Google Flu Trends

7 January 2016

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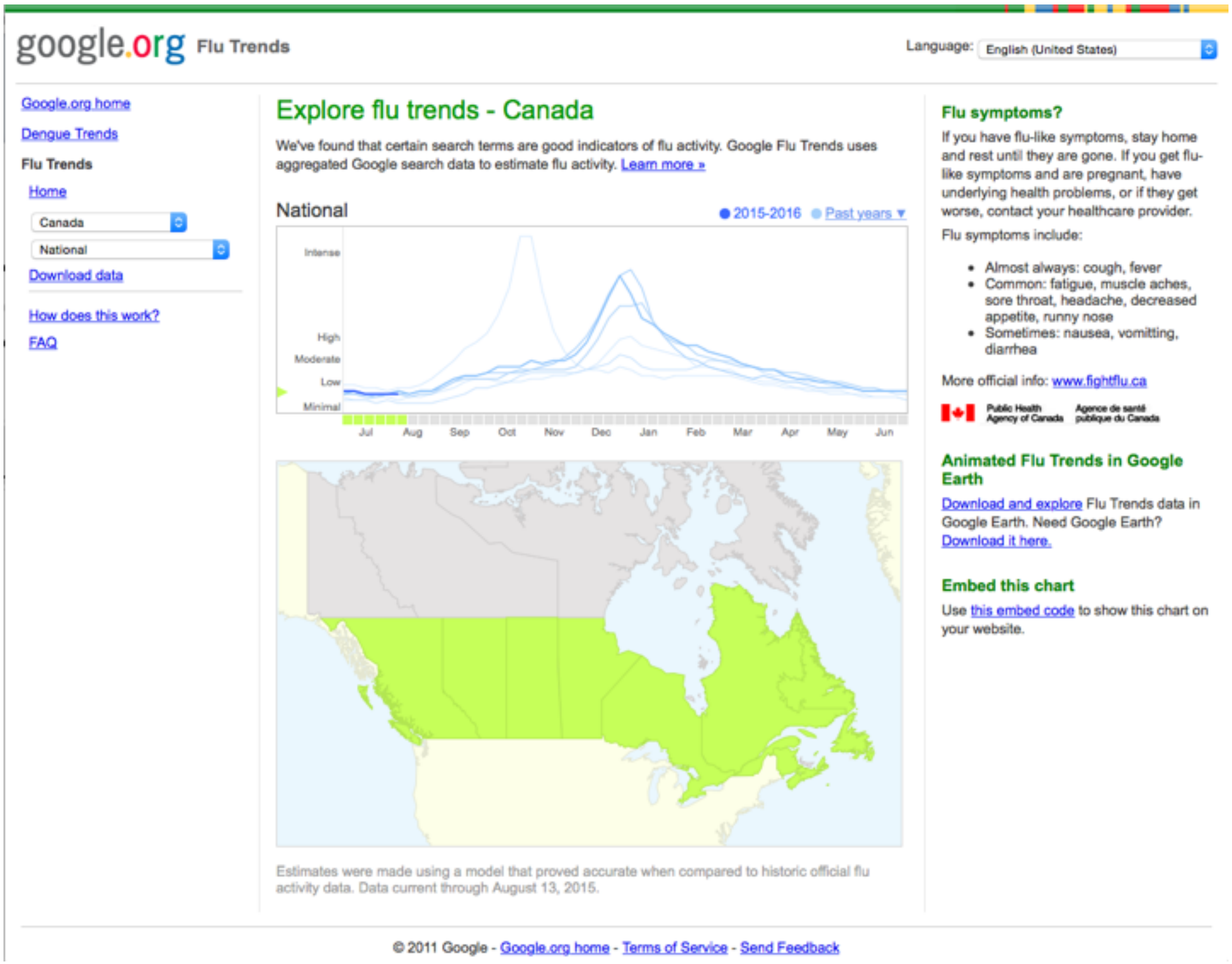
https://www.google.org/flutrends/ca/#CA



Flu Data

Proportion of Influenza-Like-Illnesses (PILI): proportion of doctor visits where patient has an "influenza-like illness"

ILINet in U.S., compiled and published by CDC.

Takes time to record, prepare, and publish (week or two). Might like to have results faster.

Google Flu tries to predict what the CDC data will be.

Google Flu Trends Model (Classic Edition)

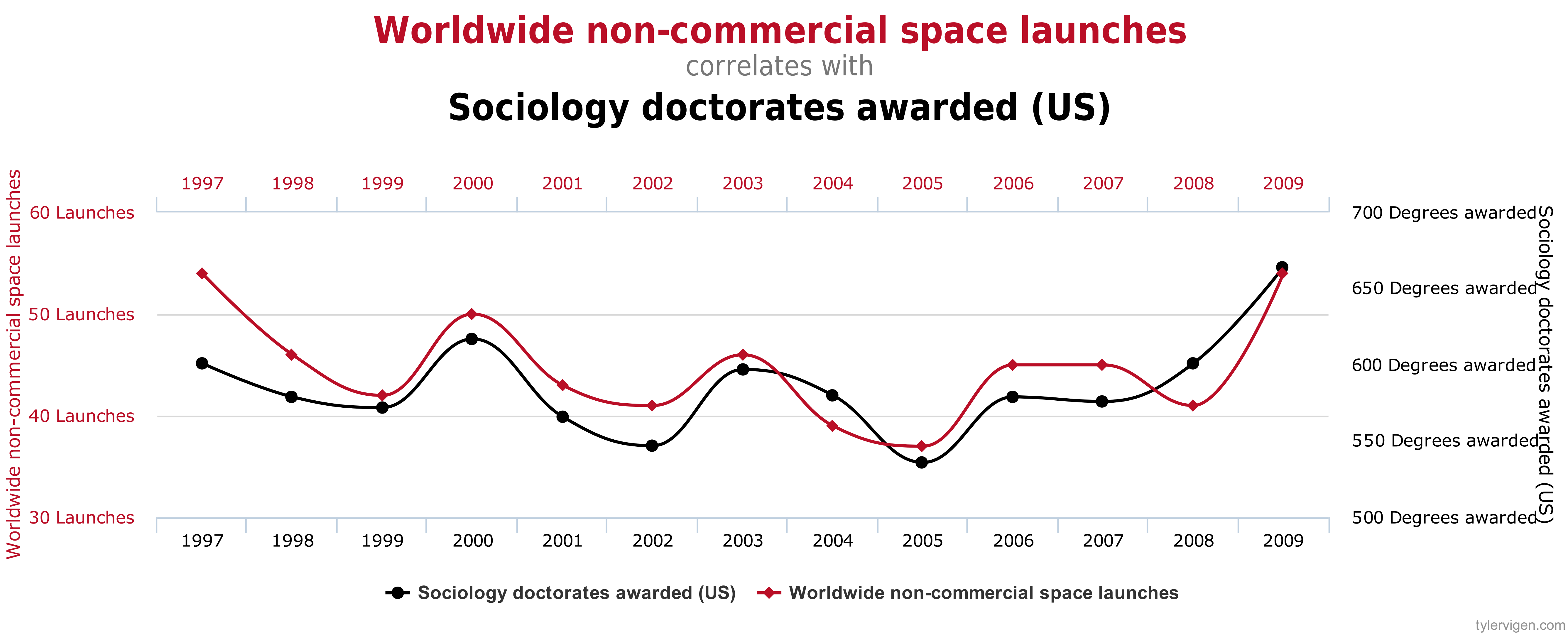
Query fraction (QF): proportion of Google searches that match a given **Query**

E.g., 16 per 100000 searches are the word “fever”

50 million distinct queries, unknown number of searches (billions)

A little EDA

Step 1: Find terms whose **QF *correlates with* PILI**



Step 2: Keep the best 45

- Most terms are secret; categories are:
  Influenza Complication, Cold/Flu Remedy, General Influenza Symptoms, Term for Influenza, Specific Influenza Symptom, Symptoms of an Influenza Complication, Antibiotic Medication, General Influenza Remedies, Symptoms of a Related Disease, Antiviral Medication, Related Disease

- [symptoms of bronchitis],[pnumonia]*,[fever], [early signs of the flu],[robitussin],[influenza a], [amoxicillin],[strep throat]

Step 3: Build Model

- Let ***S*** be the sum of the QF of the 45 terms over a 1-week period.
- Let ***Y*** be the PILI for next week, provided by CDC
- Find ***w*** and ***c*** so that

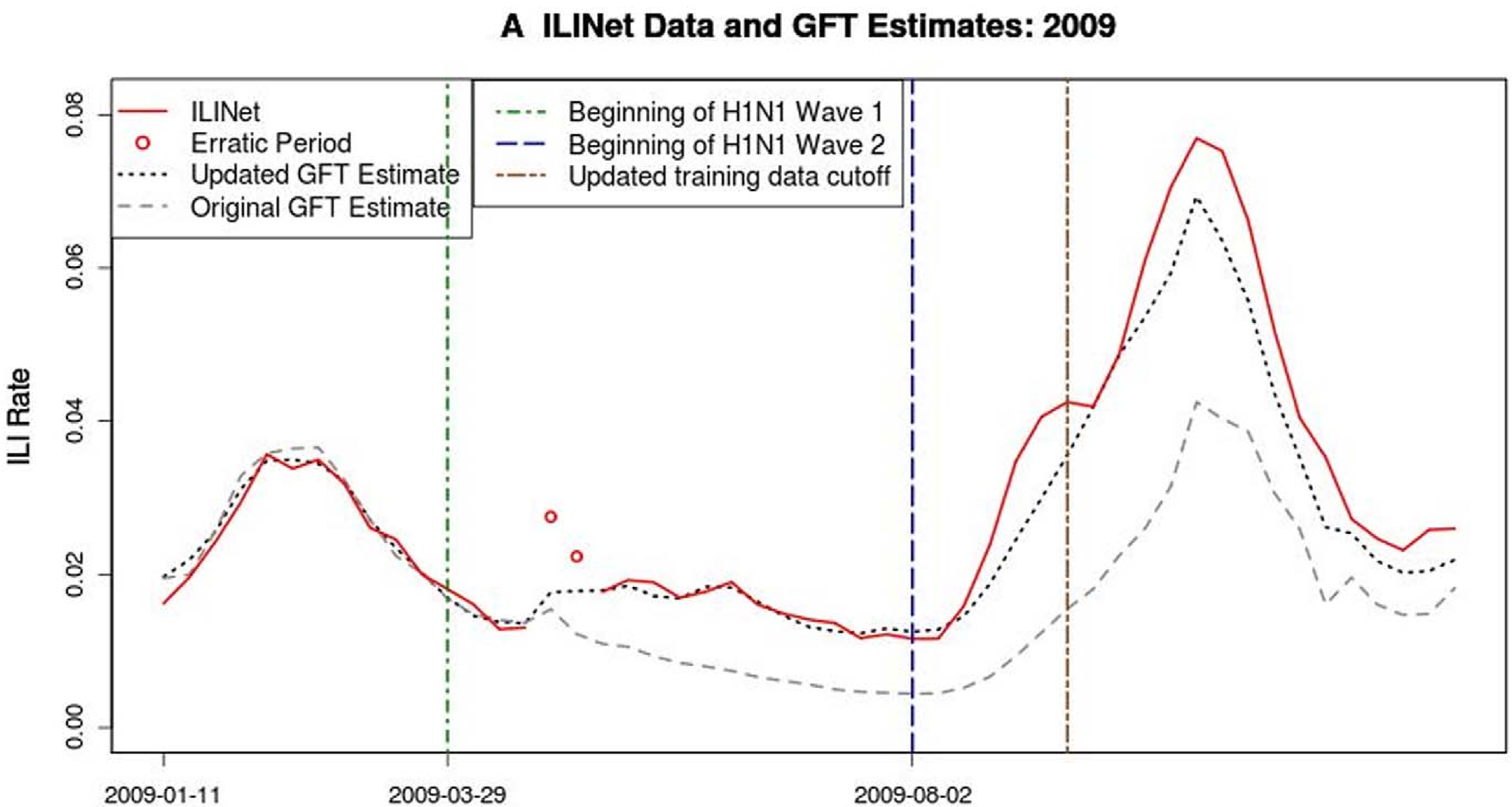
  logit(***Y***) ≈ ***w*** × logit(***S***) + ***c***

  as much as possible, on ***Y*** and ***S*** from historical data.
- ***c*** determines predicted “baseline ILI” if ***S*** = 0,
  w determines how fast predicted ***Y*** grows with ***S***
- To predict ***Y*** in the future, stick the learned ***w*** and ***c***,
  and the new ***S***, into the model, get result.

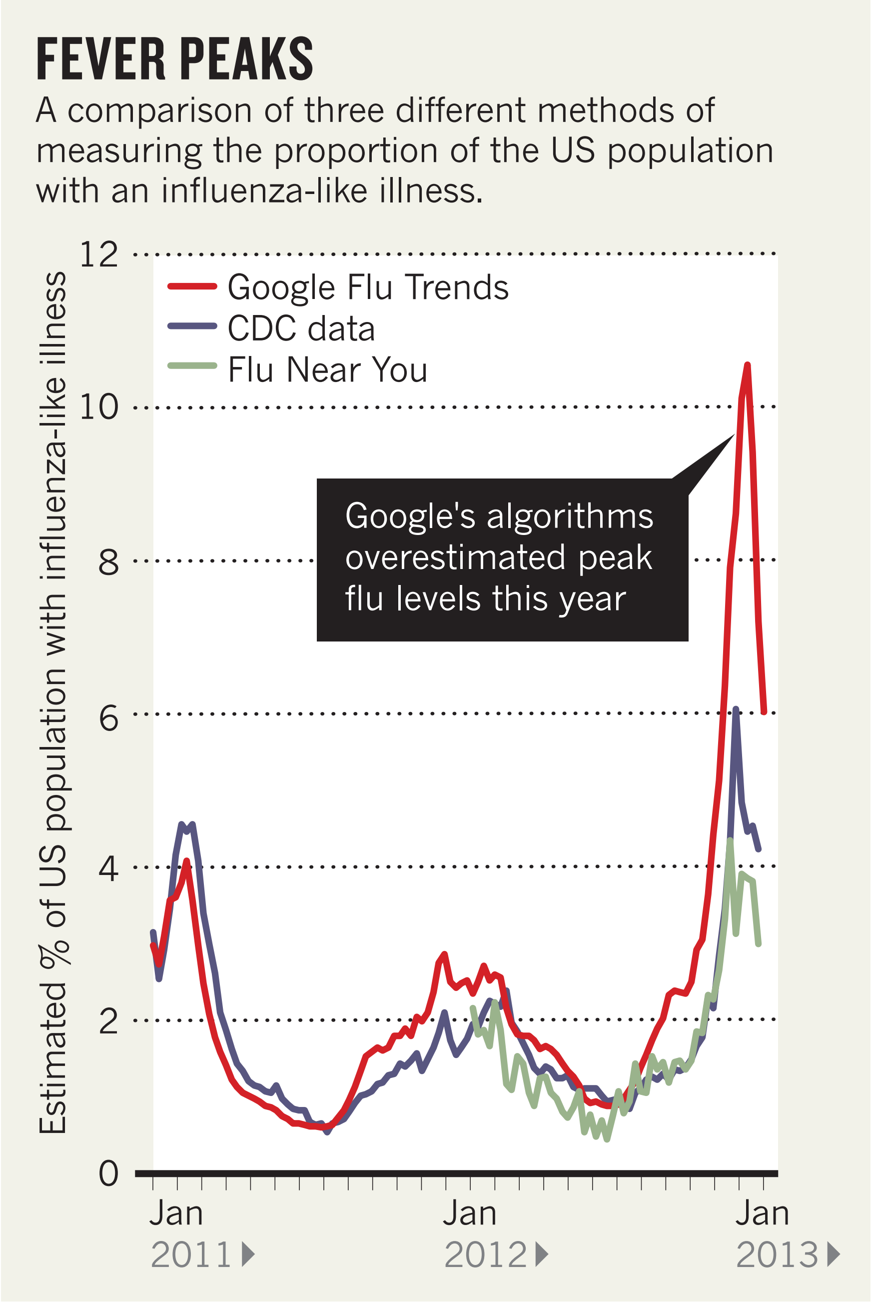
Step 2: Keep the best 45

- Why 45?
    - Chosen to maximize accuracy on unseen data

Flu Trends Ups and Downs



Flu Trends Ups and Downs



Step 2: Keep the best 45

- Why 45?
  - Chosen to maximize accuracy on unseen data
  - *Other search queries in the top 100, not included in our model, included topics like* ***“high school basketball”***

Why
“high school basketball”?

Table 1. Comparison of relative query category volume in original and updated United States GFT models.

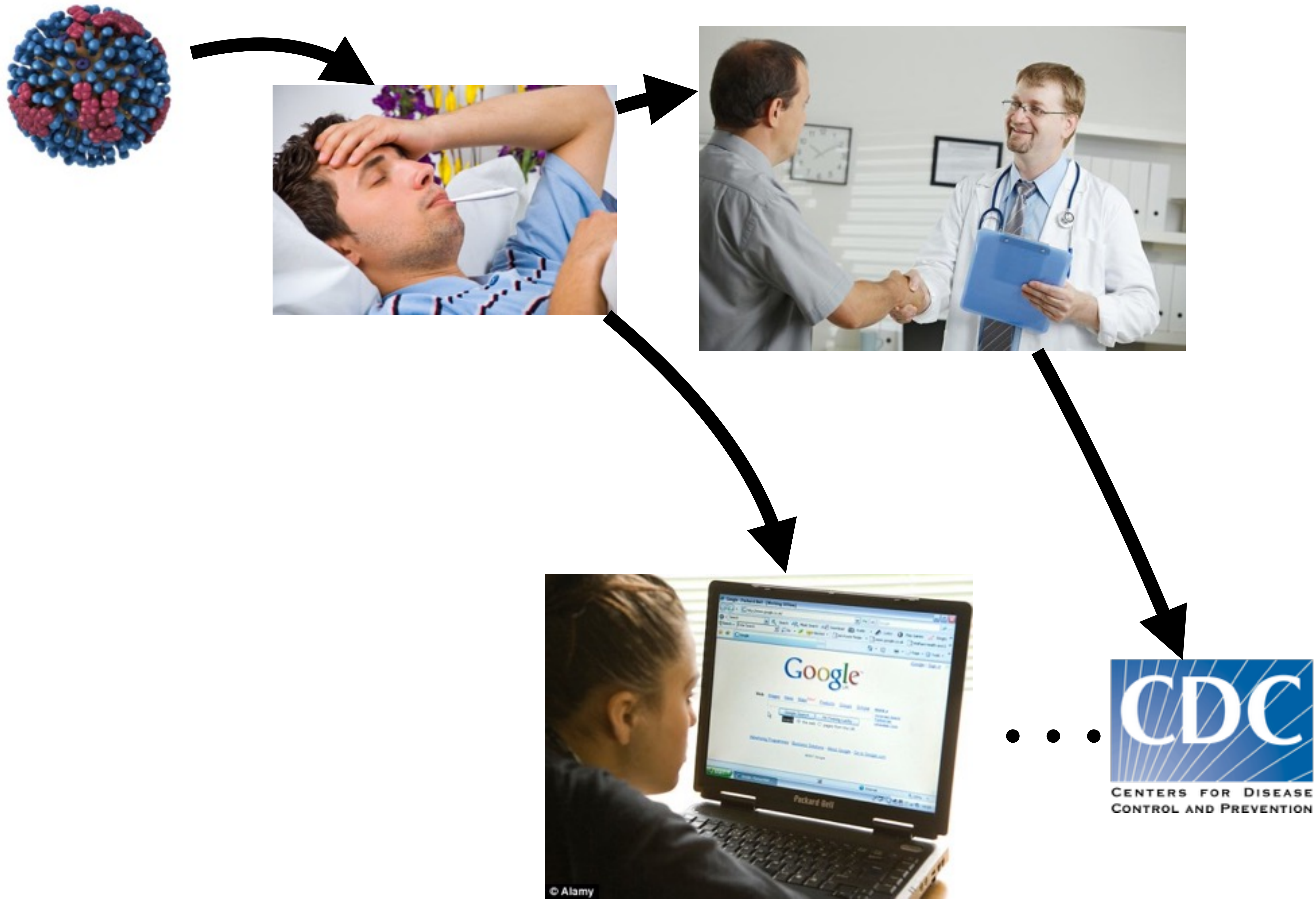
Query Category	Sample Query	Original Model Relative Category Volume	Updated Model Relative Category Volume
Symptoms of an influenza complication	[symptoms of bronchitis]	6%	11%
Influenza complication	[pnumonia]*	42%	6%
Specific influenza symptom	[fever]	6%	39%
General influenza symptoms	[early signs of the flu]	2%	30%
Cold/flu remedy	[robitussin]	12%	4%
Term for influenza	[influenza a]	<1%	3%
Antibiotic medication	[amoxicillin]	12%	0%
Related disease	[strep throat]	16%	<1%

*Search users often misspell the word *pneumonia*.
doi:10.1371/journal.pone.0023610.t001

$$\mathrm{logit}(\boldsymbol{Y}) \approx \boldsymbol{w} \times \mathrm{logit}(\boldsymbol{S}) + \boldsymbol{c}$$

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

What causes flu-related searches?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