A Cost-Effectiveness Analysis of Over-the-Counter Statins

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ABSTRACT

Objectives: To estimate the costs and benefits of over-the-counter (OTC) statins under the 2013 American College of Cardiology/American Heart Association guidelines.

Study Design: A 10-year cost-effectiveness model using a health system perspective was developed to analyze the impact of making an OTC statin drug available.

Methods: We calibrated the model by using nationally representative survey data on statin use and cardiovascular risk, data from clinical studies on the safety and efficacy of statins, and data from a study on consumer decisions to use an OTC statin.

Results: We estimated that OTC statins would result in 252,359 fewer major coronary events, 41,133 fewer strokes, and 135,299 fewer coronary revascularization procedures over 10 years, as well as reduce coronary heart disease- and stroke-related deaths by 68,534 over the same time frame. These averted events would save more than $10.8 billion in healthcare costs while the costs of drug therapy would increase by $28.3 billion. Increased statin utilization is estimated to cause 3864 more cases of rhabdomyolysis—a very rare but severe side effect of statins. The estimated incremental cost-effectiveness ratio (ICER) of OTC statins was $5667 per quality-adjusted life-year, and the 95% CI of the ICER was $1384 to $12,701.

Conclusions: With proper labeling and consumer education, it is highly likely that OTC statins would be cost-effective, as they significantly improve population health without large increases in healthcare costs.

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Statins are some of the most studied prescription drugs due to their widespread use. The evidence from both clinical trials and observational studies suggests that appropriate use of statins can avert heart disease and stroke, and, if one already has these ailments, can reduce the risk of premature mortality from these conditions.[1] A recently published meta-analysis summarizing results from 26 randomized studies shows that the use of statins results in an average reduction in the risk of a first major vascular event (MVE) of about 22% (primary prevention) and for those who already have heart disease (secondary prevention), about 20%.[2] Statins also appear to be well tolerated: a 2006 meta-analysis summarizing almost 2 decades of research across 39 randomized trials relating to 7 different compounds, demonstrates that statins generally have a low risk of adverse events (AEs).[3]

Despite this evidence, prior research shows that some people who would benefit from statins are not currently taking them. Based on the 2013 guidelines for the management of cholesterol jointly issued by the American College of Cardiology (ACC) and the American Heart Association (AHA), only 45% of adults meeting today's statin treatment criteria are currently using statins.[4] Moreover, despite the availability of relatively inexpensive generic statins, total low-density lipoprotein cholesterol (LDL-C) levels in the United States—which were in constant decline prior to 2008—have stopped declining.[5] Increasing access to statins among the statin-eligible population not currently taking them could improve population health.

One way to increase access is to make drugs available over the counter (OTC). OTC drugs do not require a physician prescription and are available through more outlets, thereby promoting greater use. A recent study examining OTC conversions in several therapeutic drug classes in the United States found that classwide utilization increases by 27% on average.[6] The idea of making statins available without a prescription is not new, however. The United King-

Take-Away Points

This paper examines the cost-effectiveness of introducing an over-the-counter (OTC) statin alternative—a controversial policy question in the United States.

- Statins are one of the most successful classes of prescription drugs, but regulators in the United States have not yet approved them for OTC use.
- This paper adds to the economic literature by estimating the impact of the introduction of an OTC statin on statin use, healthcare costs, population health, and mortality.
- This paper shows that, with proper labeling and consumer education, it is highly likely that OTC statins would be cost-effective, as they significantly improve population health without large increases in healthcare costs.

dom introduced OTC simvastatin in 2004, and a study examining this experience found that simvastatin use increased significantly following the introduction of the OTC version.[7] Nevertheless, past attempts to introduce OTC statins in the United States have not received regulatory approval.[8]

The main arguments against OTC statins are: 1) consumers who do not meet guidelines for statin therapy might use statins, thereby exposing them to very rare but serious AEs, such as rhabdomyolysis, possibly without a countervailing benefit; 2) some high-risk patients for whom high-dose statin therapy is recommended might switch to a lower-dose OTC version, resulting in less-than-optimal risk reduction; and 3) consumers with contraindications (eg, other medications, pregnancy) might use statins inappropriately.[9,10] The primary argument for OTC statins is improved access to statin treatment, leading to improved population health and healthcare cost savings from reduced cardiovascular events.[11] The key question is whether the net benefits of broader access to statins outweigh the risk of inappropriate use.

One prior study based on data from the Consumer Use Study of Over-the-Counter Lovastatin (CUSTOM) trial predicted that OTC statins could avert 23,000 to 33,000 coronary heart disease (CHD) events per 1 million users over 10 years.[12,13] However, no prior studies have evaluated both the benefit-cost tradeoff of OTC statins and their public health effects in the United States. This paper addresses these questions and adds to the literature by evaluating costs and benefits of OTC statins versus the status quo with no OTC statins under the 2013 ACC/AHA guidelines.[14]

METHODS

A 10-year cost-effectiveness model was developed to analyze the impact on healthcare costs and population health of making a statin drug available OTC. Model inputs are described in Table 1. Below, we outline the source for each input parameter.

Population Parameters

The model divides the US noninstitutionalized population over the age of 20 into 3 groups: 1) Group 1—Individuals not currently taking prescription statins who are in Class I or Class IIA, for whom the benefits of treatment exceed the risks and for whom statins are recommended or may be reasonable, according to the 2013 ACC/AHA statin guidelines[13]; 2) Group 2—Individuals not currently taking prescription statins who are not in Class I or Class IIA according to the 2013 ACC/AHA statin guidelines[13]; and 3) Group 3—Individuals currently taking prescription statins.

Data from the 2007 to 2008 National Health and Nutrition Examination Survey (NHANES) were used to identify statin users and to determine which nonstatin users would benefit from statins based on ACC/AHA guidelines and the related risk-scoring algorithm.[15-23] We assumed that individuals would benefit from statins if the guidelines state that treatment "should" be initiated or "it is reasonable" to initiate treatment.

The population was further divided into low-, moderate-, and high-risk groups based on the 10-year risk of major coronary events (MCEs) by using the Framingham score (MCE combines myocardial infarctions and CHD deaths). These 3 groups had a 10-year risk of less than 10%, between 10% and 20%, and greater than 20%, respectively. eAppendix Table 1 [eAppendices available at **www.ajmc.com**] shows estimates of the population in each of these groups. The Framingham score was not used to determine eligibility for benefit from statins, but rather to enable the use of the wide range of literature that uses Framingham scores.

Utilization

A recent study found that classwide utilization increases by 27%, on average, when an OTC therapy is introduced.[6] This figure was used to estimate the rate at which previously untreated individuals would initiate OTC statin therapy, because class-level growth is likely due to new adoption. Because statins treat an asymptomatic disease and uptake may differ from previous OTC conversions, we included a range of utilization increases in our sensitivity analysis, described below.

The percentage of OTC users who substituted OTC for prescription treatment was derived from publicly available data from a self-selection study estimating consumer use of OTC statins (SELECT).[24,25] In particular, the SELECT study found that approximately 13% of potential OTC adopters were using prescription cholesterol-lowering medication. We

Table 1. Model Inputs

Description	Estimate	Standard Error for Sensitivity Analysis
Utilization		
Average change in utilization due to introduction of OTC alternative[6]	27.0%	4.2%
Percent of population using prescription statins[15-23]	15.1%	–
Percent of prescription statin users taking high-dose statins[26]	41.0%	–
Percent of OTC statin users who do not meet statin guidelines[24,25]	15.0%	15.0%-22.0%[a]
Percent of OTC statin users who were previous prescription statin users[24]	13.0%	2.0%
Percent of population with cholesterol monitoring in past year[26]	58.0%	–
Percent of population with cholesterol monitoring 12-24 months ago[26]	11.0%	–
Costs		
Cost of Prilosec RX (September 2003)	$4.00	–
Cost of Prilosec OTC (September 2003)	$0.57	–
Cost of physician visit, statin users[26]	$253	–
Cost of physician visit, non-statin users[26]	$221	–
10-year cost of OTC statin[28,29]	$3093	$928
10-year cost of monitoring OTC statin use[30,31]	$600	$90
10-year cost of prescription statin, high dose[29,30]	$2811	$422
10-year cost of prescription statin, low dose[29,30]	$1789	$268
10-year change in cost of physician visits, non-statin to statin[12,26]	$126	$19
10-year change in cost for physician visits, prescription to OTC statin[14,26,32]	–$6333	$950
10-year change in costs for productivity changes from change in physician visits, non-statin to statin[34,35]	$12	$1
10-year change in costs for productivity changes from change in physician visits, prescription to OTC statin[34,35]	–$515	–$26
Cost of major coronary events[36]	$36,700	$5505
Cost of stroke[39]	$37,500	$5625
10-year per-capita cost of rhabdomyolysis[37]	$5.95	$0.89

(continued)

assumed that these individuals would experience reduced health benefits if they switched from high-dose prescription to low-dose OTC statin therapy. We estimated this population by using the fraction of statin users taking high-dose statins (41%) based on the 2011 Medical Expenditure Panel Survey (MEPS).[26] Therefore, we estimated that 5% of OTC statin users switch from high-dose prescription statins.

The percentage of OTC users who would not benefit from statin treatment was derived in a similar manner. In particular, approximately 15% of potential OTC adopters in the SELECT study had LDL-C concentrations below 130. We use this as a proxy for the group that would not experience benefits but would experience the cost and the risks associated with statin use.

Costs

Costs are measured at the overall healthcare system level, regardless of the party ultimately responsible for bearing the cost. Future costs are discounted by 1% per year (the 10-year real discount rate published by the Office of Management and Budget). However, this is offset by the medical care inflation rate, which exceeds the general inflation rate used by OMB by approximately 1%.[27] All cost estimates have been converted to 2014 dollars by using the real discount rate, adjusted for the medical care inflation rate.

The model uses IMS data (IMS Health, Danbury, CT) and the CMS' National Average Retail Prices (NARP) data to estimate the cost of OTC statins ($25.42/30 days).[28,29] We first used IMS data to estimate the relationship between the price of a branded prescription drug and its OTC counterpart at OTC launch by using the example of OTC Prilosec (15%). Because brand prices change after generic entry, this ratio is applied to the average branded statin prescription cost reported in the NARP data prior to the generic launch ($5.65 per pill based on the average

Table 1. Model Inputs *(continued)*

Description	Estimate	Standard Error for Sensitivity Analysis
Health and mortality outcomes		
Baseline rate of major coronary events[15-23, a]	25.0%	3.8%
Change in risk of major coronary events, non-statin to statin[2]	–23.0%	1.2%
Change in risk of major coronary events, low-dose to high-dose statin[2]	–13.0%	2.3%
Baseline rate of death due to major coronary events[2, b]	35.0%	5.3%
Change in risk of death due to major coronary events, non-statin to statin[2, b]	–18.7%	2.5%
Change in risk of death due to major coronary events, low-dose to high-dose statin[2, b]	–7.0%	5.0%
Baseline rate of stroke[2, b]	7.7%	1.2%
Change in risk of stroke, non-statin to statin[2]	–12.8%	1.4%
Change in risk of stroke, low-dose to high-dose statin[2]	–14.0%	3.7%
Baseline rate of death due to stroke[2, b]	18.7%	2.8%
Baseline rate of coronary revascularization[2, b]	14.9%	2.2%
Change in risk of coronary revascularization, non-statin to statin[2]	–21.3%	1.2%
Change in risk of coronary revascularization, low-dose to high-dose statin[2]	–19.0%	1.7%
10-year incidence of rhabdomyolysis under statin treatment[48]	0.044%	0.007%
Mortality rate due to rhabdomyolysis[49]	12.4%	1.9%
Quality-adjusted life-years		
Change in quality-adjusted life years due to statin use, non-statin to statin[53,54, b]	0.370	0.055
Change in quality-adjusted life years due to statin use, low-dose to high-dose statin[54, b]	0.047	0.007

OTC, over-the-counter.
[a]Indicates uniform distribution over range listed is used for Monte Carlo simulation.
[b]Indicates estimate listed is for high major coronary event risk group; estimate listed is reduced for moderate and low major coronary event risk groups.

of Lipitor [2012] and Crestor [2013]). The model also uses the NARP data to estimate the average cost of prescription statins. A range of OTC statin costs are used in the sensitivity analysis described below.

The model assumes that OTC statin users also initiate cholesterol monitoring, as might be directed by OTC labeling. We used 2011 MEPS data to estimate the share of the population currently receiving cholesterol tests. The cost of a cholesterol test was estimated by using public information from CVS and Walgreens ($60 per year).[30,31] The model assumes no change in monitoring costs for those switching from prescription to OTC statins because cholesterol testing is expected for both prescription and OTC patients. Additionally, because the 2013 ACC/AHA statin guidelines[13] do not have a cholesterol target that would be monitored via testing, we include a sensitivity that does not incorporate changes in monitoring costs.

The number of physician visits associated with certain conditions has been found to fall when OTC treatments are made available.[32] We estimated that prescription statin users have an average of 3.5 statin-related physician visits per year based on National Medical Ambulatory Care Survey (NAMCS) data and NHANES data[14,33]; prescription statin users who switch to OTC therapy are assumed to drop to just 1 annual visit. Previously untreated patients are assumed to increase physician office visits to monitor statin therapy based on the CUSTOM study, which notes that 57% of users interacted with a physician during the course of the study.[11] The cost for each physician visit in the current study was estimated by using MEPS data.[17] Additionally, we estimated the time costs resulting from the changes in physician visits using employment and wage data from the Bureau of Labor Statistics.[34,35]

The 1-year cost of MCEs and associated complications ($36,700) is based on a retrospective claims analysis of the costs of acute coronary syndrome and is corroborated by 2 other studies that estimate MCE costs.[36-38] The 1-year cost of stroke and associated complications ($37,500) is based on a literature review of studies measuring the cost of stroke in the United States and is also corroborated by 2 other studies.[38-40] The model does not separately consider the costs of coronary revascularization because the MCE cost estimate includes them for some patients. Because the model predicts a decline in revascularization events, this choice is conservative. Finally, the cost of AEs is derived from a study that used

the cost of hospitalization for rhabdomyolysis to estimate a per-subject per-year cost of AEs caused by statin treatment (an average of $5.95 per statin user).[37]

Health and Mortality Outcomes

A 2010 meta-analysis of statin trials is used to estimate the reduction in risk—dependent on initial risk category—of MCE, stroke, coronary revascularization, and CHD death associated with statin treatment.[2] These estimates were reduced to account for suboptimal adherence outside of the clinical trial setting and then applied to the group of previously untreated individuals that initiate OTC statin therapy and are assumed to benefit from statins. The model conservatively assumes that individuals who initiate OTC statin therapy but do not meet the guidelines receive no benefit from statin therapy. To the extent that these individuals receive any benefits, the model understates the overall cost-effectiveness of the introduction of OTC statins. The same meta-analysis also provides estimates of the differences in risk associated with low- versus high-dose statin treatment. We applied these estimates to the individuals who substitute low-dose OTC statin therapy for high-dose prescription statin treatment. The findings of this meta-analysis are corroborated by other studies and meta-analyses.[41-47]

Adverse Events

The rate of AEs for OTC statin users was derived from a published estimate of the increase in rhabdomyolysis under statin therapy[48]— a very rare but severe side effect of statins—and the rate of rhabdomyolysis mortality was derived from a separate study that investigated the effects of statin therapy.[49] The model applies these rates to all previously untreated statin users and it conservatively assumes that individuals who switch to OTC statins from high-dose prescription statins experience no reduction in AEs.

A recent FDA bulletin suggested that statin use may be associated with cognitive impairment and an increased risk of raised blood sugars and the development of type 2 diabetes.[50] However, the published literature provides no definitive evidence that statin users have an increased risk of these conditions relative to the general population.[51] Therefore, the model does not incorporate these potential AEs.

Additionally, some prior research has found an increased risk of hemorrhagic stroke with statin use.[52] The impact of this AE is a component of our measure of risk reduction for stroke overall. Other potential AEs, such as muscle pain, are accounted for through quality-adjusted life-year (QALY) measures, discussed below.

QALYs

The estimated change in QALYs due to adopting OTC statin therapy is derived from a study by the Heart Protection Study Collaborative Group, which applied results from a large UK clinical trial to determine the cost-effectiveness of prescription statin therapy for patients in the United States at different vascular risk levels.[53] The lifetime QALY change reported in that study is converted to a 10-year figure, then applied to the previously untreated individuals who meet the guidelines for statin benefit and adopt OTC statin treatment.[54] No QALY benefits were assumed for individuals who initiate statin therapy but do not meet the guidelines. The estimated QALY loss for individuals switching from high-dose prescription statins to low-dose OTC treatment was derived from a study comparing the cost-effectiveness of high- versus low-dose prescription statin treatment for high-risk individuals.[51]

Sensitivity Analysis

Monte Carlo simulation was used (100,000 draws) to measure the sensitivity of the results to adjustments in model parameters. Table 1 lists the standard deviation or range used to vary each parameter in the simulation.

RESULTS

OTC Statin Users

We estimate that of the 46.1 million patients who meet statin guidelines and are not taking prescription statins, about 7.3 million patients (15.8%) will initiate treatment with OTC statins (see **eAppendix Table 2**, which also breaks out these data by MCE risk group). Additionally, we estimate that of the 136.4 million individuals who do not meet statin guidelines and are not taking prescription statins, about 1.5 million (1.1%) will initiate treatment with OTC statins. Finally, we estimate that of the 32.5 million patients taking prescription statins, approximately 1.3 million (4.0%) will switch to OTC statins. Overall, these estimates imply that availability of OTC statins will increase the number of individuals using statins by 10.1 million (a 27.0% increase), and 85% of new OTC statin users will benefit from statin treatment.

Benefits and Costs

Table 2 summarizes the results of the model. Overall, we estimate that OTC statin conversion would result in 293,492 fewer MVEs (252,359 MCEs; 41,133 strokes), and 135,299 fewer coronary revascularization procedures over 10 years. These averted events would save more than

Table 2. Summary of Model Results

Description	Previously Untreated OTC Users Who Meet Guidelines	Previously Untreated OTC Users Who Do Not Meet Guidelines	Previous Prescription Users	Total
OTC statin utilization				
Population that initiates OTC statin therapy	7,267,759	1,514,116	1,312,234	10,094,109
Health				
Change in major coronary events	–262,165	0	9806	–252,359
Change in strokes	–44,859	0	3726	–41,133
Change in coronary revascularization	–144,676	0	9377	–135,299
Total change in major vascular events	–451,700	0	22,909	–428,791
Adverse events				
Change in rhabdomyolysis	3198	666	0	3864
Mortality				
Change in CHD deaths	–63,319	0	1543	–61,776
Change in stroke deaths	–7369	0	611	–6758
Change in deaths due to adverse events	397	83	0	479
Change in total deaths	–70,291	83	2154	–68,055
Quality-adjusted life-years				
Change in quality-adjusted life-years	2,237,222	0	–21,065	2,216,157
Costs				
Change in drug costs	$22,481,903,153	$4,683,729,823	$1,162,449,240	$28,328,082,216
Change in monitoring costs	$2,284,868,182	$476,014,205	$0	$2,760,882,387
Change in physician visit costs	$915,519,567	$190,733,243	–$8,310,707,340	–$7,204,454,530
Change in productivity from physician visit changes	$85,403,667	$17,792,431	–$676,320,459	–$573,124,362
Change in major coronary event costs	–$9,621,452,830	$0	$359,881,462	–$9,261,571,368
Change in stroke costs	–$1,682,224,950	$0	$139,724,857	–$1,542,500,093
Change in adverse event costs	$43,243,164	$9,008,993	$0	$52,252,157
Change in total costs	$14,507,259,953	$5,377,278,694	–$7,324,972,240	$12,559,566,407
Cost-effectiveness				
Incremental cost-effectiveness ratio				$5667
Incremental cost-effectiveness ratio (no change in monitoring costs)				$4421

CHD indicates coronary heart disease; OTC, over-the-counter.

$10.8 billion in healthcare costs. Moreover, OTC statin conversion would reduce CHD- and stroke-related deaths by 68,534 over the same time frame. Increased statin utilization is estimated to cause 3864 more cases of rhabdomyolysis, of which, 479 are estimated to result in death. Overall, OTC statin conversion would avert 68,055 deaths. The **eAppendix Figure** illustrates the range of this estimate based on Monte Carlo simulation (see **eAppendix Table 3** for detailed results). Total costs to the health system would increase by approximately $12.6 billion—less than $200,000 per death averted.

Group 1: Previously Untreated Patients Who Meet Statin Guidelines. We estimate that OTC statin use by the 7.3 million patients who were previously untreated but meet statin benefit guidelines will result in 451,700 fewer MVEs and 70,291 fewer deaths over a 10-year horizon. However, initiation of OTC statin use by these patients may also result in 3198 cases of rhabdomyolysis. Overall, we estimate that OTC statins will increase healthcare costs by $14.5 billion over a 10-year period ($12.2 billion assuming no change in monitoring costs), due largely to the cost of the OTC drug.

Group 2: Previously Untreated Patients Who Do Not Meet Statin Guidelines. We assume that OTC statin use by the 1.5 million patients who were previously untreated and do not meet statin guidelines yields no health benefits but we estimate it may result in 666 additional cases of rhabdomyolysis. OTC statin use by this group also results in increased expenditures on statins and associated monitoring and physician visit costs (including time costs) totaling $5.4 billion over a 10-year period, or $4.9 billion, assuming no change in monitoring costs.

Group 3: Previous Prescription Statin Users Who Take Up OTC Statin Treatment. We estimate that OTC statin use by the 538,016 patients who switch from high-dose prescription statins to low-dose OTC statins will result in 22,909 more MVEs and 2154 more deaths over a 10-year horizon. The added MVEs increase costs by $499.6 million. We also estimate that the switch from prescription to OTC statins (for all patients who switch) will result in a $1.2-billion increase in expenditures on statins, as we believe that OTC statins would be more expensive than (generally generic) prescription statins. However, the switch from prescription to OTC statins would reduce physician office visit costs by $9.0 billion (including time costs) over a 10-year horizon. Thus, switching from prescription to OTC statins will result in overall cost savings of $7.8 billion over a 10-year horizon.

Cost-Effectiveness Analysis

Overall, we estimate that the introduction of OTC statins would result in an additional 2,216,157 QALYs at a net cost of $12.6 billion, resulting in an incremental cost-effectiveness ratio (ICER) of $5667 per QALY (or an ICER of $4421 per QALY, assuming no change in cholesterol monitoring costs). In our Monte Carlo simulations, 95% of the calculated ICERs were either cost-saving or less than $23,012, and never above the $50,000 threshold (Figure 1). An important driver of cost-effectiveness is the fraction of OTC statin users who do not meet benefit guidelines. Figure 2 shows that the ICER increases as this fraction increases, but does not rise above $50,000 until this percentage is approximately 72%. In addition, because cheaper options of prescription statins are becom-

Figure 1. Sensitivity Analysis: Incremental Cost-Effectiveness Ratio

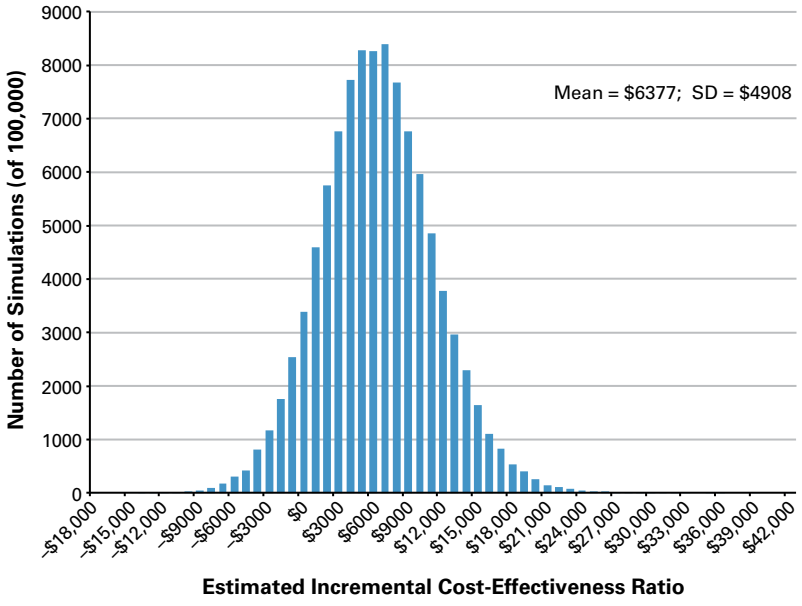
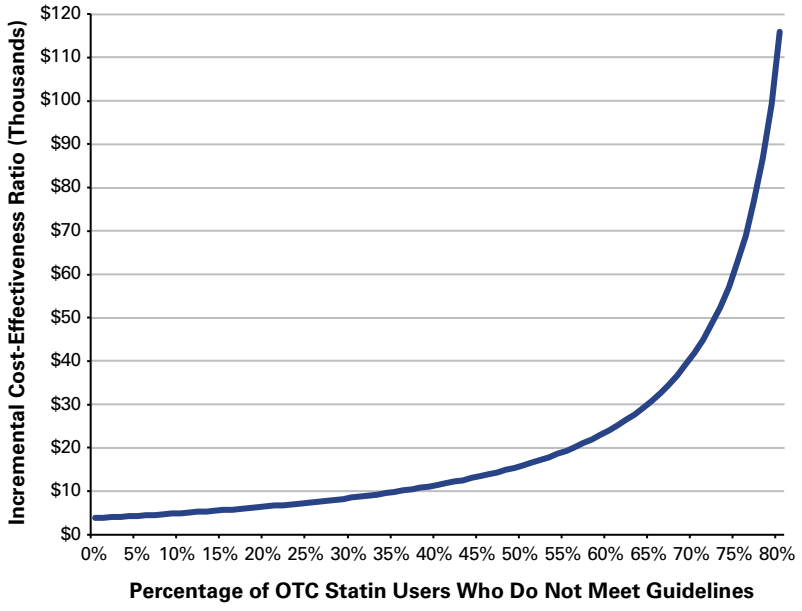
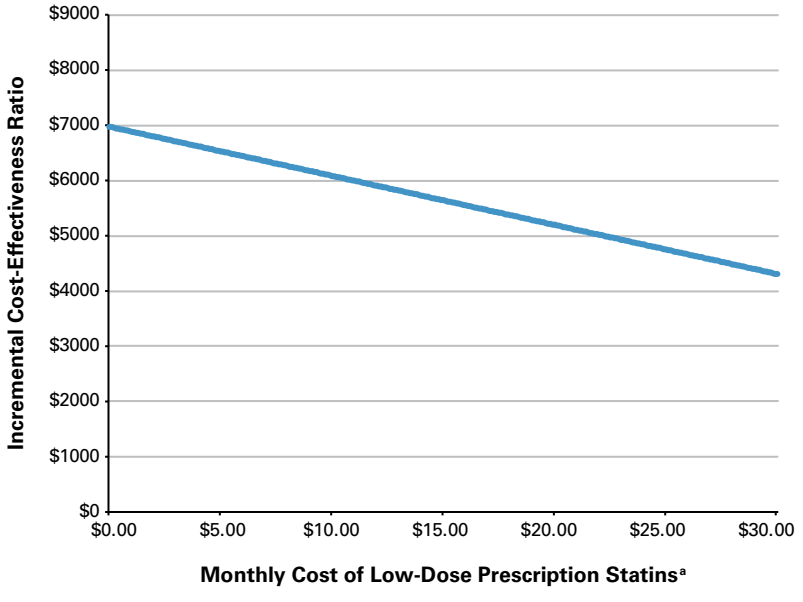


Figure 2. ICER by Percentage of OTC Users Who Do Not Meet Statin Guidelines



ICER indicates incremental cost-effectiveness ratio; OTC, over-the-counter.

Figure 3. ICER by Monthly Cost of Low-Dose Prescription Statins



ICER indicates incremental cost-effectiveness ratio.
[a]Adjustment applied accordingly to monthly cost of high-dose prescription statins.

ing available, we examined the impact of the prescription statin costs on the cost-effectiveness of OTC conversion. As shown in Figure 3, the estimated ICER does not increase beyond approximately $7000, even as the estimate of prescription statin costs are reduced toward $0.

DISCUSSION

This study used nationally representative data and evidence from clinical studies to estimate the benefits and costs of OTC statins. We found that the benefits of OTC availability of statins well exceed the costs and are a highly cost-effective option for improving population health. These results are robust to alternative assumptions about model parameters.

Limitations

One inherent limitation of this analysis is our understanding of the extent to which consumers will use statins appropriately in an OTC setting. Based on past studies, we estimated that 15% of OTC statin users would not meet guidelines for statin use. The results of this study are sensitive to this estimate. We nevertheless demonstrated that even if this rate was as high as 72%, the ICER for OTC statins remains below the $50,000 threshold.

In addition, we did not separate changes in costs by payer. Changes in total cost experienced by patients or insurers could vary substantially depending on insurance cost-sharing provisions for prescription drugs, office visits, and major medical events. Understanding who bears those costs (and when) would require modeling insurance coverage, but it would also improve our understanding of the incentives of various parties and how they might alter behavior.

Another limitation is that we did not model differences in compliance rates between OTC and prescription settings, and so it is not clear whether OTC access would increase or decrease compliance. This would require more explicit modeling of the time dimension than can be incorporated in the current model; a Markov Chain simulation framework would be one potential approach for modeling these differences.

Finally, we also did not consider the impact of OTC statin availability on statin treatment alternatives. For example, the availability of OTC statins may encourage some consumers to avoid lifestyle changes such as diet and exercise. The extent to which taking statins induces changes in lifestyle is, however, not well understood, although the CUSTOM study found a slight increase in healthy diet and physical activity in an OTC setting.[55] The OTC availability of statins could also result in fewer opportunities for doctors to manage their patients' cardiovascular health, which is likely to adversely affect patient health—particularly for high-risk consumers—but this is also not well understood. These questions underscore the importance of educating consumers at risk for heart disease about adopting a healthy lifestyle and seeking medical advice.

CONCLUSIONS

Ultimately, the effects of OTC statins are uncertain and highly dependent on product labeling and consumer education. The results from our study suggest that with proper labeling and consumer education, it is very likely that OTC statins would be cost-effective, as they significantly improve population health without large increases in healthcare costs.

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Authorship Information: Concept and design (MA, NS, CS); analysis and interpretation of data (MA, SS, NS, CS); drafting of the manuscript (MA, NS, CS); critical revision of the manuscript for important intellectual content (MA, SS, NS, CS); statistical analysis (MA, NS, CS); obtaining funding (CS, MA); and supervision (MA, CS).

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eAppendix

Table 1. Population Parameters

Description	High Major Coronary Event Risk	Moderate Major Coronary Event Risk	Low Major Coronary Event Risk	Total
Currently taking prescription statins	16,898,924 (7.9%)	2,501,817 (1.2%)	13,124,722 (6.1%)	**32,525,463 (15.1%)**
Not currently taking prescription statins but meet the statin guidelines	19,016,693 (8.8%)	8,262,498 (3.8%)	18,793,338 (8.7%)	**46,072,529 (21.4%)**
Not currently taking prescription statins and do not meet the statin guidelines	4,059,624 (1.9%)	1,517,498 (0.7%)	130,853,119 (60.9%)	**136,430,241 (63.4%)**
Total	**39,975,241 (18.6%)**	**12,281,814 (5.7%)**	**162,771,179 (75.7%)**	**215,028,234 (100.0%)**

Table 2. Population that Initiates OTC Statin Therapy (Percentage Indicates Percentage of Group that Initiates OTC Statin Therapy)

Description	High Major Coronary Event Risk	Moderate Major Coronary Event Risk	Low Major Coronary Event Risk	Total
Currently taking prescription statins	681,784 (4.0% of group)	100,935 (4.0%)	529,515 (4.0%)	**1,312,234 (4.0%)**
Not currently taking prescription statins but meet the statin guidelines	3,776,035 (19.9%)	559,027 (6.8%)	2,932,697 (15.6%)	**7,267,759 (15.8%)**
Not currently taking prescription statins and do not meet the statin guidelines	786,764 (19.4%)	116,464 (7.7%)	610,978 (0.5%)	**1,514,116 (1.1%)**
Total	**5,244,494 (13.1%)**	**776,426 (6.3%)**	**4,073,190 (2.5%)**	**10,094,109 (4.7%)**

Table 3. Summary of Model and Sensitivity Results

Description	Baseline scenario	Sensitivity analysis	
		Mean	95% confidence interval
OTC statin utilization			
Population that initiates OTC statin therapy	10,094,109	10,103,358	7,057,347-13,192,226
Health			
Change in major coronary events	-252,359	-239,704	-354,808 to -144,276
Change in strokes	-41,133	-38,934	-60,468 to -22,110
Change in coronary revascularization	-135,299	-128,182	-190,542 to -76,484
Total change in major vascular events	-428,791	-406,820	-571,265 to -264,340
Adverse events			
Change in rhabdomyolysis	3864	3867	2358 to 5632
Mortality			
Change in CHD deaths	-61,776	-58,677	-98,683 to -29,681
Change in stroke deaths	-6758	-6392	-10,669 to -3297
Change in deaths due to adverse events	479	480	262-760
Change in total deaths	-68,055	-64,590	-105,746 to -34,393
Quality-adjusted life years			
Change in quality-adjusted life years	2,216,157	2,106,763	1,276,126-3,081,224
Costs			
Change in drug costs	$28,328,082,216	$28,346,489,659	$9,462,202,200-$50,225,492,757
Change in monitoring costs	$2,760,882,387	$2,763,226,298	$1,687,588,109-$4,018,385,650
Change in physician visit costs	-$7,204,454,530	-$7,226,482,372	-$12,177,871,851 to -$3,494,586,110
Change in productivity from physician visit changes	-$573,124,362	-$576,451,928	-$913,042,554 to -$312,392,269
Change in major coronary event costs	-$9,261,571,368	-$8,796,384,430	-$14,127,381,906 to -$4,772,772,232
Change in stroke costs	-$1,542,500,093	-$1,460,026,815	-$2,432,481,204 to -$751,543,631
Change in adverse event costs	$52,252,157	$52,262,869	$31,828,265-$76,069,760
Change in total costs	$12,559,566,407	$13,102,633,281	-$6,025,815,962-$33,550,880,092
Cost effectiveness			
Incremental cost effectiveness ratio	$5926	$6377	-$2923-$16,481

Figure. Sensitivity Analysis: Number of Deaths Averted Over 10 Years