Supplementary Materials for
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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A. Data sources, electronic health record outcomes, and data missingness

Data Sources

The L2 database is collected and assembled by the L2 organization and sold for use in academic, political, or business settings.[1] In addition to minimizing data gathering steps, the database was constructed using a number of standardization and cleaning preprocessing steps that ensure greater comparability across states. We obtain voter name, state, date of birth, and registered political party for 214,125,844 voters nationally, using a 2024 snapshot for the main findings. For robustness checks in Appendix Figures C–D and Appendix Tables J–L, we switch to the earliest available snapshot in 2018.

The American Family Cohort (AFC) dataset is derived from the American Board of Family Medicine PRIME Registry.[2–4] PRIME, currently the largest national Qualified Clinical Data Registry for primary care, contains over 8.5 million patient records across all 50 states, Washington, D.C., and U.S. territories.[5] Primary care clinicians opt in to this system, which helps them improve patient outcomes and alleviate the burden of Medicare and Medicaid reporting as well as measurement of social determinants of health.[6]

We use these datasets to link parents to children and parents to their political affiliations. We first infer likely parent-child pairs within AFC. AFC contains household ID numbers for 70.52% of patients, where identical household IDs indicate patients at the same address living together and are only generated for patients with sufficiently detailed address information. Thus, we restrict potential parent-child relationships to exist only among patients who share a household ID number. Since these parent-child matches rely on shared household ID, all children who appear in our dataset are indicated as still living at home at the time of data collection. This introduces a source of bias in our analysis of pre-2006 birth cohorts, as it excludes adult children who have moved away from home by 2024.

To ensure that potential parents are not simply older siblings, we restrict potential parents to be adults over 18 who are 12-55 years older than potential children.[7] Children with no such potential parents are excluded. We allow a child to have any number of potential parents at this stage.

To pair potential parents from the AFC dataset with voters from the L2 dataset, we use a matching strategy informed by [8] and implemented in [9,10]. This prior work compared six different matching methods:

- Tier 1: Unique match on exact first name, last name, state, and birth date (day/month/year)
- Tier 2: Unique match on exact first name, last name, state, and birth month/year
- Tier 3: Unique match on exact first name, last name, state, and birth year
- Tier 4: Unique match on exact first name, last name, and birth date (day/month/year)
- Tier 5: Unique match on exact first name, last name, and birth month/year
- Tier 6: Unique match on exact first name, last name, and birth year

For our analysis, we apply all six tiers sequentially, with any tied matches within a tier being discarded. Out of 456,317 potential parents, we match 267,513 (58.62%) to political parties. Using this information, we construct a household-level measure of political affiliation. We classify a child as living in a “Republican” household if all potential parents in the household are Republicans (133,271 total children), and a “Democratic” household if all potential parents in the household are Democrats (93,628 total children). These children lived in all U.S. states, as well as Washington, D.C. However, no children from Republican households lived in Vermont.

For our regressions, we iteratively add covariates at the regional level for U.S. Census region,[11] Rural-Urban Commuting Area code as an indicator of rurality,[12] the 2022 Social Vulnerability Index of the patient’s ZIP code,[13,14] and the share of the county that voted for the Republican candidate in the presidential election year less than or equal to, and closest to, the child’s birth year.[15] Due to differences in the geometries for Alaska between our county Republican vote share data (which includes Alaska’s voting districts only) and our merged L2-AFC data (which includes Alaska’s counties only), we were unable to analyze data from children living in Alaska, since we could not adjust for their Republican vote share.

Because the AFC data do not always contain full medical histories,[16] older children may not have recorded measles, mumps, and rubella (MMR) vaccinations or vaccine refusals because their electronic health record (EHR) does not stretch back far enough. For this reason, we require potential children to have a documented engagement in their EHR at least once prior to 1 year of age for all analyses. Once we made this restriction, our dataset contained children in 47 states (excluding Alaska, Vermont, and North Dakota), with a total of 27,577 children in Republican households and 19,562 children in Democratic households.

EHR Outcomes

The AFC data are stored using the Observational Medical Outcomes Partnership Common Data Model (OMOP CDM), which stores many types of patient information (including drugs, procedures, observations, measurements, and conditions). The OMOP CDM is useful because it brings together many existing vocabularies, such as International Classification of Diseases (ICD)-9 and ICD-10,[17] CVX, and more. For each piece of information, called a "concept," OMOP creates a specific "ID," internal to OMOP, and also includes a "code," from the external vocabulary that the concept is sourced from. For equivalent concepts across multiple vocabularies, the OMOP CDM creates one "standard concept" and maps equivalent concepts to that concept. However, these mappings are known to be faulty, especially for vaccine data.[18] Mappings also use IDs, not codes, and we observe that many entries in AFC contain only codes, with no matched ID. Since multiple codes can match to the same ID, there is no way to guarantee that existing codes can be matched to the correct ID and linked using the OMOP CDM mappings. To avoid inadvertently using incorrect mappings and falsely recording or missing refusals or MMR vaccination events, we determine refusals and MMR vaccination events using lists of codes and IDs that we generate from Athena, an online tool provided by Observational Health Data Sciences and Informatics, the organization that creates the standardized vocabularies for OMOP. For vaccine refusals, we source 20 codes associated with a refusal event. We also source 1,363 codes and IDs representing MMR vaccination events (full list available on GitHub: https://github.com/reglab/partisan_vaccination).

We extract vaccine refusal events from the "Observation" table. We extract potential MMR vaccine events from the "Drug," "Procedure," "Measurement," and "Condition" tables. We then filter these tables to valid vaccine refusals and MMR vaccine events. A valid refusal or MMR vaccine event is one in which the ID exactly matches an ID in our list, or one where the ID is not entered but the code is an exact match to a code in our list. We exclude codes with length under 3 characters for this match. We implement this exclusion because of concerns about false matches. For example, the code "03," corresponding to ID "40213183," indicates an MMR vaccination in the "Drug" table. However, the same code, corresponding to ID "2000163" indicates a spinal operation in the "Procedure" table. Because of known issues where vaccination events meant to be recorded in the "Drug" table are instead recorded in the "Procedure" table,[19] we were concerned that code "03" in the "Procedure" table, where an ID was missing, could refer to spinal operations or MMR vaccines, with no way to distinguish the two. For this reason, we exclude short codes. We also observe that patient codes within the AFC data often do not solely contain the code (and sometimes do not contain a code at all), but instead contain entries such as "03 MMR" or simply "MMR vaccine." We use regular expressions to subset entries from these tables with nonstandard codes that correspond to MMR vaccination events and vaccination refusals.

In addition to working with OMOP codes and IDs, we extract additional vaccine refusals and MMR vaccination events from patient notes. We subset patient notes to notes containing "refus" or "MMR" or "measle" for vaccine refusals and MMR vaccination events. For vaccine refusals, we further subset notes that contain ICD-9 and ICD-10 codes indicating refusal, locate sections of notes pertaining to refusals, and find the date of refusal, if present. If no date is present, we take the date of the patient note to be the date of refusal. For MMR vaccination notes, we pull prior dates of MMR vaccinations from the "Immunizations" section of the notes, which records patient immunization history. Visits in which an MMR vaccine is administered record the vaccine in the "Procedures," "Procedures Ordered," or "Orders" sections of notes – we include these as vaccination events on the date the note was recorded. Some patient notes do not have sections, instead only recording "MMR" or "MMR given." We also include these as MMR vaccine events on the date that the note was recorded.

Data Missingness

We note that both our vaccine refusal rate and MMR vaccination rates are lower than expected. Previous studies assessing vaccine refusals have found refusal rates between 8.00% and 9.10% for children before 2 years of age.[20,21]

Our corresponding refusal rate before age 2 is considerably lower, at 4.52%. This discrepancy could be caused by several factors. The EHR data we have access to are not complete—in particular, they may be missing parts of records for patients who change providers or for early in patients' health histories. We note that our MMR vaccination rate (77.81%) is also lower than expected (92.7%).[22] We attribute this incompleteness mainly to issues with our EHR data related to practices not digitizing historical records, not recording records transferred from other practices, or failing to record vaccinations that were not directly provided by the practice.

B. Vaccination practices in the U.S.

Traditionally, vaccination practices in the U.S. have been in accordance with the recommendations of the CDC. Since the 1940s, vaccines have been recommended by the government, with vaccines being added (or removed in the case of smallpox) over the past 80 years. Current CDC recommendations are synthesized in the "Child and Adolescent Immunization Schedule by Age,"[23] which is updated by the Advisory Committee on Immunization Practices. More recently, the medical community has also increasingly relied on the recommendations of professional societies, such as the American Academy of Pediatrics.[24]

Other than such recommendations, there is no federal mandate for childhood vaccination in the U.S. Instead, state legislatures enact state-level mandates for specific immunizations prior to entry into daycare and school systems, and such mandates may include state-specific exemptions that reflect and/or shape different degrees of political polarization in vaccination uptake and refusal across states.

C. Equations

Equation 1. Characterizing evolving polarization semi-parametrically (linear regression)

$$Y_{it} = \beta_t P_{it} + \alpha_t + \epsilon_{it}$$

Where Y_{it} = 1 if patient *i* born in year *t* refused at least one vaccination, 0 otherwise
or 1 if patient *i* born in year *t* received an MMR vaccination, 0 otherwise
or delay of first MMR dose in days for patient *i* born in year *t*

P_{it} = Household political party indicator for patient *i* born in year *t*

ϵ_{it} = Error for patient *i* born in year *t*

Equation 2. Statistically testing for increasing polarization over time (linear regression)

$$Y_i = \beta_0 + \beta_1 P_i + \beta_2 t_i + \beta_3 P_i \cdot t_i + \beta_4 X_i + \epsilon_i$$

Where Y_i = 1 if patient *i* refused at least one vaccination, 0 otherwise
or 1 if patient *i* received an MMR vaccination, 0 otherwise
or delay of first MMR dose in days for patient *i*

P_i = Household political party indicator for patient *i*

t_i = Numerical birth year of patient *i*

X_i = Covariates

Baseline: acting vaccine policy;
Level 1: Baseline + U.S. census region + urban/rural indicator + social vulnerability index + county share Republican;
Level 2: Level 1 + patient sex + patient race + patient ethnicity;
Level 3: Level 2 + state-specific intercepts;
Level 4: Level 3 + practice-specific intercepts

ϵ_i = Error for patient *i*

Equation 3. Statistically testing for increasing polarization over time (logistic regression)

$$logit(P(Y_i = 1)) = \beta_0 + \beta_1 P_i + \beta_2 t_i + \beta_3 P_i \cdot t_i + \beta_4 X_i + \epsilon_i$$

Where Y_i = 1 if patient *i* refused at least one vaccination, 0 otherwise

or 1 if patient *i* received an MMR vaccination, 0 otherwise

P_i = Household political party indicator for patient *i*

t_i = Numerical birth year of patient *i*

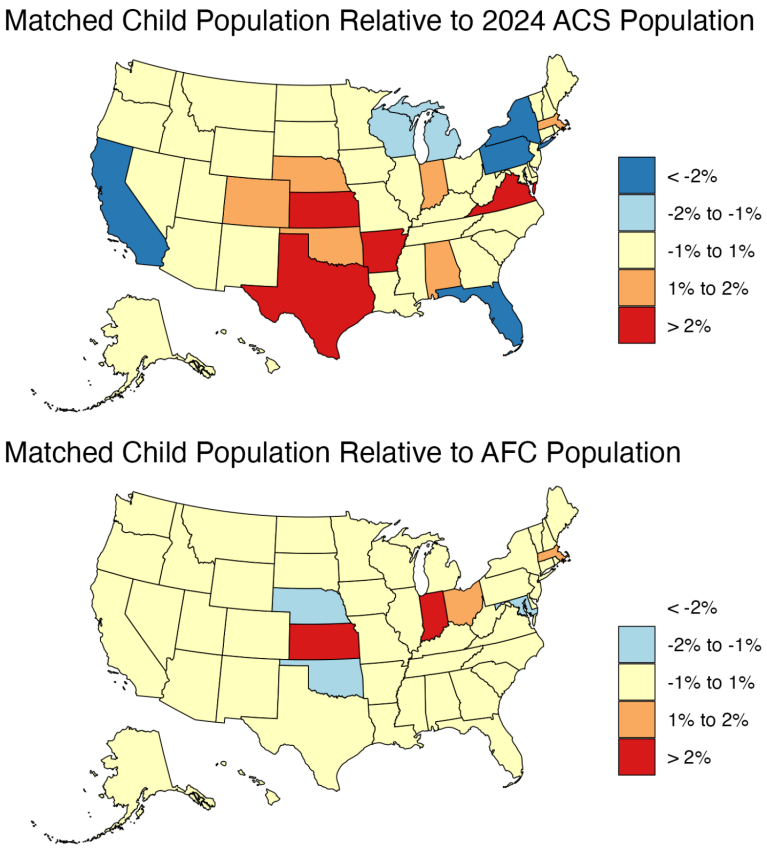
X_i = Covariates

Baseline: acting vaccine policy;
Level 1: Baseline + U.S. census region + urban/rural indicator + social vulnerability index + county share Republican;
Level 2: Level 1 + patient sex + patient race + patient ethnicity;
Level 3: Level 2 + state-specific intercepts;
Level 4: Level 3 + practice-specific intercepts

ϵ_i = Error for patient *i*

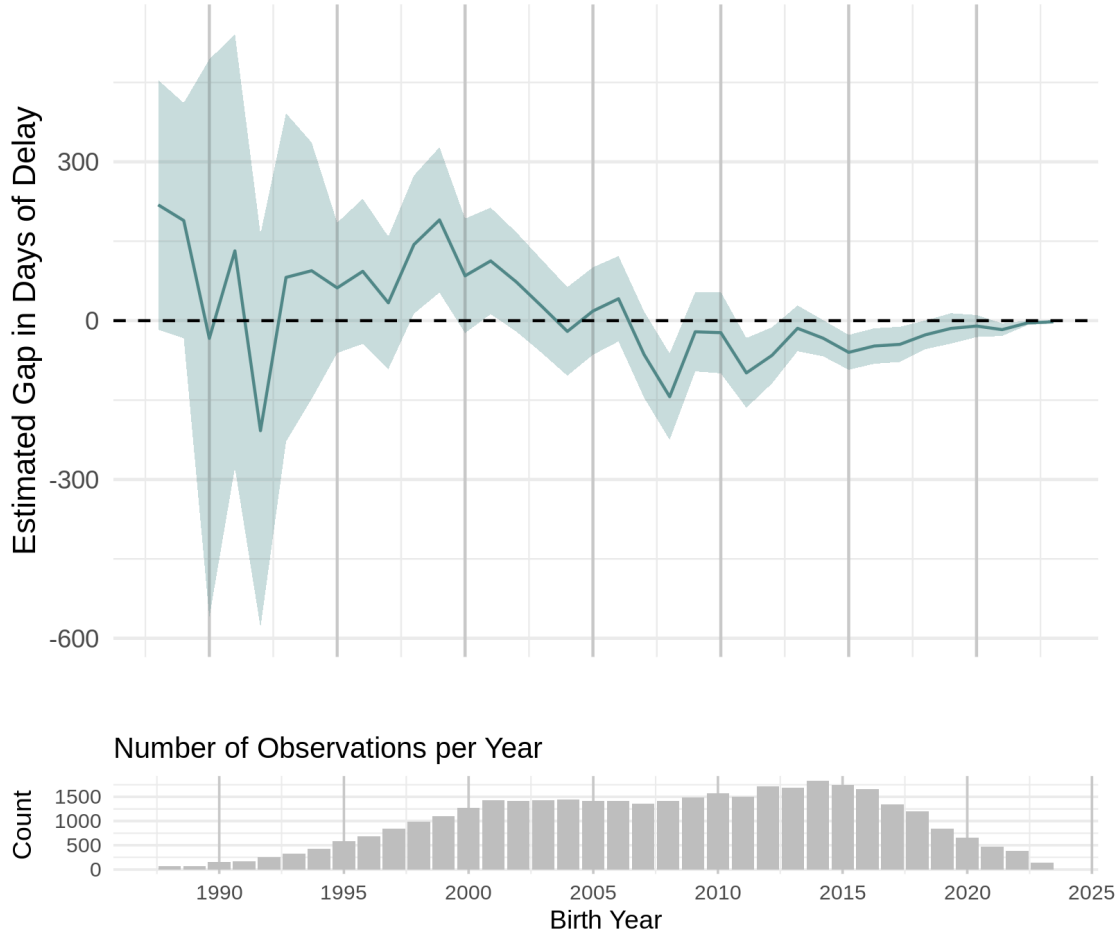
D. Additional figures and tables

Figure A. Relative Allocations of Study Population to ACS and AFC, by State



Top panel displays the proportion of children linked to parents in the L2 data living in each state minus the proportion of residents in each state from the 2024 American Community Survey (ACS) 1-year summary (min: -3.64%, max: 5.91%). Bottom panel displays the proportion of children linked to parents in the L2 data living in each state minus the proportion of residents in each state in the full population of the American Family Cohort (AFC) (min: -1.34%, max: 3.92%).

Figure B. Difference in days of MMR vaccination delay (Democrat–Republican) by birth year for children with in-time MMR vaccination



Top panel displays estimated gap in days of delay for MMR vaccination (line; Democratic delay minus Republican delay) and 95% confidence region (shaded) for linear model with birth year fixed effects. Lower panel displays total patient counts (*n* = 36,513) by birth year. MMR = measles, mumps, and rubella.

Table A. Dropout analysis

	Patients with no household ID	Children with no parental political information	Children with mixed or other parental political affiliation	Children with parents who are all Democrats or all Republicans
n	2,523,397	174,512	76,534	226,899
Sex				
Female	1,023,948 (54.6%)	93,419 (53.6%)	39,428 (51.6%)	118,143 (52.1%)
Male	850,539 (45.4%)	80,981 (46.4%)	37,047 (48.4%)	108,534 (47.9%)
Race/Ethnicity				
Hispanic or Latino	235,774 (9.3%)	28,990 (16.6%)	7,866 (10.3%)	26,109 (11.5%)
American Indian and Alaska Native	36,729 (1.5%)	834 (0.5%)	269 (0.4%)	768 (0.3%)
Asian	49,393 (2%)	4,634 (2.7%)	2,036 (2.7%)	3,863 (1.7%)
Black or African American	175,724 (7%)	10,025 (5.7%)	3,320 (4.3%)	13,088 (5.8%)
Multiple Races	1,462 (0.1%)	76 (0%)	52 (0.1%)	117 (0.1%)
Native Hawaiian and Other Pacific Islander	5,843 (0.2%)	595 (0.3%)	199 (0.3%)	463 (0.2%)
White	1,435,840 (56.9%)	90,141 (51.7%)	48,724 (63.7%)	142,447 (62.8%)
Social Vulnerability Index Score				
[0,25)	126,648 (7.1%)	7,611 (4.4%)	5,348 (7%)	14,667 (6.5%)
[25,50)	335,174 (18.8%)	25,710 (14.7%)	14,544 (19%)	43,467 (19.2%)
[50,75)	507,942 (28.5%)	44,145 (25.3%)	23,673 (30.9%)	67,454 (29.7%)
[75,100]	812,261 (45.6%)	97,017 (55.6%)	32,960 (43.1%)	101,277 (44.6%)
Rural/Urban Indicator				
Rural	365,644 (20.5%)	27,836 (16%)	12,485 (16.3%)	36,876 (16.3%)
Urban	1,421,635 (79.5%)	146,665 (84%)	64,047 (83.7%)	190,016 (83.7%)
Missing Information				
Missing or Other Sex	648,910 (25.7%)	112 (0.1%)	59 (0.1%)	222 (0.1%)
Missing or Other Race/Ethnicity	582,632 (23.1%)	39,217 (22.5%)	14,068 (18.4%)	40,044 (17.6%)
Missing Social Vulnerability Index Score	741,372 (29.4%)	29 (0%)	9 (0%)	34 (0%)
Missing Urban/Rural Indicator	736,118 (29.2%)	11 (0%)	2 (0%)	7 (0%)

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.

Table B. State vaccine policies

State	With religious exemption	Without religious exemption	With personal beliefs exemption	Without personal beliefs exemption
AL	01/01/1988-04/28/2025			01/01/1988-04/28/2025
AK	01/01/1988-04/28/2025			01/01/1988-04/28/2025
AZ	01/01/1988-04/28/2025		12/31/1991-04/28/2025	01/01/1988-12/30/1991
AR	01/01/1988-04/28/2025		04/01/2003-04/28/2025	01/01/1988-03/31/2003
CA	01/01/1988-01/01/2016	01/02/2016-04/28/2025	01/01/1988-01/01/2016	01/02/2016-04/28/2025
CO	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
CT	01/01/1988-04/27/2021	04/28/2021-04/28/2025		01/01/1988-04/28/2025
DE	01/01/1988-04/28/2025			01/01/1988-04/28/2025
DC	01/01/1988-04/28/2025			01/01/1988-04/28/2025
FL	01/01/1988-04/28/2025			01/01/1988-04/28/2025
GA	01/01/1988-04/28/2025			01/01/1988-04/28/2025
HI	01/01/1988-04/28/2025			01/01/1988-04/28/2025
ID	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
IL	01/01/1988-04/28/2025			01/01/1988-04/28/2025
IN	01/01/1988-04/28/2025		01/01/1988-05/05/1993	05/06/1993-04/28/2025
IA	01/01/1988-04/28/2025			01/01/1988-04/28/2025
KS	01/01/1988-04/28/2025			01/01/1988-04/28/2025
KY	01/01/1988-04/28/2025		03/28/2021-04/28/2025	01/01/1988-03/27/2021
LA	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
ME	01/01/1988-08/31/2021	09/01/2021-04/28/2025	01/01/1988-08/31/2021	09/01/2021-04/28/2025
MD	01/01/1988-04/28/2025			01/01/1988-04/28/2025
MA	01/01/1988-04/28/2025			01/01/1988-04/28/2025
MI	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
MN	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
MS	07/15/2023-04/28/2025	01/01/1988-07/14/2023		01/01/1988-04/28/2025
MO	01/01/1988-04/28/2025		01/01/1988-07/05/1992	07/06/1992-04/28/2025
MT	01/01/1988-04/28/2025			01/01/1988-04/28/2025
NE	01/01/1988-04/28/2025		01/01/1988-06/30/1994	07/01/1994-04/28/2025
NV	01/01/1988-04/28/2025			01/01/1988-04/28/2025
NH	01/01/1988-04/28/2025			01/01/1988-04/28/2025
NJ	01/01/1988-04/28/2025			01/01/1988-04/28/2025
NM	01/01/1988-04/28/2025			01/01/1988-04/28/2025

Table B. State vaccine policies (continued)

State	With religious exemption	Without religious exemption	With personal beliefs exemption	Without personal beliefs exemption
NY	01/01/1988-06/12/2019	06/13/2019-04/28/2025		01/01/1988-04/28/2025
NC	01/01/1988-04/28/2025			01/01/1988-04/28/2025
ND	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
OH	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
OK	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
OR	01/01/1988-04/28/2025		06/26/2013-04/28/2025	01/01/1988-06/25/2013
PA	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
RI	01/01/1988-04/28/2025		07/26/1993-04/28/2025	01/01/1988-07/25/1993
SC	10/19/1993-04/28/2025	01/01/1988-10/18/1993		01/01/1988-04/28/2025
SD	01/01/1988-04/28/2025			01/01/1988-04/28/2025
TN	01/01/1988-04/28/2025			01/01/1988-04/28/2025
TX	01/01/1988-04/28/2025		09/01/2003-04/28/2025	01/01/1988-08/31/2003
UT	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
VT	01/01/1988-04/28/2025		01/01/1988-06/30/2016	07/01/2016-04/28/2025
VA	01/01/1988-04/28/2025			01/01/1988-04/28/2025
WA	01/01/1988-04/28/2025		01/01/1988-11/21/2019	11/22/2019-04/28/2025
WV		01/01/1988-04/28/2025		01/01/1988-04/28/2025
WI	01/01/1988-04/28/2025		01/01/1988-04/28/2025	
WY	01/01/1988-04/28/2025			01/01/1988-04/28/2025

The level of MMR vaccine exemption present in every U.S. state from January, 1988 to April, 2025. MMR = measles, mumps, and rubella.

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

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	0.528 (0.41,0.64)	< 0.001
+Regional covariates	0.463 (0.35,0.58)	< 0.001
+Individual covariates	0.435 (0.32,0.55)	< 0.001
+State Fixed Effects	0.485 (0.13,0.84)	0.011
+Practice Fixed Effects	0.386 (0.11,0.66)	0.0066

Linear probability models include all children (n = 46,924), with outcome 1 if the patient received an MMR vaccination from age 12 months to age 15 months (n = 27,579), 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 C). See Appendix Table O for logistic regression version.
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 D. Difference in percentage points of in-time MMR vaccination indicator (Democrat–Republican) per 1-year increase in birth year by linear model type for all children

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	0.490 (0.39,0.59)	< 0.001
+Regional covariates	0.423 (0.33,0.52)	< 0.001
+Individual covariates	0.395 (0.30,0.49)	< 0.001
+State Fixed Effects	0.467 (0.16,0.78)	0.0049
+Practice Fixed Effects	0.327 (0.09,0.56)	0.0072

Linear probability models include all children (n = 46,924), with outcome 1 if the patient received an MMR vaccination from age 12 months to age 6 years, 11 months (n = 35,762), 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 C). See Appendix Table P for logistic regression version.
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 E. Difference in percentage points of vaccine refusal indicator by state policy (Non-medical exemptions–Medical exemptions) and linear model type for all children

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
No covariates	3.26 (0.29, 6.22)	0.03
+Regional covariates	3.39 (0.42, 6.36)	0.03
+Individual covariates	3.13 (0.15, 6.11)	0.04

Linear probability models include all children (n = 40,410), with outcome 1 if the patient had a recorded vaccine refusal prior to 7 years of age (n = 3,648). Partisan refusal gap is defined as (children in Democratic households under non-medical vaccine exemptions minus children in Republican households under non-medical vaccine exemptions) minus (children in Democratic households under medical vaccine exemptions minus children in Republican households under medical vaccine exemptions). Each row represents a model with newly added covariates, cumulative of all previous rows (see Equation 2 in Appendix C). 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.

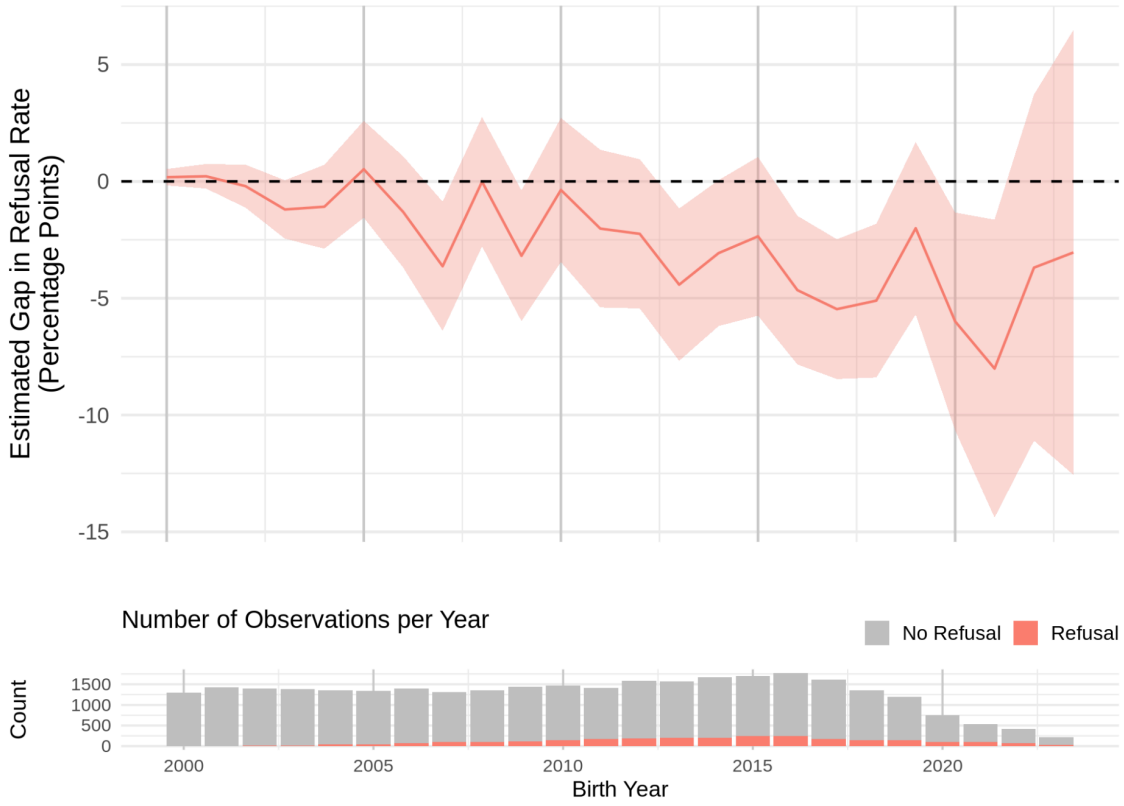
Table F. Difference in percentage points of on-track MMR indicator by state policy (Non-medical exemptions–Medical exemptions) and linear model type for all children

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
No covariates	-3.70 (-10.70, 3.30)	0.30
+Regional covariates	-3.07 (-10.06, 3.91)	0.39
+Individual covariates	-4.04 (-10.94, 2.85)	0.25

Linear probability models include all children (n = 46,924), with outcome 1 if the patient received an MMR vaccine from age 12 months to age 3 years, 11 months (n = 33,157). Partisan MMR vaccine gap (children in Democratic households under non-medical vaccine exemptions minus children in Republican households under non-medical vaccine exemptions) minus (children in Democratic households under medical vaccine exemptions minus children in Republican households under medical vaccine exemptions). Each row represents a model with newly added covariates, cumulative of all previous rows (see Equation 2 in Appendix C).
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.
MMR = measles, mumps, and rubella.

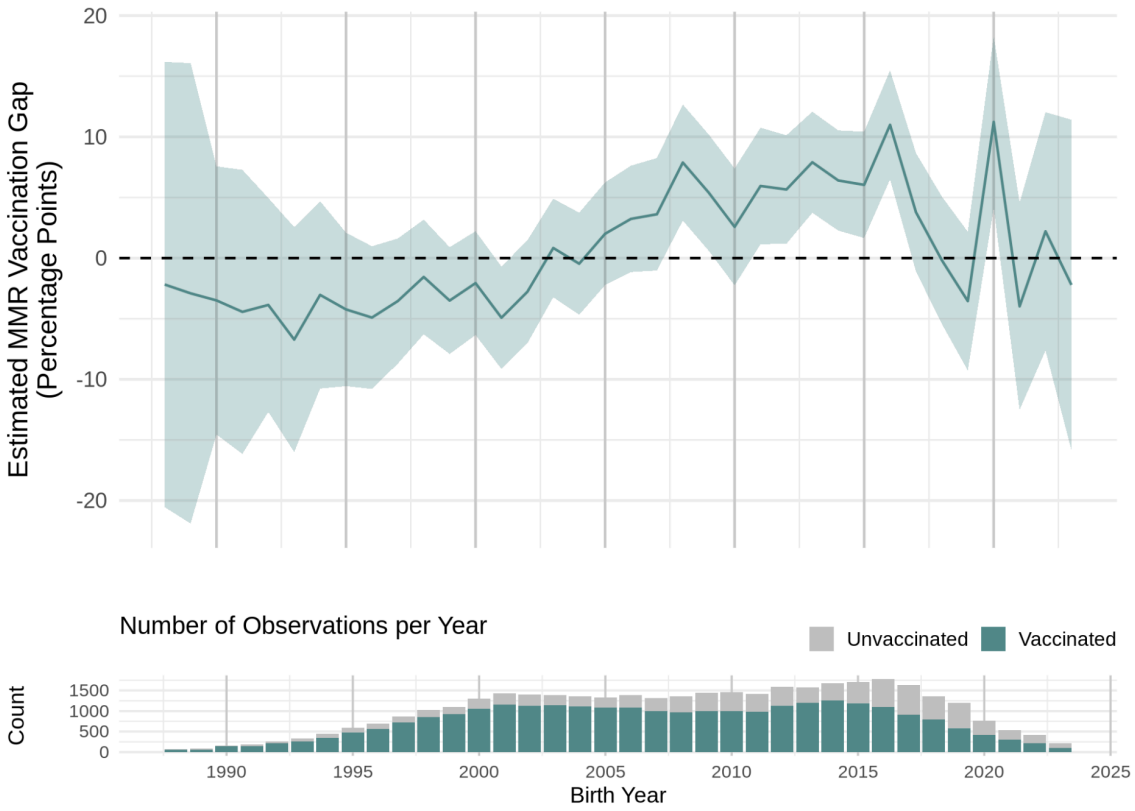
E. Robustness checks

Figure C. Percentage point gap in partisan vaccination refusals (Democrat–Republican) by birth year for all children, where parental political affiliation uses 2018 data



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 = 30,980) and patient refusal counts (n = 2,693) by birth year.

Figure D. Percentage point gap in on-track MMR vaccine uptake (Democrat–Republican) by birth year for all children, where parental political affiliation uses 2018 data



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 = 36,876) and vaccinated patient counts (n = 26,674) 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.

Table G. Difference in percentage points of vaccine refusal indicator (Democrat–Republican) per 1-year increase in birth year by linear model type for children with 1 or 2 potential parents

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	-0.247 (-0.34,-0.15)	< 0.001
+Regional covariates	-0.271 (-0.36,-0.18)	< 0.001
+Individual covariates	-0.279 (-0.37,-0.19)	< 0.001
+State Fixed Effects	-0.256 (-0.55,0.04)	0.1
+Practice Fixed Effects	-0.242 (-0.50,0.02)	0.066

Linear probability models include children associated with 1 or 2 potential parents, born after 2000, with valid vaccine refusal dates (n = 38,094), with outcome 1 if the patient had a recorded vaccine refusal prior to 7 years of age (n = 3,498). 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 C).
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 H. Difference in percentage points of on-track MMR vaccination indicator (Democrat–Republican) per 1-year increase in birth year by linear model type for children with 1 or 2 potential parents

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	0.493 (0.39,0.60)	< 0.001
+Regional covariates	0.420 (0.31,0.53)	< 0.001
+Individual covariates	0.395 (0.29,0.50)	< 0.001
+State Fixed Effects	0.467 (0.17,0.76)	0.0033
+Practice Fixed Effects	0.353 (0.13,0.57)	0.0019

Linear probability models include all children associated with 1 or 2 potential parents (n = 44,354), with outcome 1 if the patient received an MMR vaccination from age 12 months to age 3 years, 11 months (n = 31,404), 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 C).
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 I. Difference in days of MMR vaccination delay (Democrat–Republican) per 1-year increase in birth year by linear model type for children with 1 or 2 potential parents

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	-1.840 (-2.82,-0.86)	< 0.001
+Regional covariates	-1.635 (-2.62,-0.65)	0.0012
+Individual covariates	-1.615 (-2.60,-0.63)	0.0014
+State Fixed Effects	-1.575 (-3.04,-0.11)	0.04
+Practice Fixed Effects	-1.343 (-2.37,-0.31)	0.011

Ordinary least squares regression models include all children associated with 1 or 2 potential parents who received an MMR vaccination after age 12 months and before age 6 years, 11 months (n = 33,862). 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 C).

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 J. Difference in percentage points of vaccine refusal indicator (Democrat–Republican) per 1-year increase in birth year by linear model type for all children, where parents use their political affiliation in 2018

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	-0.239 (-0.34,-0.14)	< 0.001
+Regional covariates	-0.264 (-0.37,-0.16)	< 0.001
+Individual covariates	-0.278 (-0.38,-0.18)	< 0.001
+State Fixed Effects	-0.240 (-0.53,0.05)	0.11
+Practice Fixed Effects	-0.223 (-0.48,0.03)	0.083

Linear probability models include all children (n = 30,980) born in and after 2000, with outcome 1 if the patient had a recorded vaccine refusal prior to 7 years of age (n = 2,693). Parental party affiliation is based on 2018 voter data. 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 C).
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 K. 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, where parents use their political affiliation in 2018

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	0.455 (0.34,0.57)	< 0.001
+Regional covariates	0.393 (0.28,0.51)	< 0.001
+Individual covariates	0.359 (0.24,0.47)	< 0.001
+State Fixed Effects	0.458 (0.06,0.86)	0.028
+Practice Fixed Effects	0.348 (0.08,0.62)	0.012

Linear probability models include all children (n = 36,876) 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 = 26,674), and 0 otherwise. Parental party affiliation is based on 2018 voter data. 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 C).
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 L. 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, where parents use their political affiliation in 2018

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	-2.368 (-3.43,-1.30)	< 0.001
+Regional covariates	-2.194 (-3.26,-1.12)	< 0.001
+Individual covariates	-2.094 (-3.17,-1.02)	< 0.001
+State Fixed Effects	-2.045 (-3.59,-0.50)	0.013
+Practice Fixed Effects	-1.795 (-2.98,-0.61)	0.0031

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 = 28,754). Parental party affiliation is based on 2018 voter data. 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 C).
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.
Fixed effects are state-specific and practice-specific intercepts.
MMR = measles, mumps, and rubella.

Table M. Difference in log odds of vaccine refusal indicator (Democrat–Republican) per 1-year increase in birth year by logistic model type for all children

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	0.989 (0.98,1.00)	0.11
+Regional covariates	0.982 (0.97,1.00)	0.0083
+Individual covariates	0.984 (0.97,1.00)	0.02
+State Fixed Effects	0.985 (0.96,1.01)	0.28
+Practice Fixed Effects	0.979 (0.95,1.01)	0.13

Logistic regression 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 = 3,648). The difference presented is in the log odds of the Democratic refusal rate minus Republican refusal rate. Each row represents a model with newly added covariates, cumulative of all previous rows (see Equation 3 in Appendix C).
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 N. Difference in log odds of on-track MMR vaccination indicator (Democrat–Republican) per 1-year increase in birth year by logistic model type for all children

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	1.025 (1.02,1.03)	< 0.001
+Regional covariates	1.022 (1.02,1.03)	< 0.001
+Individual covariates	1.021 (1.02,1.03)	< 0.001
+State Fixed Effects	1.026 (1.01,1.05)	0.011
+Practice Fixed Effects	1.027 (1.01,1.05)	0.0045

Logistic regression 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 in the log odds of the Democratic uptake rate minus Republican uptake rate. Each row represents a model with newly added covariates, cumulative of all previous rows (see Equation 3 in Appendix C).
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 O. Difference in log odds of on-schedule MMR vaccination indicator (Democrat–Republican) per 1-year increase in birth year by logistic model type for all children

Model	Democrat-Birth Year Interaction (95% CI)	*p* value
Policy covariates	1.022 (1.02,1.03)	< 0.001
+Regional covariates	1.020 (1.01,1.02)	< 0.001
+Individual covariates	1.019 (1.01,1.02)	< 0.001
+State Fixed Effects	1.022 (1.01,1.04)	0.0089
+Practice Fixed Effects	1.020 (1.01,1.03)	0.0047

Logistic regression models include all children (*n* = 46,924), with outcome 1 if the patient received an MMR vaccination from age 12 months to age 15 months (*n* = 27,579), and 0 otherwise. The difference presented is in the log odds of the Democratic uptake rate minus Republican uptake rate. Each row represents a model with newly added covariates, cumulative of all previous rows (see Equation 3 in Appendix C).
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 P. Difference in log odds of in-time MMR vaccination indicator (Democrat–Republican) per 1-year increase in birth year by logistic model type for all children

Model	Democrat-Birth Year Interaction (95% CI)	p value
Policy covariates	1.026 (1.02,1.03)	< 0.001
+Regional covariates	1.022 (1.02,1.03)	< 0.001
+Individual covariates	1.020 (1.01,1.03)	< 0.001
+State Fixed Effects	1.026 (1.00,1.05)	0.029
+Practice Fixed Effects	1.027 (1.00,1.05)	0.033

Logistic regression models include all children (n = 46,924), with outcome 1 if the patient received an MMR vaccination from age 12 months to age 6 years, 11 months (n = 35,762), and 0 otherwise. The difference presented is in the log odds of the Democratic uptake rate minus Republican uptake rate. Each row represents a model with newly added covariates, cumulative of all previous rows (see Equation 3 in Appendix C).
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.

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