccine communication before and after the introduction of male vaccination.