

Analysis of Adverse Event Rates

In this section we compare the rate of Global and US reports of post-vaccination adverse events (AE), for the COVID-19 vaccine and the Flu vaccine. For each of the AE, we compare three relevant rates of reporting: i) the rate of reported AE per unit time, ii) the rate of reported AE per dose given, and iii) the rate of reported AE per person vaccinated.

In Table 0 below, we report the period used for normalizing the data, Global values are reported on the top line, US value on the second line.

Vaccine	Time Tracked	Billion Doses Given	Billion People Vaccinated
COVID-19	18 Months	12.07	5.23
		0.596	0.260
Flu	294 Months	66 (estimated)	7.71 (simulated)
		3.3	0.313 (simulated)

Table 0

Counting the number of people vaccinated with the COVID-19 vaccine is straightforward because there has only been one worldwide attempt at vaccination and the data has been tracked from day one. The Flu vaccine is harder because individuals are not tracked and there are yearly seasons where an individual may choose to receive a subsequent vaccinations. We run a Monte Carlo simulation to estimate the number of people that have received at least one Flu vaccine in the US since 1998.

We track a sample population where each year a fraction of the eligible (old enough) population is vaccinated, f_v , a fraction of the population dies (some of whom may be vaccinated), f_d , and a new fraction of the population becomes eligible (none of whom are vaccinated), f_e . By simulating the demographics change yearly, we can estimate the total number of people who have received at least one flu vaccine by 2022. We use the UN population data to estimate f_e and f_d each year (reference: <https://population.un.org/>) and the conditional probability of Flu vaccination from Kwong, et al. (reference: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6961264/>). Kwong reports that roughly 57% (33,234 out of 58,021) of the population in their study who receives a flu shot in one year repeats it a subsequent year. The CDC reports that approximately 50% of the population receives the vaccine in any given year. From that, we approximate $f_v = 0.57$ for previously vaccinated individuals and $f_v = 0.43$ for previously unvaccinated individuals, which will result in the rough CDC approximation of 50% of the population being vaccinated any given year.

To allow simulation "burn in" for the stochastic nature of this experiment, we start in 1980 with a sample of the eligible US population of 100,000,000 people with 50% of them "pre-vaccinated" from previous years. From 1980 to 1997 we grow the population by f_e , shrink it by f_d , and vaccinate individuals by the conditional f_v based on their current vaccination status, by 1997 we can see that the fraction of vaccinated population has stabilized. We continue the simulation until 2021 with the addition that in 1998 we start accumulating the number of people who were vaccinated and died. The results of that simulation are shown below in Table 00.

End of Year	Sample Population (Thousands)	Vaccinated Population (Thousands)	Total Vaccinated Since 1998 (Thousands)
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End of Year	Sample Population (Thousands)	Vaccinated Population (Thousands)	Total Vaccinated Since 1998 (Thousands)
1980	100685	70921 (70.4%)	--
1981	101328	82921 (81.8%)	--
1982	101936	89923 (88.2%)	--
1983	102629	94190 (91.8%)	--
1984	103253	96842 (93.8%)	--
1985	103924	98746 (95.0%)	--
1986	104615	100133 (95.7%)	--
1987	105344	101170 (96.0%)	--
1988	106017	102026 (96.2%)	--
1989	106742	102790 (96.3%)	--
1990	107434	103590 (96.4%)	--
1991	108187	104335 (96.4%)	--
1992	108919	105104 (96.5%)	--
1993	109637	105790 (96.5%)	--
1994	110313	106507 (96.5%)	--
1995	110959	107191 (96.6%)	--
1996	111615	107893 (96.7%)	--
1997	112289	108579 (96.7%)	--
1998	112919	109203 (96.7%)	110157 (97.6%)
1999	113542	109799 (96.7%)	111722 (98.4%)
2000	114182	110390 (96.7%)	113264 (99.2%)
2001	114821	111055 (96.7%)	114889 (100.1%)
2002	115497	111745 (96.8%)	116497 (100.9%)
2003	116175	112461 (96.8%)	118139 (101.7%)
2004	116819	113102 (96.8%)	119745 (102.5%)
2005	117465	113757 (96.8%)	121371 (103.3%)
2006	118119	114412 (96.9%)	122989 (104.1%)
2007	118792	114997 (96.8%)	124521 (104.8%)

End of Year	Sample Population (Thousands)	Vaccinated Population (Thousands)	Total Vaccinated Since 1998 (Thousands)
2008	119496	115736 (96.9%)	126181 (105.6%)
2009	120074	116317 (96.9%)	127789 (106.4%)
2010	120665	116899 (96.9%)	129362 (107.2%)
2011	121265	117562 (96.9%)	130979 (108.0%)
2012	121819	118175 (97.0%)	132571 (108.8%)
2013	122308	118774 (97.1%)	134195 (109.7%)
2014	122830	119335 (97.2%)	135733 (110.5%)
2015	123360	119866 (97.2%)	137231 (111.2%)
2016	123855	120378 (97.2%)	138736 (112.0%)
2017	124287	120819 (97.2%)	140225 (112.8%)
2018	124730	121263 (97.2%)	141695 (113.6%)
2019	125123	121666 (97.2%)	143178 (114.4%)
2020	125570	122107 (97.2%)	144657 (115.2%)
2021	125981	122575 (97.3%)	146200 (116.0%)

Table 00

After running the simulation, in 2021 our sample population grew to 125,981,000, with a total of 146,200,000 (current vaccinated living plus the accumulated vaccinated dead) receiving at least one dose of the Flu vaccine since 1998 (116% of the current population). Now, we scale this estimate to the true 2022 the total eligible population of 269.5 million (329.5 million minus 60 million who are too young) (reference: <https://population.un.org/>), we estimate the same fraction of 116% of the current population vaccinated since 1998, that results in roughly a total 313 million people in the US that have received at least one dose of flu vaccine. Using the same scaling factor for an eligible world population of 6.65 (7.95 billion minus 1.3 billion), we get an estimate of 7.71 billion people worldwide who have received at least one dose of the flu vaccine since 1998. These are all rough estimates given the limited data available; however, even if these estimates are high by a factor of 2 (highly unlikely), the signals reported below are still significant.

Kwong, et al. track the number of vaccine doses a population of 38,766 people had over a 10-year period (Table 4 in their paper). A weighted average of the number of doses given per person over that 10-year period is 0.62 doses/person/year. Our estimates of 7.71 billion people receiving 66 billion doses globally (0.30 doses/person/year) and 313 million people receiving 3.3 billion doses in the US (0.35 doses/person/year) provide more evidence that our estimates are not wildly inconsistent with existing studies. Kwong, et al. are specifically studying people in the 65+ age category, which has roughly double the uptake of the general population (reference: <https://www.cdc.gov/flu/fluview/coverage-1819estimates.htm>), consistent with our estimates.

In Table 1 below we show the count of AE reported post vaccine in VAERS along with the mean rate of report over the time tracked, the mean rate of report per billion doses given, and the mean rate of report per billion people vaccinated. Report count and rates for the COVID-19 Vaccine are on the top line with the counts and rates for the Flu vaccine below them for each AE. The same data for global counts and rates is shown in Table 2.

Adverse Event	US Count of AE reports post Vaccine	US Rate of reported AE (count/Month)	US Rate of reported AE (count/billion doses)	US Rate of reported AE (count/billion people vaccinated)
Abnormal uterine bleeding (menstrual irregularity)	6352 54	353 0.184	10700 16.4	24400 173
Miscarriage	1232 259	68.4 0.881	2070 78.5	4740 827
Fetal chromosomal abnormalities	7 0	0.389 0.00	11.7 0.00	26.9 0.00
Fetal malformation	2 1	0.111 0.00340	3.35 0.303	7.69 3.19
Fetal cystic hygroma	5 0	0.278 0.00	8.39 0.00	19.2 0.00
Fetal cardiac disorders	10 2	0.556 0.00680	16.8 0.606	38.5 6.39
Fetal arrhythmia	3 0	0.167 0.00	5.03 0.00	11.5 0.00
Fetal cardiac arrest	3 0	0.167 0.00	5.03 0.00	11.5 0.00
Fetal vascular mal- perfusion	5 0	0.278 0.00	8.39 0.00	19.2 0.00
Fetal growth abnormalities	59 20	3.28 0.0680	99.0 6.06	227 63.9
Fetal abnormal surveillance	125 36	6.94 0.122	210 10.9	481 115
Fetal placental thrombosis	5 0	0.278 0.00	8.39 0.00	19.2 0.00
Fetal death (stillbirth)	168 42	9.33 0.143	282 12.7	646 134

Table 1

Adverse Event	Global Count of AE reports post Vaccine	Global Rate of reported AE (count/Month)	Global Rate of reported AE (count/billion doses)	Global Rate of reported AE (count/billion people vaccinated)
Abnormal uterine bleeding (menstrual irregularity)	12843 65	714 0.221	1060 0.985	2460 8.43
Miscarriage	3338 325	185 1.11	277 4.92	638 42.2
Fetal chromosomal abnormalities	10 0	0.556 0.00	0.829 0.00	1.91 0.00
Fetal malformation	22 2	1.22 0.00680	1.82 0.0303	4.21 0.259
Fetal cystic hygroma	8 0	0.444 0.00	0.663 0.00	1.53 0.00
Fetal cardiac disorders	18 2	1.00 0.00680	1.49 0.0303	3.44 0.259
Fetal arrhythmia	5 0	0.278 0.00	0.414 0.00	0.956 0.00
Fetal cardiac arrest	20 0	1.11 0.00	1.66 0.00	3.82 0.00
Fetal vascular mal-perfusion	12 0	0.667 0.00	0.994 0.00	2.29 0.00
Fetal growth abnormalities	188 24	10.4 0.0816	15.6 0.364	35.9 3.11
Fetal abnormal surveillance	178 45	9.89 0.153	14.7 0.682	34.0 5.84
Fetal placental thrombosis	6 0	0.333 0.00	0.497 0.00	1.15 0.00
Fetal death (stillbirth)	402 64	22.3 0.218	33.3 0.970	76.9 8.30

Table 2

For all AE, the rates of reports post COVID-19 vaccine are higher than the Flu vaccine across all three normalization methods: by unit time, by dose given, and by person vaccinated. We proceed with two analyses below: 1) compute the p-value to determine if the AE report rates are statistically different between the two vaccines, and 2) compute the relative rate and 95% CI of AE reports after the COVID-19 vaccine versus the Flu vaccine. That is, we answer the questions: 1) "Are the rate of AE reports post COVID-19 vaccine (statistically) different than the rates of report post

Flu vaccine?” and 2) “How much more frequently is an AE reported after the COVID-19 vaccine than after the Flu vaccine?”

Statistical Significance

We treat each AE report as discrete independent events occurring at the mean rate specified in Tables 1 and 2 which we model as a Poisson distribution. Given two rates r_1 and r_2 over a period, P , we perform a Poisson E-test [reference: <https://userweb.ucs.louisiana.edu/~kxk4695/JSPI-04.pdf>] to compute the p-value. The E-test is used for Poisson statistics analogous to the traditional t-test used for Gaussian statistics. The p-value is interpreted in the same way: the probability that the observed events came from the same probability distribution. Or stated another way: the probability that the means (in this case rates) are same by random chance.

We use the rates in Tables 1 and 2 above and normalize the event counts over each period, P : the time-, dose-, or people-vaccinated-window and report the p-values below in Table 3. Where there is sufficient data, the p-values are small, and where 0.0 is reported, it was too small to represent as a double precision floating point number in our E-test function [reference: <https://github.com/nolanbconaway/poisson-etest>].

Estimating Relative Reporting Rates

For the rates that have non-zero counts in the reporting period, we compute ratio of rates of AE reports for each vaccine and the 95% confidence interval (We do not use the p-value as a metric here to avoid claims of p-hacking, the full confidence interval is shown and the reader can deduce significance from that). That is, we compute how much more often a post COVID-19 vaccination AE is reported compared to post Flu vaccination. Consider a case where Event A is reported at a rate of 100 per month and Event B is reported at a rate of 10 per month. The naïve approach is to simply state that Event A is reported $\frac{100/\text{month}}{10/\text{month}} = 10$ times as often as Event B. However, events do not occur at uniform frequency, independent events occur at frequencies described by the Poisson distribution. We proceed by computing the ratio distribution, R , which is the distribution of the ratio of two different Poisson distributions. That is, given two Poisson distributions, $Poisson(r_1)$ and $Poisson(r_2)$, we aim to compute the ratio distribution, R , which represents the probability distribution of the ratio of the distribution of events.

$$R(r_1, r_2) = \frac{Poisson(r_1)}{Poisson(r_2)}$$

We estimate the shape of R for each AE and period, P , by performing Monte Carlo simulations. We draw 1,000,000 random samples from Poisson distributions with rates r_1 and r_2 resulting in a sample of paired event counts n_1 and n_2 , respectively, over the observation window P .

$$n_i \leftarrow Poisson(r_i)$$

That is, we create a set of 1,000,000 tuples of event counts $\{(n_1, n_2)_1, (n_1, n_2)_2, \dots, (n_1, n_2)_{1000000}\}$ drawn from the two Poisson distributions. The ratio distribution, R , is built up from the ratio of the draws of each pair of n_1 and n_2

$$R(r_1, r_2) = \left\{ \left(\frac{n_1}{n_2} \right)_1, \left(\frac{n_1}{n_2} \right)_2, \dots, \left(\frac{n_1}{n_2} \right)_{1000000} \right\}$$

The mean of R is the expectation value for the ratio of the two Poisson distributions and the empirically-derived quantile function of R is used to estimate the 95% CI of the mean. All computed values have converged to a precision of 1% or better. For AE that are reported infrequently post Flu vaccine there is finite probability that n_2 is zero resulting in R being undefined. To mitigate this problem, we use the zero-truncated Poisson distribution [reference: <https://www.jstor.org/stable/2527552>] and only count instances of non-zero n_2 draws. This approach skews the R distribution to the left [reference: <https://epubs.siam.org/doi/10.1137/0134043>] and makes the AE rates for the COVID-19 vaccine actually look better. That is, in these cases, the AE rate is actually a lower bound.

We did these analyses using a custom-written Python script, and will make it available upon request.

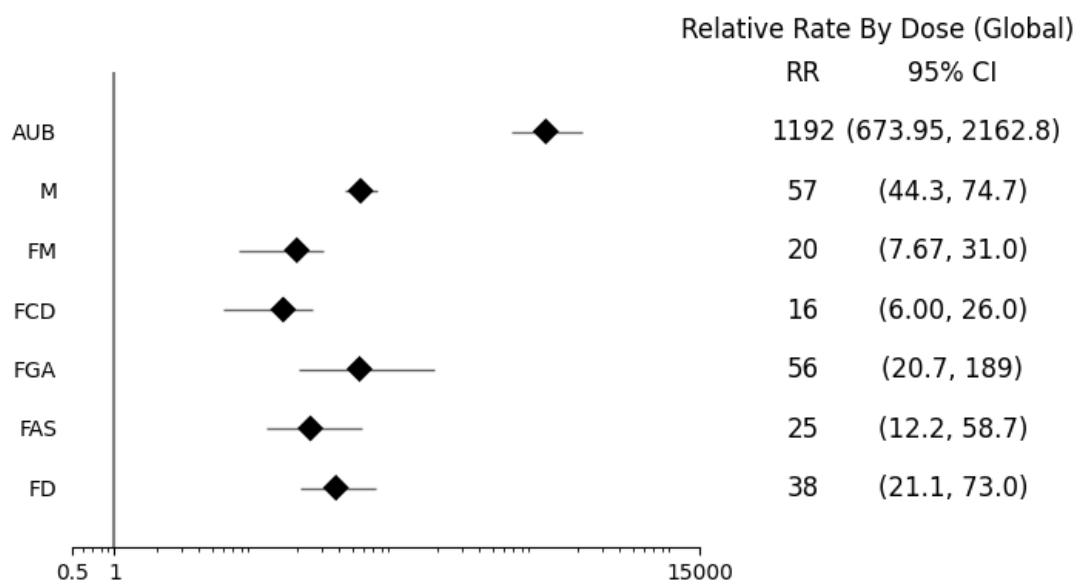
We report in Table 3 below the relative rate of post COVID-19 vaccine AE reports to post Flu vaccine AE report. Global values are the top line and US values are in the bottom line for each AE. A relative rate greater than 1 implies that there are more post COVID-19 vaccine AE reports than post Flu vaccine AE report. According to CDC's Standard Operating Procedures for COVID-19 [reference: <https://www.cdc.gov/vaccinesafety/pdf/VAERS-v2-SOP.pdf>] when doing a Proportional Reporting Ratio (PRR) analysis (which is analogous to the analysis presented here in this paper), a 2x increase in reporting is a sufficient signal to be concerned.

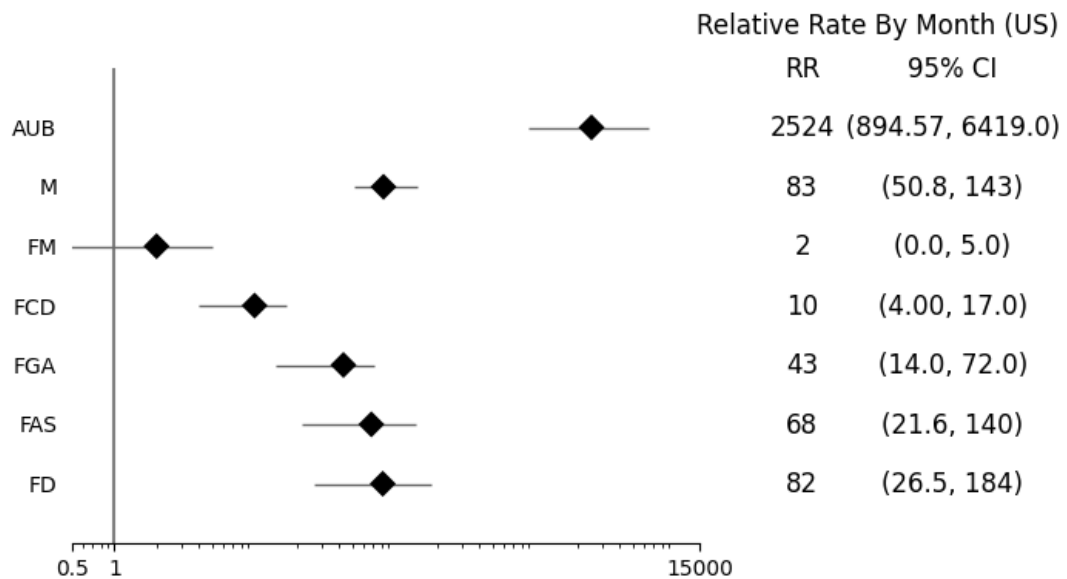
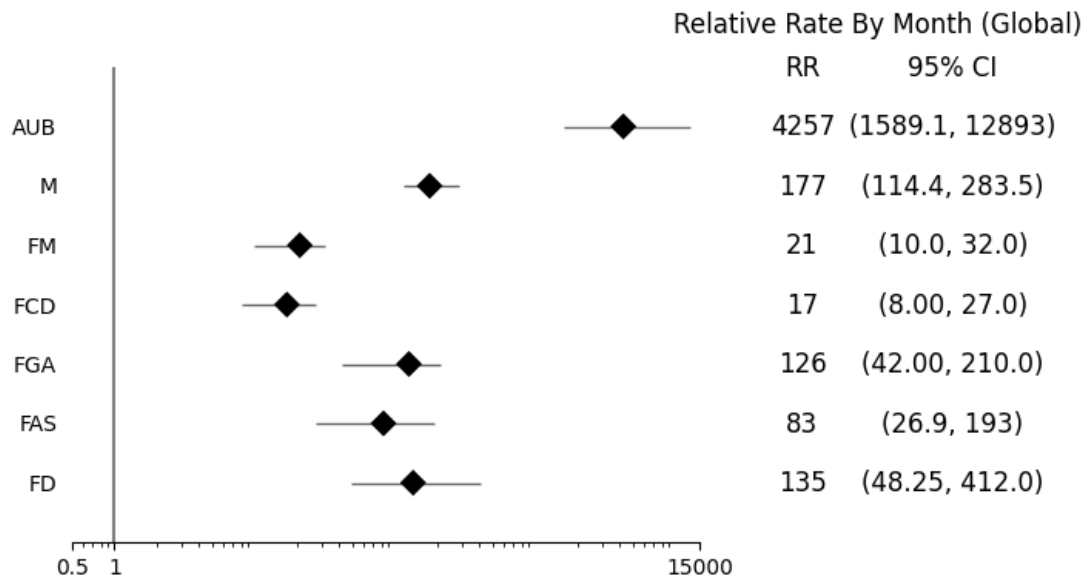
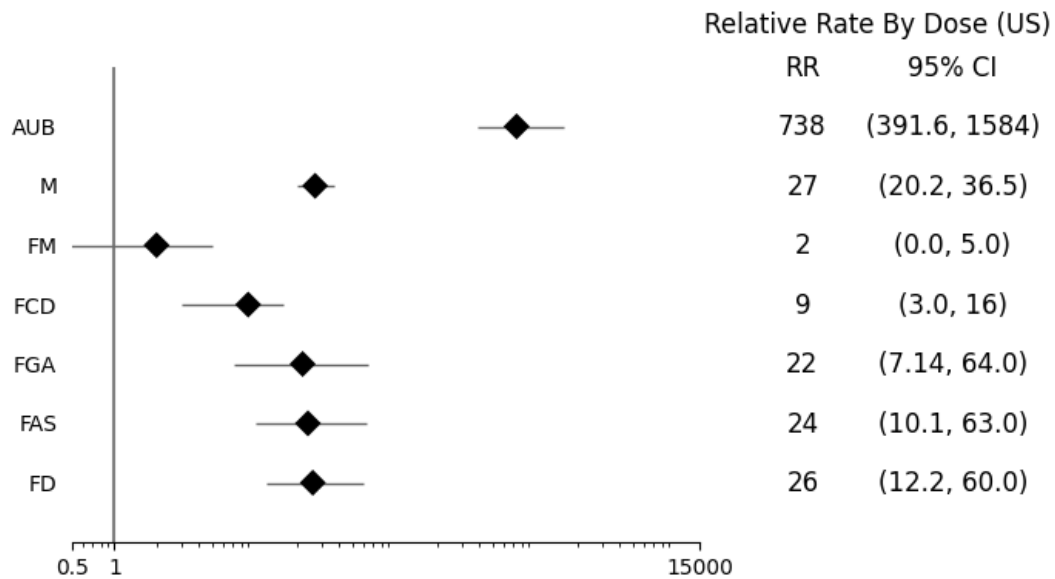
Adverse Event	Relative Rate (by time)	Relative Rate (by dose)	Relative Rate (by person vaccinated)
Abnormal uterine bleeding (menstrual irregularity)	4257 [1589.1-12893] p=0.0 2524 [894.57-6419.0] p=0.0	1192 [673.95-2162.8] p=0.0 738 [391.6-1584] p=0.0	298 [223.0-406.0] p=0.0 145 [108.6-197.4] p=0.0
Miscarriage	177 [114.4-283.5] p=0.0 83 [50.8-143] p=0.0	57 [44.3-74.7] p=0.0 27 [20.2-36.5] p=0.0	15 [13.3-17.5] p=0.0 6 [5.0-6.7] p=0.0
Fetal chromosomal abnormalities	p=0.00058 p=0.0048	p=0.00058 p=0.0048	p=0.00058 p=0.0048
Fetal malformation	21 [10.0-32.0] p=1.9x10 ⁻⁰⁷ 2 [0.0-5.0] p=0.20	20 [7.67-31.0] p=1.9x10 ⁻⁰⁷ 2 [0.0-5.0] p=0.20	15 [4.50-30.0] p=2.1x10 ⁻⁰⁶ 2 [0.0-5.0] p=0.20
Fetal cystic hygroma	p=0.0024 p=0.020	p=0.0024 p=0.020	p=0.0024 p=0.020
Fetal cardiac disorders	17 [8.00-27.0] p=2.6x10 ⁻⁰⁶ 10 [4.00-17.0] p=0.00058	16 [6.00-26.0] p=2.6x10 ⁻⁰⁶ 9 [3.0-16] p=0.00058	12 [3.60-25.0] p=2.7x10 ⁻⁰⁵ 6 [1.5-15] p=0.0047
Fetal arrhythmia	p=0.020 p=0.088	p=0.020 p=0.088	p=0.020 p=0.088
Fetal cardiac arrest	p=6.9x10 ⁻⁰⁷ p=0.088	p=6.9x10 ⁻⁰⁷ p=0.088	p=6.9x10 ⁻⁰⁷ p=0.088
Fetal vascular mal-perfusion	p=0.00015 p=0.020	p=0.00015 p=0.020	p=0.00015 p=0.020
Fetal growth abnormalities	126 [42.00-210.0] p=0.0 43 [14.0-72.0] p=0.0	56 [20.7-189] p=0.0 22 [7.14-64.0] p=0.0	12 [7.42-21.4] p=0.0 4 [2.2-6.8] p=3.2x10 ⁻⁰⁷

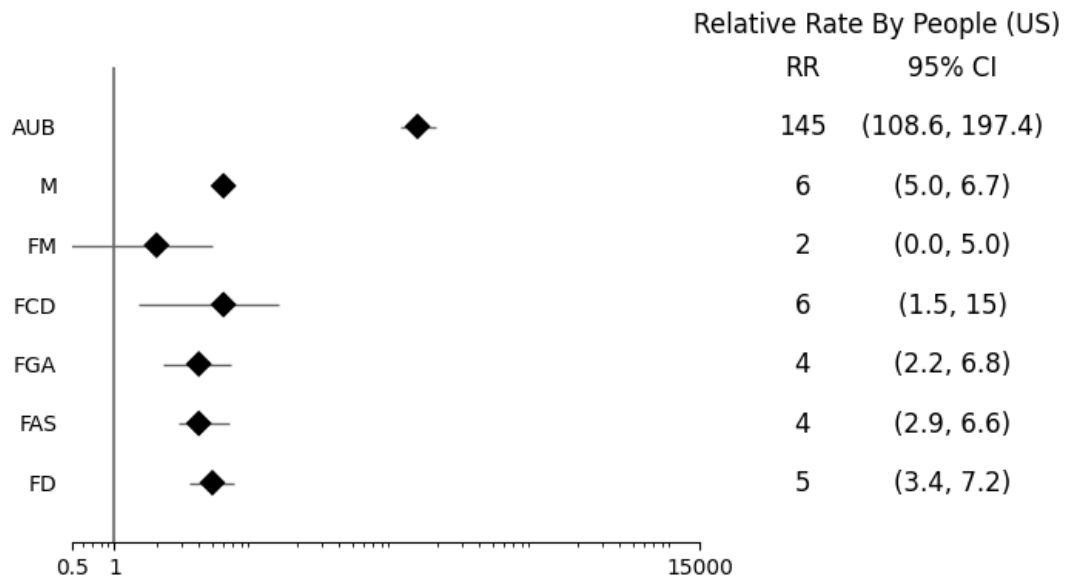
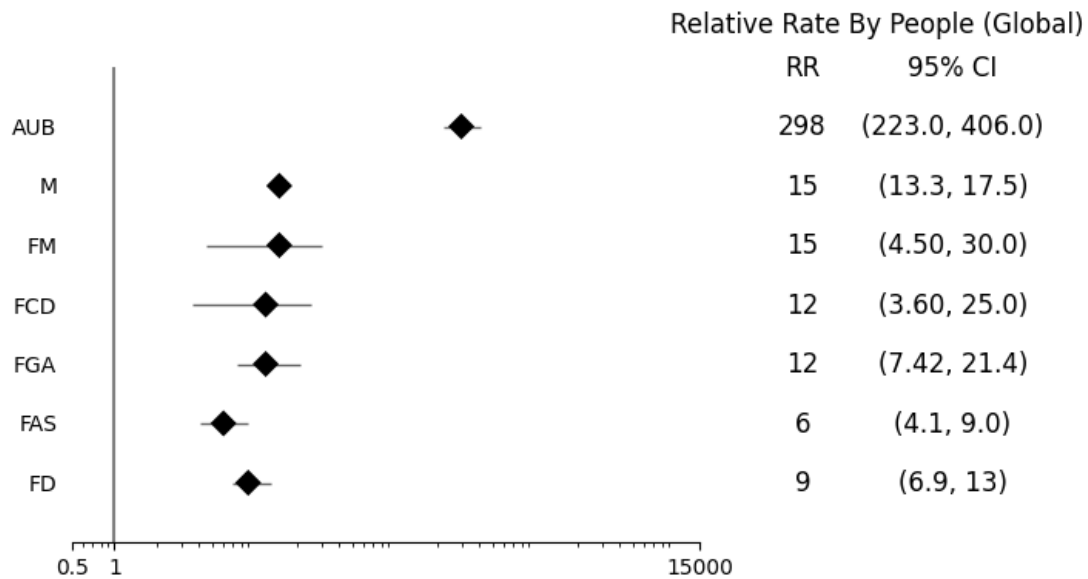
Adverse Event	Relative Rate (by time)	Relative Rate (by dose)	Relative Rate (by person vaccinated)
Fetal abnormal surveillance	83 [26.9-193] p=0.0 68 [21.6-140] p=0.0	25 [12.2-58.7] p=0.0 24 [10.1-63.0] p=0.0	6 [4.1-9.0] p=0.0 4 [2.9-6.6] p=0.0
Fetal placental thrombosis	p=0.0096 p=0.020	p=0.0096 p=0.020	p=0.0096 p=0.020
Fetal death (stillbirth)	135 [48.25-412.0] p=0.0 82 [26.5-184] p=0.0	38 [21.1-73.0] p=0.0 26 [12.2-60.0] p=0.0	9 [6.9-13] p=0.0 5 [3.4-7.2] p=0.0

Table 3

In the Figures below we show the Global and US relative rates of the reports of AE after the COVID-19 vaccine versus the Flu vaccine for the rates of AE by unit time, by dose given, and by person vaccinated. A value greater than 1 implies that the AE is reported more frequently after the COVID-19 vaccine than after the Flu vaccine. Note the log scale spanning multiple orders of magnitude indicating a large effect across many different AE - all (much) greater than 1.







Scripts

Private for the authors only: I have a git hub repository here and if you're comfortable with git hub I will give you permission to clone the repo and check out what I did.

<https://github.com/mikedeskevich/fetal-ae>

Logs

Output log from analysis code

```
*****
***** Dose (US) *****
```

```
[('Abnormal uterine bleeding (menstrual irregularity)', 'AUB', 6352, 54),
('Miscarriage', 'M', 1232, 259), ('Fetal chromosomal abnormalities', 'FCM', 7, 0),
('Fetal malformation', 'FM', 2, 1), ('Fetal cystic hygroma', 'FCM', 5, 0), ('Fetal
cardiac disorders', 'FCD', 10, 2), ('Fetal arrhythmia', 'FA', 3, 0), ('Fetal
cardiac arrest', 'FCA', 3, 0), ('Fetal vascular mal-perfusion', 'FVMP', 5, 0),
('Fetal growth abnormalities', 'FGA', 59, 20), ('Fetal abnormal surveillance',
'FAS', 125, 36), ('Fetal placental thrombosis', 'FPT', 5, 0), ('Fetal death
(stillbirth)', 'FD', 168, 42)]
```

```
cperiod= 0.59623
```

```
cperiod= 3.3
```

```
*****
```

*** RATES ***

Abnormal uterine bleeding (menstrual irregularity)	6352	10653.6068	54
16.3636			
Miscarriage	1232	2066.3167	259
78.4848			
Fetal chromosomal abnormalities	7	11.7404	0
0.0000			
Fetal malformation	2	3.3544	1
0.3030			
Fetal cystic hygroma	5	8.3860	0
0.0000			
Fetal cardiac disorders	10	16.7721	2
0.6061			
Fetal arrhythmia	3	5.0316	0
0.0000			
Fetal cardiac arrest	3	5.0316	0
0.0000			
Fetal vascular mal-perfusion	5	8.3860	0
0.0000			
Fetal growth abnormalities	59	98.9551	20
6.0606			
Fetal abnormal surveillance	125	209.6506	36
10.9091			
Fetal placental thrombosis	5	8.3860	0
0.0000			
Fetal death (stillbirth)	168	281.7705	42
12.7273			

```
*****
```

*** P VALUES ***

Abnormal uterine bleeding (menstrual irregularity)	0.000e+00
Miscarriage	0.000e+00
Fetal chromosomal abnormalities	4.759e-03
Fetal malformation	1.973e-01
Fetal cystic hygroma	1.976e-02
Fetal cardiac disorders	5.781e-04
Fetal arrhythmia	8.838e-02
Fetal cardiac arrest	8.838e-02
Fetal vascular mal-perfusion	1.976e-02
Fetal growth abnormalities	0.000e+00

Fetal abnormal surveillance	0.000e+00
Fetal placental thrombosis	1.976e-02
Fetal death (stillbirth)	0.000e+00

*** RELATIVE RATES ***

Abnormal uterine bleeding (menstrual irregularity)	738.1339	391.6250
1583.5000		
Miscarriage	26.9146	20.1833
36.5294		
Fetal chromosomal abnormalities	0.0000	0.0000
0.0000		
Fetal malformation	1.9072	0.0000
5.0000		
Fetal cystic hygroma	0.0000	0.0000
0.0000		
Fetal cardiac disorders	9.1187	3.0000
16.0000		
Fetal arrhythmia	0.0000	0.0000
0.0000		
Fetal cardiac arrest	0.0000	0.0000
0.0000		
Fetal vascular mal-perfusion	0.0000	0.0000
0.0000		
Fetal growth abnormalities	21.5757	7.1429
64.0000		
Fetal abnormal surveillance	23.5755	10.1111
63.0000		
Fetal placental thrombosis	0.0000	0.0000
0.0000		
Fetal death (stillbirth)	26.2801	12.2000
60.0000		

***** Month (US) *****

```
[('Abnormal uterine bleeding (menstrual irregularity)', 'AUB', 6352, 54),
('Miscarriage', 'M', 1232, 259), ('Fetal chromosomal abnormalities', 'FCM', 7, 0),
('Fetal malformation', 'FM', 2, 1), ('Fetal cystic hygroma', 'FCM', 5, 0), ('Fetal
cardiac disorders', 'FCD', 10, 2), ('Fetal arrhythmia', 'FA', 3, 0), ('Fetal
cardiac arrest', 'FCA', 3, 0), ('Fetal vascular mal-perfusion', 'FVMP', 5, 0),
('Fetal growth abnormalities', 'FGA', 59, 20), ('Fetal abnormal surveillance',
'FAS', 125, 36), ('Fetal placental thrombosis', 'FPT', 5, 0), ('Fetal death
(stillbirth)', 'FD', 168, 42)]
```

cperiod= 18

cperiod= 294

*** RATES ***

Abnormal uterine bleeding (menstrual irregularity)	6352	352.8889	54
0.1837			

Miscarriage	1232	68.4444	259
0.8810			
Fetal chromosomal abnormalities	7	0.3889	0
0.0000			
Fetal malformation	2	0.1111	1
0.0034			
Fetal cystic hygroma	5	0.2778	0
0.0000			
Fetal cardiac disorders	10	0.5556	2
0.0068			
Fetal arrhythmia	3	0.1667	0
0.0000			
Fetal cardiac arrest	3	0.1667	0
0.0000			
Fetal vascular mal-perfusion	5	0.2778	0
0.0000			
Fetal growth abnormalities	59	3.2778	20
0.0680			
Fetal abnormal surveillance	125	6.9444	36
0.1224			
Fetal placental thrombosis	5	0.2778	0
0.0000			
Fetal death (stillbirth)	168	9.3333	42
0.1429			

*** P VALUES ***

Abnormal uterine bleeding (menstrual irregularity)	0.000e+00
Miscarriage	0.000e+00
Fetal chromosomal abnormalities	4.759e-03
Fetal malformation	1.973e-01
Fetal cystic hygroma	1.976e-02
Fetal cardiac disorders	5.781e-04
Fetal arrhythmia	8.838e-02
Fetal cardiac arrest	8.838e-02
Fetal vascular mal-perfusion	1.976e-02
Fetal growth abnormalities	0.000e+00
Fetal abnormal surveillance	0.000e+00
Fetal placental thrombosis	1.976e-02
Fetal death (stillbirth)	0.000e+00

*** RELATIVE RATES ***

Abnormal uterine bleeding (menstrual irregularity)	2523.5285	894.5714
6419.0000		
Miscarriage	83.4301	50.8333
143.2222		
Fetal chromosomal abnormalities	0.0000	0.0000
0.0000		
Fetal malformation	1.9811	0.0000
5.0000		

Fetal cystic hygroma	0.0000	0.0000
0.0000		
Fetal cardiac disorders	9.6984	4.0000
17.0000		
Fetal arrhythmia	0.0000	0.0000
0.0000		
Fetal cardiac arrest	0.0000	0.0000
0.0000		
Fetal vascular mal-perfusion	0.0000	0.0000
0.0000		
Fetal growth abnormalities	42.5020	14.0000
72.0000		
Fetal abnormal surveillance	67.9890	21.6000
140.0000		
Fetal placental thrombosis	0.0000	0.0000
0.0000		
Fetal death (stillbirth)	82.1521	26.5000
184.0000		

***** People (US) *****

```
[('Abnormal uterine bleeding (menstrual irregularity)', 'AUB', 6352, 54),
('Miscarriage', 'M', 1232, 259), ('Fetal chromosomal abnormalities', 'FCM', 7, 0),
('Fetal malformation', 'FM', 2, 1), ('Fetal cystic hygroma', 'FCM', 5, 0), ('Fetal
cardiac disorders', 'FCD', 10, 2), ('Fetal arrhythmia', 'FA', 3, 0), ('Fetal
cardiac arrest', 'FCA', 3, 0), ('Fetal vascular mal-perfusion', 'FVMP', 5, 0),
('Fetal growth abnormalities', 'FGA', 59, 20), ('Fetal abnormal surveillance',
'FAS', 125, 36), ('Fetal placental thrombosis', 'FPT', 5, 0), ('Fetal death
(stillbirth)', 'FD', 168, 42)]
```

cperiod= 0.25996

cperiod= 0.313

*** RATES ***

Abnormal uterine bleeding (menstrual irregularity)	6352	24434.5284	54
172.5240			
Miscarriage	1232	4739.1906	259
827.4760			
Fetal chromosomal abnormalities	7	26.9272	0
0.0000			
Fetal malformation	2	7.6935	1
3.1949			
Fetal cystic hygroma	5	19.2337	0
0.0000			
Fetal cardiac disorders	10	38.4675	2
6.3898			
Fetal arrhythmia	3	11.5402	0
0.0000			
Fetal cardiac arrest	3	11.5402	0
0.0000			

Fetal vascular mal-perfusion 0.0000	5	19.2337	0
Fetal growth abnormalities 63.8978	59	226.9580	20
Fetal abnormal surveillance 115.0160	125	480.8432	36
Fetal placental thrombosis 0.0000	5	19.2337	0
Fetal death (stillbirth) 134.1853	168	646.2533	42

*** P VALUES ***

Abnormal uterine bleeding (menstrual irregularity)	0.000e+00
Miscarriage	0.000e+00
Fetal chromosomal abnormalities	4.759e-03
Fetal malformation	1.973e-01
Fetal cystic hygroma	1.976e-02
Fetal cardiac disorders	4.682e-03
Fetal arrhythmia	8.838e-02
Fetal cardiac arrest	8.838e-02
Fetal vascular mal-perfusion	1.976e-02
Fetal growth abnormalities	3.200e-07
Fetal abnormal surveillance	0.000e+00
Fetal placental thrombosis	1.976e-02
Fetal death (stillbirth)	0.000e+00

*** RELATIVE RATES ***

Abnormal uterine bleeding (menstrual irregularity) 197.3942	144.9039	108.5862
Miscarriage 6.6613	5.7544	4.9793
Fetal chromosomal abnormalities 0.0000	0.0000	0.0000
Fetal malformation 5.0000	1.6113	0.0000
Fetal cystic hygroma 0.0000	0.0000	0.0000
Fetal cardiac disorders 15.0000	6.3575	1.5000
Fetal arrhythmia 0.0000	0.0000	0.0000
Fetal cardiac arrest 0.0000	0.0000	0.0000
Fetal vascular mal-perfusion 0.0000	0.0000	0.0000
Fetal growth abnormalities 6.7500	3.7993	2.1538
Fetal abnormal surveillance 6.5500	4.3309	2.8889

```

Fetal placental thrombosis          0.0000      0.0000
0.0000
Fetal death (stillbirth)            4.9627      3.4348
7.2400
*****

*****

***** Dose (Global) *****
[('Abnormal uterine bleeding (menstrual irregularity)', 'AUB', 12843, 65),
('Miscarriage', 'M', 3338, 325), ('Fetal chromosomal abnormalities', 'FCM', 10,
0), ('Fetal malformation', 'FM', 22, 2), ('Fetal cystic hygroma', 'FCM', 8, 0),
('Fetal cardiac disorders', 'FCD', 18, 2), ('Fetal arrhythmia', 'FA', 5, 0),
('Fetal cardiac arrest', 'FCA', 20, 0), ('Fetal vascular mal-perfusion', 'FVMP',
12, 0), ('Fetal growth abnormalities', 'FGA', 188, 24), ('Fetal abnormal
surveillance', 'FAS', 178, 45), ('Fetal placental thrombosis', 'FPT', 6, 0),
('Fetal death (stillbirth)', 'FD', 402, 64)]
cperiod= 12.07
cperiod= 66
*****

*** RATES ***
Abnormal uterine bleeding (menstrual irregularity)    12843    1064.0431    65
0.9848
Miscarriage                                           3338     276.5534    325
4.9242
Fetal chromosomal abnormalities                      10        0.8285      0
0.0000
Fetal malformation                                  22        1.8227      2
0.0303
Fetal cystic hygroma                                8         0.6628      0
0.0000
Fetal cardiac disorders                             18        1.4913      2
0.0303
Fetal arrhythmia                                     5         0.4143      0
0.0000
Fetal cardiac arrest                                20        1.6570      0
0.0000
Fetal vascular mal-perfusion                         12        0.9942      0
0.0000
Fetal growth abnormalities                           188       15.5758     24
0.3636
Fetal abnormal surveillance                           178       14.7473     45
0.6818
Fetal placental thrombosis                           6         0.4971      0
0.0000
Fetal death (stillbirth)                            402       33.3057     64
0.9697
*****

*** P VALUES ***
Abnormal uterine bleeding (menstrual irregularity)    0.000e+00
Miscarriage                                           0.000e+00

```


Fetal chromosomal abnormalities	5.781e-04
Fetal malformation	1.855e-07
Fetal cystic hygroma	2.378e-03
Fetal cardiac disorders	2.618e-06
Fetal arrhythmia	1.976e-02
Fetal cardiac arrest	6.949e-07
Fetal vascular mal-perfusion	1.473e-04
Fetal growth abnormalities	0.000e+00
Fetal abnormal surveillance	0.000e+00
Fetal placental thrombosis	9.631e-03
Fetal death (stillbirth)	0.000e+00

*** RELATIVE RATES ***

Abnormal uterine bleeding (menstrual irregularity)	1191.8561	673.9474
2162.8333		
Miscarriage	57.1421	44.3421
74.6591		
Fetal chromosomal abnormalities	0.0000	0.0000
0.0000		
Fetal malformation	20.0241	7.6667
31.0000		
Fetal cystic hygroma	0.0000	0.0000
0.0000		
Fetal cardiac disorders	16.3892	6.0000
26.0000		
Fetal arrhythmia	0.0000	0.0000
0.0000		
Fetal cardiac arrest	0.0000	0.0000
0.0000		
Fetal vascular mal-perfusion	0.0000	0.0000
0.0000		
Fetal growth abnormalities	56.1703	20.6667
189.0000		
Fetal abnormal surveillance	25.2665	12.1538
58.6667		
Fetal placental thrombosis	0.0000	0.0000
0.0000		
Fetal death (stillbirth)	37.9790	21.0526
73.0000		

***** Month (Global) *****

```
[('Abnormal uterine bleeding (menstrual irregularity)', 'AUB', 12843, 65),
('Miscarriage', 'M', 3338, 325), ('Fetal chromosomal abnormalities', 'FCM', 10,
0), ('Fetal malformation', 'FM', 22, 2), ('Fetal cystic hygroma', 'FCM', 8, 0),
('Fetal cardiac disorders', 'FCD', 18, 2), ('Fetal arrhythmia', 'FA', 5, 0),
('Fetal cardiac arrest', 'FCA', 20, 0), ('Fetal vascular mal-perfusion', 'FVMP',
12, 0), ('Fetal growth abnormalities', 'FGA', 188, 24), ('Fetal abnormal
surveillance', 'FAS', 178, 45), ('Fetal placental thrombosis', 'FPT', 6, 0),
('Fetal death (stillbirth)', 'FD', 402, 64)]
```

cperiod= 18

cperiod= 294

*** RATES ***

Abnormal uterine bleeding (menstrual irregularity) 0.2211	12843	713.5000	65
Miscarriage 1.1054	3338	185.4444	325
Fetal chromosomal abnormalities 0.0000	10	0.5556	0
Fetal malformation 0.0068	22	1.2222	2
Fetal cystic hygroma 0.0000	8	0.4444	0
Fetal cardiac disorders 0.0068	18	1.0000	2
Fetal arrhythmia 0.0000	5	0.2778	0
Fetal cardiac arrest 0.0000	20	1.1111	0
Fetal vascular mal-perfusion 0.0000	12	0.6667	0
Fetal growth abnormalities 0.0816	188	10.4444	24
Fetal abnormal surveillance 0.1531	178	9.8889	45
Fetal placental thrombosis 0.0000	6	0.3333	0
Fetal death (stillbirth) 0.2177	402	22.3333	64

*** P VALUES ***

Abnormal uterine bleeding (menstrual irregularity)	0.000e+00
Miscarriage	0.000e+00
Fetal chromosomal abnormalities	5.781e-04
Fetal malformation	1.855e-07
Fetal cystic hygroma	2.378e-03
Fetal cardiac disorders	2.618e-06
Fetal arrhythmia	1.976e-02
Fetal cardiac arrest	6.949e-07
Fetal vascular mal-perfusion	1.473e-04
Fetal growth abnormalities	0.000e+00
Fetal abnormal surveillance	0.000e+00
Fetal placental thrombosis	9.631e-03
Fetal death (stillbirth)	0.000e+00

*** RELATIVE RATES ***

Abnormal uterine bleeding (menstrual irregularity) 12893.0000	4256.6142	1589.1250
--	-----------	-----------

Miscarriage	177.1452	114.4138
283.5000		
Fetal chromosomal abnormalities	0.0000	0.0000
0.0000		
Fetal malformation	21.3265	10.0000
32.0000		
Fetal cystic hygroma	0.0000	0.0000
0.0000		
Fetal cardiac disorders	17.4539	8.0000
27.0000		
Fetal arrhythmia	0.0000	0.0000
0.0000		
Fetal cardiac arrest	0.0000	0.0000
0.0000		
Fetal vascular mal-perfusion	0.0000	0.0000
0.0000		
Fetal growth abnormalities	126.2765	42.0000
210.0000		
Fetal abnormal surveillance	82.6192	26.8571
193.0000		
Fetal placental thrombosis	0.0000	0.0000
0.0000		
Fetal death (stillbirth)	135.3308	48.2500
412.0000		

***** People (Global) *****

```
[('Abnormal uterine bleeding (menstrual irregularity)', 'AUB', 12843, 65),
('Miscarriage', 'M', 3338, 325), ('Fetal chromosomal abnormalities', 'FCM', 10,
0), ('Fetal malformation', 'FM', 22, 2), ('Fetal cystic hygroma', 'FCM', 8, 0),
('Fetal cardiac disorders', 'FCD', 18, 2), ('Fetal arrhythmia', 'FA', 5, 0),
('Fetal cardiac arrest', 'FCA', 20, 0), ('Fetal vascular mal-perfusion', 'FVMP',
12, 0), ('Fetal growth abnormalities', 'FGA', 188, 24), ('Fetal abnormal
surveillance', 'FAS', 178, 45), ('Fetal placental thrombosis', 'FPT', 6, 0),
('Fetal death (stillbirth)', 'FD', 402, 64)]
```

cperiod= 5.23

cperiod= 7.71

*** RATES ***

Abnormal uterine bleeding (menstrual irregularity)	12843	2455.6405	65
8.4306			
Miscarriage	3338	638.2409	325
42.1530			
Fetal chromosomal abnormalities	10	1.9120	0
0.0000			
Fetal malformation	22	4.2065	2
0.2594			
Fetal cystic hygroma	8	1.5296	0
0.0000			

Fetal cardiac disorders	18	3.4417	2
0.2594			
Fetal arrhythmia	5	0.9560	0
0.0000			
Fetal cardiac arrest	20	3.8241	0
0.0000			
Fetal vascular mal-perfusion	12	2.2945	0
0.0000			
Fetal growth abnormalities	188	35.9465	24
3.1128			
Fetal abnormal surveillance	178	34.0344	45
5.8366			
Fetal placental thrombosis	6	1.1472	0
0.0000			
Fetal death (stillbirth)	402	76.8642	64
8.3009			

*** P VALUES ***

Abnormal uterine bleeding (menstrual irregularity)	0.000e+00
Miscarriage	0.000e+00
Fetal chromosomal abnormalities	5.781e-04
Fetal malformation	2.096e-06
Fetal cystic hygroma	2.378e-03
Fetal cardiac disorders	2.707e-05
Fetal arrhythmia	1.976e-02
Fetal cardiac arrest	6.949e-07
Fetal vascular mal-perfusion	1.473e-04
Fetal growth abnormalities	0.000e+00
Fetal abnormal surveillance	0.000e+00
Fetal placental thrombosis	9.631e-03
Fetal death (stillbirth)	0.000e+00

*** RELATIVE RATES ***

Abnormal uterine bleeding (menstrual irregularity)	298.1365	223.0345
405.9688		
Miscarriage	15.2108	13.2857
17.4694		
Fetal chromosomal abnormalities	0.0000	0.0000
0.0000		
Fetal malformation	15.2630	4.5000
30.0000		
Fetal cystic hygroma	0.0000	0.0000
0.0000		
Fetal cardiac disorders	12.4868	3.6000
25.0000		
Fetal arrhythmia	0.0000	0.0000
0.0000		
Fetal cardiac arrest	0.0000	0.0000
0.0000		

Fetal vascular mal-perfusion 0.0000	0.0000	0.0000
Fetal growth abnormalities 21.4444	12.3590	7.4167
Fetal abnormal surveillance 9.0000	6.0354	4.1000
Fetal placental thrombosis 0.0000	0.0000	0.0000
Fetal death (stillbirth) 13.1290	9.4869	6.9464

Output log from the flu vaccine population simulation

End of Year	Sample Population (Thousands)	Vaccinated Population (Thousands)	Total Vaccinated Since 1998 (Thousands)
1980	100685	70921 (70.4%)	--
1981	101328	82921 (81.8%)	--
1982	101936	89923 (88.2%)	--
1983	102629	94190 (91.8%)	--
1984	103253	96842 (93.8%)	--
1985	103924	98746 (95.0%)	--
1986	104615	100133 (95.7%)	--
1987	105344	101170 (96.0%)	--
1988	106017	102026 (96.2%)	--
1989	106742	102790 (96.3%)	--
1990	107434	103590 (96.4%)	--
1991	108187	104335 (96.4%)	--
1992	108919	105104 (96.5%)	--
1993	109637	105790 (96.5%)	--
1994	110313	106507 (96.5%)	--
1995	110959	107191 (96.6%)	--
1996	111615	107893 (96.7%)	--
1997	112289	108579 (96.7%)	--
1998	112919	109203 (96.7%)	110157 (97.6%)
1999	113542	109799 (96.7%)	111722 (98.4%)
2000	114182	110390 (96.7%)	113264 (99.2%)
2001	114821	111055 (96.7%)	114889 (100.1%)
2002	115497	111745 (96.8%)	116497 (100.9%)
2003	116175	112461 (96.8%)	118139 (101.7%)
2004	116819	113102 (96.8%)	119745 (102.5%)
2005	117465	113757 (96.8%)	121371 (103.3%)
2006	118119	114412 (96.9%)	122989 (104.1%)
2007	118792	114997 (96.8%)	124521 (104.8%)
2008	119496	115736 (96.9%)	126181 (105.6%)
2009	120074	116317 (96.9%)	127789 (106.4%)
2010	120665	116899 (96.9%)	129362 (107.2%)
2011	121265	117562 (96.9%)	130979 (108.0%)
2012	121819	118175 (97.0%)	132571 (108.8%)
2013	122308	118774 (97.1%)	134195 (109.7%)
2014	122830	119335 (97.2%)	135733 (110.5%)

2015	123360	119866 (97.2%)	137231 (111.2%)
2016	123855	120378 (97.2%)	138736 (112.0%)
2017	124287	120819 (97.2%)	140225 (112.8%)
2018	124730	121263 (97.2%)	141695 (113.6%)
2019	125123	121666 (97.2%)	143178 (114.4%)
2020	125570	122107 (97.2%)	144657 (115.2%)
2021	125981	122575 (97.3%)	146200 (116.0%)

US total Flu vaccine since 1998 = 388538000
 Global total Flu vaccine since 1998 = 9230502000

Extra

![[Abnormal uterine bleeding (menstrual irregularity)-Dose (Global)

