Partisan differences in childhood measles vaccination and general refusals: a retrospective cohort study of electronic health records in the United States, 1988–2024

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The Lancet Regional Health - Americas 2026;60: 101495

Published Online xxx

https://doi.org/10.1016/j.lana.2026.101495

Summary

Background Vaccination remains one of the most effective public health tools globally. Yet recent years have seen increasing political polarization around vaccination, particularly in the United States, as well as measles outbreaks among unvaccinated children. Using individual-level data, we characterize the national evolution of parental political polarization in childhood vaccination refusal, timely receipt of a child's first measles, mumps, and rubella (MMR) dose, and delay in first MMR vaccination.

Methods In this retrospective cohort study, using electronic health records from a primary care clinic registry and voter registration data with representative coverage across all 50 U.S. states, we identify children born from 1988 to 2024 (n = 46,924) with primary care clinic activity who can be matched to potential parents with exclusively Democratic (n = 19,449) or exclusively Republican (n = 27,475) party affiliation. We statistically test for increasing polarization over time across three outcomes: whether or not a patient had a documented vaccination refusal for any childhood vaccination, whether a patient received a timely first MMR dose, and the time delay to first MMR vaccination.

Findings Partisan polarization in childhood vaccine refusals spiked for children born during the COVID-19 pandemic—up to a gap of 9.2 [4.2–14.1, 95% confidence interval] percentage points for children born in 2021—but has been increasing since approximately 2000, with Republican parents more likely to refuse vaccinations than Democratic parents by an additional 0.25 [0.16–0.34] percentage points per year ($p < 0.01$), on average. Refusals are 3.3 [0.29–6.22] percentage points ($p = 0.03$) more polarized in states allowing non-medical vaccine exemptions. Political polarization in MMR vaccinations has also increased over time; the difference in on-track coverage between children of Republican and Democratic parents has grown, on average, by 0.52 [0.42–0.62] percentage points per year ($p < 0.01$), while the partisan gap in delays has widened, on average, by 2.0 [1.0–3.0] days per year ($p < 0.01$), or approximately 2.5 months over the study period.

Interpretation This study provides the first nationwide, individual-level evidence linking parental political affiliation to vaccine refusal rates, MMR vaccination rates, and MMR vaccination delays. Despite various data limitations, our finding of the emergence and widening of partisan gaps over time suggests that political identity has become an increasingly important factor in childhood health decision-making.

Funding This research was supported in part by the Stanford Institute for Human-Centered Artificial Intelligence and the Robert Wood Johnson Foundation.

Keywords: Vaccination; Polarization; MMR; Vaccine refusals

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Research in context

Evidence before this study

Based on our literature search across PubMed within the period 2015–2026 using various keyword combinations including "childhood vaccination," "political polarization," and "vaccine refusal," as well as consultation of the references cited in these search results, we reviewed a variety of temporal studies which have characterized increasing political polarization in vaccination outcomes but are limited by ecological inference and/or survey response biases. Cross-sectional studies have also been limited, examining geographic correlations between partisanship and vaccine coverage or disease outcomes only at the county, state, or national level. We identified a lack of national, individual-level studies examining whether the relationship between parental political party and childhood vaccination refusals or outcomes has changed over time.

Added value of this study

We provide the first nationwide, individual-level evidence linking parental political affiliation to both vaccine refusal rates and measles, mumps, and rubella vaccination rates. We find that partisan gaps in childhood vaccine refusals and uptake have widened over time, and this polarization emerged prior to the COVID-19 pandemic.

Implications of all the available evidence

Our findings highlight how polarization has increasingly extended into routine health decisions for children, with substantial implications for public health strategies, policy, and practice. Partisanship and state vaccination policies may act as key mediators for growing undervaccination.

Introduction

Although pediatric vaccination is generally recognized as a safe and effective public health intervention, childhood vaccination delays and refusals are on the rise, and the World Health Organization has identified vaccine hesitancy as a major public health threat.[1] Declining childhood vaccination rates have led to a resurgence of vaccine-preventable diseases, with Canada, and by extension the Americas as a region, losing its measles elimination certification by the Pan American Health Organization (PAHO) in 2025.[2] The United States, which declared measles eliminated in 2000, reported more measles cases in 2025 than in any full year since 1991, with most linked to unvaccinated children.[3] Vaccine hesitancy is now widespread enough to pose a serious threat to herd immunity, especially in states that allow childhood vaccination exemptions for non-medical reasons.[4] PAHO is scheduled to review the measles-free certification status of both the U.S. and Mexico in 2026.[5]

Studies show that legislation relating to childhood vaccination policy is becoming more politically polarized.[6] Understanding to what extent household political affiliation influences or mediates childhood vaccination outcomes, and how this relationship has changed over time, is critical to strengthening public health protections. Previous temporal studies investigating this relationship have either been conducted only at an aggregated (ecological), not individual, level,[7,8] or have reported changes only in vaccine attitudes, not uptake.[9] Cross-sectional studies have also been limited, examining geographic correlations between partisanship and vaccine coverage or disease outcomes only at the county, state, or national level.[10,11] For example, one study using school-level immunization data in California found that personal belief exemption rates were higher in schools located in highly Republican neighborhoods, compared to highly Democratic neighborhoods, by approximately 4.4 percentage points, and had grown since 2007.[12] Survey-based, point-in-time studies have evaluated both vaccine outcomes[13] and vaccine hesitancy,[14] and have generally suggested that Republican adults are more vaccine-hesitant[15,16] and less likely to vaccinate their children.[17] One recent survey-based study estimated a partisan MMR vaccination gap of roughly 5.5 percentage points.[18] Each of these existing approaches have limitations: ecological studies cannot disentangle household-level political identity from broader contextual factors, especially when they solely consider individual states, and surveys are subject to non-response and social desirability biases,[19] particularly of concern when considering reported attitudes towards vaccination.

The lack of related national, individual-level studies in the literature limits our ability to assess the extent of political polarization in parental medical decision-making and design targeted, evidence-based policy responses to improve children's health. Additionally, though vaccine exemption policies are known to impact exemption rates,[20] our literature review surfaced no studies examining the links between state vaccine policy and partisan polarization in vaccine behavior.

We aim to fill this gap in the literature by linking national voter registration data with longitudinal electronic health record (EHR) data from primary care patients and providing the first national, individual-level assessment of how parental political affiliation correlates with children's vaccination uptake and refusals, and how these associations have evolved over time. We proceed as follows. First, we describe our methods, including study design, data, outcomes, and statistical analysis. Next, we present main findings related to general vaccine refusals followed by a focus on measles, mumps, and rubella (MMR) vaccine uptake and delay, given recent attention on measles outbreaks and policy in the U.S. by scholars, journalists, and policymakers.[21–24] We also analyze how state vaccine exemption policies may mediate the relationship between partisanship and vaccination refusals or MMR vaccine uptake. We conclude with a discussion of the implications of our findings for public health policy and scholarship.

Methods

Study design

In this retrospective cohort study, in order to evaluate temporal links between parental political affiliation and childhood vaccination, we construct a unique matched dataset linking individual-level voter registration records to EHR data, as illustrated in Fig. 1 and further detailed in Appendix A. Our EHR records come from a 2024 snapshot of the American Family Cohort (AFC),[25–28] a longitudinal database that aggregates EHR data from primary care practices for over 8.5 million patients nationwide, while our voter records come from a 2024 snapshot of L2 Political,[29] which assembles detailed voter registration information from state and county agencies, including party affiliation, for over 200 million voters nationwide. However, despite the considerable coverage of these datasets, we restrict our study cohort initially to 477,945 children in AFC who *(1)* are recorded as living in the same household as other recorded patients who *(2)* are themselves potential parents (*i.e.*, over 18 years old, and 12–55 years older than the child).[30] From there, we further restrict our analysis to 226,899 children for whom their potential parents *(3)* can be linked to voter records in L2, following prior linkage methodology,[31,32] and *(4)* are exclusively Democratic (n = 93,628) or exclusively Republican (n = 133,271) in their registered party affiliation. Finally, based on the particular availability of different vaccination outcomes of interest, we further restrict specific statistical analyses to children born in specific year ranges (depending on the outcome) with documented engagement in their EHR at least once prior to 1 year of age, yielding cohort sizes by outcome ranging from 35,762 to 46,924 and resulting in the exclusion of three states (Alaska, Vermont, and North Dakota). Given the highly selective nature of our study criteria, we provide balance checks, comparing the patient characteristics of our study cohort to those of the U.S. population and various patient subsets dropped from the analysis, in Table 1 and Appendix Table A. We also compare the state-by-state distribution of the 226,899 AFC children linkable to L2 parents to state-by-state census population and visualize the degree of underrepresentation (up to 3.64 percentage points) or overrepresentation (up to 5.91 percentage points) in Appendix Figure A. While our broad research aim regarding partisan gaps was pre-defined, our choices of covariates and statistical modeling approaches were developed post-hoc and shaped by exploratory data analyses.

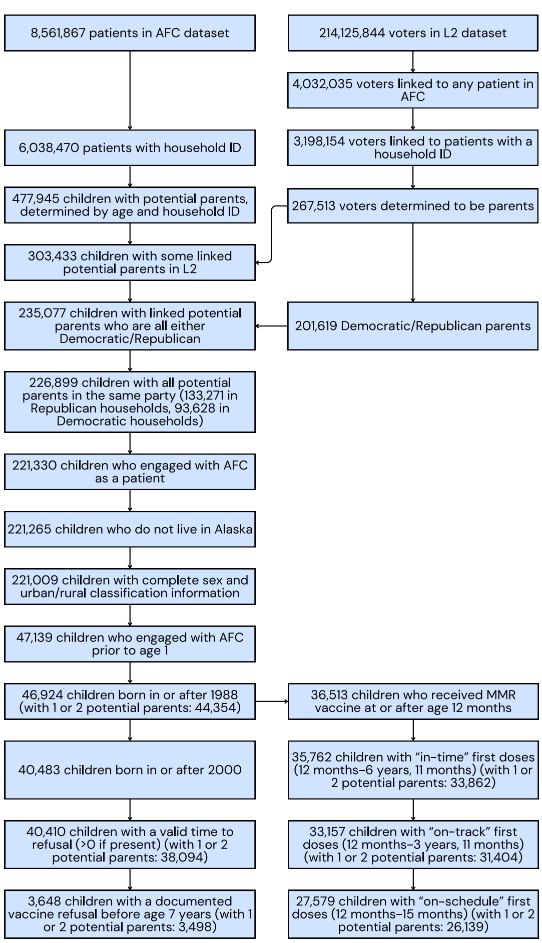

Fig. 1: **Flow chart of cohort size.** AFC = American Family Cohort; MMR = measles, mumps, and rubella.

Additional covariates

The EHR data also include: patient date of birth, from which we derive age in years; patient sex assigned at birth, which we code into the categories male and female, omitting patients with missing or other sex, which are both coded in the same way; patient race/ethnicity, coded using 1997 federal standards as Hispanic or Latino, White, Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, Two or More Races, and Some Other Race[33]; and patient residential address. We clean residential address (*i.e.*, omit multiple conflicting or unresolved addresses), and match addresses to ZIP codes for the purpose of obtaining a 2022 Social Vulnerability Index (SVI) score (where a high SVI score is associated with low socioeconomic

	U.S. population	Overall study	Refusal analysis	MMR analysis	Delay analysis
n	340,110,990	477,945	40,410	46,924	35,762
Sex					
Female	171,816,647 (50.5%)	250,990 (52.6%)	19,775 (48.9%)	23,284 (49.6%)	17,836 (49.9%)
Male	168,294,343 (49.5%)	226,562 (47.4%)	20,635 (51.1%)	23,640 (50.4%)	17,926 (50.1%)
Race/ethnicity					
Hispanic or Latino	68,013,553 (20.0%)	62,965 (13.2%)	4853 (12%)	5365 (11.4%)	4242 (11.9%)
American Indian and Alaska Native	1,768,838 (0.5%)	1871 (0.4%)	141 (0.3%)	148 (0.3%)	110 (0.3%)
Asian	21,036,558 (6.2%)	10,533 (2.2%)	377 (0.9%)	486 (1%)	412 (1.2%)
Black or African American	39,959,479 (11.7%)	26,433 (5.5%)	2133 (5.3%)	2525 (5.4%)	1956 (5.5%)
Multiple races	15,515,949 (4.6%)	245 (0.1%)	28 (0.1%)	29 (0.1%)	20 (0.1%)
Native Hawaiian and Other Pacific Islander	581,100 (0.2%)	1257 (0.3%)	52 (0.1%)	60 (0.1%)	46 (0.1%)
White	191,382,624 (56.3%)	281,312 (58.9%)	27,296 (67.5%)	32,216 (68.7%)	25,164 (70.4%)
Social vulnerability index score					
[0,25]	46,870,048 (14.2%)	27,626 (5.8%)	3376 (8.4%)	4143 (8.8%)	3090 (8.6%)
[25,50]	76,368,716 (23.1%)	83,721 (17.5%)	7279 (18%)	9066 (19.3%)	7019 (19.6%)
[50,75]	93,124,942 (28.1%)	135,272 (28.3%)	12,340 (30.5%)	14,286 (30.4%)	11,082 (31%)
[75,100]	114,733,887 (34.7%)	231,254 (48.4%)	17,415 (43.1%)	19,429 (41.4%)	14,571 (40.7%)
Rural/urban indicator					
Rural	26,811,461 (8.0%)	77,197 (16.2%)	9280 (23%)	9869 (21%)	6761 (18.9%)
Urban	308,740,723 (92.0%)	400,728 (83.8%)	31,130 (77%)	37,055 (79%)	29,001 (81.1%)
Parental political affiliation					
Democratic		93,628 (30.9%)	16,527 (40.9%)	19,449 (41.4%)	15,196 (42.5%)
Republican		133,271 (43.9%)	23,883 (59.1%)	27,475 (58.6%)	20,566 (57.5%)
Both		8178 (2.7%)	*NA*	*NA*	*NA*
Other parental political affiliation		68,356 (22.5%)	*NA*	*NA*	*NA*
Missing information					
Missing or other sex		393 (0.1%)	*NA*	*NA*	*NA*
Missing or other race/ethnicity		93,329 (19.5%)	5530 (13.7%)	6095 (13%)	3812 (10.7%)
Missing parental political affiliation		174,512 (36.5%)	*NA*	*NA*	*NA*
Missing social vulnerability index score		72 (0%)	*NA*	*NA*	*NA*
Missing urban/rural indicator		20 (0%)	*NA*	*NA*	*NA*

Data are n (%). Race categories are exclusive (*i.e.*, White is "Non-Hispanic White alone"). For sex and for race/ethnicity, "Missing" and "Other" were not distinguishable in patient data, so are aggregated in the table. Percentages provided for available characteristics do not include patients with missing information in the denominator. Percentages provided for missing characteristics include all patients in the denominator. NA values represent zero counts by design of the cohort definition. U.S. population data use American Community Survey 2024 1-Year Estimates. MMR = measles, mumps, and rubella.

***Table 1:* Baseline characteristics.**

status) from the Centers for Disease Control and Prevention (CDC)[34,35] and a 2010 Rural-Urban Commuting Area (RUCA) code from the U.S. Department of Agriculture (assigning rurality for RUCA codes 7 or higher).[36] We also match addresses to counties to determine the county share of the population who voted for the Republican candidate in the presidential election year less than or equal to, and closest to, the child's birth year.[37] These covariates are utilized both to assess the demographic balance of dropped and analyzed cohorts (where comparisons to U.S. population sex and race/ethnicity use American Community Survey 2024 1-Year Estimates) and to adjust for confounders in our statistical analyses.

Outcomes

First, we assess whether or not a patient had a recorded vaccine refusal, as identified through explicit administrative codes designated for vaccine refusals or through keyword search in clinical notes (see Appendix A), for any vaccination prior to 7 years of age. We include only vaccine refusals prior to 7 years of age because the CDC recommends that children should have been offered all doses of major childhood vaccinations by this time.[38] Due to data sparseness,[39] we focus on vaccine refusals for children born in or after 2000. Of these 40,410 children, 3648 had a recorded vaccine refusal (9.03%). Although vaccine refusals in EHR data have been validated and used by prior studies[40] to measure vaccine refusal, these codes are recorded infrequently, and recording rates vary with time and by practice.[41]

Second, since we cannot separate vaccine refusals based on which vaccines they are related to, we also investigate whether patients received a first dose MMR vaccination (also via administrative codes or clinical notes). We obtained earlier data on MMR vaccinations, so we include children born in or after 1988 (n = 46,924), the earliest year with sufficient sample size. Our primary MMR vaccination outcome is whether the patient received their first MMR dose between the ages of 12 months and 3 years 11 months. This time window, defined here as "on-track" vaccination, encompasses both children who receive an "on-schedule" first dose (*i.e.*, between 12 and 15 months) and those who receive a catch-up first dose in time to allow the child to receive a second dose by the child's fourth birthday (the earliest recommended age for a second dose),[38] and helps to distinguish households that experience temporary barriers or surmountable hesitancy from households that forgo vaccination entirely.[42–44] We also provide supplementary results focused on the stricter set of "on-schedule" MMR first doses, as well as the looser set of "in-time" first doses administered from age 12 months to age 6 years, 11 months, a range which allows a child to receive a second dose just before the latest recommended age.[38]

Finally, we determine the delay of patients' first MMR dose in days. We perform this analysis for patients with "in-time" first doses (n = 35,762). The delay is set to 0 for children who received their first MMR vaccine between 12 and 15 months old (77.12% of the in-time dosage population).[45] We focus on first dose MMR delays because second dose delays are known to be driven by other structural factors, whereas first dose delays are more related to parental hesitancy.[46]

We consider how our vaccine refusal and MMR vaccine uptake rates compare with prior studies in Appendix A.

State-level vaccine policy

We provide background on vaccination practices in the U.S. in Appendix B. Broadly, each state has one of two types of MMR vaccine exemption policy. As of 2025, 5 states allow children to obtain MMR vaccine exemptions only for medical reasons ("medical exemptions"). 45 states also allow MMR vaccine exemptions for medical and religious or personal reasons ("non-medical exemptions"). We manually document state MMR vaccination policies in all 50 states (and the District of Columbia) from 1988 to 2025, including when discrete policy changes occurred, and make them available for future research in Appendix Table B. We compare states allowing only medical exemptions to states allowing both medical and non-medical exemptions, accounting for the time-varying nature of these policies, to test whether more permissive exemption policies heighten polarization.

Statistical analysis

We perform two main analyses. First, we descriptively characterize evolving polarization semi-parametrically by modeling distinct partisan effects in each year (Equation 1 in Appendix C).

Second, to statistically test for increasing polarization over time, we model our outcomes as the result of linear interactions between birth year and parental political partisanship (Equation 2 in Appendix C). We carry out these analyses on each of our outcomes. For the delay in days of the first dose MMR vaccine for "in-time" patients, we employ an ordinary least squares (OLS) regression. For our binary outcomes indicating whether a patient had a vaccine refusal prior to 7 years of age, and indicating whether the patient received a first MMR vaccine dose "on-schedule," "on-track," and "in-time," we employ linear probability models (LPM) estimated via OLS. We select LPMs over nonlinear alternatives (*i.e.*, logistic regression) in order to avoid bias associated with the incidental parameters problem in models with fixed effects (*i.e.*, unit-specific intercepts),[47,48] and to allow for a more direct interpretation of coefficients as marginal effects on probabilities. Because LPMs are inherently heteroskedastic, we estimate all models using heteroskedasticity-robust standard errors. As a robustness check, we also replicate our binary outcome analyses using logistic regression (see Equation 3 in Appendix C and Appendix Tables M–P).

For the analyses represented by (Equation 2 in Appendix C), we adjust for time-varying state policy at the patient's year of birth (medical, religious, or personal exemptions), then iteratively add covariates: *(1)* at the regional level, including U.S. Census region, RUCA code as an indicator of rurality, the SVI score of the patient's ZIP code, and the share of the patient's county that voted for the Republican candidate in the presidential election year matching the patient's birth year; *(2)* at the individual level for patient sex (limited to male/female only), race, and ethnicity; and *(3)* at the state level, *i.e.*, state-specific intercepts to control for all time-invariant, unobserved factors unique to each state.

A known issue with EHR data is that information about refusals and vaccination events is incomplete.[49] We assume that this missingness does not vary by parental political party membership, conditional on covariates. That is, we assume that children of Democratic and Republican parents are equally likely, after adjusting for other factors like race/ethnicity, rurality, and county voting patterns, to have their vaccination information recorded in their EHR, given that the refusal or vaccination itself has already taken place in the clinical setting. As for probable mechanisms of divergence between vaccination events and vaccination records, we posit that different primary care practices may have different norms or abilities to record such information during or after the visit, to digitize prior physical records, or to receive records of refusals or vaccinations from other practices or locations (*e.g.*, a pharmacy dispensing MMR vaccinations). All of these factors are at the practice level, not the individual patient level. Thus, in addition to all other iterative covariates, we add *(4)* practice-specific intercepts for each of

749 unique practices to investigate whether the observed relationships stem from practice-level or individual-level differences.

Finally, as a secondary analysis, we analyze the connections between state vaccine policy and partisan vaccine refusal or MMR uptake, using the same linear probability model design. For the binary refusal and on-track MMR uptake outcomes, we assess whether the partisan vaccine gap is different under medical and non-medical exemptions.

We use the *fixest* package in R (version 4.1.2).[50] A priori, the threshold for statistical significance was set at $\alpha = 0.05$. Accordingly, 95% confidence intervals are reported for all primary estimates.

Ethics statement

The AFC dataset is used solely for research purposes, allowing researchers to investigate core questions of health equity and to generate knowledge that may inform the improvement of healthcare services across a nationwide network of primary care practices. All data are collected during the routine assessment of clinical care of patients, and patient data. All analyses were conducted on secure, remote servers approved for High Risk and Protected Health Information data, and the research was approved by the Institutional Review Board, including Waiver of Informed Consent, Waiver of Assent, and Waiver of HIPAA Authorization.

Role of funding source

No study sponsors were involved in study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

Results

Table 1 shows baseline patient characteristics for the full study cohort (n = 477,945) and three sub-cohorts used for analyses of general refusals (n = 40,410), MMR uptake (n = 46,924), and MMR delay (n = 35,762). Our three sub-cohorts contain 9280 (23%), 9869 (21%), and 6761 (18.9%) patients, respectively, in rural areas, and 17,415 (43.1%), 19,429 (41.4%), and 14,571 (40.7%) patients, respectively, in areas with SVI scores in the highest quartile. As such, relative to the U.S. population, they overrepresent areas that are more rural (18.9–23% versus 8% in the U.S.) and have higher social vulnerability (40.7–43.1% in highest quartile versus 34.7% in the U.S.), as is consistent with the EHR dataset's robust coverage of small and rural primary care practices.[28] Our three sub-cohorts also contain 27,296 (67.5%), 32,216 (68.7%), and 25,164 (70.4%) non-Hispanic White individuals, respectively, versus 56.3% in the U.S. as a whole; this overrepresentation is consistent with the fact that patients excluded from our analysis because of missing parental political affiliation (see Appendix Table A) are more likely to be non-White. Furthermore, our three sub-cohorts contain 23,883 (59.1%), 27,475 (58.6%), and 20,566 (57.5%) individuals, respectively, in Republican-affiliated households, whereas national household polling has found Democratic party affiliation to either match or exceed Republican party affiliation across our study period.[51] We highlight four key study results below.

First, in Fig. 2, we observe a persistent unadjusted partisan gap in vaccine refusals for the second half of our study period (approximately 2010 onwards), with children in Republican households more likely to have a recorded vaccine refusal prior to 7 years of age than children in Democratic households. In the first two years of the pandemic (2020–2021), we see a significant ($p < 0.001$) widening of the gap compared to the 2010–2019 pre-pandemic period; the largest gap, for children born in 2021, is 9.2 [4.2–14.1, 95% confidence interval] percentage points. In contrast, for the first half of our study period, we observe gaps in partisan vaccination refusals that are small and, in most years, statistically indistinguishable from zero.

Second, we reject the null hypothesis that partisan vaccine refusals remain constant over time using the regression-based test. On average, children in Republican households have become more likely to refuse a vaccine prior to 7 years of age than children in Democratic households since 2000. The estimated gap has widened by 0.25 [0.16–0.34] percentage points per year (Table 2). For context, approximately 3.6 million children were born in 2023,[52] so this estimate suggests the partisan vaccination refusal gap is growing, on average, by almost 9000 children per year. This marginal increase in the refusal gap is statistically significant even when adjusting for regional characteristics, such as county proportion of Republican residents, and individual characteristics, such as patient race and ethnicity. However, there is a lack of evidence for a statistically significant gap once adjusting for state-level fixed effects.

Third, focusing on MMR vaccinations, we similarly find that estimated partisan vaccination gaps for MMR vaccination increase over time. In particular, from approximately 2005 onwards, children with Republican parents were less likely to receive an on-track first dose of the MMR vaccine (Fig. 3). On average, this gap increases by 0.52 [0.42–0.62] percentage points per year (Table 3). This fitted trend is significant even when adjusting for state-level and practice-level fixed effects. We observe similar results for our other measures of first-dose MMR vaccinations (on-schedule and in-time, see Appendix Tables C–D), and when using logistic regression (see Appendix Tables M–P). Appendix Figure B presents similar results for days of vaccination delay; since 1988, the partisan gap in MMR vaccination delays has widened by an average of approximately 2.0 [1.0–3.0] days per year (approximately

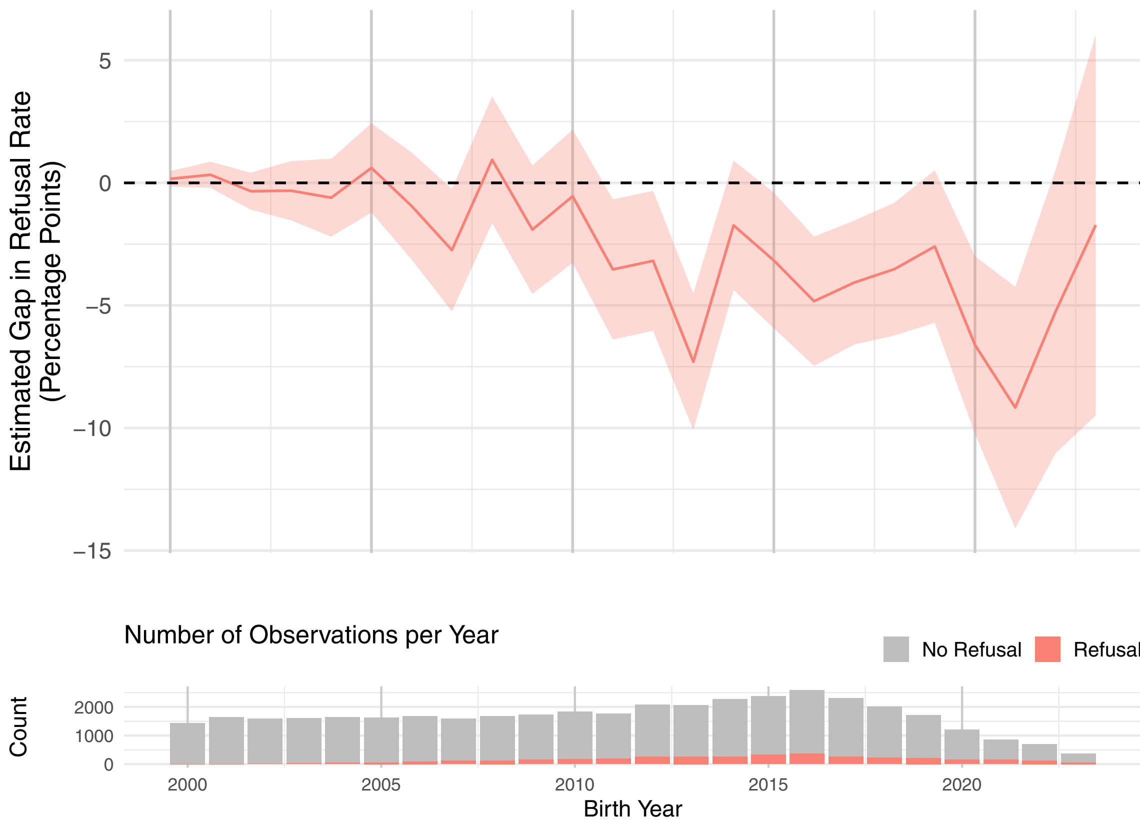

Fig. 2: **Percentage point gap in partisan vaccination refusals (Democrat–Republican) by birth year for all children.** Top panel displays estimated vaccine refusal gap (line; Democratic refusal rate minus Republican refusal rate) and 95% confidence region (shaded) for linear model with birth year fixed effects. Lower panel displays total patient counts (*n* = 40,410) and patient refusal counts (*n* = 3648) by birth year.

Model	Democrat-birth year interaction (95% CI)	p value
Policy covariates	−0.254 (−0.34,−0.16)	<0.001
+Regional covariates	−0.280 (−0.37,−0.19)	<0.001
+Individual covariates	−0.290 (−0.38,−0.20)	<0.001
+State fixed effects	−0.267 (−0.57,0.03)	0.089
+Practice fixed effects	−0.247 (−0.50,0.01)	0.061

Linear probability models include all children (*n* = 40,410) born in and after 2000, with outcome 1 if the patient had a recorded vaccine refusal prior to 7 years of age (*n* = 3648). The difference presented is the Democratic refusal rate minus Republican refusal rate. Each row represents a model with newly added covariates, cumulative of all previous rows (see Equation 2 in Appendix B). Policy covariates are categorical for whether the patient's state had *(1)* medical only, *(2)* medical and religious, or *(3)* medical, religious, and personal vaccine exemptions for MMR at time of birth. Regional covariates are Census-defined region, a rurality indicator, the Social Vulnerability Index of the patient's ZIP code, and the county share Republican in the presidential election year matching the patient's birth year. Individual covariates are sex, race, and ethnicity. Fixed effects are state-specific and practice-specific intercepts. MMR = measles, mumps, and rubella.

Table 2: **Difference in percentage points of vaccine refusal indicator (Democrat–Republican) per 1-year increase in birth year by linear model type for all children.**

2.5 months over the study period), a difference that is statistically significant even with state-level and practice-level fixed effects (Table 4). This suggests that there is polarization in vaccine delays among children who receive their first MMR vaccination late but within a window to receive their second vaccine on time, and that this polarization in delay time is at the individual, not practice, level.

Last, we find that partisan gaps in vaccine refusals are approximately 3.3 [0.29–6.22] percentage points larger when state policy allows non-medical vaccine exemptions (Appendix Table E). For MMR vaccination, however, we find a lack of evidence for a statistically significant difference (Appendix Table F).

Discussion

Our results show that the partisan gaps in childhood vaccine refusals and MMR vaccination have, on average, widened over time. While much debate has focused on COVID-19,[53–55] the role of the pandemic in hesitancy for other vaccines,[8,56] or how the polarization

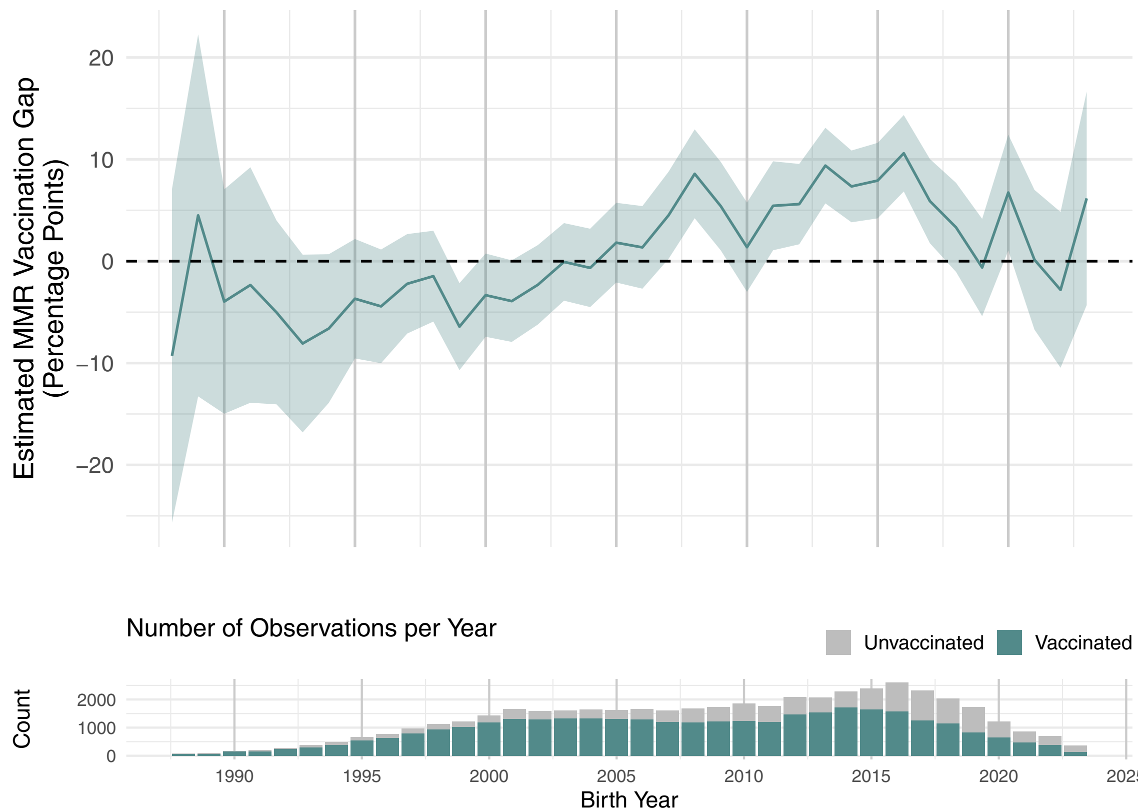

Fig. 3: **Percentage point gap in on-track MMR vaccine uptake (Democrat–Republican) by birth year for all children.** Top panel displays estimated MMR vaccination gap (line; Democratic uptake rate minus Republican uptake rate) and 95% confidence region (shaded) for linear model with birth year fixed effects. Lower panel displays total patient counts (*n* = 46,924) and vaccinated patient counts (*n* = 33,157) by birth year. An "on-track" MMR vaccine is a first MMR dose between the ages of 12 months and 3 years 11 months. MMR = measles, mumps, and rubella.

Model	Democrat-birth year interaction (95% CI)	*p* value
Policy covariates	0.521 (0.42,0.62)	<0.001
+Regional covariates	0.457 (0.35,0.56)	<0.001
+Individual covariates	0.429 (0.33,0.53)	<0.001
+State fixed effects	0.495 (0.17,0.82)	0.0047
+Practice fixed effects	0.380 (0.14,0.62)	0.0017

Linear probability models include all children (n = 46,924) born in and after 1988, with outcome 1 if the patient received an MMR vaccination from age 12 months to age 3 years, 11 months (n = 33,157), and 0 otherwise. The difference presented is the Democratic uptake rate minus Republican uptake rate. Each row represents a model with newly added covariates, cumulative of all previous rows (see Equation 2 in Appendix B). Policy covariates are categorical for whether the patient's state had (1) medical only, (2) medical and religious, or (3) medical, religious, and personal vaccine exemptions for MMR at time of birth. Regional covariates are Census-defined region, a rurality indicator, the Social Vulnerability Index of the patient's ZIP code, and the county share Republican in the presidential election year matching the patient's birth year. Individual covariates are sex, race, and ethnicity. Fixed effects are state-specific and practice-specific intercepts. MMR = measles, mumps, and rubella.

Table 3: **Difference in percentage points of on-track MMR vaccination indicator (Democrat–Republican) per 1-year increase in birth year by linear model type for all children.**

increased over the course of the pandemic,[57] we show that polarization emerged prior to the pandemic, with the Democratic–Republican MMR vaccination gap in particular growing by an average of one percentage point every four years since 1988. While a causal analysis of polarization's impacts on measles herd immunity, reported by the American Academy of Pediatrics to be 92–94% immunization,[58] in any particular geographic region is beyond the scope of our study, our findings suggest that political factors may play a role in regions that lose herd immunity and become more susceptible to outbreaks.

Our findings inform the scarce body of existing work. A prior ecological study in North Carolina found no significant association (p = 0.47) between county partisanship and vaccine refusal rates from 2009–2016.[7] Our individual-level findings suggest that the challenges associated with ecological inference may have masked individual-level effects in prior research. Another temporal study using national-level data, which evaluates vaccine opinions, not outcomes, found that the partisan gap in public opinion on vaccinations

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	−2.003 (−2.96,−1.05)	<0.001
+Regional covariates	−1.837 (−2.80,−0.88)	<0.001
+Individual covariates	−1.804 (−2.76,−0.84)	<0.001
+State fixed effects	−1.746 (−3.31,−0.19)	0.033
+Practice fixed effects	−1.483 (−2.53,−0.44)	0.0055

Ordinary least squares regression models include only children born in and after 1988 who received an MMR vaccination from age 12 months to age 6 years, 11 months (n = 35,762). The difference presented is the Democratic delay minus Republican delay. Each row represents a model with newly added covariates, cumulative of all previous rows (see Equation 2 in Appendix B). Policy covariates are categorical for whether the patient's state had (1) medical only, (2) medical and religious, or (3) medical, religious, and personal vaccine exemptions for MMR at time of birth. Regional covariates are Census-defined region, a rurality indicator, the Social Vulnerability Index score of the patient's ZIP code, and the county share Republican in the presidential election year matching the patient's birth year. Individual covariates are sex, race, and ethnicity. MMR = measles, mumps, and rubella.

***Table 4:* Difference in days of MMR vaccination delay (Democrat–Republican) per 1-year increase in birth year by linear model type for children with in-time vaccination.**

increased from 6 to 13 points from 2015–2019.[9] Our study finds a similar degree of partisan gap on refusal outcomes, while also tracing them to an earlier period, which suggests that reported public opinion may trail vaccine refusal behavior.

While ours is the first study to temporally assess vaccine outcomes by political party nationally, a survey-based study using data from late 2023 estimated a partisan MMR vaccination gap of roughly 5.5 percentage points,[18] and another study using school-level data in California found a 4.4 percentage point gap in personal belief exemptions between schools in highly Republican and highly Democratic neighborhoods,[12] both of which fall within our estimated range. Additionally, other studies have suggested that undervaccination has grown over time,[40] and our results suggest that partisanship and state vaccination policies may act as key mediators for this growing undervaccination.

We note several limitations of our approach. First, our data are based on EHR information from AFC, which aims to represent primary care practices and oversamples rural regions.[28] We note that Kansas was overrepresented in our population of children connected to parents in the L2 dataset compared to the U.S. population and to the AFC population; Indiana was also overrepresented compared to the AFC population (Appendix Figure A). Thus, while the degree of overrepresentation we observe is relatively low, our effects may not generalize to other populations, especially if there are temporal changes in selection for the AFC dataset. Nonetheless, EHR data present a distinct advantage of providing provider-recorded, individual-level outcomes as opposed to existing survey-based approaches that capture potentially unreliable self-reports.

Second, while we adjusted for key individual-level attributes and area-based measures of social vulnerability in our statistical analyses, we may have missed other factors that bias our findings. Our examination of the incremental effects of covariates (Tables 2–4) provides some confidence that our results are robust to such potential confounders.

Third, while there are advantages to utilizing EHR data, it took significant data processing to extract information about refusals and MMR records. While we have adhered to existing best practices for extracting vaccination information from EHR data,[59] our refusal and MMR vaccination rates are still lower than reported elsewhere.[60,61] We adjust for potential practice-level variations in recording rates in our statistical analyses, but otherwise must assume in our research design that the recording rate of refusals or vaccination outcomes does not vary across children of Democratic and Republican parents; future work may evaluate this assumption more directly or otherwise corroborate our findings with more robustly recorded vaccination information.

Fourth, the availability of data for our patient cohort diminishes, past a peak of observations for patients born in 2016, likely due to a combination of factors. Eligibility criteria may be restricted for more recent years; for instance, refusals are observed for any vaccination prior to 7 years of age, but children with birth years 2017 and on have a shorter window of observation, leading to fewer refusal observations. Data availability is also likely affected by differential lags in data collection and processing across different practices and EHR systems. We also suspect overall clinical activity across our cohort may have decreased during the pandemic. While our inferences are stronger in earlier years, and our overall findings remain clear while subject to smaller sample sizes in more recent years, future work can corroborate our results once more comprehensive data become available for the early 2020s and monitor the ongoing trajectory of partisanship trends in childhood vaccination.

Fifth, record linkage between large and distinct administrative datasets like EHRs and voter registration records,[62] as well as within EHRs in the case of identifying parent-child relationships, may have errors and limitations. Patients missing parental party affiliation due to failed record linkage are more likely to be Hispanic and more likely to live in areas with high social vulnerability (see Appendix Table A). Our analysis also assumes that individuals residing at the same address who of parental age are potential parents (which may include more than 2 parents), misses parents who do not live with their children, and is unable to link parental party affiliation to the exact year of the child's vaccination outcome across our full study period. We conduct robustness checks based on family structure (omitting patients who have over 2 potential parents) and based on year of parental party affiliation (replacing a 2024 L2 snapshot with a 2018 L2 snapshot), none of which reflect substantive changes to our findings (see Appendix E). Future work may corroborate our findings using datasets with improved parent-child linkage or with more temporally granular party affiliation.

Sixth, while we focus on households with potential parents of exclusively Democratic or exclusively Republican affiliation, future work should examine the relative vaccine behavior of households with mixed or independent party affiliation, which we are unable to examine due to sample size limitations.

Finally, while our study presents measures of state-level policy, this analysis does not measure the ease of obtaining non-medical exemptions, which can vary over time and affect exemption rates.[20,63] We make our state MMR policy data available for future research seeking to answer these questions (Appendix Table B).

Despite these limitations, our findings highlight how polarization has increasingly extended into routine health decisions for children. Public health strategies and exemption policies, in their aim to maintain herd immunity and protect vulnerable populations, should account for the growing influence of political identity on childhood health decisions.

Contributors

D.E.H and J.G. conceived of the idea. D.E.H., D.O., and C.M.M obtained, accessed, and verified the data. D.S. provided feedback on the validity of measures. C.M.M. conducted the analysis and wrote the manuscript. All authors edited the manuscript. D.E.H. was responsible for the decision to submit the manuscript.

Data sharing statement

Data and code, along with the study protocol, related to the study are available online (see https://github.com/reglab/partisan_vaccination). Due to privacy concerns, individual-level EHR data cannot be made publicly available, but can be accessed by researchers through the ABFM PRIME Registry and L2.

Declaration of interests

The authors declare no competing interest.

Acknowledgements

The authors thank the Stanford Center for Population Health Sciences for their expertise on electronic health records; the ABFM PRIME Registry participating clinicians and the American Board of Family Medicine, without whom the American Family Cohort would not be possible; Aparna Balagopalan, Jennah Gosciak, and Julian Morimoto for helpful comments and conversations; and the Stanford Institute for Human-Centered Artificial Intelligence and Robert Wood Johnson Foundation for supporting this work.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lana.2026.101495.

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