



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

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Project Title Accurate Simulation of Influenza Pandemics	
Abstract Objectives/Goals The Great "Spanish Flu" Influenza Pandemic of 1918-19 was the worst in recent history and is viewed by epidemiologists as a "worst case" scenario. My objective was to learn if a simple Susceptible-Infected-Removed or SIR model could accurately track actual pandemic deaths in major American cities. An SIR model is governed by two parameters: the inverse of the average number of days a sick person is infectious and $R(0)$, the average number of people infected by an infected person while contagious. My hypothesis is that an SIR model with $R(0) = 2$ can track actual deaths in the second wave of the Spanish Flu pandemic for each of 46 American cities. Methods/Materials This SIR model was simulated in the Mathematica programming language to predict the time path of infection. Actual pneumonia and influenza deaths were scaled in magnitude and shifted in time to make the number of deaths comparable to the number of infected people. Results The evolution of infected individuals in this SIR model was compared with the time path of scaled shifted pneumonia and influenza deaths in each city. It tracked deaths in 34 cities extremely well, closely matching the infected curve between week 4 and week 11 during which 98% of the infection occurs in the model. The evolution of pandemic deaths in 12 cities differed substantially from the model. Conclusions/Discussion Public health officials should fear a pandemic like the Spanish flu with $R(0) = 2$ because more than 1/2 of the susceptible population would need to be vaccinated or given appropriate antiviral treatment to stop an epidemic. They would have between 35 and 40 days to detect and identify the type of flu and produce and distribute the necessary medicine, which would be especially difficult if the flu was a new enough strain.	
Summary Statement Can a simple model of epidemics track actual deaths in 46 major American cities during the worst phase of the Great Spanish Flu Pandemic of 1918-19?	
Help Received Mom helped lay out the poster board. Dad helped with the formatting.	