Vax-The-Nation: A Budget Impact Analysis of Costs Associated with Measles Outbreaks in the USA Through Increasing Measles, Mumps and Rubella Vaccination Uptake

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Objectives

- This research aimed to estimate the budget impact of achieving a measles, mumps and rubella (MMR) vaccination rate in each US state of 95%, the World Health Organization recommendation for countries aiming to eliminate measles.[1]

Background

- Measles is one of the most contagious human diseases and can be fatal. While there is no specific treatment for measles, the disease is preventable and can be eliminated by vaccination, which is safe, effective and inexpensive.[1] In 2000, measles was declared eliminated in the US, however, as of March 28, 2019, 387 individual cases of measles have been confirmed this year.[2]
- The estimated 2018 US-wide vaccination rate for children receiving at least one dose of the MMR vaccine was 92.8%.[3, 4]

Methods

- A budget impact analysis was conducted from a public sector perspective to analyze the effect of increasing vaccination rates from current levels to a US-wide MMR vaccination rate of 95%.
- A previously published predictive model of measles outbreaks in US children over one year (Lo and Hotez, 2017) was adapted to provide state-level outcomes.[5]
- The model was updated to use the latest publicly available SchoolVaxView and ChildVaxView state-level data for vaccination rates of at least one dose of the MMR vaccine and age cohort sizes from the US Centers for Disease Control and Prevention (CDC).[3, 4]
- The public sector cost of an MMR vaccination was obtained from the CDC Vaccines for Children price list ($2.12 per dose).[6]
- Scenario analyses varied the cost per case of measles to the public sector from its mean base case value of $76,172, to the lower and upper estimates ($21,717 to $130,627, respectively) from Ortega-Sanchez *et al,* 2014,[7] cited by the CDC,[8] inflated to 2019 costs.[9]
- Further scenario analyses were performed where the number of measles cases predicted by the model (at both current vaccination rates and at a 95% vaccination rate) was increased by 100%, 200% and 300%.

Results

- To achieve a US-wide MMR vaccination rate of 95%, vaccination of an additional 827,085 individuals would be required at a total outlay cost of $1,755,074 ($2.12 per individual), with an estimated total budget impact of $276,750 ($0.33 per additional person vaccinated).
- Six states already had a childhood MMR vaccination rate of greater than 95% and therefore required no additional vaccination outlays and had a budget impact of $0. For the remaining 44 states (plus District of Colombia [D.C.]), the budget impact per state ranged from -$74,487 (Indiana) to $143,928 (California), as displayed in **Figure 1**.

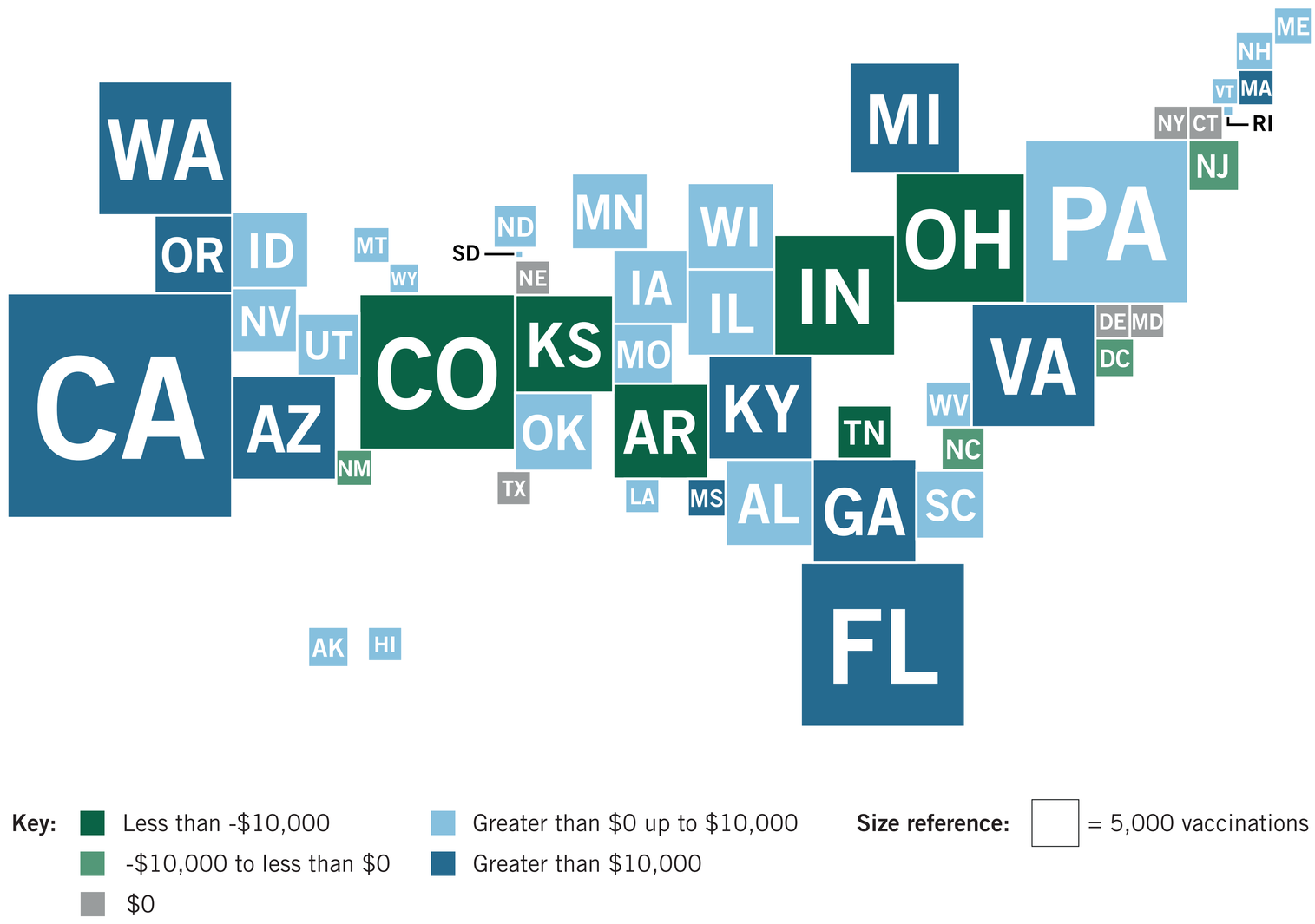
Scenario Analyses (Figure 2)

- When the public sector cost per case of measles was increased to an upper estimate of $130,627, the inflated upper limit of the range estimated by Ortega-Sanchez *et al,* 2014,[7, 8] 28 states and D.C. were estimated to produce budget savings, indicating that increasing vaccination can be fiscally prudent.
- The base case model predicted a conservative US-wide annual number of measles cases of 99 cases at the current level of vaccinations and 79 at the target MMR vaccination rate of 95%. This was substantially lower than the number of cases observed in the US in 2018 (372 cases) and 2019 thus far (387 cases as of March 28, 2019).[2] In scenarios where the number of measles cases predicted by the model was increased by between 100% and 300%, the number of states predicted to have budget savings rose to a maximum of 39 plus D.C.

Conclusions

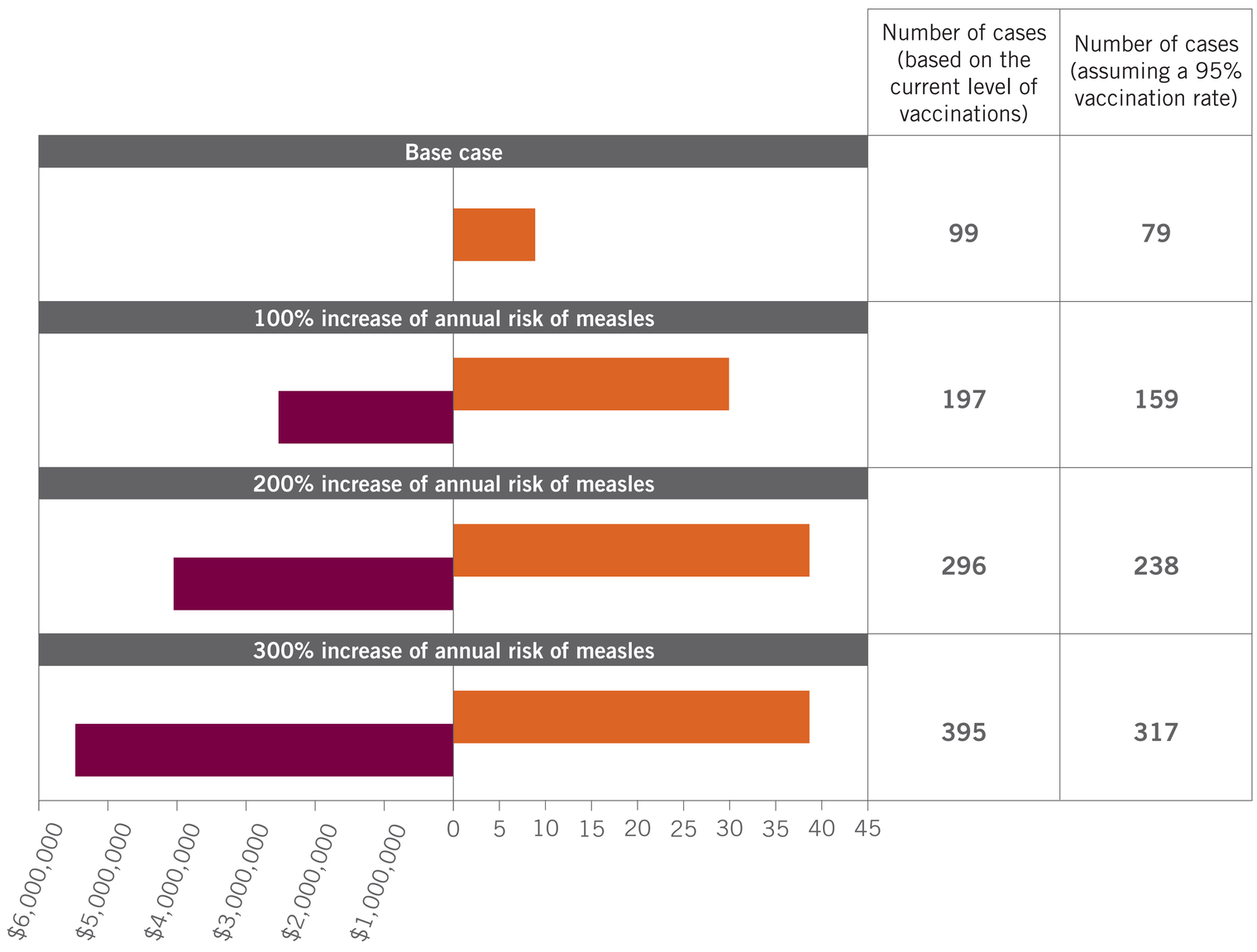
- Increasing the MMR vaccination rate to achieve 95% coverage in all US states is expected to have a minimal budget impact and should be enacted to progress towards measles elimination.
- The expected decrease in the annual number of measles cases would also result in benefits not encompassed in this analysis, including the reduction in mortality and loss of quality of life due to measles, a reduction in exported cases of measles to other countries and a reduction in cases of measles in future years.[1]
- Increased MMR vaccination coverage also offers protection against mumps and rubella, which would be expected to confer additional cost-savings.

Figure 1 | Budget impact in each US state (plus D.C.), with states sized by the number of additional vaccinations required to reach an MMR vaccination rate of 95%



States which already had a MMR vaccination rate of greater than or equal to 95% (Connecticut, Delaware, Maryland, Nebraska, New York and Texas) did not require any additional vaccinations, hence these states have a budget impact equal to $0 and their size is notional. D.C.: District of Columbia; MMR: measles, mumps and rubella.

Figure 2 | Results from scenario analyses of increasing estimated measles cases



	Number of cases (based on the current level of vaccinations)	Number of cases (assuming a 95% vaccination rate)
Base case	99	79
100% increase of annual risk of measles	197	159
200% increase of annual risk of measles	296	238
300% increase of annual risk of measles	395	317

D.C.: District of Columbia.

References

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