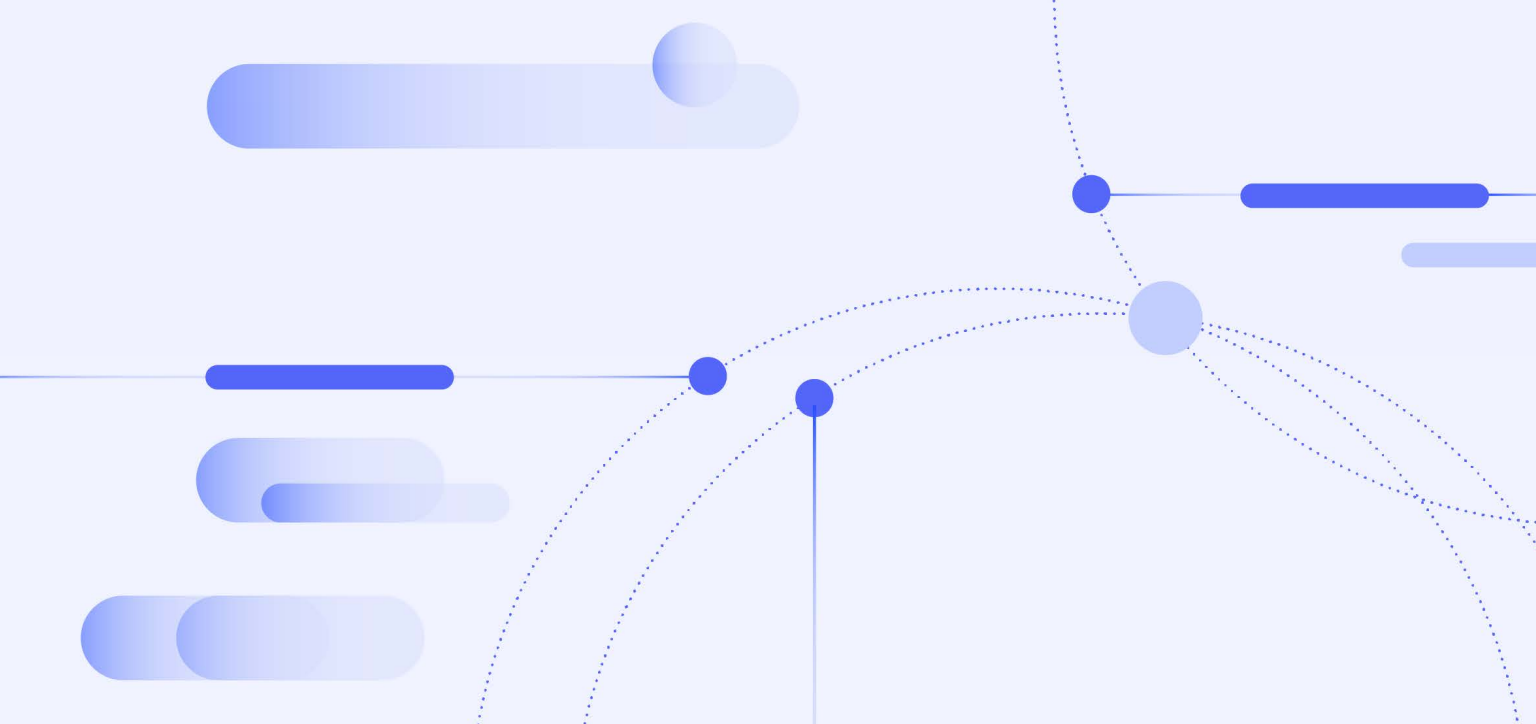**2023 Machine Learning Discounts Report**

Powering Mission and Margin

Providers shouldn't have to compromise their mission to improve their bottom line. With machine learning discounts, they no longer have to.

For many patients, a medical crisis is also a financial crisis

A 2022 Kaiser Family Foundation survey found that a staggering 100 million people live with medical debt, with many forced to make gut-wrenching sacrifices. Most report cutting back on food, clothing, and other necessities. Some have been uprooted from their homes or pushed into bankruptcy.[1] Most perversely, an increasing number of patients with medical debt are forgoing necessary care.[2] All of this is rooted in a simple reality: half of Americans do not have the funds to cover an unexpected $500 medical bill.[1]

Although most healthcare providers are willing to work with patients on price, many patients still fall through the cracks. When they do offer discounts, these providers have to walk a tightrope to figure out the right discount recipient and amount, without degrading collections.

At Cedar, we have learned that many factors influence an individual's likelihood to pay. This makes discounting a complex problem, one that is particularly well-suited for machine learning.

This report explores how providers can use machine learning to personalize self-pay discounts at scale. By matching the right discounts to the right patients through an automated process, we have proven that providers can improve both affordability and collections and, ultimately, keep patients out of debt.

Why machine learning?
Machine learning algorithms recognize complex patterns in data that humans might miss. This intelligence can enable new forms of predictive analytics, such as anticipating how an individual might respond to a discount.

Machine learning made possible through experimentation

Before developing a machine learning model, Cedar had two objectives. First, demonstrate that discounts are a win-win for both patients and providers. Second, acquire enough data to train the model.

To achieve these goals, we launched an experiment at a large, national provider to measure the effect of self-pay discounts on collection rate. The experimental group randomly received discounts of 15%, 30%, and 45%, while the control group received no discount.

We quickly observed that if providers offer discounts when patients first get notified about bills—as opposed to when they call in later in the billing cycle—the likelihood of bill resolution goes up. Encouraged by the early results, we introduced more variables into the experiment, like a feature to allow patients to enroll discounted bills in payment plans.

Experiment Results Across Discount Groups: Impact on Collection Rate

COLLECTION RATE

0%   15%   30%   45%

DISCOUNT SIZE

15% discounts outperformed all other groups
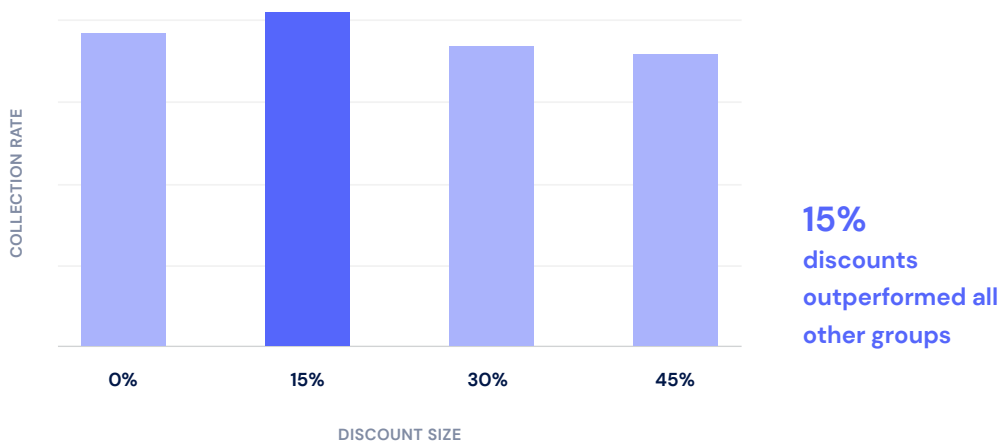
Over time, we found that 15% discounts outperformed all other groups. While 30% and 45% discounts motivated more patients to pay, these rates lowered bills so much that they had a neutral impact on collections. We also saw that payment plans combined with discounts were even more effective than discounts alone.
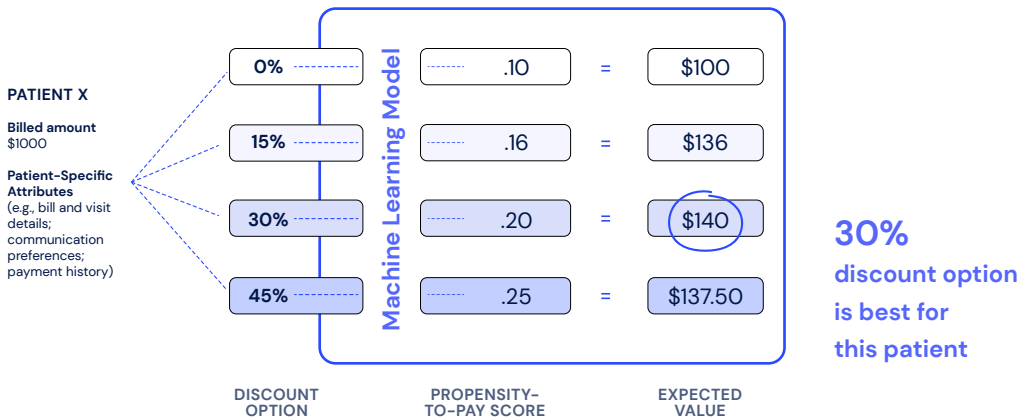
Beyond validating the impact of discounts, we amassed a significant volume of data on how different patients respond to different discount offers. This laid the foundation for our machine learning model.

Fine-tuning self-pay discounts with a personalized approach

While the 15% discount showed positive outcomes on average, Cedar knew that it might not be the best option for every patient. Our objective was to optimize affordability and collections for each patient and this required a personalized approach.

Using the experimental data as the training set, Cedar launched a propensity–to–pay machine learning model to predict the likelihood a patient would pay their bill given a specific discount.

How the Machine Learning Model Selects the Best Discount

PATIENT X

Billed amount $1000

Patient–Specific Attributes (e.g., bill and visit details; communication preferences; payment history)

DISCOUNT OPTION		PROPENSITY–TO–PAY SCORE		EXPECTED VALUE
0%		.10	=	$100
15%		.16	=	$136
30%		.20	=	$140
45%		.25	=	$137.50

30% discount option is best for this patient

How it works

1. Based on **patient–specific attributes** such as bill and visit details, communication preferences, and payment history, the machine learning model produces a **propensity–to–pay** score for each discount option

2. The model predicts an individual's **expected value** of collections from each discount option. It also calculates long–term outcomes such as the expected collections from using a payment plan to resolve a discounted bill.

3. After comparing the **expected value** of collections between discount offers, the model selects the **discount percentage option that is best for each patient**.

4. The model gets retrained and **improved over time**, as the machine learning algorithm continuously learns from real–world data.

Machine learning delivers superior outcomes for patients and providers

Cedar's machine learning model outperformed the other discount groups from the experiment. The results were clear—offering personalized discounts creates a win-win scenario for patients and providers.

Machine Learning Model Performance: Impact On 120 Day Collection Rate
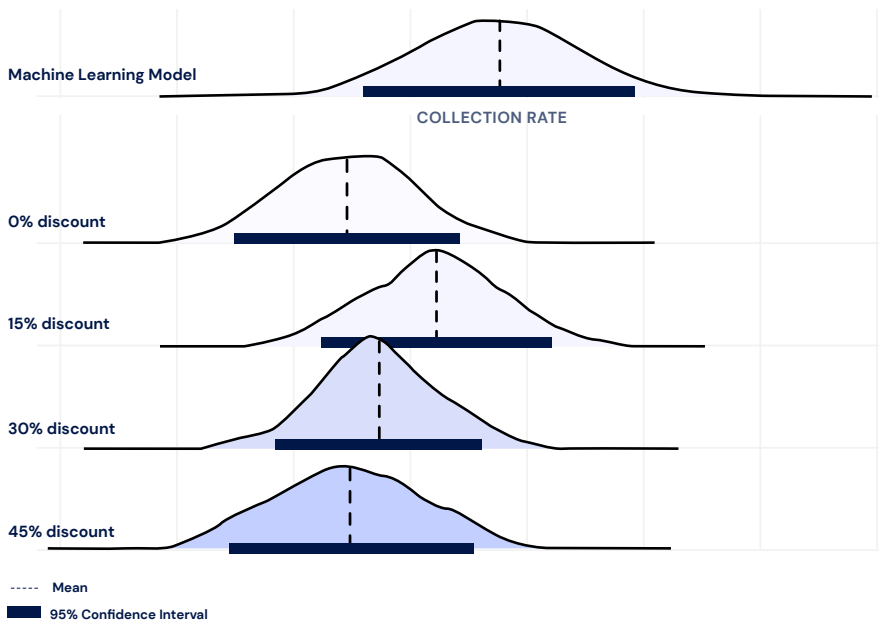
Machine learning model drives highest collection rate

The plots show the results of a statistical procedure called "bootstrapping," which enabled us to evaluate the performance between the discount groups.

Specifically, the model produced a 4% relative increase in the collection rate when compared to the best-performing discount group and a 10% relative increase when compared to no discount. This translated into a 5% relative increase in the collection rate at the population level.[3]

Understanding the data:

10%
lift in collection rate compared to no discount

5%
lift in the collection rate at the population level

86%
of large bills ($800+) receive a discount

With machine learning discounts, more patients can affordably pursue the care they need. Beyond avoiding bad debt collections, these patients now have more money in their pockets for household expenses and may be encouraged to seek care in the future. They are also more likely to stay loyal to their provider, as 55% of consumers say that a provider's discount policies are an important factor in their decision to return for care.[4]

Not only does the model provide the right discounts, but it also helps patients with the highest need. Our analysis revealed that 86% of bills greater than $800 received a discount compared to 12% of bills less than $800. Patients who have an estimated income of less than $50,000 (based on the zip code median household income) were more likely to get a discount than patients who have an estimated income greater than $50,000. The data proves the model is capable of making fair and equitable decisions, making a difference where it matters most.

You have a discount available

We understand the challenges of paying medical bills. This is why we are offering a one time discount to help you save.

Pay your total balance or start a payment plan by **Dec 12, 2023** to qualify.

Pay discounted total

$ **2,271.60**

~~$3,786.00~~ **Save $1,540.40**

Pay total

Plans starting at

$ **189.30** / mo

0% interest on all plans

Very grateful for the discount and low monthly payments. I'm scared of going to the doctor because of the cost, but this experience made me feel better about it."

–Real patient feedback

Cedar recognizes that providers make significant investments in staff, programs, and EHR tools to help uninsured and underinsured populations. The unfortunate truth is that these efforts are not enough to support the 100 million people struggling with medical debt.

We believe modern consumer engagement technology can scale financial assistance and optimize outcomes for both patients and providers. By using machine learning to personalize discounts at scale, we have proven that providers can fulfill their missions to serve the most vulnerable patients, without compromising financial performance.

1. Lopes, L., Kearney, A., Montero, A., & Brodie, M. (2022, June 16). Health Care Debt in the U.S.: The broad consequences of medical and dental bills. Kaiser Family Foundation. https://www.kff.org/health-costs/report/kff-health-care-debt-survey/

2. Abelson, R. (2023, February 16). Higher bills are leading Americans to delay medical care. The New York Times, pp. 14. https://www.nytimes.com/2023/02/16/health/inflation-delayed-health-care.html?smid=nytcore-ios-share&referringSource=articleShare

3. Based on the available Cedar machine learning-powered discounts performance data for an acute care provider as of June 2023 (Total number of patients: 55,173; start of time period: 11/22/2022; end of time period: 05/03/2023; date of report: 06/21/2023)

4. Based on consumer responses to a Cedar-sponsored attitudinal survey conducted in 2023 (Total number of respondents: 1,239; start of time period: April 2023; end of time period: May 2023)

![Cedar logo]

Cedar is a patient financial engagement platform that transforms the end-to-end consumer journey. Through an integrated platform that aligns providers, payers, and other ecosystem partners, Cedar delivers an optimized patient financial experience that drives real engagement and guaranteed results.

For more information, visit **cedar.com**.