Accepted for publication in *Professional Psychology: Research and Practice*

Examining Psychologist Prescriptive Authority as a Cost-Effective Strategy for Reducing Suicide Rates

Phillip M. Hughes, MS[1,2,3*] Derek C. Phillips, PsyD, MSCP[4,5] Robert E. McGrath, PhD,[4] Kathleen C. Thomas, PhD, MPH[1,3]

[1]Division of Pharmaceutical Outcomes and Policy, University of North Carolina Eshelman School of Pharmacy

[2]Division of Research, UNC Health Sciences at MAHEC, Asheville, NC

[3]Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, Chapel Hill, NC

[4]School of Psychology and Counseling, Fairleigh Dickinson University, Teaneck, NJ

[5]Department of Neurology, Sarah Bush Lincoln Health Center, Mattoon, IL

*Corresponding Author:

phughes1@email.unc.edu
ATTN: Phillip Hughes
UNC ESHELMAN SCHOOL OF PHARMACY
Campus Box 7573
301 Pharmacy Lane
Chapel Hill, NC 27599-7573

Funding: This research was partially supported by a National Research Service Award Pre-Doctoral/Post-Doctoral Traineeship from the Agency for Healthcare Research and Quality sponsored by The Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill, Grant No. T32-HS000032.

Conflicts of Interest: The authors declare no conflicts of interest.

Acknowledgements: We would like to thank Dr. Casey Tak for his helpful comments on an early draft of this work.

Abstract

Six states (NM, LA, IL, IA, ID, CO) grant prescriptive authority to qualified psychologists, and research has shown that these policies are associated with a reduction in suicides. In this study, we assess the cost-effectiveness of these policies in reducing suicide rates. This study used a Markov Model with a time horizon of 20 years to estimate the incremental net monetary benefit (INMB) of the policy from the societal perspective with a simulated cohort of 100,000 people. Transition probabilities and utilities were collected from the literature, and costs were assessed using a mixed macro-micro costing approach. Using this approach, we found that the 20-year INMB for the policy was estimated to be $12.81 million ($USD) per quality-adjusted life year (QALY). The probability of cost-effectiveness was greater than 50% at a willingness-to-pay threshold as low as $10,000 per QALY. The probability of cost-effectiveness was only modestly associated with the implementation costs of the policy, but was sensitive to the estimated effect of the policy intervention. The models estimated in this study support prescriptive authority for psychologists as a cost-effective strategy for reducing state-level suicide rates. A considerable amount of research is needed to understand the impact of this policy with finer granularity.

Public Significance Statement: Prescriptive authority for psychologists may be a cost-effective means to reduce suicide deaths at the policy level. However, this study also highlights several important knowledge gaps that should be addressed regarding the patient outcomes associated with psychologist prescriptive authority.

Examining Psychologist Prescriptive Authority as a Cost-Effective Strategy for Reducing Suicide Rates

Suicide is one of the leading causes of death in the United States, with a rate of 13.5 suicide deaths per 100,000 people in 2020 (Garnett et al., 2022). In addition to the societal impact of suicide deaths, suicide attempts are also a major source of healthcare expenditures, totaling over $26.7 billion dollars in 2019 alone (Peterson et al., 2021). As a result of this substantial impact on population health, reducing the suicide rate has been included as one of the goals for Healthy People 2030 (National Academies of Sciences & Committee on Informing the Selection of Leading Health Indicators for HealthyPeople 2030, 2020). To accomplish that goal, it will be important to identify cost-effective policies and interventions.

The ongoing shortage of mental health providers, especially those with prescriptive authority (Andrilla et al., 2020; Thomas et al., 2009), is thought to play a role in the elevated suicide rate. While an ideal scenario may allow for patients to receive comprehensive mental health care from a team of psychiatrists, psychologists, and social workers, this is not the reality patients face. Instead, less than half (46.2%) of people with mental health needs receive care (Substance Abuse and Mental Health Services Administration, 2022), and the majority of psychotropic prescribing (65.0%) is done in primary care settings (Mark et al., 2009). One potential strategy to address this shortage of prescribers to improve population mental health and reduce suicides is to allow qualified psychologists to prescribe psychotropic medications. Such a policy has been advocated for by psychologists and the American Psychological Association since the mid-1980s (DeLeon et al., 1991; Fox et al., 2009). This advocacy increased substantially following the success of the Psychopharmacology Demonstration Project, in which 10 military psychologists were trained to safely prescribe medications resulting in qualified

psychologists in the DOD and United States Public Health Service being eligible to prescribe (Sammons & Brown, 1997). To date, six states have passed such policies (New Mexico, Louisiana, Illinois, Iowa, Idaho, and Colorado) with generally modest variations between their licensing requirements (McGrath, 2020; Robiner et al., 2020).

A recent study demonstrated that extending prescriptive authority to psychologists may successfully reduce suicide rates. Choudhury and Plemmons (2021) found that the implementation of this policy was associated with a 4.8% reduction in suicides, a finding that has since been corroborated by a second study using different methods (Hughes et al., 2022). However, while such a reduction is promising, the cost of implementation remains unclear due to the complexities involved in scope-of-practice changes. Based on the existing policies, there is a range of potential costs associated with their implementation, including costs to the state (e.g., changes to licensure boards), educational institutions (e.g., psychopharmacology programs), and individual psychologists (e.g., tuition and licensure fees). However, these costs have not been examined in detail to date.

Given evidence for a reduction in suicides associated with policies enabling prescriptive authority, it is important to examine the implementation costs incurred in order to assess the potential cost-effectiveness of this approach to reducing suicides. Therefore, the objective of this study was to assess the cost-effectiveness of state-level policies granting prescriptive authority to psychologists from the societal perspective. In addition, given the potential for variability in state-level policies, our secondary objectives were to 1) examine the relationship between the implementation cost and the overall cost-effectiveness of the policy, and 2) identify specific cost components that influence the overall implementation cost.

Methods

We approached this model from the societal perspective at the state level given that prescriptive authority is regulated independently by each state. Our study used a simulated cohort of 100,000 people from the general population to facilitate comparison to annual statistics using a 20-year time horizon based on the time elapsed since the passage of the first prescriptive authority policy (New Mexico, 2002) at the time of this study. We use a cohort of "average" individuals to whom no individual-level characteristics (e.g., age, race, etc.) are ascribed due to the paucity of research on patient-level outcomes relating to prescribing psychologists.

To assess the cost-effectiveness of prescriptive authority for psychologists as a suicide reduction strategy, we constructed a four-state Markov model with a one-year cycle length comparing the costs and outcomes of the policy to treatment as usual (Figure 1). We used this comparison for two reasons. First, reducing the suicide rate is a complex issue that will undoubtably require multiple interventions at the policy and individual levels in order to address it sufficiently. Second, there is extensive literature on the cost-effectiveness of other mental health promotion and suicide prevention measures, including a recent systematic review (Le et al., 2021), allowing policymakers to compare the result of our study to myriad other interventions. The overall structure of the model is a modification of a previously published suicide prevention cost-effectiveness model and included the following states: healthy (no recent suicide attempt), a suicide attempt resulting in an emergency department (ED) visit, a suicide attempt resulting in a hospitalization, and suicide death (Lebenbaum et al., 2020). Using the approach described by Lebenbaum et al. (2020), individuals who had a suicide attempt (either ED or hospitalized) entered a five-year tunnel state (a one-way sequence of states) in which they had an elevated risk of a repeat suicide attempt or suicide death. Individuals within the tunnel

states who have a non-fatal suicide attempt re-enter the tunnel state at year one. After five years with no repeated attempts, individuals transitioned back to the healthy state.

Model Parameters & Utilities

Transition probabilities from the healthy state were derived using suicide data (fatal and non-fatal) for 2019 from the Centers for Disease Control and Prevention (CDC) Web-based Injury Statistics Query and Reporting System (WISQARS) (Centers for Disease Control and Prevention, 2021). Annual probabilities for each suicide state were calculated as the total number of events divided by the total population. For the intervention model, these annual probabilities were reduced by 4.83% based on the estimated effect of the policy found by Choudhury and Plemmons (2021) (i.e., intervention probability = original probability - (original probability x 0.0483)) Transition probabilities for the five-year tunnel state were sourced from Lebenbaum et al., (2020) who used data from a meta-analysis (Carroll et al., 2014) to derive annual probabilities of both fatal and non-fatal suicide attempts. Tunnel probabilities for the intervention model were reduced in the same manner as the suicide state probabilities. Using the CDC WISQARS data, we calculated the probability that a non-fatal suicide attempt would result in a hospitalization or an emergency department (ED) visit and used this value to distribute the overall non-fatal attempt tunnel state probabilities into the two categories. Death was an absorption state in the model with a retention probability of 1. Transition probabilities can be seen in Table 1. Utilities for each state (healthy, recent non-fatal attempt, and suicide death; Table 2) were obtained from existing literature (Fleishman, 2005; van Spijker et al., 2011).

Costs

Costs were identified through existing data sources for suicide costs and a combination of micro and macro costing for intervention costs (Table 3). Most costs were available in 2021 US

dollars ($USD); all others were converted using the chained Consumer Price Index for Medical Costs (U.S. Bureau of Labor Statistics, 2019). All costs were discounted at 3% annually in accordance with the recommendations from the Second Panel on Cost-Effectiveness in Health and Medicine (Basu & Ganiats, 2016). Average suicide-related costs were available through the CDC WISQARS system for fatal, non-fatal suicide attempt ED visits, and non-fatal suicide attempt hospitalizations. These costs were available as the medical costs (e.g., inpatient hospitalization costs) and societal costs (i.e., productivity and quality of life costs) for the year following a suicide or suicide attempt. These costs are described in greater detail elsewhere (Centers for Disease Control and Prevention, 2021; Peterson et al., 2021). Suicide-related costs were incurred in the first year that each individual transitioned to a given suicide-related state. No additional costs were incurred for years spent in the tunnel states.

Costs associated with the prescriptive authority policy intervention included costs to the state, universities, and individual prescribing psychologists. These costs were compiled from a combination of state licensure boards, university websites, and wage information from the Bureau of Labor and Statistics' Occupational Outlook Handbook (U.S. Bureau of Labor Statistics, 2022). Given the challenges of identifying the costs associated with a policy intervention, we opted to use more conservative measures of cost where possible. Additionally, two psychologists with expertise on prescriptive authority for psychologists provided feedback on the overall and individual costs throughout the costing process in order to support the face validity of the resulting model.

The cost identified at the state level was potential changes to the state licensure board. Illinois added two physicians to their licensure board, which we conservatively included as two half-time positions using the median salary of a physician (Bureau of Labor Statistics, 2020).

Given the additional education requirements for psychologists seeking to prescribe, we included the cost of maintaining a Master of Science in Clinical Psychopharmacology (MSCP) program as the university cost. This included the cost for the initial three-year APA designation ($1500) and the annual fee of $250 (American Psychological Association, 2012). Additionally, after the initial three-year designation, programs must renew their designation every three to five years (American Psychological Association, 2012). We annualized this cost at the rate of every five years ($300 per year). The annual cost of instructors and a program director for such a program was estimated based on the median number of instructors across currently existing programs as listed on their websites and the median salary for post-secondary educators (instructors) and the median annual salary for a psychologist (program director) (U.S. Bureau of Labor Statistics, 2020b, 2020a). Currently, five universities offer an MSCP: Fairleigh Dickinson University, Alliant International University, The Chicago School of Professional Psychology, Idaho State University, and New Mexico State University (Alliant International University, 2021; Fairleigh Dickinson University, 2021; Idaho State University, 2021; New Mexico State University, 2021; The Chicago School of Professional Psychology, 2021).

Individual costs for education were based on the average cost per credit at all five universities and the average number of credits required to complete the MSCP. The certification exam required by all states (Psychopharmacology Examination for Psychologists or PEP) has a fixed cost, as well as opportunity costs in the form of time spent studying for the exam (Association of State and Provincial Psychology Boards, 2022). We estimated the study time for the PEP to be approximately 250 hours and converted this to a cost via the median hourly wage for a psychologist (U.S. Bureau of Labor Statistics, 2020b). Given the state-level variation in licensure requirements, licensure costs were based on average requirements and costs across the

five states where prescriptive authority for psychologists has been enacted (Rules of the Idaho State Board of Psychologist Examiners, 2021; Clinical Psychologist Licensing Act, 2017; Iowa Department of Public Health/Bureau of Professional Licensure, n.d.; Louisiana Board of Pharmacy, 2021; Louisiana State Board of Medical Examiners, n.d.; New Mexico Regulation & Licensing Department, n.d.). These costs included an initial application fee and an annual renewal fee. New Mexico, Louisiana, and Illinois also require a controlled substance license from the state Board of Pharmacy, which we included in the initial cost. Additionally, a three-year DEA registration to prescribe controlled substances was included at an annualized rate (Registration and Reregistration Fees for Controlled Substance and List I Chemical Registrants, 2020). The final item included in the individual-level costs was a malpractice insurance add-on for prescribing coverage. Given that the cost of provider malpractice insurance coverage can vary substantially by state and depending on a variety of other factors, we relied on expert opinion to incorporate this component of our costing. We estimated the insurance add-on to be a 15% increase to an $800 annual insurance premium ($120).

Analysis

The outcomes of interest in this simulation were incremental costs, suicide attempts, suicide deaths, and quality-adjusted life years (QALYs), calculated as the difference in outcome between the no-intervention condition and the psychologist prescriptive authority policy. Cost outcomes were calculated separately for medical costs, societal costs, intervention costs, and total costs. To calculate QALYs, we multiplied the number of people in each of the four model states per model cycle by the appropriate utility weight. We then applied a half-cycle correction to this value to adjust for the timing of model state transitions within cycles (Caro et al., 2012).

Incremental QALYs were then calculated as the difference between the no-intervention condition and the psychologist prescriptive authority policy.

To assess the cost-effectiveness of this policy for reducing suicide deaths, we calculated the Incremental Net Monetary Benefit (INMB) for suicide attempts averted, suicide deaths averted, and QALYs (Briggs et al., 2007). The INMB was calculated as the difference between the monetary value of each outcome based on a willingness-to-pay (WTP) threshold of $50,000 per outcome and the incremental cost per outcome. Under this specification, a positive INMB was considered to be cost effective. For example, if an intervention produced a net of 50 QALYs worth $50,000 each ($2,500,000 total) and cost $1,000,000 to implement, the INMB would be $1,500,000. This approach offers a more intuitive approach to understanding cost-effectiveness than the traditional incremental cost-effectiveness ratio (Trippoli, 2017). Given that broad public health impact of suicides could be valued differently depending on the context, we also examined the INMB using WTP thresholds of $100,000 and $150,000.

Probabilistic Uncertainty Analysis

To examine how sensitive our base-case assessment was to uncertainty in our estimates, we conducted a probabilistic uncertainty analysis (PUA). We simulated 10,000 replications of our model in which we allowed all model parameters to vary using probabilistic distributions. Model state transition probabilities were parameterized using a Dirichlet distribution of random Gamma draws. The intervention effect was normally distributed and applied to the probabilistic model state transition probabilities in the same manner as the base-case analysis. In order to maintain the hierarchical relationship between utilities, we introduced uncertainty via a normally-distributed incrementing value that also kept the utilities between a value of 0 and 1. Costs were parameterized with Gamma distributions. Uncertainty applied to the quantity of

certain costs were parameterized using a uniform distribution across a range of values. The ranges for the number of licensure board members (0-2) and MSCP instructors (2-12) were based on the minimum and maximum of current policies and MSCP programs, respectively. The range for the number of hours needed to study for the PEP exam was set as a 30% deviation from the base-case in either direction (175-325).

The results of the 10,000 simulated trials were summarized in several ways. First, we calculated the probability of cost-effectiveness over a range of WTP thresholds as the proportion of the trials that had a positive INMB at each threshold. Second, we examined the relationship between the intervention cost of each trial and the probability of cost-effectiveness at different WTP thresholds. We did this in order to identify potential cost points at which the policy was no longer likely to be cost-effective. In order to reduce the impact of outlier cost estimates, we restricted this analysis to rounded costs that occurred in at least 50 trials (e.g., 50+ trials had an intervention cost of $5.1 million.) Third, we conducted distributional one-way deterministic sensitivity analyses to examine the specific factors that explain the most variation in the INMB (Vreman et al., 2021). To do this, each parameter was set to the 5^{th} and 95^{th} percentile value from the distribution used in the PUA. We used the $50,000 per QALY INMB as the outcome for these analyses in order to assess model variation using the outcome with the lowest threshold; however, the results of these analyses are consistent across our different outcomes. Fourth, given the wide range of intervention costs identified and the complexities involved in assigning costs to a policy, we conducted one-way deterministic sensitivity analyses for intervention costs, as well. This sensitivity analysis was conducted in order to identify potential cost-saving measures in the implementation of future policies. Model construction and evaluation were conducted using

Microsoft Excel 2016 (Redmond, WA) and Crystal Ball (Oracle Crystal Ball v 11.1.2.4, Oracle Software, 2020). This study was not pre-registered.

Results

In the base-case analysis, the 20-year intervention cost of the psychologist prescriptive authority policy intervention was $22.67 million dollars. The policy had higher overall medical costs than the no-intervention strategy ($88.00 million versus $75.72 million), but lower overall societal ($2.77 trillion versus $3.00 trillion) and total ($2.83 trillion versus $3.08 trillion) costs per 100,000 population. Additionally, there were 844 fewer non-fatal suicide attempts (2,962 versus 3,806) and 805 fewer suicide deaths (2,615 versus 3,420), resulting in 502 more QALYs (1,593,350 versus 1,592,848) for the policy intervention. As seen in Table 4, the policy produced a positive INMB across all three outcomes for all three costs at all three WTP thresholds. The INMBs produced ranged from $12.81 million (QALYs using medical costs at a WTP of $50,000) to $370.30 million (deaths averted using total costs at a WTP of $150,000). The prescriptive authority for psychologists policy was cost-effective for all outcomes. Additionally, given the lower overall costs and superior outcomes for both societal and total costs, it was the dominant strategy when examining any costs beyond medical costs alone.

Probabilistic Uncertainty Analysis

In our probabilistic uncertainty analysis, we found that the policy had approximately a 50% probability cost-effectiveness at a WTP threshold of $10,000 per suicide attempt averted (50.3%), death averted (50.3%), and QALY (49.7%; Figure 2). In our examination of the relationship between intervention cost and the probability of cost-effectiveness (Figure 3), we found that the probability was generally stable across intervention costs for all three WTP thresholds. The lowest probability of cost-effectiveness was 44.9% at a cost of $5.8 million and a

WTP of $50,000, while the highest probability of cost-effectiveness was 73.1% at a cost of $5.8 million and a WTP of $150,000.

The results of the one-way sensitivity analyses for INMB are displayed as a tornado chart (Figure 4). We found that the estimated policy effect explained the majority of the variation in INMB (88.34%). At the 5th percentile (a 0.6% reduction in the suicide rate), there was a 132.6% reduction in the INMB, resulting in the policy no longer being cost-effective. At the 95th percentile (a 9.0% reduction in the suicide rate), there was a 132.6% increase in the INMB. The societal cost per suicide death (11.64%) and the MCSP instructor/staff salary (0.01%) were the only additional factors required to explain 100% of the variation in INMB. There was a positive INMB for both the upper and lower range for both factors.

The tornado chart displaying the results of the one-way sensitivity analysis for the overall intervention costs can be seen in Figure 5. We found that the salary of instructors for the MSCP program was the single largest cost-driver for the intervention, explaining 79.36% of the variation in total intervention costs. At the 5th percentile ($36,857 per instructor), there was a 38.9% reduction in total intervention costs, while at the 95th percentile ($222,732 per instructor), there was a 124.4% increase in total intervention costs. The second most influential individual cost was the number of MSCP instructors, which explained an additional 19.16% of the variance. There was a 49.0% reduction in total costs at the 5th percentile of instructors (2.5 instructors) and a 31.2% increase at the 95th percentile (11.5 instructors). The number of physician full-time equivalents added to the psychology board (1.39%), tuition per psychologist for the MSCP program (0.08%), and the hourly opportunity cost per psychologist for PEP study time (0.01%) explained the remaining variation in intervention costs.

Discussion

Granting prescriptive authority to psychologists as a policy intervention to reduce suicides was a dominant strategy from the societal perspective at a WTP threshold of $50,000. Additionally, the policy intervention was found to have a 50-60% probability of cost effectiveness in the probabilistic uncertainty analysis. Importantly, this result appears to be stable across a range of intervention costs, suggesting that states have the flexibility to add additional components to their policies (such as expanding the board of psychologists) without severely limiting the cost-effectiveness of the policy. However, this study highlights several areas for future research regarding the underlying mechanism by which these policy interventions reduce the suicide rate. These knowledge gaps will need to be remedied in order to tailor state policies to be the most effective.

Limitations

This study has several limitations worth consideration. First, the results of this study represent a very macro view of the policy intervention due to the limited evidence around this policy. In particular, this study does not include changes in prescribing patterns and medication costs, non-suicide related outcomes (e.g., psychiatric hospitalizations), and changes in the availability and geographic distribution of psychologists as a result of the expanded scope-of-practice. The etiology of suicide is complex and it can be difficult to identify the causal mechanisms involved in addressing suicide. However, the model used in the present study is intentionally agnostic to the mechanism by which suicide occurs; it is built to model the change in suicide rates that results from the adoption of the RxP policy with no assumptions related to the mechanism underlying the policy effect. Additionally, due to a lack of more granular data, the intervention effect was assumed to be consistent across all suicide state transitions and tunnel

states in our model. Future work is needed to examine the nuances of how this policy affects suicide rates, particularly in the time period following a suicide attempt.

Second, we used a policy intervention effect estimate reflecting the average effect in the population given that our model reflects the general population and broad societal perspective; however, Choudhury and Plemmons (2021) identified heterogeneous treatment effects by sex, race, marital status, and age. Future work is needed to identify the causal mechanism underlying these heterogeneous effects in order to facilitate more nuanced cost-effectiveness approaches, such as a microsimulation study in which patients with individual-level characteristics choose where to receive care and experience subsequent outcomes based on that decision. Additionally, our study relied on the policy effect estimate of this singular study. While this is common in cost-effectiveness work (e.g., Lebenbaum et al., 2020), it does present a potential limitation. The quasi-experimental design employed by Choudhury and Plemmons is a highly rigorous design frequently used in policy analysis where a randomized controlled trial is infeasible, which lends some confidence that the use of a singular estimate is appropriate.

Third, inherent in this study is the assumption that qualified psychologists can be effective prescribers, which some may argue is a strong assumption given the complexity of psychotropic medications. To date, no study has empirically compared the rates of adverse drug events to examine this assumption; however, there is some evidence to suggest that prescribing psychologists are safe and effective prescribers. The two studies to date that demonstrated a reduction in deaths related to mental health would strongly suggest that qualified psychologists can successfully prescribe (Choudhury & Plemmons, 2021; Hughes et al., 2022). Additionally, a survey of prescribing psychologists' medical colleagues found that they felt the prescribing psychologists were adequately trained, safe prescribers, and knew when to refer to a physician

(Linda & McGrath, 2017). Additionally, a thesis from 2020 found that the psychopharmacology content knowledge of prescribing psychologists was equivalent to that of psychiatrists and psychiatric nurse practitioners and higher than that of non-psychiatric physicians and nurses (Cooper, 2020). While the available evidence suggests that prescribing psychologists are capable of being safe prescribers, future research on outcomes is needed to solidify this assumption underlying our model.

Finally, we were intentional in using a highly conservative approach to estimating the costs associated with this policy intervention where possible. Given the macro view captured in this model, we sought to reduce the potential for a type I error ('false positive') in estimating the cost-effectiveness of the intervention through using overly conservative cost estimates. For example, while we included full-time costs for the MSCP program director and faculty instructors, these are often part-time positions and, with the exception of the program director, comprised of adjunct instructors. The resulting total intervention cost is therefore considerably overestimated, ultimately biasing the INMB towards a negative value. Given this limitation, we have a higher degree of confidence in our conclusion that the policy is cost-effective; the actual INMB is potentially much higher than presented here.

Policy Implications

Reducing the suicide rate nationally has been identified as a significant health target of Healthy People 2030 (National Academies of Sciences & Committee on Informing the Selection of Leading Health Indicators for HealthyPeople 2030, 2020). Our findings suggest that granting prescriptive authority to psychologists is a cost-effective policy strategy to help achieve this goal. However, policymakers will likely need to be thoughtful in their implementation strategy for this policy to have the most impact. Our results appear to be sensitive to variation in the size of the

policy effect given that it explained the majority of the variation in the INMB, and it was the only factor capable of producing a non-cost effective result in the one-way sensitivity analysis. Future research will be critical in identifying specific policy components that increase the impact of the policy, such as identifying ways to increase the number of psychologists who become licensed under the policy, formalizing mechanisms for referring suicidal patients to prescribing psychologists, and specifying appropriate patient case mix for psychologists and other psychotropic medication prescribers.

It is important to note that the policy examined here likely has additional effects on mental health at the individual level that have been unexamined to date, such as reducing utilization of the ED for psychiatric conditions more generally. An evaluation of individual-level effects (either harms or benefits) would both improve our understanding of the full impact of the policy, as well as enhance our ability to evaluate its cost effectiveness in other areas. Given sufficient individual-level outcomes, a future cost-effectiveness microsimulation study may provide a significantly more nuanced understanding of the potential impact of this policy.

One area in need of considerable further examination is the prescribing patterns and costs associated with prescribing psychologists. This area is of particular interest given the economic impact of mental health prescribing, as psychotropic medication spending in the US was projected to be $71 billion in 2020 (Hodgkin et al., 2016). How integrating psychologists into the prescribing workforce may change medication spending is unclear and is critical to address for future cost-effectiveness work related to the subject. While it seems logical that increasing the number of prescribers would increase the number of prescriptions, it has been suggested that prescriptive authority for psychologists may result in the *deprescribing* of psychotropic medications in patients who may see more benefits from psychotherapy or other non-

pharmacologic interventions. One recent survey of prescribing psychologists found that they had decreased the dosage or removed a medication from 28.3% and 29.5% of their current patients respectively (Peck et al., 2021), suggesting the increase in medication costs associated with this policy may be smaller than anticipated.

Conclusion

We found that policies granting prescriptive authority to psychologists may be a cost-effective approach to reducing the suicide rate. The effect of the policy on the suicide rate was the single most important factor in the sensitivity analysis, suggesting that future research on maximizing the intervention effect is needed. Research examining additional patient-level outcomes is needed to further understand the potential impacts of prescriptive authority for psychologists.

References

Alliant International University. (2021). *MS Clinical Psychopharmacology*. https://www.alliant.edu/psychology/clinical-psychopharmacology/ms

American Psychological Association. (2012). *Policies and Procedures for the Designation of Postdoctoral Education and Training Programs in Psychopharmacology in Preparation for Prescriptive Authority*. https://www.apa.org/education-career/grad/designation

Andrilla, C. H. A., Garberson, L. A., Patterson, D. G., Quigley, T. F., & Larson, E. H. (2020). Comparing the Health Workforce Provider Mix and the Distance Travelled for Mental Health Services by Rural and Urban Medicare Beneficiaries. *The Journal of Rural Health : Official Journal of the American Rural Health Association and the National Rural Health Care Association*. https://doi.org/10.1111/jrh.12504

Association of State and Provincial Psychology Boards. (2022). *Psychopharmacology Examination for Psychologists (PEP)*. https://www.asppb.net/page/PEPExam

Basu, A., & Ganiats, T. G. (2016). Discounting in Cost-Effectiveness Analysis. In P. J. Neumann, T. G. Ganiats, L. B. Russell, G. D. Sanders, & J. E. Siegel (Eds.), *Cost-Effectiveness in Health and Medicine* (pp. 277–288). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780190492939.003.0010

Briggs, A. H., Claxton, K., & Sculpher, M. (2007). *Decision modelling for health economic evaluation*.

Bureau of Labor Statistics. (2020). Physicians and Surgeons. In *Occupational Outlook Handbook*. U.S. Department of Labor. https://www.bls.gov/ooh/healthcare/physicians-and-surgeons.htm#tab-5

Caro, J. J., Briggs, A. H., Siebert, U., & Kuntz, K. M. (2012). Modeling Good Research Practices—Overview: A Report of the ISPOR-SMDM Modeling Good Research Practices Task Force–1. *Medical Decision Making*, *32*(5), 667–677. https://doi.org/10.1177/0272989X12454577

Carroll, R., Metcalfe, C., & Gunnell, D. (2014). Hospital Presenting Self-Harm and Risk of Fatal and Non-Fatal Repetition: Systematic Review and Meta-Analysis. *PLoS ONE*, *9*(2), e89944. https://doi.org/10.1371/journal.pone.0089944

Centers for Disease Control and Prevention. (2021). *Web-based Injury Statistics Query and Reporting System (WISQARS)*. https://www.cdc.gov/injury/wisqars/

Choudhury, A. R., & Plemmons, A. (2021). *Deaths of Despair: Prescriptive Authority of Psychologists and Suicides*. The Center for Growth and Opportunity at Utah State University. https://www.thecgo.org/research/deaths-of-despair/

Cooper, R. R. (2020). *Comparing Psychopharmacological Prescriber Training Models via Examination of Content-Based Knowledge* [Master's Thesis. Digital Archives, Harvard University]. https://nrs.harvard.edu/URN-3:HUL.INSTREPOS:37365636

DeLeon, P. H., Fox, R. E., & Graham, S. R. (1991). Prescription privileges: Psychology's next frontier? *American Psychologist*, *46*(4), 384–393. https://doi.org/10.1037/0003-066X.46.4.384

Fairleigh Dickinson University. (2021). *MS Clinical Psychopharmacology*. https://www.fdu.edu/program/ms-clinical-psychopharmacology-post-doctoral/

Fleishman, J. A. (2005). *Methodology Report #15: Demographic and Clinical Variations in Health Status.* Agency for Healthcare Research and Quality. http://www.meps.ahrq.gov/data_files/publications/mr15/mr15.shtml

Fox, R. E., DeLeon, P. H., Newman, R., Sammons, M. T., Dunivin, D. L., & Baker, D. C. (2009). Prescriptive authority and psychology: A status report. *American Psychologist*, *64*(4), 257–268. https://doi.org/10.1037/a0015938

Garnett, M., Curtin, S., & Stone, D. (2022). *Suicide Mortality in the United States, 2000–2020*. National Center for Health Statistics (U.S.). https://doi.org/10.15620/cdc:114217

Hodgkin, D., Thomas, C. P., O'Brien, P. L., Levit, K., Richardson, J., Mark, T. L., & Malone, K. (2016). Projected Spending on Psychotropic Medications 2013–2020. *Administration and Policy in Mental Health and Mental Health Services Research*, *43*(4), 497–505. https://doi.org/10.1007/s10488-015-0661-x

Hughes, P. M., McGrath, R. E., & Thomas, K. C. (2022). Evaluating the Impact of Prescriptive Authority for Psychologists on the Rate of Deaths Attributed to Mental Illness. *Research in Social and Administrative Pharmacy*. https://doi.org/10.1016/j.sapharm.2022.12.006

Rules of the Idaho State Board of Psychologist Examiners, Idaho Code § 24.12.01 (2021). https://adminrules.idaho.gov/rules/current/24/241201.pdf

Idaho State University. (2021). *MS Clinical Psychopharmacology*. https://www.isu.edu/pharmacy/prospective-students/clinical-psychopharmacology-program/

Clinical Psychologist Licensing Act, Ill. Comp. Stat. § 68.1400.40 (2017). https://www.ilga.gov/commission/jcar/admincode/068/068014000A00400R.html

Iowa Department of Public Health/Bureau of Professional Licensure. (n.d.). *Application for Conditional Prescribing Psychologist Certificate*. Retrieved March 1, 2022, from https://idph.iowa.gov/Licensure/Iowa-Board-of-Psychology/Licensure

Le, L. K.-D., Esturas, A. C., Mihalopoulos, C., Chiotelis, O., Bucholc, J., Chatterton, M. L., & Engel, L. (2021). Cost-effectiveness evidence of mental health prevention and promotion interventions: A systematic review of economic evaluations. *PLOS Medicine*, *18*(5), e1003606. https://doi.org/10.1371/journal.pmed.1003606

Lebenbaum, M., Cheng, J., de Oliveira, C., Kurdyak, P., Zaheer, J., Hancock-Howard, R., & Coyte, P. C. (2020). Evaluating the Cost Effectiveness of a Suicide Prevention Campaign Implemented in Ontario, Canada. *Applied Health Economics and Health Policy*, *18*(2), 189–201. https://doi.org/10.1007/s40258-019-00511-5

Linda, W. P., & McGrath, R. E. (2017). The current status of prescribing psychologists: Practice patterns and medical professional evaluations. *Professional Psychology: Research and Practice*, *48*(1), 38–45. https://doi.org/10.1037/pro0000118

Louisiana Board of Pharmacy. (2021). *Application for New Louisiana Controlled Dangerous Substance (CDS) License For Practitioners*. https://www.pharmacy.la.gov/page/cds-practitioners-selected-persons

Louisiana State Board of Medical Examiners. (n.d.). *Application & Instructions for Initial Licensure—Medical Psychology*. Retrieved March 1, 2022, from https://www.lsbme.la.gov/content/application-instructions-initial-licensure-medical-psychology

Mark, T. L., Levit, K. R., & Buck, J. A. (2009). Datapoints: Psychotropic Drug Prescriptions by Medical Specialty. *Psychiatric Services*, *60*(9), 1167–1167. https://doi.org/10.1176/ps.2009.60.9.1167

McGrath, R. E. (2020). What is the right amount of training? Response to Robiner et al. *Clinical Psychology: Science and Practice*, *27*(1). https://doi.org/10.1111/cpsp.12315

National Academies of Sciences, E., and Medicine (U. S.). & Committee on Informing the Selection of Leading Health Indicators for HealthyPeople 2030. (2020). *Leading health indicators 2030: Advancing health, equity, and well-being*. https://go.openathens.net/redirector/umoncton.ca?url=https%3A%2F%2Fsearch.ebscohost.com%2Flogin.aspx%3Fdirect%3Dtrue%26scope%3Dsite%26db%3Dnlebk%26AN%3D2461105

New Mexico Regulation & Licensing Department. (n.d.). *Psychologist Examiners: Fees*. Retrieved March 1, 2022, from https://www.rld.nm.gov/boards-and-commissions/individual-boards-and-commissions/psychologist-examiners/psychologist-examiners-fees/

New Mexico State University. (2021). *Postdoctoral M.S. in Clinical Psychopharmacology (MSCP) Degree*. https://cep.nmsu.edu/academic-programs/index1.html

Peck, K. R., McGrath, R. E., & Holbrook, B. B. (2021). Practices of prescribing psychologists: Replication and extension. *Professional Psychology: Research and Practice*, *52*(3), 195–201. https://doi.org/10.1037/pro0000338

Peterson, C., Miller, G. F., Barnett, S. B. L., & Florence, C. (2021). Economic Cost of Injury—United States, 2019. *MMWR. Morbidity and Mortality Weekly Report*, *70*(48), 1655–1659. https://doi.org/10.15585/mmwr.mm7048a1

Registration and Reregistration Fees for Controlled Substance and List I Chemical Registrants, 85 FR 44710 (2020). https://www.federalregister.gov/d/2020-16169

Robiner, W. N., Tompkins, T. L., & Hathaway, K. M. (2020). Prescriptive authority: Psychologists' abridged training relative to other professions' training. *Clinical Psychology: Science and Practice*, *27*(1). https://doi.org/10.1111/cpsp.12309

Sammons, M. T., & Brown, A. B. (1997). The Department of Defense Psychopharmacology Demonstration Project: An evolving program for postdoctoral education in psychology. *Professional Psychology: Research and Practice*, *28*(2), 107–112. https://doi.org/10.1037/0735-7028.28.2.107

Substance Abuse and Mental Health Services Administration. (2022). *2020 NSDUH Detailed Tables* [National Report]. Substance Abuse and Mental Health Services Administration. https://www.samhsa.gov/data/report/2020-nsduh-detailed-tables

The Chicago School of Professional Psychology. (2021). *MS Clinical Psychopharmacology*. https://www.thechicagoschool.edu/online/programs/m-s-clinical-psychopharmacology/

Thomas, K. C., Ellis, A. R., Konrad, T. R., Holzer, C. E., & Morrissey, J. P. (2009). County-Level Estimates of Mental Health Professional Shortage in the United States. *Psychiatric Services*, *60*(10), 1323–1328. https://doi.org/10.1176/ps.2009.60.10.1323

Trippoli, S. (2017). Incremental cost-effectiveness ratio and net monetary benefit: Current use in pharmacoeconomics and future perspectives. *European Journal of Internal Medicine*, *43*, e36. https://doi.org/10.1016/j.ejim.2017.05.015

U.S. Bureau of Labor Statistics. (2019). *Consumer Price Index: Medical care in U.S. city average, all urban consumers, chained, not seasonally adjusted*. https://beta.bls.gov/dataViewer/view/timeseries/SUUR0000SAM

U.S. Bureau of Labor Statistics. (2020a). Postsecondary Teachers. In *Occupational Outlook Handbook*. U.S. Department of Labor. https://www.bls.gov/ooh/education-training-and-library/postsecondary-teachers.htm#tab-5

U.S. Bureau of Labor Statistics. (2020b). Psychologists. In *Occupational Outlook Handbook*. U.S. Department of Labor. https://www.bls.gov/ooh/life-physical-and-social-science/psychologists.htm#tab-5

U.S. Bureau of Labor Statistics. (2022). *Occupational Outlook Handbook*.

van Spijker, B. A. J., van Straten, A., Kerkhof, A. J. F. M., Hoeymans, N., & Smit, F. (2011). Disability weights for suicidal thoughts and non-fatal suicide attempts. *Journal of Affective Disorders*, *134*(1–3), 341–347. https://doi.org/10.1016/j.jad.2011.05.020

Vreman, R. A., Geenen, J. W., Knies, S., Mantel-Teeuwisse, A. K., Leufkens, H. G. M., & Goettsch, W. G. (2021). The Application and Implications of Novel Deterministic Sensitivity Analysis Methods. *PharmacoEconomics*, *39*(1), 1–17. https://doi.org/10.1007/s40273-020-00979-3

Tables

Table 1. Markov Model Transition Probabilities

Model States		Base-Case	Source
Starting	Ending		
Healthy	Healthy	0.99845	CDC WISQARS, 2020
Healthy	Nonfatal Attempt (ED)	0.00042	
Healthy	Nonfatal Attempt (Hospital)	0.00098	
Healthy	Suicide Death	0.00014	
Nonfatal Attempt (ED + Hospital)	Nonfatal Repeat (ED)		Lebenbaum et al., 2020; Carroll, Metcalfe, & Gunnell, 2014
	Year 1	0.04884	
	Year 2	0.01558	
	Year 3	0.00476	
	Year 4	0.00144	
	Year 5	0.00043	
	Nonfatal Repeat (Hospital)		
	Year 1	0.11416	
	Year 2	0.03640	
	Year 3	0.01113	
	Year 4	0.00336	
	Year 5	0.00101	
	Suicide Death		
	Year 1	0.01600	
	Year 2	0.01027	
	Year 3	0.00658	
	Year 4	0.00422	
	Year 5	0.00270	

Notes: ED = Emergency Department. Given the multiple transition states for each transition probability, parameters were included in probabilistic uncertainty analysis using a Dirichlet distribution of Gamma values using a scale parameter of 1 and a shape parameter of 1000.

Table 2. Utilities

Model States	Utility	Source
Healthy	0.7984	Fleishman, 2005
Nonfatal Attempt	0.5400	van Spijker et al., 2011
Suicide Death	0	

Notes: Death is assumed to have a utility of 0. Utilities (excluding death) were included in the probabilistic uncertainty analysis using a normally-distributed incrementing value (Mean = 0; Standard Deviation = 0.5). This approach preserved the ordinal relationship between utilities.

Table 3. Costs

Item	Frequency	Quantity	Base Cost	Lower	Upper	Cost Year	Source
Non-Fatal Suicide Attempts							
Medical Costs							
Emergency Department^	Each	1	$ 10,237.60	$ 7,166.32	$ 13,308.87	2019	Centers for Disease Control and Prevention, 2021
Hospitalization^	Each	1	$ 36,569.96	$ 25,598.97	$ 47,540.95	2019	
Societal Costs							
Emergency Department^	Each	1	$ 13,281.67	$ 9,297.17	$ 17,266.17	2019	
Hospitalization^	Each	1	$ 40,154.46	$ 28,108.13	$ 52,200.80	2019	
Suicide Deaths							
Medical Costs^	Each	1	$ 5,307.02	$ 3,714.91	$ 6,899.13	2019	
Societal Costs^	Each	1	$10,210,779.96	$7,147,545.97	$13,274,013.95	2019	
Policy Costs							
State Costs							
Licensure Board Changes^		1*	$ 218,777.38	$ 153,144.17	$ 284,410.59	2020	Bureau of Labor Statistics, 2020a
Institutional Costs							
Program Director^^	Annual	1	$ 82,814.95	$ 46,627.50	$ 138,653.06	2020	Bureau of Labor Statistics, 2020c
Instructors/Staff^^	Annual	8*	$ 81,182.43	$ 41,145.46	$ 180,927.18	2020	Bureau of Labor Statistics, 2020b
APA Designation							American Psychological Association, 2012
Initial Designation Fee	Startup	1	$ 1,500.00	-	-	2021	
Annual Fee	Annual	1	$ 250.00	-	-	2021	
Annualized 5-year Renewal Fee	Annual	0.2	$ 1,500.00	-	-	2021	
Individual Costs per Psychologist							
MSCP Tuition^^^	Startup	1	$ 23,501.86	$ 12,766.74	$ 34,236.98	2021	Alliant International University, 2021; Fairleigh Dickinson University, 2021; Idaho State University, 2021; New Mexico State University, 2021; The Chicago School of Professional Psychology, 2021

PEP Exam	Startup	1	$	825.00		-		-	2021	Association of State and Provincial Psychology Boards, 2022; Expert Opinion
PEP Study Time^^	Startup	250**	$	39.81	$	22.42	$	66.66	2020	Bureau of Labor Statistics, 2020c
RxP License - Application^^^	Startup	1	$	256.00	$	199.51	$	312.49	2021	Idaho Code § 24.12.01; Ill. Comp. Stat. § 68.1400.40; Iowa Code § 645.244; Louisiana Board of Pharmacy, 2021; Louisiana State Board of Medical Examiners, n.d.; New Mexico Regulation & Licensing Department, n.d.
RxP License - Renewal^^^	Annual	1	$	118.50	$	51.06	$	185.94	2021	
DEA License	Annual	0.33	$	888.00		-		-	2021	21 CFR 1301.13
Insurance Add-on	Annual	1	$	120.00	$	84.00	$	156.00	2021	Expert Opinion

Notes: Startup costs were calculated prior to the first cycle of the model. No upper and lower estimates are provided for fix costs. All variable costs were incorporated in the probabilistic uncertainty analysis using a Gamma distribution. All costs from years other than 2021 were adjusted for inflation using the Chained Consumer Price Index. ^Upper and Lower estimates are calculated as +/- 30% of base value. ^^Base value is the median and the upper and lower are the 10th and 90th percentiles, respectively. ^^^Values represent mean and 95% confidence intervals estimated from existing programs and policies. *These quantities were varied in the probabilistic uncertainty analysis using a uniform distribution covering the minimum and maximum values in existing policies (0-2 MDs on the licensing board) and MSCP programs (2-12 faculty). **The hours of study time is based on expert opinion and was allowed to vary by +/- 30 using a Gamma distribution in the probabilistic uncertainty analysis.

Table 4. Net Monetary Benefit (In million $USD) for QALYs, Suicide Attempts Averted, and Deaths Averted at Different Willingness to Pay Thresholds

	Willingness to Pay		
	$50,000	**$100,000**	**$150,000**
QALYs			
Medical + RxP Policy	$12.81	$37.91	$63.00
Societal + RxP Policy	$258.46	$283.55	$308.64
Total + RxP Policy	$268.85	$293.94	$319.03
Suicide Attempts Averted			
Medical + RxP Policy	$27.97	$68.23	$108.48
Societal + RxP Policy	$273.62	$313.87	$354.12
Total + RxP Policy	$284.01	$324.26	$364.52
Deaths Averted			
Medical + RxP Policy	$29.90	$72.08	$114.26
Societal + RxP Policy	$275.54	$317.72	$359.90
Total + RxP Policy	$285.94	$328.12	$370.30

Figures

Figure 1. Markov Model for Annual Suicide Attempts

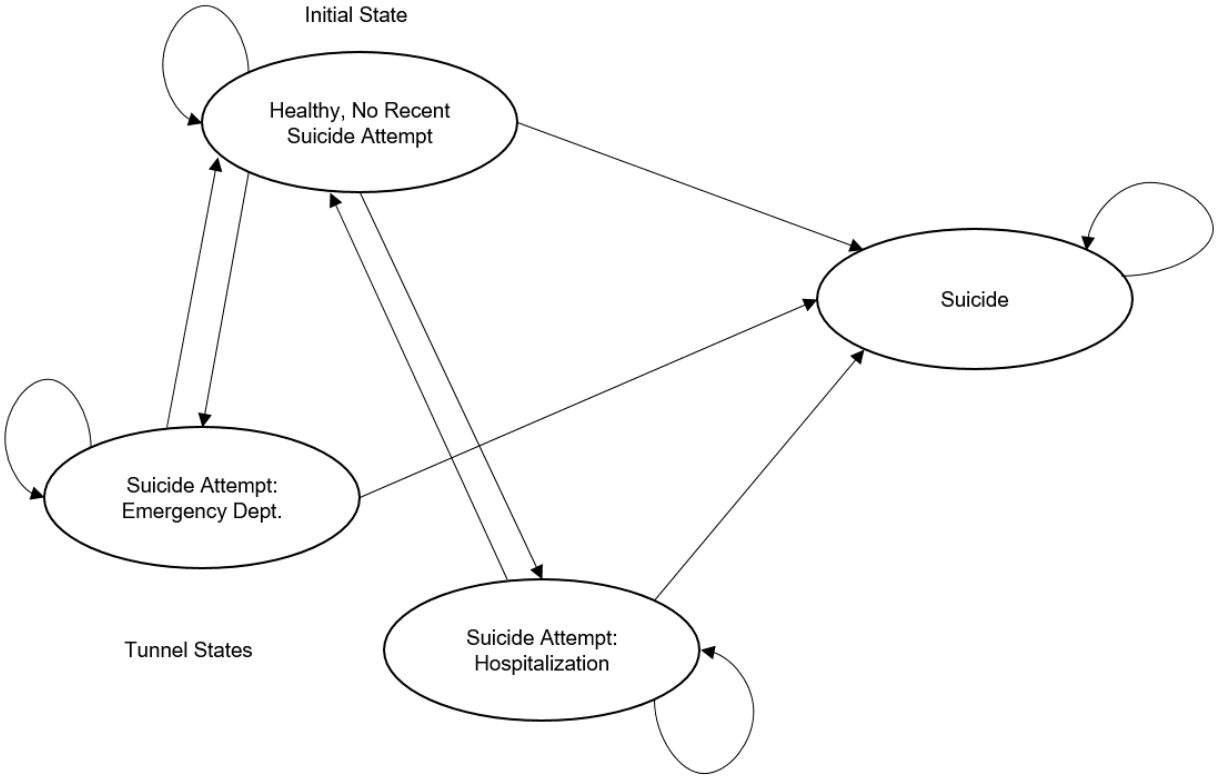

Figure 1 Caption: The full simulated cohort begins in the healthy state. Suicide death is an absorption state. Dept. = Department. Individuals in either Suicide Attempt tunnel states remain in those states for 5 years before returning to healthy. During that time, they have an elevated probability of a repeat suicide attempt or suicide fatality that decreases with each additional cycle year.

Figure 2. Probability of Cost Effectiveness by Willingness-to-Pay Threshold

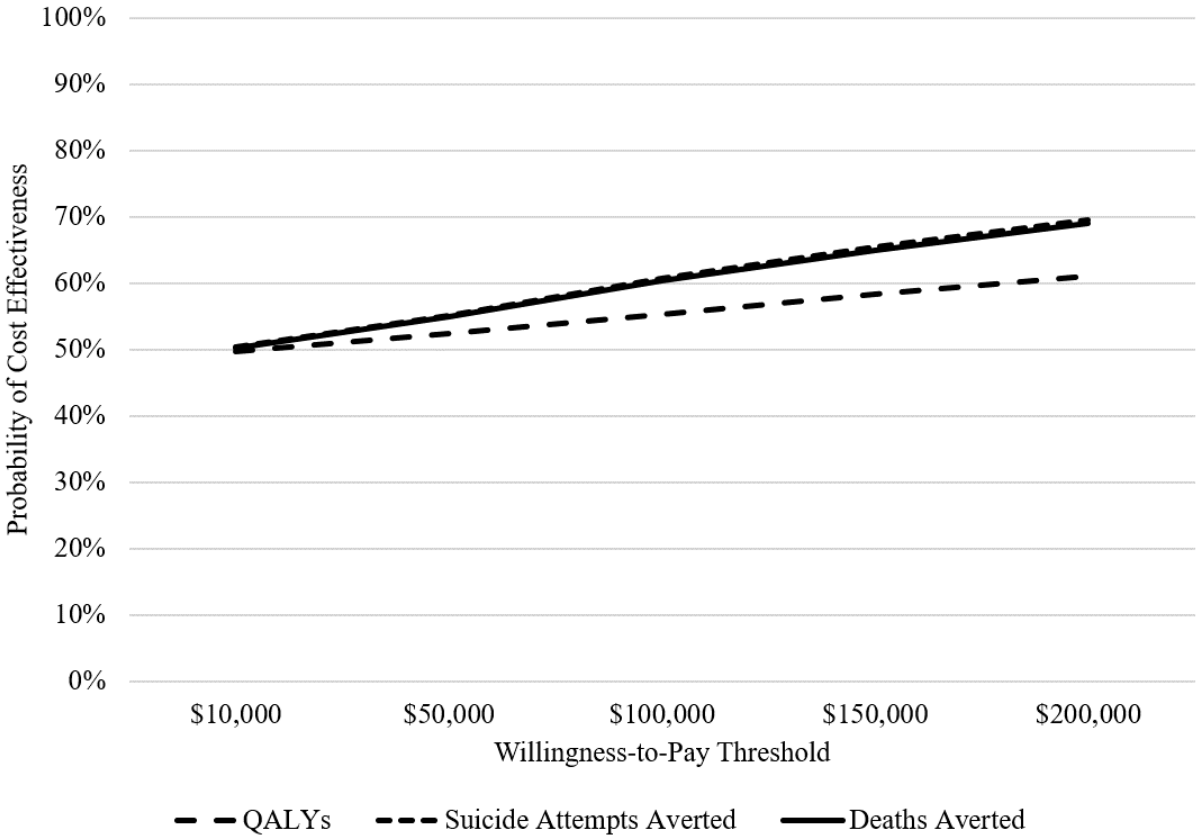

Figure 2 Caption: Results of a probabilistic uncertainty analysis of 10,000 trials. Trials with a positive incremental net monetary benefit were considered cost-effective

Figure 3. Probability of Cost Effectiveness by Intervention Cost

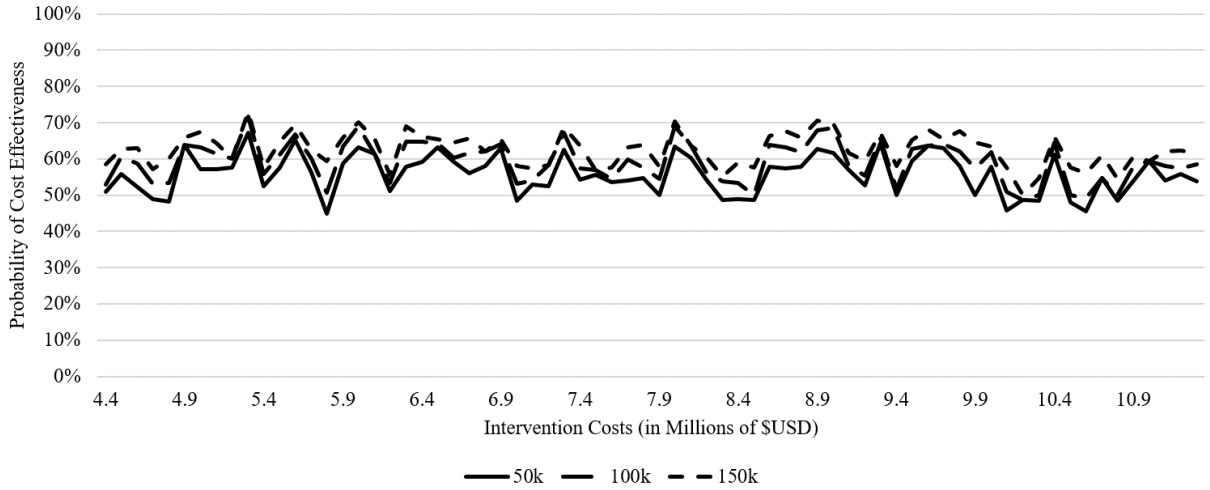

Figure 3 Caption: Results of a probabilistic uncertainty analysis of 10,000 trials. Trials with a positive incremental net monetary benefit for quality-adjusted life years were considered cost-effective

Figure 4. Tornado Chart of One-Way Sensitivity Analyses for Net Monetary Benefits.

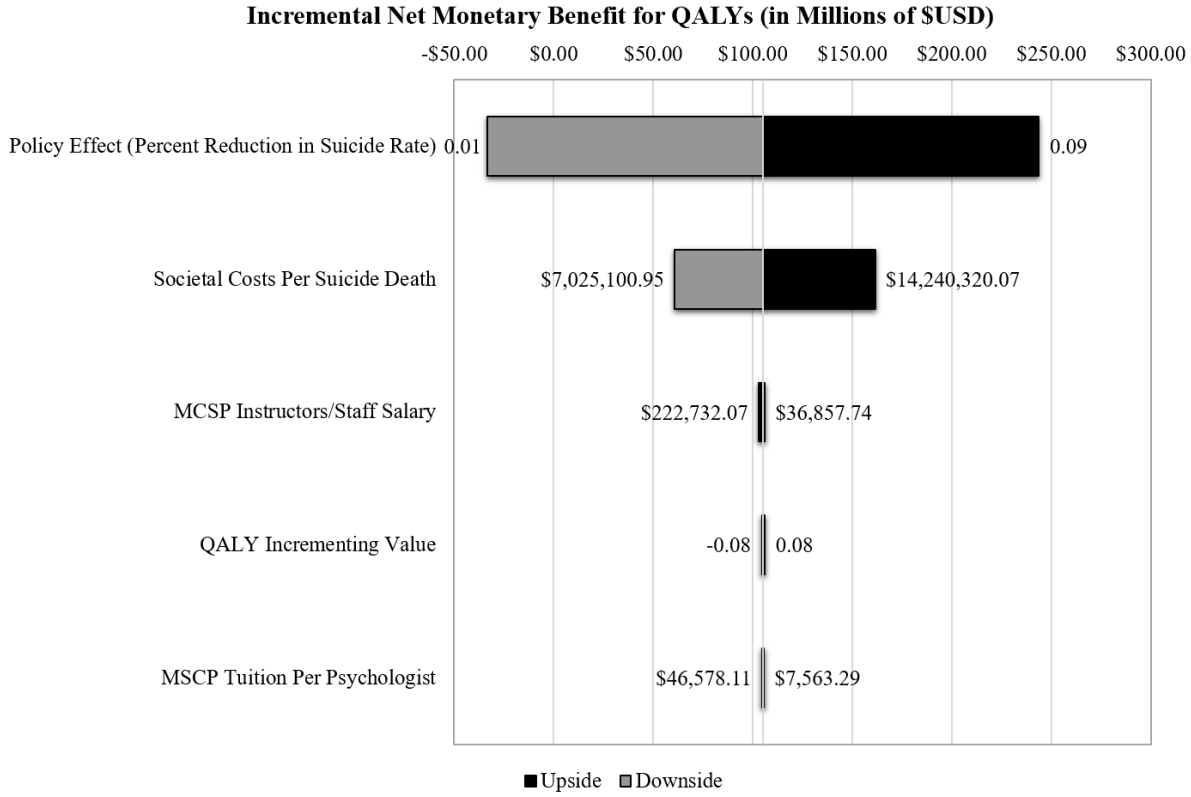

Figure 4 Caption: Upside and downside ranges represent the 95th and 5th percentiles of the variable, respectively. Incremental net monetary value was calculated at a willingness-to-pay threshold of $50,000. The value next to each bar represents the test value of the variable.

Figure 5. Tornado Chart of One-Way Sensitivity Analyses for Implementation Cost.

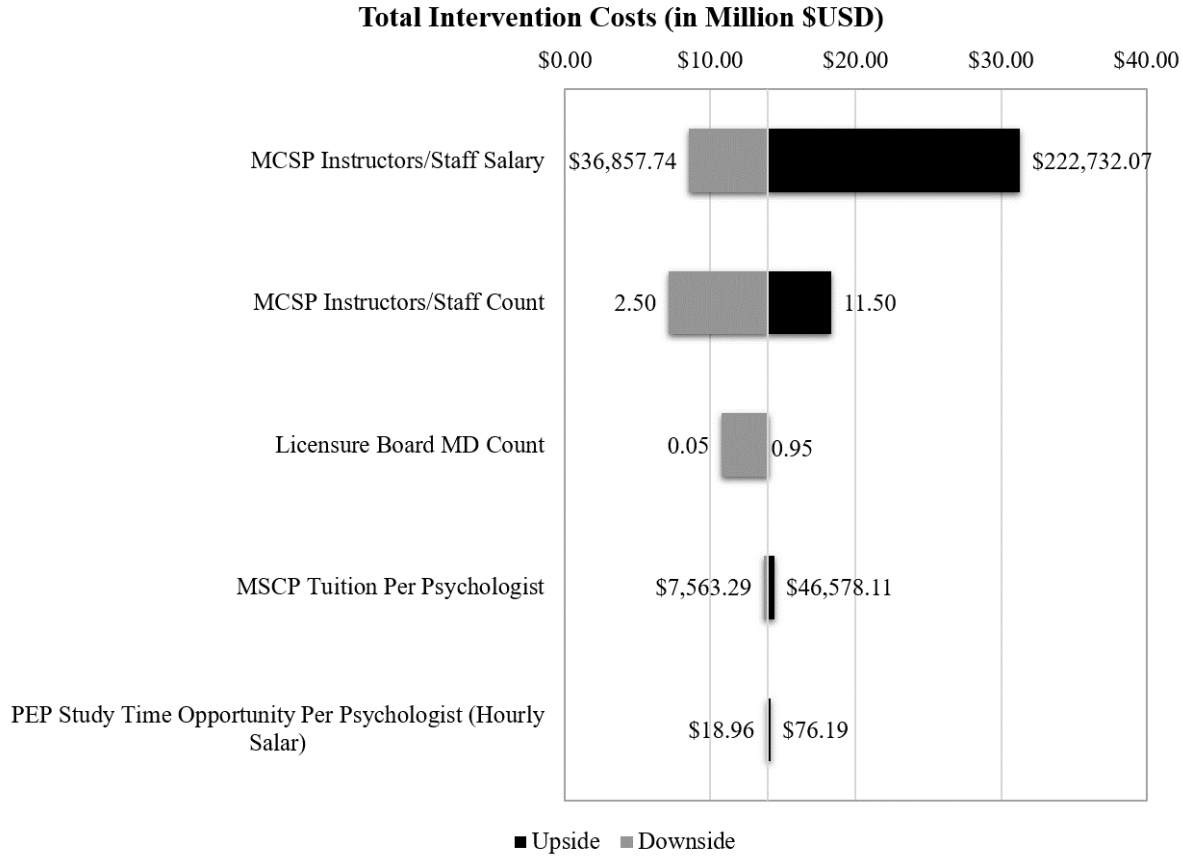

Figure 5 Caption: Upside and downside ranges represent the 95th and 5th percentiles of the variable, respectively. The value next to each bar represents the test value of the variable.