The Price Isn't Right: Autonomous Vehicles, Public Health, and Social Justice

Reducing socioeconomic health inequalities is a long-term goal requiring multiple strategies. One underexplored dimension of how health inequalities are created and sustained is the numerous transportation challenges faced by the poor. Access to, quality of, and utilization of health care matter for health and, although health care debates often prioritize affordability of coverage, countries that provide universal coverage still show reduced frequency of health care service utilization by those with less income and education compared with their wealthier, better-educated peers.[1] This divergence is explained in part by transportation-related inequalities. In the United States alone, more than 3.6 million patients miss or delay nonemergency medical treatment annually owing to a lack of affordable transportation alternatives.[2] The ensuing impact is significant, as life-threatening conditions can go undiagnosed, culminating in graver clinical outcomes.

Public transit infrastructure yields some limited benefits. Although public transit access is associated with increased health care service utilization, this transportation mode imposes longer-than-average travel times compared with privately owned vehicles,[3] which increases the likelihood of missed treatments. However, private vehicle ownership imposes its own negative externalities. High costs make ownership unaffordable to many low-income households, and those who can afford automotive purchases are—owing to fiscal constraints—less likely to own new vehicles. Thus low-income automobile owners are particularly susceptible to motor vehicle crashes and postcrash injuries, as older automobiles lack advanced safety systems and have lower crash test ratings,[4] features that offer more protection against driver errors implicated in most motor vehicle crashes.

Autonomous vehicles—vehicles that drive themselves some or all of the time—promise relief. By shifting responsibility for vehicular control from humans to machines, the technology minimizes opportunities for driver error. From the vantage point of public health, the overarching goal of autonomous vehicles is to transform the current approach to automotive safety from reducing injuries after collisions to complete collision prevention.[5] Affordability concerns surrounding the technology are addressed by a shared mobility-on-demand setup. So-called autonomous taxis distribute expenditures over a large number of consumers, thereby lowering per unit costs. This facilitates reductions in socioeconomic health disparities as access to timely, cost-effective mobility services increases.

ASSESSING VALUE

Although realization of the aforementioned scenario ultimately relies on the cost proposition of autonomous taxis, no studies have—to date—examined their fiscal viability with respect to low-income consumer adoption. We compared the cost of using autonomous taxis to the cost of driving older, conventionally driven vehicles. Cost equivalence between these transportation modes would imply instantiation of some public health benefits, as low-income households that currently own older vehicles could potentially use safer autonomous taxis, absent fiscal penalties. A superior cost proposition of autonomous taxis over older conventionally driven vehicles would facilitate wider public health benefits, as patients who would normally delay care owing to a lack of affordable, mobility-on-demand alternatives would be incentivized to actively access treatment.

We used a bottom-up approach, using publicly available data (e.g., vehicle financing, licensing, insurance, maintenance, cleaning, fuel, and safety oversight expenditures) in a select city, namely San Francisco, California, to estimate autonomous taxi consumer costs (see the Appendix, available as a supplement to the online version of this article at http://www.ajph.org). We estimated costs at varying levels of technological maturity. We found that if commercial autonomous taxi services were offered today, fares would be—on a per mile basis—significantly costlier than continued ownership of older vehicles. Key drivers of this differential include supply–demand matching inefficiencies, impracticable profit expectations of commercial fleet operators, and safety oversight costs associated with autonomous

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vehicle technology (Table 1). Achieving cost competitiveness under these conditions requires—in addition to rectifying supply–demand-matching inefficiencies—the complete forfeiture of profit expectations by commercial fleet operators and technological maturity levels that demand minimal safety oversight. Our findings have implications for other cities owing to structural similarities in mobility-on-demand services used by commercial fleet operators worldwide.

IMPLICATIONS FOR PUBLIC HEALTH

If commercial autonomous taxis could create consistent access to mobility-on-demand alternatives, it could improve health care access and lead to better treatment outcomes. Moreover, with the potential to significantly reduce road crashes, autonomous vehicles portend the most significant advance in auto safety history by shifting focus from postcrash injury minimization to collision prevention.[5,6] Given that the poor tend to have both fewer transportation options and worse postcrash outcomes than the rich, transitioning to autonomous vehicles could reduce health inequalities.

However, realizing the public health benefits associated with autonomous vehicle technology demands a cost proposition the poor can afford. Our results suggest this is unlikely at present, owing to impediments that are not part of the current discourse. Absent willingness to address these impediments, socioeconomic inequalities in health are likely to widen, even if only in relative terms. Fatal crash rates have been increasing as the US economy has slowly recovered from the Great Recession, and inequalities were already on the rise before the recession.[4] The lack of affordable mobility-on-demand alternatives will force the poor to continue to suffer delayed access to nonemergency medical treatment. Moreover, individuals who can afford older conventionally driven vehicles will continue to be exposed to relatively greater risks of fatal crashes. Both scenarios are likely to contribute to excess morbidity and mortality for society's most vulnerable.

TABLE 1—Autonomous Taxi Fare per Mile Elasticity Given a 5% Change in Specified Parameters: San Francisco, CA, January 2018–January 2020

	Low Absolute Change in Fare per Mile and Relative Change		
Cost	Low, $ (%)	Medium, $ (%)	High, $ (%)
Financing	0.004 (−0.149)	0.004 (−0.214)	0.004 (−0.226)
Licensing	0.015 (−0.640)	0.015 (−0.917)	0.015 (−0.970)
Insurance	0.010 (−0.429)	0.010 (−0.615)	0.010 (−0.651)
Maintenance	0.008 (−0.318)	0.008 (−0.456)	0.008 (−0.482)
Cleaning	0.005 (−0.202)	0.005 (−0.290)	0.005 (−0.306)
Fuel	0.007 (−0.282)	0.007 (−0.404)	0.007 (−0.427)
Safety oversight	0.045 (−1.892)	0.009 (−0.543)	0.005 (−0.287)
Profit	0.026 (−1.089)	0.026 (−1.561)	0.026 (−1.651)
Capacity utilization	0.114 (−4.762)	0.079 (−4.762)	0.075 (−4.762)

Note. With the exception of capacity utilization, directionality of all input parameters is negative.

PUBLIC POLICY INSTRUMENTS

One policy instrument to make commercial autonomous taxi services more affordable is the elimination of expensive licensing costs. These government-imposed expenditures constitute—in our target market analysis—nearly 20% of an autonomous taxi's fare. Forgoing this figure entirely would admittedly facilitate the production of more cost-competitive fares. Such action alone will not, however, produce cost parity, as autonomous taxi fares would still remain more expensive than older conventionally driven vehicle ownership. This is noteworthy given the absence of similar government-imposed expenditures in the markets of other countries, such as India and China.

A complementary approach would create consumer subsidies for low-income individuals using autonomous taxi services. Although this approach would be politically challenging, missed or delayed medical appointments, at least partially owing to the lack of affordable mobility-on-demand alternatives, currently impose significant economic penalties. Furthermore, public revenues already pay for a portion of motor vehicle crashes that disproportionally involve low-income individuals.[4] In the United States, this amounts to an added $18 billion annually, the equivalent of more than $156 in additional taxes for every household.[7] If consumer subsidies directed toward low-income individuals can deliver an equivalent or greater benefit, using subsidies to incentivize widespread autonomous taxi use becomes politically palatable.

The proliferation of autonomous vehicle technology will no doubt result in some unintended consequences. We hope that a clear-eyed consideration of policy alternatives, such as targeted consumer subsidies, will help to prevent exacerbating health inequalities as one of them. AJPH

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A. Nunes and K. D. Hernandez planned the research. All authors interpreted the results and wrote the editorial.

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CONFLICTS OF INTEREST

The authors declare no potential conflict of interest nor any material transfer agreements, patents, or patent applications that apply to reagents, methods, or data in the editorial.

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