# Combining Discrete Choice Experiment and Contingent Valuation to Estimate Willingness-to-Pay for Lyme Disease Vaccine Attributes in the United States

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## INTRODUCTION

- Approximately 476,000 people are diagnosed and treated with Lyme Disease (LD) in the United States (US) annually and the geographical distribution is expanding.[1]
- Currently, treatment options for LD primarily involve antibiotics that are generally effective, yet 5-10% of patients continue to have persistent symptoms even after treatment[2], highlighting the need for effective preventive measures.
- It is necessary to understand the extent to which potential vaccine recipients weigh vaccine benefits and risks against cost, and what their willingness-to-pay (WTP) for specific vaccine characteristics is for guiding development and implementation strategies

## OBJECTIVES

- This study aimed to quantify WTP for an LD vaccine among potential vaccine recipients in the US and identify which vaccine attributes most influence consumer choices

## METHODS

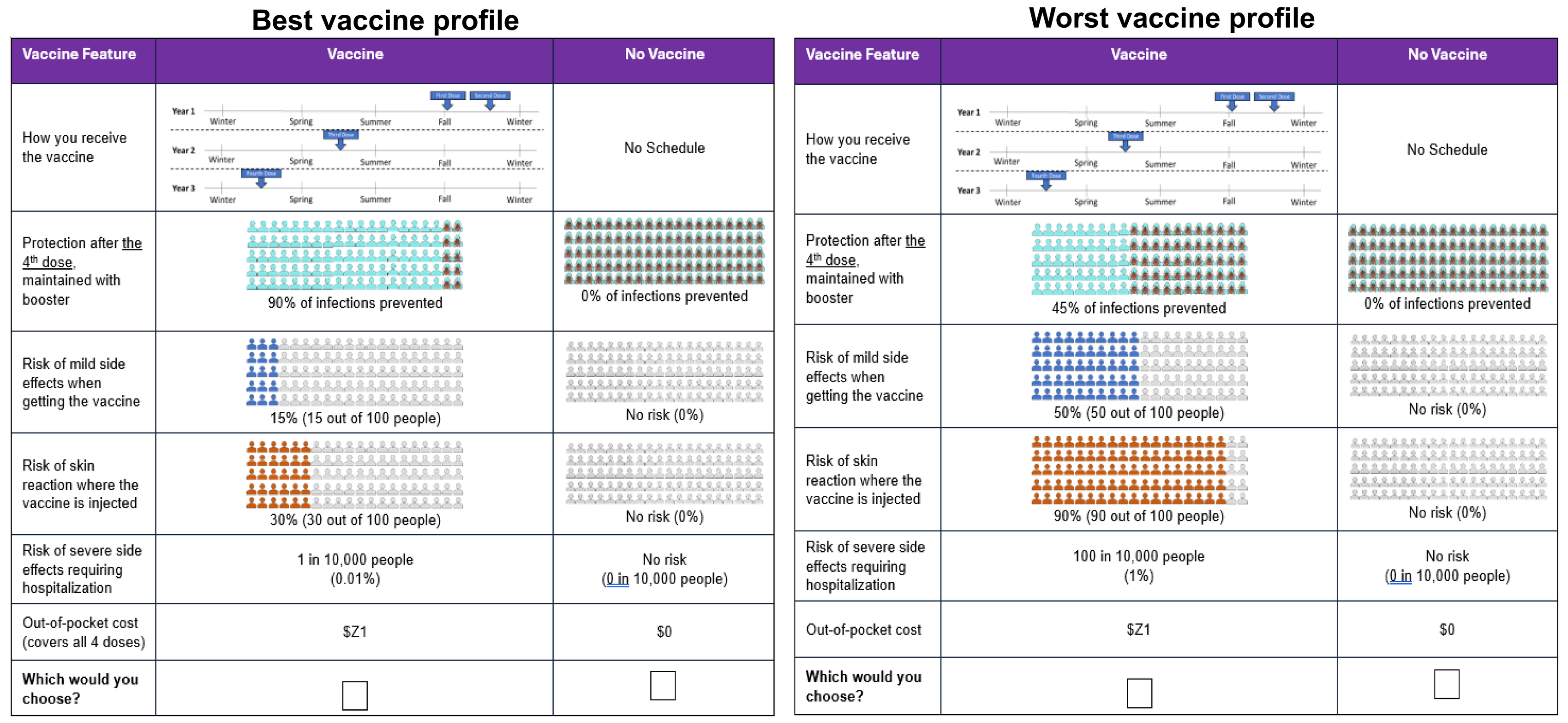
- A web-based survey including a discrete-choice experiment (DCE) and a double-bound contingent valuation (DBCV)[3] exercise was administered to 2,000 adults living in 17 US high LD incidence states and 10 neighboring states. The survey excluded those who reported being opposed to all vaccines
- The sample was split into 3 groups:
  - Caregivers who were asked in the survey to make vaccine decisions for a child aged 5-17 ( "Caregivers", N = 1,000),
  - Caregivers who were asked in the survey to make vaccine decisions for themselves (Caregivers-self, N = 499),
  - Adults not responsible for children at home, asked in the survey to make vaccine decisions for themselves (Adults, N = 501).
- The DCE included three alternatives per task: two hypothetical vaccine profiles (defined by vaccine efficacy [45%, 65%, 80%, 90%], risk of mild systemic adverse events [AEs] [15%, 30%, 50%], risk of injection site reactions [30%, 50%, 90%], and risk of severe AEs requiring hospitalization [0.01%, 0.1%, 1%]) and a no-vaccine opt-out.
- Cost was excluded from the DCE.
- Following the DCE, respondents completed two DBCV exercises to explore the WTP for two vaccine profiles (fully administered in 4 doses) defined by attribute levels from the DCE.
  - Each respondent was randomly assigned to an initial out of pocket cost for the vaccine, as described in Table 1.

**Table 1. Cost amounts**

| Version | Initial amount ($Z1) | If "Yes" to initial amount | If "No" to initial amount |
|---|---|---|---|
| I | $30 | $50 | $15 |
| II | $120 | $210 | $75 |
| III | $240 | $300 | $150 |
| IV | $360 | $480 | $270 |
| V | $500 | $1,000 | $250 |

  - If in the first question a respondent chose no vaccine, they were then asked the same question, but with a lower out-of-pocket vaccine cost
  - If they chose the vaccine initially, they were asked the same question, but with a higher out-of-pocket vaccine cost
  - The same exercise was repeated for 2 hypothetical scenarios, assigned to respondents in random order: choosing between no vaccine and a vaccine with the highest levels of efficacy and lowest levels of risk (best profile), and choosing between no vaccine and a vaccine with the lowest levels of efficacy and highest levels of risk (worst profile)
- A double bounded or interval data model (using the "doubleb" routine in Stata)[4] was used to estimate WTP for each vaccine profile and respondent characteristics were included as effects-coded covariates. The omitted levels of covariates, their standard errors, and the comparisons were calculated using the delta method.
- The difference in WTP between profiles was combined with utility estimates from a random-parameters logit model estimated using DCE responses to derive WTP for each change in attribute levels. Standard errors were calculated using Krinsky-Robb[5] simulations with 10,000 draws.
- Figure 1 shows the initial DBCV question for the best and worst vaccine profiles

**Figure 1. Best and worst vaccine profiles**




## RESULTS

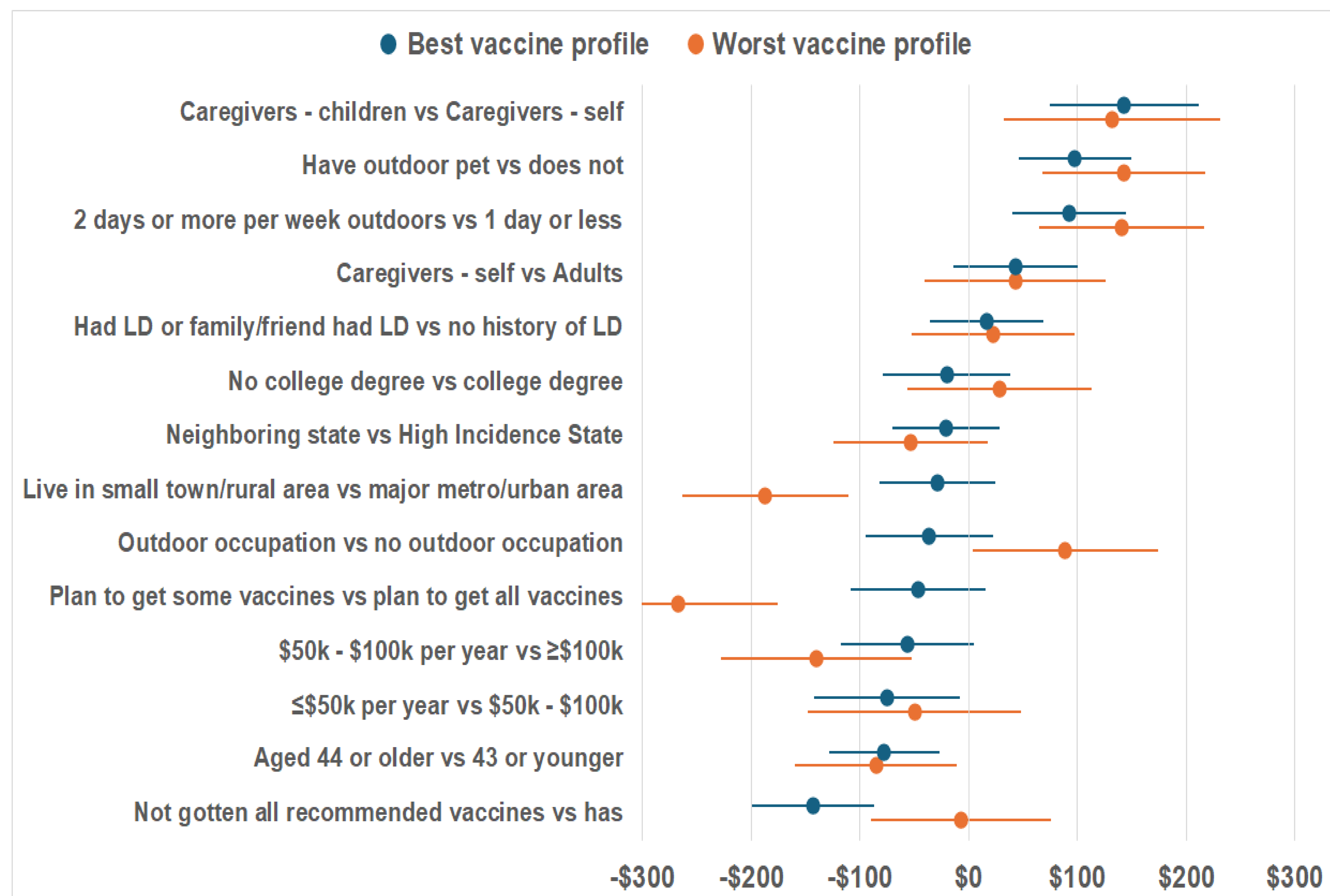
- Table 2 presents selected characteristics of respondents in the study

**Table 2. Respondent characteristics**

| Category | Caregivers – children (N=1000) | Caregivers – self (N=499) | Adults (N=501) |
|---|---|---|---|
| | N (%) or Mean (SD) | | |
| Age in years | 41.4 (9.0) | 41.1 (8.1) | 58.3 (17.3) |
| Male | 584 (58.4%) | 306 (61.3%) | 237 (47.3%) |
| Reside in high incidence state | 608 (60.8%) | 321 (64.3%) | 270 (53.9%) |
| Decided not to get a vaccine that was recommended by healthcare provider | 327 (32.7%) | 166 (33.3%) | 121 (24.2%) |
| Plan to get some recommended vaccines in the next 5 years | 162 (16.2%) | 113 (22.7%) | 170 (33.9%) |
| Had LD or family/friend had LD | 563 (56.3%) | 286 (57.3%) | 180 (35.9%) |
| Outdoor occupation | 415 (41.5%) | 199 (39.9%) | 40 (8.0%) |
| Live in suburb, small town, or rural area | 403 (40.3%) | 215 (43.1%) | 400 (79.8%) |
| Completed 4-year college degree | 681 (68.1%) | 343 (68.7%) | 157 (31.3%) |
| 2 or more days outdoors per week | 676 (67.6%) | 342 (68.5%) | 180 (35.9%) |
| Aged 44 or older | 375 (37.5%) | 173 (34.7%) | 390 (77.8%) |
| Have outdoor pet | 649 (64.9%) | 328 (65.7%) | 175 (34.9%) |
| Income under $50,000 per year | 152 (15.2%) | 76 (15.2%) | 239 (47.7%) |
| Income between $50,000 and $100,000 per year | 272 (27.2%) | 134 (26.9%) | 169 (33.5%) |
| Income over $100,000 per year | 570 (57.0%) | 287 (57.5%) | 82 (16.4%) |

- Results from the double-bounded models are presented in Figure 2. For each covariate, the omitted group is listed second

**Figure 2. Deviations from mean WTP for subgroups**

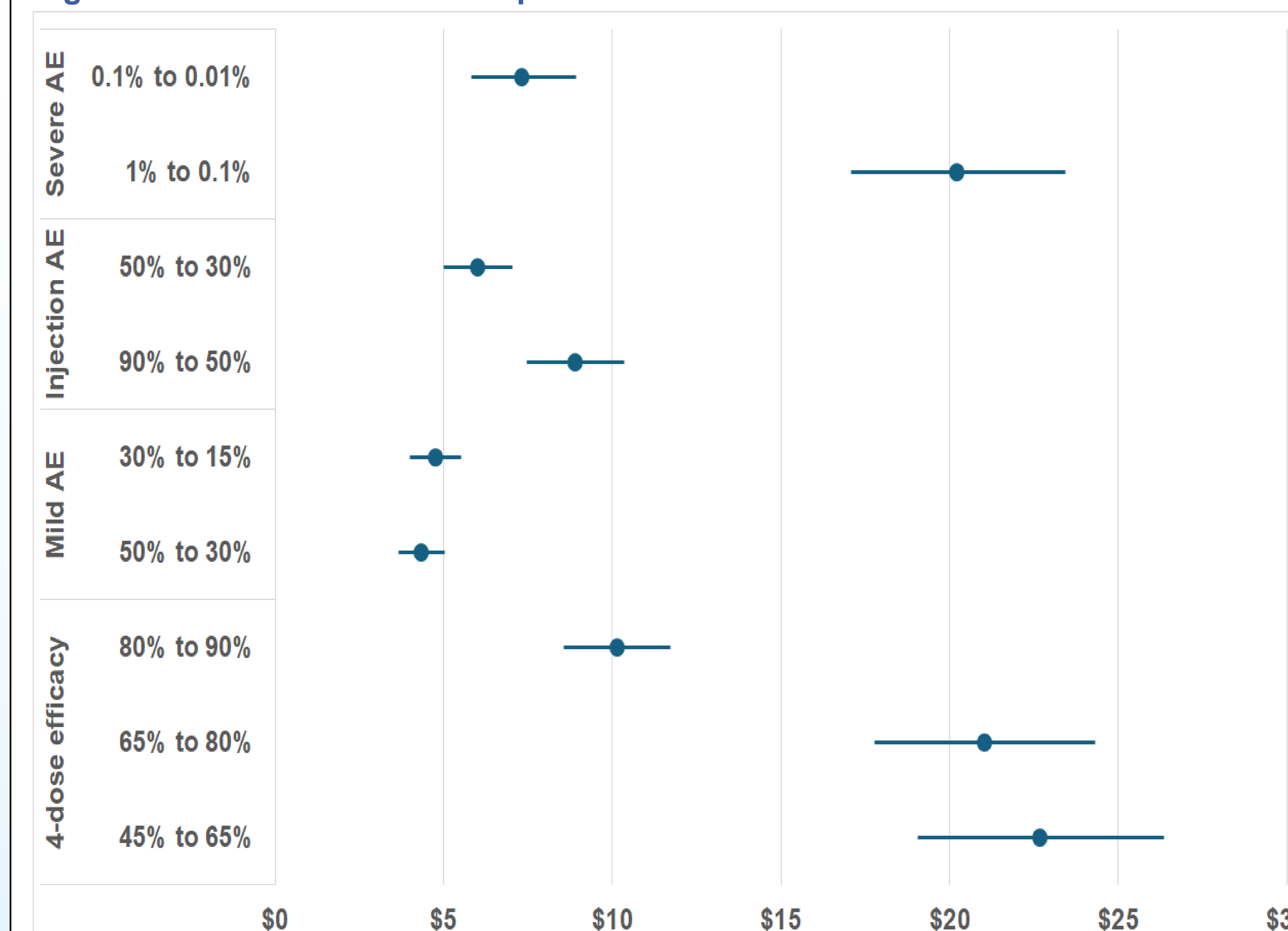



- The "Mean" value for the **best vaccine profile was $373.74**, and **$268.40 for the worst vaccine profile**. The mean value represents the WTP estimate of the "average" respondent.
- WTP estimates on covariates indicate how much more or less respondents with one level of a covariate would pay than respondents with another level of the covariate (i.e., respondents that "Have outdoor pet" would pay $98 more for the best vaccine profile than respondents who reported not having a pet that goes outdoors regularly).
- Caregivers answering for their children would pay significantly more for both vaccine profiles compared to adults, and caregivers answering for themselves would pay significantly more for the best vaccine profile.
- Those who are less vaccine hesitant would pay significantly more for the worst vaccine profile.
- Respondents who are younger, outdoors more often, own outdoor pets, and with more income would pay more for both vaccine profiles
- The constant, representing the mean WTP for the average respondent for the worst vaccine profile was $268.4, indicating that even at the lowest efficacy and highest risks, respondents are willing to pay to be vaccinated. The average WTP for the best vaccine profile, with the highest efficacy and lowest risks, is $373.70.
- The difference between the two WTP values for the profiles ($105.34) can be combined with the preference weights from the DCE to calculate average WTP, for improvements in the attributes of a vaccine

## RESULTS (cont.)

- Figure 3 shows the WTP for each attribute level improvement. These improvements can be combined for the total value of the attribute to respondents.

**Figure 3. Mean WTP for each improvement in vaccine attribute levels**




*Severe AE risk of 0% is removed due as it is part of the opt-out no vaccine alternative

- Respondents placed the largest value on increasing efficacy ($53.8 from lowest to highest level), but showed diminishing marginal returns at higher levels
- Respondents placed a much higher value on avoiding higher severe AE risks (1% risk to 0.1% risk) compared to avoiding lower severe AE risks (0.1% to 0.01%)

## DISCUSSION

- Overall, respondents had high WTP for a vaccine for LD, and relatively small increases in WTP estimates for the best vaccine profile compared to the worst vaccine profile
- The difference in WTP between the two profiles shows that most of the WTP is driven by the desire to vaccinate and not by the attributes of the vaccine.
- Increases in WTP were strongly associated with certain respondent characteristics such as time spent outdoors, ownership of an outdoor pet, and vaccines for their children, while decreases in WTP were strongly associated with increases in age, lower incomes, rural or small-town residencies, and vaccine hesitancy

## CONCLUSIONS AND LIMITATIONS

- **Respondents placed a value of nearly $375 on a safe and efficacious hypothetical LD vaccine**
- **Respondents still valued a less efficacious vaccine with a less favorable safety profile at nearly $270.**
- **The high WTP value for both vaccine profiles suggests a large unmet need for a LD vaccine among the target population.**
- **There is potential for heterogeneity in DCE results; different vaccine recipients may tradeoff between vaccine characteristics differently**

## REFERENCES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## DISCLOSURES


This analysis was supported and jointly funded by Valneva and Pfizer Inc. as part of their co-development of a LD vaccine. Marco Boeri, Matthew Wallace, and Divya Mohan are employees of OPEN Health. OPEN Health received funding from Pfizer Inc. to conduct the study used to create this poster. Josh Coulter, Brett Hauber, L. Hannah Gould, Stephanie Ann Duench, Justin J. O'Hagan, and Holly Yu are employees of Pfizer Inc, the sponsor of this study, and may own company stock/stock options. All authors participated in the design of the study, in the analysis and interpretation of data, and in creating this poster.


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Presented at ISPOR 2026, 17-20 May 2026, Philadelphia