The Hilltop Institute

The Hilltop Pre-AH Model™ Predictive Power Update
July 2020

The Hilltop Pre-AH Model™ uses information on patients' utilization, medications, comorbidities, social determinants of health, and other risk factors to generate monthly risk scores. These risk scores, transmitted to providers via CRISP, are intended to capture beneficiaries' risk of experiencing an avoidable hospital event in the near future. Avoidable hospital events are defined as either emergency room visits or inpatient stays for certain conditions that are believed to be preventable though the receipt of timely preventative care.[1] These scores were first released on October 11, 2019, and have been updated monthly since then.

The scores are designed to assist providers by allowing them to easily identify patients at a high risk of incurring avoidable hospital events. Using this information in conjunction with clinical judgement, providers can make informed decisions about how to allocate scarce care coordination resources, directing these resources to the individuals that will benefit from them the most. Given this goal, it is crucial that the Pre-AH Model™ risk score ranking is accurate: individuals with a high likelihood of incurring an avoidable hospital event should receive high risk scores, and individuals with a low likelihood of incurring an avoidable hospital event should receive low risk scores.

The Hilltop Institute designed the Pre-AH Model™ to prospectively maximize the accuracy of the risk score ranking: we feed into the model a pool of approximately 200 risk factors that have already been demonstrated, in published research, to be predictive of avoidable hospitalizations; we let the data speak for itself in selecting which risk factors are most important; we use a split-sample development process to ensure that we are not overfitting the model; and we use a shadow coding system to ensure that we are not introducing error into the model that would weaken the predictions. Good model design, however, is no guarantee of good predictive power. Additionally, the rarity of these events makes this *a priori* difficult to predict: for a typical monthly cohort of 350,000 individuals, only about 2,500 incur an avoidable hospital event in a given month.[2]

One of the ways we gauge the predictive accuracy of the Pre-AH Model™ is to look backwards and compare the risk scores released at a certain point (for example, on November 8, 2019) with actual patient experience in the following month (for example, November 8, 2019 – December 12, 2019, the day before the next risk scores were released). This allows us to know that, for example, seventy percent of the riskiest individuals as ranked by the November 8th Pre-AH Model™ *actually* incurred avoidable hospital events in the following month. This is suggestive of good model

[1] For additional information, see *Maryland Primary Care Program (MDPCP) Pre-AH Risk Score Specifications and Codebook Version 3*.

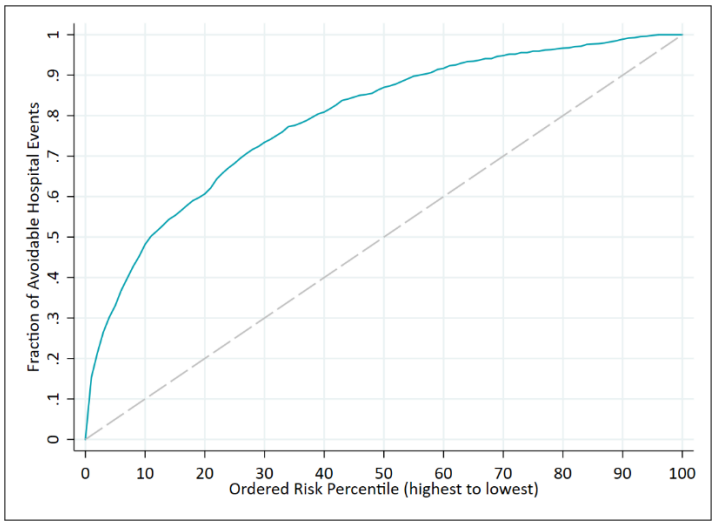
[2] This fell to roughly 2,000 in March 2020 and 1,200 in April 2020 due to the COVID-19 pandemic.

performance: the individuals that our model predicts to be very risky do actually have a high risk of incurring an avoidable hospital event.

In order to capture program-wide model performance, our preferred measure of model accuracy comes from the *concentration curve*. This allows us to answer the question, "Of all the people who have an avoidable hospital event in a given month, what percentage is accounted for by the top 10% riskiest individuals as ranked by the Hilltop Pre-AH Model™?" Intuitively, if the answer is close to 100%, this means the model is performing very well: all the people who have avoidable hospital events are captured by high risk scores. Analogously, if the answer is close to 10%, then this means that the model has no predictive value and is essentially ranking people at random.

In the figure below, we show the concentration curve for the Pre-AH Model™ risk scores released on April 10, 2020 (the latest month for which we have follow-up data available). We find that over 48% of all individuals experiencing an avoidable hospital event in the following month are contained in the top 10% riskiest individuals as ranked by the Pre-AH Model™. It is important to note that, when these scores were released, the model had no knowledge of who, in the following month, would experience an avoidable hospital event; that is, the scores are purely predictive.

Concentration Curve for Pre-AH Model™ Scores from April 10, 2020



We interpret this as good performance of the model, and the other months show similar results.[3] These results imply that, if care managers were to focus their efforts on the top 10% riskiest beneficiaries each month, they could reach almost half of all individuals experiencing avoidable hospital events that month. Additionally, this measure does not account for the individuals that *would* have incurred an avoidable hospital event but did not due to receipt of advanced primary care; therefore, the true accuracy of the Pre-AH Model™ risk scores may be even higher that what is reported here.

[3] Ranging from 45.0% to 48.5% of all avoidable hospital events captured in the top 10% riskiest individuals, with minor variations from month to month.