

The Impact of Funding Tocilizumab for the Inpatient Treatment of COVID-19 in the United States: A Distributional Cost-Effectiveness Analysis

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BACKGROUND

Underserved, low-income, and socially vulnerable individuals and communities faced a disproportionate burden of COVID-19–related hospitalizations and deaths.

Distributional cost-effectiveness analysis (DCEA) provides information on population subgroups who benefit the most, and least, from a decision to predict impacts on population health equity consequences and overall social welfare.

OBJECTIVES

We conducted a DCEA to evaluate how tocilizumab for inpatient treatment of COVID-19 from 2021–2023 impacted health equity in the United States (US).

CONCLUSIONS

Our analysis found that use of tocilizumab was both cost-effective and equity-improving at the population level.

Assuming an opportunity cost threshold of \$150,000 per QALY and an Atkinson aversion parameter of 11, the funding of tocilizumab led to a population net health gain of 52,252 QALYs. Though the total number of patients treated with tocilizumab was relatively small, estimated at 363,696 from 2021–2023, its use led to larger relative health gains in population subgroups with lower baseline health and reduced US health inequalities by 0.003% since 2021.

Although funding of tocilizumab led to opportunity costs that are borne across the full US population, the benefits of treatment outweighed those costs. Specifically, more vulnerable subgroups and subgroups with lower baseline health experienced larger relative benefits from treatment, which led to overall reductions in health disparities and improvements in social welfare.

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DISCLOSURES

KR and SK are employees and stockholders of Genentech, Inc., a member of the Roche group. JB was an employee of Genentech, Inc., at the time of this research.

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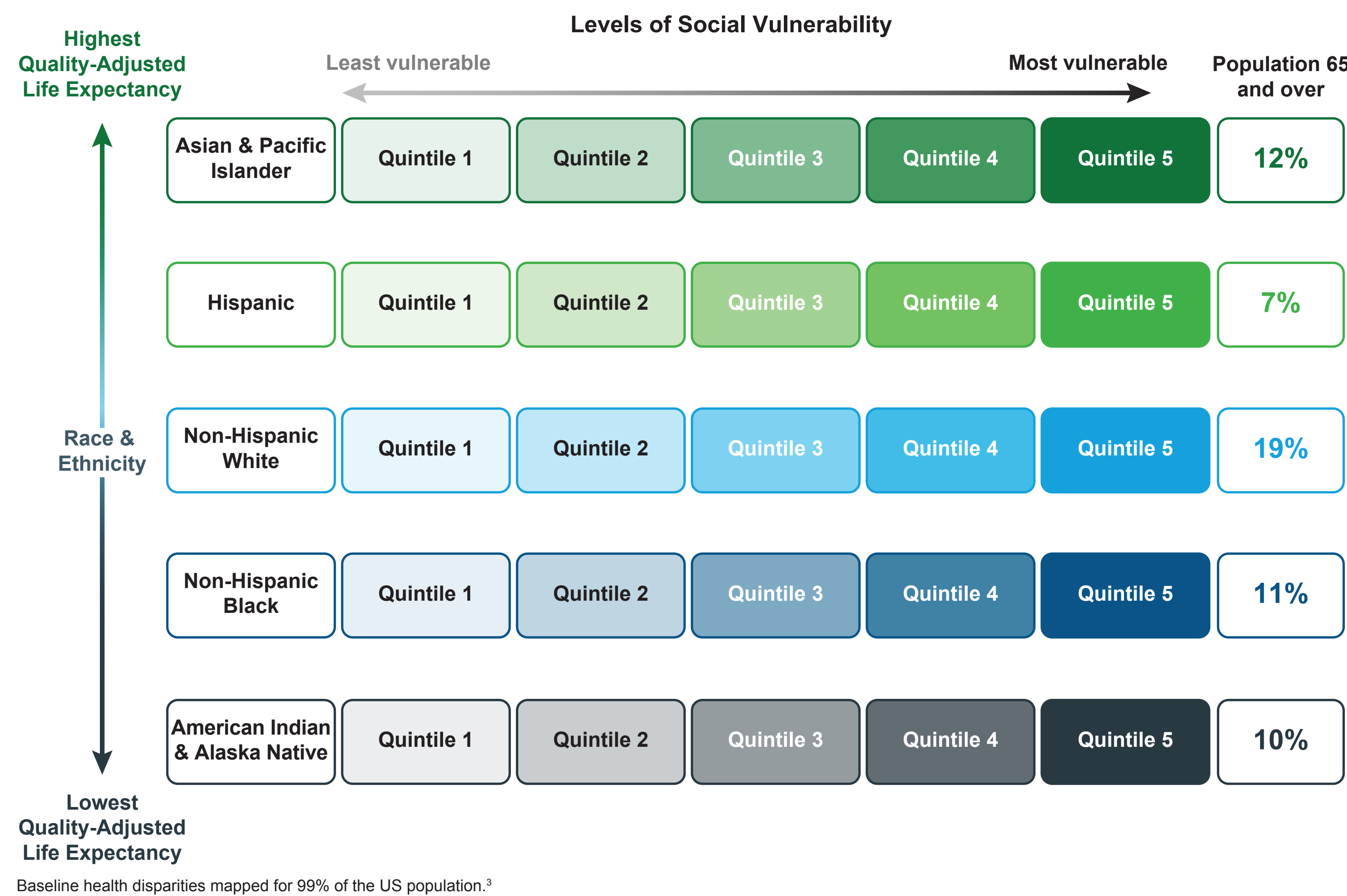
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METHODS

- Following methods outlined by Cookson et al,¹ we assess the impact of funding tocilizumab on US health equity, whereby patients receiving treatment with tocilizumab are subject to health gains from treatment but the full US population is subject to health losses given opportunity costs of treatment.
- A published payer perspective DCEA for inpatient COVID-19 treatments was adapted to include information on baseline health disparities across 25 equity-relevant subgroups based on race/ethnicity (5 census-based groups) and county-level social vulnerability (5 geographic quintiles)² (Figure 1).

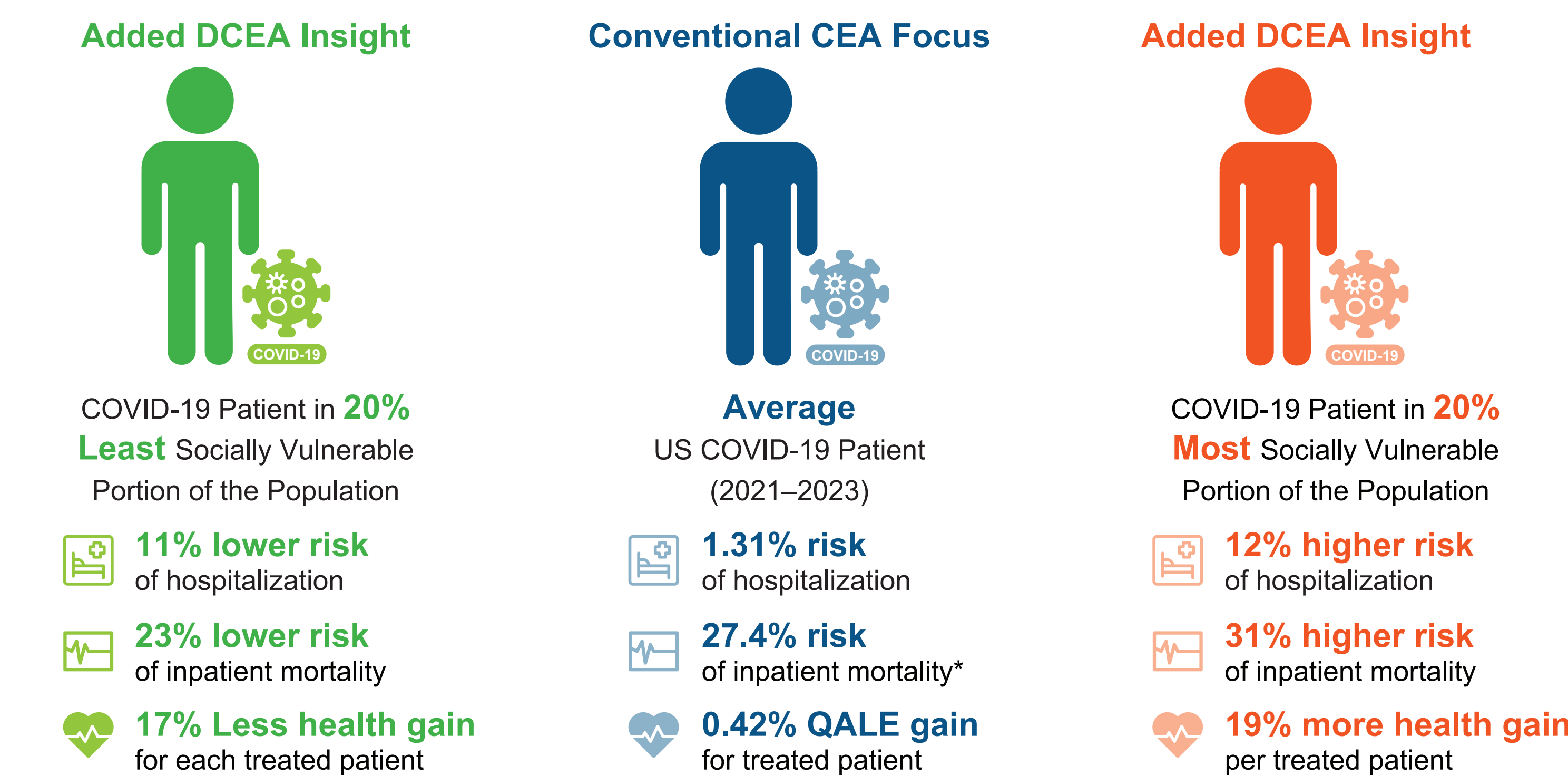
Figure 1. Population Subgroups Included in the Equity Analysis



Baseline health disparities mapped for 99% of the US population.³

- The underlying cost-effectiveness model was updated to reflect tocilizumab efficacy, contemporary unit costs, patient characteristics at admission, and standard of care outcomes based on published estimates.
- Hospitalization patterns by year and age from Jun 2021–Sep 2023 were derived from the Centers for Disease Control and Prevention National Healthcare Safety Network and COVID-NET.
- Age-based incidence rates each year (2021–2023) were applied to the 25 equity-relevant subgroups to risk adjust based on county-level social vulnerability index values to create a more nuanced picture of the distribution of COVID-19 hospitalization burden across geography and race and ethnicity, reflecting differences in the underlying age-distribution across subgroups³ (Figure 2).

Figure 2. Impact of Distributional Lens



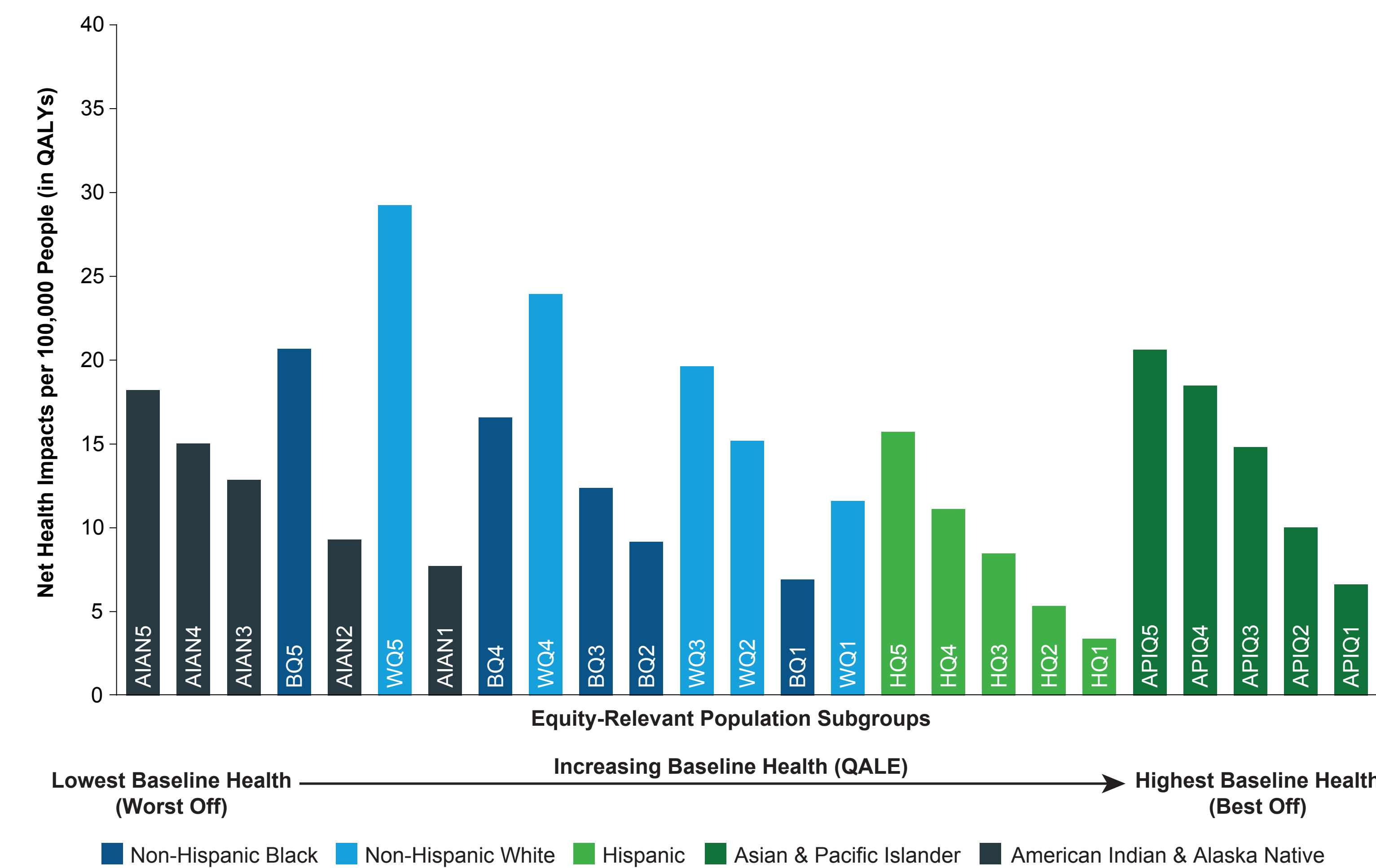
*Represents average inpatient mortality for patients receiving standard of care treatment across patients on supplemental oxygen, noninvasive ventilation, and invasive mechanical ventilation based on a meta-analysis of interleukin-6 COVID-19 trials.⁴
CEA = cost-effectiveness analysis; DCEA = distributional cost-effectiveness analysis.

- Opportunity costs were estimated by converting total tocilizumab spend into quality-adjusted life-years (QALYs) using an equal distribution of opportunity costs across subgroups. Sensitivity analyses examined changes in tocilizumab utilization, social vulnerability risk adjustments, Atkinson inequality aversion levels, and opportunity cost thresholds.

RESULTS

- The updated DCEA model found tocilizumab to be cost-effective, with an average incremental cost-effectiveness ratio per QALY gained of \$49,771.
- The estimated cost of inpatient COVID-19 treatment with tocilizumab was \$3.92 billion to treat 363,696 patients since 2021, leading to 79,000 QALYs gained in the total population overall and 26,149 in opportunity cost health losses (Figure 3).

Figure 3. Net Health Impact of Tocilizumab Use Per 100,000 (in QALYs)



Abbreviations: AIAN = American Indian & Alaska Native; API = Asian and Pacific Islander; B = Black, non-Hispanic; H = Hispanic; Q: Quintile (1 = least socially vulnerable; 5 = most socially vulnerable); QALY = quality-adjusted life year; W = White non-Hispanic.

- Using an opportunity cost threshold of \$150,000/QALY and Atkinson aversion parameter of 11, tocilizumab is estimated to have improved social welfare by increasing population health (53,252 QALYs gained) and reducing existing overall US health inequalities (by 0.003%) since 2021.
- Distributional insights indicate that health gains were largest for patients in population subgroups with: (1) lower baseline health; (2) higher levels of social vulnerability; and (3) in the white, non-Hispanic population, due to a larger proportion of individuals in older age groups.
- Conclusions were robust across all levels of inequality aversion and opportunity cost thresholds. Impact on social welfare was driven primarily by tocilizumab utilization and social vulnerability risk adjustments (Figure 4).

Figure 4. Social Welfare Impact of Tocilizumab Across Modeled Scenarios

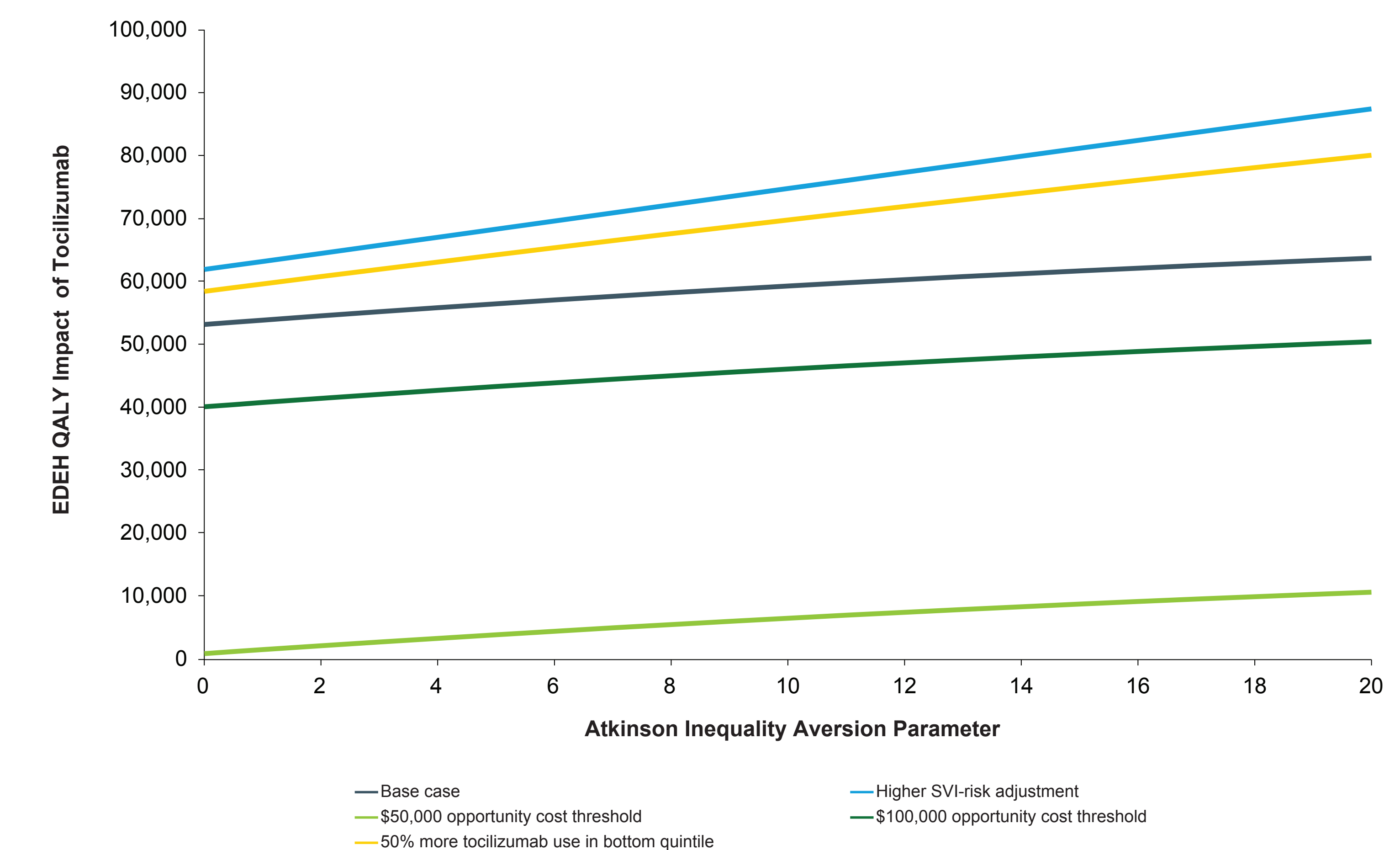


Table Note: The EDEH is the equity-weighted mean of the health distribution that considers relative inequality and total health to represent overall social welfare. On the EDEH graph, values above 0 on the y-axis represent overall net increases in social welfare and the slope on the graph captures changes in social welfare across Atkinson aversion parameters. A positive slope suggests increasing equity improvement under increased equity weighting, or higher preference values placed on reducing health disparities.

EDEH = equally distributed equivalent health; QALY = quality adjusted life year; SVI = Social Vulnerability Index.