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The Chronic(les) of Absenteeism Measurement: Unpacking the Many Measures of Attendance and Evidence for a Lower Chronic Absenteeism Threshold

Tiffany Wu
University of Michigan

Christina Weiland
University of Michigan

Thomas Staines
University of Michigan

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Tiffany Wu
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Abstract

This study investigates how absenteeism can be more rigorously measured as an early warning indicator of future academic risk. Using administrative data from 8,891 Boston Public Schools students followed from Pre-K through eighth grade, we (1) describe patterns in excused, unexcused, and total absences, measured as both days and rates, across grades; (2) apply Signal Detection Theory and Receiver Operating Characteristic (ROC) curve analyses to compare the diagnostic accuracy of different absenteeism measures for predicting standardized test scores; (3) use Youden's J to identify optimal thresholds for defining chronic absenteeism; and (4) examine how the diagnostic accuracy of different absence measures varies with temporal proximity to academic outcomes. We find that total absence rate provides the most consistent diagnostic signal across grades and that diagnostic accuracy increases with temporal proximity, with same-year or immediately preceding-year absences generally providing the strongest signal. Notably, empirically derived thresholds for identifying students at risk using Youden's J consistently fall below the widely used 10% chronic absenteeism benchmark, generally around 7-8% in Pre-K and kindergarten and 3-6% throughout the elementary and middle school grades.

Keywords: chronic absenteeism, student attendance, receiver operating characteristic (ROC) curves, signal detection theory, Youden's J, early warning indicator

The Chronic(les) of Absenteeism Measurement: Unpacking the Many Measures of Attendance and Evidence for a Lower Chronic Absenteeism Threshold

In the 2013-2014 school year, the United States Department of Education reported nationwide rates of chronic absenteeism for the first time through the Civil Rights Data Collection survey. That year, approximately 14% of school-age children, or 6.8 million students nationwide, were chronically absent (U.S. Department of Education, 2016a). In less than a decade, the proportion of chronically absent students has doubled to 28% in 2022-23 (U.S. Department of Education, 2025), an alarming trend with serious implications for educational equity and policy.

Chronic absenteeism has been consistently linked to lower academic achievement, weaker social-emotional skills, and reduced likelihood of high school graduation and postsecondary enrollment (Allensworth et al., 2021; Romero & Lee, 2007). As such, absenteeism has become a central indicator for early warning systems (EWSs) used to identify students at risk of adverse academic outcomes and to provide timely supports (Allensworth, 2013; Balfanz & Byrnes, 2019; U.S. Department of Education, 2016b). Threshold-based EWSs flag students for additional supports once they exceed a specified cutoff on a given early warning indicator. While the recommended cutoffs can vary for chronic absenteeism, they most often center on *missing 10% or more of school days for any reason* (Balfanz & Byrnes, 2019; Bruce et al., 2011; Romero & Lee, 2007).

However, defining chronic absenteeism this way reflects a commonly adopted convention rather than one grounded in empirical evidence. That is, this definition implicitly makes two assumptions: first, that all types of absences carry equal weight in signaling academic risk; and second, that 10% represents a meaningful decision point for identifying students who may need

additional supports. Neither of these assumptions have been empirically validated (Henderson & Fantuzzo, 2023). This is consequential because how chronic absenteeism is defined can determine which students are identified for additional supports and how schools allocate attendance resources.

In this study, we respond to the growing demand for greater clarity and rigor in how absenteeism is measured, in particular for use as an early warning indicator. Using a demographically diverse sample of students from Boston Public Schools, we investigate descriptive patterns of absenteeism from Pre-K to 8th grade, use Signal Detection Theory (SDT) and Receiver Operating Characteristic (ROC) curve methodology to evaluate the diagnostic accuracy of different absence measures for predicting later academic achievement, empirically test candidate thresholds for defining chronic absenteeism using Youden's J, and assess how the diagnostic accuracy of different measures changes with temporal proximity to academic outcomes.

We find that measurement choices meaningfully shape conclusions about absenteeism as an early warning indicator. Total absence rate provides the most consistent diagnostic signal across grade levels, while unexcused absences become increasingly informative in later grades. Absence rates also modestly outperform corresponding counts of days absent. Diagnostic accuracy increases with temporal proximity to the academic outcome, with more recent absences generally providing the strongest signal. Finally, empirically derived thresholds based on ROC curve methodology consistently fall below the widely used 10% chronic absenteeism benchmark, generally clustering around 7-8% in Pre-K and kindergarten and 3-6% in later grades. These lower thresholds may provide a more timely signal for identifying students at academic risk. Taken together, our findings demonstrate how chronic absenteeism reflects consequential

measurement choices about absence type, scale, threshold, and timing, and show how these choices can be evaluated more rigorously for use as early warnings.

The Measurement of Student Absenteeism

Schools and districts frequently rely on the common 10% chronic absenteeism threshold to inform early warning decision-making (Balfanz & Byrnes, 2019; Bruce et al., 2011; Romero & Lee, 2007; U.S. Department of Education, 2016b). Attendance Works recommends that "students who missed 10% of school in the prior school year should be prioritized for extra outreach and support for the current school year and the upcoming summer" (Attendance Works, 2023) and to provide Tier 2 supports such as attendance improvement plans and family outreach once students pass the 10% threshold (Attendance Works, n.d.). This framework has been used by programs such as Head Start (Attendance Works, 2016) and also integrated into tiered attendance support systems like that used by Boston Public Schools (Boston Public Schools, n.d.). Consequently, where thresholds are set directly determine which students are identified as at risk, when supports are initiated, and how schools allocate educational resources. Yet, the threshold itself is only one of several consequential choices embedded in how chronic absenteeism has been measured and interpreted.

Operationalizing Absenteeism

Operationalizing student absenteeism involves a series of key decisions. These decisions can fall into four main categories:

1. **Absence type:** Whether to use excused absences, unexcused absences, or total absences (a combination of both excused and unexcused absences).
2. **Scale of measurement:** Whether to use the raw number of days absent or to calculate an absence rate (e.g., days absent divided by days enrolled).

3. **Variable type:** Whether to measure absenteeism as a continuous variable (e.g., number of days absent) or as a binary indicator of chronic absenteeism (e.g., whether a student meets or exceeds a defined threshold), and if using a binary indicator, what threshold should distinguish students who are flagged as chronically absent from those who are not.
4. **Timing of measurement:** Which grade levels or school years to use.

Among the options for absence type, excused absences are often perceived as less detrimental because they indicate that communication between a student's family and the school has occurred (Gottfried, 2009). These absences are typically associated with reasons considered legitimate by schools, such as illness, and may reflect a higher level of parental engagement. In contrast, unexcused absences, also referred to as truancy, are viewed as more concerning, as they may reflect disengagement with school or insufficient adult supervision. At the same time, the distinction between excused and unexcused absences may reflect school- or district-level policies and practices for how absences are classified, including differences in documentation requirements and administrative discretion. Still, several studies support meaningful differences between absence types. Gershenson et al. (2017) reported that unexcused absences were twice as harmful to academic achievement as excused ones among fourth and fifth graders in North Carolina. Gottfried (2009) found that a higher proportion of excused absences relative to total absences was actually associated with positive effects on reading and math test scores. More recently, Henderson and Fantuzzo (2023) concluded that only unexcused absences provided diagnostic accuracy in predicting later academic performance in early elementary grades.

However, the widely-used chronic absenteeism binary indicator does not distinguish between absence types. Because chronic absenteeism is most commonly defined as having a *total* absence rate of greater than or equal to 10%, this translates to missing 18 or more days of

school *for any reason* in most U.S. schools with 180-day academic calendars (Faria et al., 2017; Romero & Lee, 2007). Implicit in this definition is the assumption that all absences, regardless of type or underlying cause, have equivalent consequences for student learning (Henderson & Fantuzzo, 2023). Indeed, some evidence also supports this assumption. Balfanz and Byrnes (2012) argued that the total amount of instructional time lost is what matters most. Furthermore, in the Gershenson et al. (2017) study cited above, the authors found no statistically significant difference between excused and unexcused absences when analyzing academic outcomes using nationally representative ECLS-K data, contrasting with their North Carolina findings and highlighting the importance of context and sample characteristics.

Another decision concerns the scale of measurement. When deciding whether to use raw counts of absent days or to use an absence rate, researchers must consider enrollment variation. Absence rates, calculated as the number of days absent divided by the number of days enrolled, adjust for differences in enrollment length caused by student mobility or by calendar variations across school types (charter, public, private) and states. Because 31 states and the District of Columbia require a minimum of 180 instructional days, most schools operate on a standard 180-day calendar. However, notable variation exists between states. Colorado, for example, mandates a minimum of 160 days. Thirty-five states also differentiate requirements by grade level, either in terms of days or instructional hours (Silva-Padron & McCann, 2023). As such, using rates may offer a more comparable metric across diverse student populations and is the scale of measurement used currently in the 10% definition of chronic absenteeism. That said, day counts align with how attendance is typically tracked and communicated by educators and families.

A third decision concerns variable type: whether absenteeism should remain a continuous measure or be converted into a binary indicator of chronic absenteeism. Although continuous

measures preserve more information, binary indicators can be useful for practical decision-making because they provide a clear rule for determining when a student should be flagged for additional supports. The most widely used binary definition uses a 10% threshold (Faria et al., 2017; Romero & Lee, 2007), but there is no universal agreement on the appropriate cutoff for how much school a student has to miss before being counted as chronically absent. Dougherty (2018) found that research definitions vary widely, from no explicit threshold (Gottfried, 2009), to fixed day-count cutoffs such as 11, 15, 18, or 20 days (Gottfried, 2015; Morrissey et al., 2014; Gershenson, 2016; Sheldon & Epstein, 2004), to percentage-based thresholds such as 10% (e.g., Aucejo & Romano, 2016). Consequently, converting absenteeism from a continuous measure into a binary indicator introduces the additional measurement decision of where to place the threshold that distinguishes students who are classified as chronically absent, and what that threshold represents.

Lastly, researchers must consider the timing of the absenteeism measure, as patterns of absenteeism differ across grade levels and developmental stages (Dougherty, 2018). The school year in which attendance is measured may influence both which operationalization of absenteeism is most appropriate and how well absenteeism predicts later academic outcomes. In early grades, school attendance is largely dependent on parents or caregivers. As a result, unexcused absences may be less frequent, and even when present, they may reflect logistical challenges or communication breakdowns at the family level (e.g., forgetting to call the school) rather than student intent to miss school (Chang & Romero, 2008; Epstein & Sheldon, 2002). In such cases, researchers may be more likely to use total absences to better capture the full picture of lost instructional time. Absences in the early grades may also be more heavily influenced by common childhood illnesses, especially as children adjust to new social environments (Lenhoff

& Singer, 2025; Ready, 2010). As students age, however, the meaning of absenteeism may shift. In later elementary and secondary grades, absenteeism is more likely reflective of student-driven factors, such as academic disengagement or school avoidance (Kearney, 2008). As students gain autonomy over their routines, patterns of unexcused absences may become more meaningful. These developmental differences suggest that the predictive value of absenteeism depends not only on how it is measured, but also on when it is measured, underscoring the importance of considering temporal context when operationalizing absenteeism for early warnings.

In all, three absence types (excused, unexcused, or total), two scales of measurement (number of days or rate), and two variable types (continuous or binary) yield at minimum 12 different combinations of possible absenteeism measures. Adding in variation in how the binary variable of chronic absenteeism could be defined (at minimum, a choice between two different thresholds such as 15 days versus 18 days) raises this to 18 potential combinations. Various considerations regarding the timing of the absenteeism measure, such as students' grade level, further expand the number of possible approaches. Taken together, these choices provide researchers with multiple degrees of freedom in how absenteeism can be operationalized.

Signal Detection Theory & the ROC Curve: A Primer

Given the multiplicity of possible absenteeism measures, it is useful to consider frameworks designed specifically to evaluate how well different measurements distinguish between students who are and are not at risk. One such framework is Signal Detection Theory (SDT), with ROC curves as a common method for applying SDT. Because SDT and ROC curves form the basis of our primary analyses and because this method is less commonly used in education research, we provide a brief primer on these approaches before describing their application in the Methods.

Originating in engineering and the computer sciences with radar researchers and now widely applied in medicine and cognitive psychology, the central insight of SDT is that binary outcomes are often predicted using imperfect or noisy information, complicating accurate classification. To illustrate the logic of SDT, consider the following scenario of a radiologist reviewing a CT scan for signs of a tumor (Heeger, 2007). There is an underlying objective "truth": the tumor is either present or absent. However, the radiologist's interpretation of the CT scan, which may already be unclear or difficult to interpret, may or may not correspond with this objective reality. This creates four possible outcomes: a) A true positive (hit): A tumor is present, and the radiologist correctly identifies it; b) A true negative (correct rejection): A tumor is absent, and the radiologist correctly confirms that; c) A false positive (false alarm): A tumor is absent, but the radiologist mistakenly identifies one; or d) A false negative (miss): A tumor is present, but the radiologist incorrectly says there is none. True positives and negatives (hits and correct rejections) represent accurate classifications, while false positives and negatives (false alarms and misses) constitute diagnostic errors.

The same logic can be applied when using absenteeism to predict which students will be at future academic risk, which we will operationalize as scoring in the *Not Meeting Expectations* category on a standardized test. Just as in the medical example, there is an underlying "truth" (i.e., a student will either score high enough to meet expectations or not), but our measure (e.g., a student's total absence rate) may or may not correctly capture that risk. This leads to the same four aforementioned outcomes: true positives (hits; correctly identifying students who will not meet expectations), true negatives (correct rejections; correctly identifying students who will meet expectations), false positives (false alarms; failing to identify students who will meet expectations), and false negatives (misses; failing to identify students who will not meet

expectations). The goal is then to evaluate how well a given absence measure distinguishes between true cases and diagnostic errors.

A widely used method for operationalizing this framework is the ROC (Receiver Operating Characteristic) curve. ROC methods have been less commonly applied in education, although their use has grown in recent years across areas such as learning analytics, measurement, and predictive analytics for early warning systems (Bowers & Zhou, 2019; Hutt et al., 2019; Keller-Margulis et al., 2008; Wu & Weiland, 2026). To our knowledge, the aforementioned Henderson and Fantuzzo (2023) study provides the only prior application of ROC methods specifically to student absenteeism.

ROC analysis is useful because it evaluates the consequences of all possible thresholds of a continuous indicator. Figure 1 illustrates this logic using absenteeism to predict *Not Meeting Expectations* on a standardized test. In Figure 1A, we illustrate a hypothetical "ideal" ROC scenario, where the distributions of students who score at or above the *Meeting Expectations* category on a standardized test (in blue in Figure 1A) and those who do not (in red in Figure 1A, representing a smaller proportion of students) would be entirely distinct on the absence rate spectrum. In this case, a single threshold on the absence rate (dotted line in Figure 1A) would perfectly separate the two groups, enabling a flawless classification: all students with an absence rate lower than the absence threshold would be correctly classified as *Meeting Expectations,* and all the students with an absence rate higher than the absence threshold would be correctly classified as *Not Meeting Expectations.*

However, in reality, the actual distribution of these two groups likely overlap, as shown in Figure 1B. Notice that, because the distributions overlap, there will inevitably be both false negatives (misses) and false positives (false alarms) no matter which absence threshold is

chosen. For example, setting a lower threshold (Figure 1C) captures most students who are likely to not meet expectations, ensuring few students at risk of failing slip through the cracks, but also increases the number of false positives, which can lead to unnecessary interventions. In contrast, a high threshold (Figure 1D) minimizes false positives, meaning fewer students are incorrectly flagged. However, the lower false positive rate comes at the cost of more false negatives, potentially overlooking students who would benefit from additional supports. In either case, the overlapping distributions underscore a central challenge in SDT: no single threshold is perfect, and each decision point involves important trade-offs in accuracy.

The full range of possible thresholds and their consequences can be visualized using a single graph known as the ROC curve (Figure 2). ROC curves plot the true positive rate (TPR, also known as sensitivity) on the y-axis against the false positive rate (FPR, also known as 1 – specificity, or 1 – the true negative rate) on the x-axis across all possible threshold values of a given indicator or classifier. TPR reflects the proportion of actual positive cases (e.g., students who do not meet expectations) that are correctly identified by the indicator. It is calculated as:

$$TPR = Sensitivity = \frac{True\ Positives}{True\ Positives + False\ Negatives} = \frac{Hits}{Hits + Misses}$$

FPR reflects the proportion of actual negative cases (e.g., students who meet expectations) that are incorrectly identified. It is calculated as:

$$FPR = 1 - Specificity = \frac{False\ Positives}{False\ Positives + True\ Negatives} = \frac{False\ Alarms}{False\ Alarms + Correct\ Rejections}$$

A strong indicator would have a high TPR rate and a low FPR rate, hugging the top-left corner of the ROC plot.

Figure 2A illustrates two hypothetical ROC curves. Each point along both Curves A and B corresponds to a possible threshold cutoff (e.g., a particular absence level). At very high thresholds (bottom-left), only the most extreme cases are flagged, yielding low rates of both true

positives and false positives. At very low thresholds (top-right), nearly all students are flagged, producing high true positive rates but also high false positive rates. Curve A represents a stronger classifier: it rises quickly toward the top-left corner, showing that it captures many true positives with relatively few false alarms. Curve B, by contrast, performs less effectively, lying closer to the diagonal line (i.e., when TPR = FPR or y = x), which represents random guessing.

The overall accuracy of each classifier can be summarized by the *area under the ROC curve (AUC),* which ranges from 0.5 (random guessing) to 1.0 (perfect classification) and has been proposed as a useful diagnostic measure for evaluating predictors of educational outcomes (Bowers & Zhou, 2019). As illustrated in Figure 2B, AUC represents the area beneath the ROC curve across all possible thresholds. Curve A has a larger shaded area than Curve B, indicating stronger overall diagnostic accuracy and therefore a higher AUC (0.78 for Curve A vs. 0.60 for Curve B). In other words, a higher AUC indicates that a given absence measure more reliably distinguishes between students who do and do not meet expectations on a standardized test. To test whether differences between AUCs are statistically significant, we use the DeLong test (DeLong et al., 1988). This nonparametric method estimates the covariance between AUC estimates using U-statistics, accounting for the fact that the ROC curves are calculated from the same sample of students. A statistically significant DeLong test result indicates that one predictor has significantly greater diagnostic accuracy than another.

While AUC provides a global summary of a classifier's accuracy across all possible thresholds, applied contexts often require selecting a single cutoff. A commonly used index for this purpose is *Youden's J* (Youden, 1950), defined as:

$$J = Sensitivity + Specificity - 1 = TPR - FPR$$

Youden's J ranges from 0 to 1, where higher values indicate a better balance between sensitivity (correctly identifying students who do not meet expectations and need additional support) and specificity (correctly identifying students who meet expectations). A value of 1 indicates a perfect signal with no false positives or false negatives, while a value of 0 indicates a signal that is no better than random chance. As shown in Figure 2C, the optimal Youden's J corresponds to the red point on the ROC curve that lies farthest above the random guessing diagonal. The TPR and FPR at this point can be translated back into an underlying absence rate or number of days absent, yielding a concrete cutoff. This "optimal" threshold is often chosen because it identifies the point where the tradeoff between sensitivity and specificity is best balanced. As such, this provides a data-driven way to compare candidate chronic absenteeism thresholds.

Taken together, SDT and ROC methods provide a framework for thinking through how absenteeism can best be operationalized as an early warning indicator. As Dougherty (2018) emphasized, the threshold used to define chronic absenteeism is itself an important measurement decision that warrants careful consideration. In a similar vein, Henderson and Fantuzzo (2023) emphasized that the current chronic absenteeism threshold lacks a strong empirical basis, underscoring the need for additional studies that not only apply ROC methods across different districts and developmental contexts but also directly examine whether the 10% cutoff is a meaningful threshold.

Current Study

This study builds on the growing body of research that interrogates how absenteeism is measured. We broaden the empirical scope of ROC curve applications by examining the diagnostic accuracy of absenteeism measures from early elementary through middle school within a large, urban district. In doing so, we test the generalizability of a ROC curve framework

across diverse grade spans and developmental contexts. We also demonstrate one way to empirically identify a chronic absenteeism threshold, discussing its strengths and limitations relative to the conventional 10% cutoff. We organize our research questions around the four measurement decisions described in the literature review:

RQ1. Absence Type & Scale of Measurement: How do descriptive patterns of absenteeism differ across Pre-K through 8th grade under different measurement approaches?

RQ2. Absence Type & Scale of Measurement: Using ROC curve analysis, how do different operationalizations of absenteeism compare in their diagnostic accuracy for predicting 8th grade math and ELA performance across grade levels?

RQ3. Variable Type: If absenteeism is operationalized as a binary indicator for early warning systems, what threshold for absenteeism is empirically supported by ROC curve methodology?

RQ4. Timing of Measurement: How does the diagnostic accuracy of absenteeism measures vary depending on when absenteeism is measured, and does temporal proximity to students' assessments improve prediction or alter the empirically derived threshold?

RQ1 describes how measurement choices—absence type (excused, unexcused, or total absences) and scale of measurement (days absent or absence rate)—shape patterns of absenteeism across Pre-K through 8th grade. RQ2 compares these choices to determine how decisions regarding absence type and scale of measurement are associated with the diagnostic accuracy of absenteeism measures for identifying students at academic risk. Building on those results, RQ3 considers how the most informative absenteeism measure in RQ2 might be

translated into a binary chronic absenteeism indicator for use as an early warning signal. Specifically, RQ3 focuses on one way to empirically select a cutoff using Youden's J, which identifies the threshold that best balances correctly predicting students who later experience academic difficulty with avoiding false positives among students who do not. Finally, RQ4 evaluates the timing of measurement by assessing how the predictive utility of absenteeism varies across grade levels.

RQ2 and RQ3 focus on 8th grade standardized test outcomes because they provide a key benchmark of middle school achievement and readiness for high school (Smerillo et al., 2018). Looking from Pre-K to 8th grade also allows us to evaluate how the diagnostic accuracy of absenteeism as a signal evolves over time and across developmental stages, providing insight into when absenteeism functions as a stronger or weaker early warning signal. Extending the analysis further into high school was complicated by the COVID-19 pandemic, which disrupted traditional schooling beginning in spring 2020, when students in our cohorts were in grades 9 through 11, and during which time attendance records were deemed unreliable for research purposes by the school district (Appendix A Table 1).

Methods

Data

Our sample for this paper was the population of students who enrolled in the Boston Public Schools (BPS) Pre-K program for four-year-olds between the 2007-2008 and 2009-2010 school years. We defined our sample by Pre-K entry because approximately 70% of children attend some form of preschool (Klein & Whitehurst, 2015), over half of U.S. public schools now have a Pre-K program (Little et al., 2025), and recent research shows that absenteeism patterns established in Pre-K not only persist into the early elementary grades but also can be used to

predict later academic and attendance outcomes (Wu & Weiland, 2026). Additionally, BPS operated one of the nation's largest city-run Pre-K programs during this period, providing a unique opportunity to examine attendance patterns for students from early school entry through middle school (Weiland et al., 2025). We followed students from their Pre-K application to 8th grade (school years 2016-17 to 2018-19; Appendix A Table 1). Using each student's unique identifier, we merged on district and state administrative records, including information on demographics, students' attendance records, and ELA and math standardized test scores from the Massachusetts Department of Elementary and Secondary Education.

Across our three cohorts, there was a total of 8,891 BPS Pre-K applicants. For RQ1, we included all students with non-missing attendance data for a given grade and verified evidence of enrollment and attendance (i.e., both days enrolled and days attended greater than zero). Sample sizes ranged from N = 6,226 to N = 8,014 across grade levels, as shown at the bottom of Figure 3. For RQ2-RQ3, we restricted the sample to students with non-missing state standardized test scores in eighth grade, resulting in a final analytic sample of N = 7,145. For RQ4, we restricted the sample to students with non-missing state standardized test scores in each respective grade from grades 3-7, with sample sizes ranging from N = 6,813 to N = 7,343. We explored whether findings were driven by different students joining or leaving the sample across the Pre-K through 8th grade years. To do so, for RQ1-RQ4, we refit our models using a common sample of students with no missing data in attendance or standardized test scores in all grades. We found our broad conclusions for all RQs were robust to a broader versus common sample approach. All findings for the common sample approach can be found in Appendix F.

Table 1 reports demographic characteristics for students with non-missing state standardized test outcomes in 8th grade (RQ2-RQ3), followed by 3rd through 7th grades (RQ4).

In 8th grade, the analytic sample was approximately 48% female and racially/ethnically diverse (45% Hispanic/Latino, 29% Black, 15% White, 9% Asian, 3% multiracial/other). Roughly 49% of students spoke English as their home language, 30% spoke Spanish, and 21% spoke another language other than English or Spanish. About 94% of the sample listed the United States as their country of origin, and approximately 58% of students were eligible for free or reduced-price lunch. The samples for grades 3-8 were comparable for all student characteristics except for eligibility for free or reduced-price lunch, where the 8th grade sample was less likely to be eligible. The analytic sample for grades 3-8 were similar to the full population of BPS Pre-K applicants during our study years on observed demographic characteristics, with the same aforementioned exception for the 8th grade sample.

Measures

Student Absences

For each student and school year, we constructed measures of excused, unexcused, and total absences. We operationalized each absence type as both the number of days absent and as an absence rate (number of days absent divided by the total days the student was enrolled in their majority-enrolled school during a given year). Thus, we considered six continuous attendance measures: excused days, unexcused days, total days absent, excused absence rate, unexcused absence rate, and total absence rate.

Academic Achievement

To measure academic achievement, we used children's Massachusetts state standardized test performance in both math and ELA, focusing on 8th grade test scores for RQ2 and RQ3 and extending to grades 3-7 for RQ4. In Massachusetts, students are required to complete the Massachusetts Comprehensive Assessment System (MCAS) every year in grades 3-8

(Massachusetts Department of Elementary & Secondary Education, 2018; Massachusetts Department of Elementary & Secondary Education, 2025; Rennie Center for Education Research & Policy, 2018). The state used three different MCAS tests from the spring of 2012, the 3rd grade year for our earliest cohort, to the spring of 2019, the 8th grade year of our last cohort. Up until 2014, Massachusetts used a version of MCAS now called "Legacy MCAS." This test reported four achievement levels: *Warning/Failing, Needs Improvement, Proficient, and Advanced*. In 2015 and 2016, districts were able to choose to administer either Legacy MCAS or the Partnership for Assessment of Readiness for College and Careers (PARCC) assessment. The PARCC exam reported five achievement levels: *Did Not Yet Meet Expectations, Partially Met Expectations, Approached Met Expectations, Met Expectations, and Exceeded Expectations.* Beginning in spring 2017, all districts administered a new version of MCAS called Next-Generation MCAS. The Next-Generation MCAS reported four achievement levels: *Not Meeting Expectations, Partially Meeting Expectations, Meeting Expectations, and Exceeding Expectations.*

Importantly, our primary ROC analyses (RQ2-RQ3) focusing on 8th grade standardized test outcomes relied exclusively on the Next-Generation MCAS test results, ensuring that our comparisons were conducted within a single assessment framework. We defined the outcome of interest in these research questions as whether a student scored in the *Not Meeting Expectations* category. However, for RQ4, we aligned achievement levels across tests pragmatically since examining temporal proximity required incorporating earlier grades measured under different testing regimes. Consistent with state definitions of not meeting expectations, we grouped together the following categories that fell short of demonstrating at least a partial understanding of the subject matter: Legacy MCAS's *Warning/Failing*, PARCC's *Did Not Yet Meet*

Expectations, and Next-Generation MCAS's *Not Meeting Expectations*. We use the Next-Generation MCAS terminology and refer to this group collectively as those *Not Meeting Expectations* throughout the rest of this paper. We focused on the lowest performance category because it most closely aligns with the practical goal of EWSs: identifying students who are at greatest risk and may require additional supports.

Analytical Approach

RQ1. Absence Type & Scale of Measurement: Descriptive Patterns. To examine how absenteeism patterns differed across measurement choices, we generated descriptive statistics for excused, unexcused, and total absences, expressed both as number of days absent and as absence rates. We examined these patterns from Pre-K through 8th grade and visualized longitudinal trends across grade levels.

RQ2. Absence Type & Scale of Measurement: ROC Curve Analysis. We evaluated the diagnostic accuracy of six absenteeism measures—days excused, days unexcused, total days absent, excused absence rate, unexcused absence rate, and total absence rate—for predicting whether students scored in the *Not Meeting Expectations* category on 8th grade math and ELA assessments. For each measure and grade level, we calculated the AUC. To assess whether differences in diagnostic accuracy across alternative operationalizations were statistically significant, we used paired DeLong tests to compare correlated AUCs estimated on the same students.

RQ3. Variable Type: Identifying Empirical Thresholds with Youden's J. If chronic absenteeism is intended to function as an early warning indicator of future academic risk, then a useful binary cutoff should identify as many students who later struggle academically as possible without unnecessarily flagging large numbers of students who do not. Based on the ROC

analyses in RQ2, we therefore used Youden's J to identify the total absence rate threshold that best balanced these two goals for predicting 8th grade math and ELA performance. We then compared these empirically derived thresholds with the conventional chronic absenteeism benchmark of missing 10% of enrolled school days.

RQ4: Timing of Measurement: Temporal Proximity. To examine how the diagnostic accuracy of absenteeism varied with the timing of measurement, we extended the ROC and Youden's J analyses to standardized math and ELA outcomes in grades 3 through 7. We included absence measures from the same academic year or earlier years to ensure that attendance measures did not occur after the achievement outcome. We then examined whether absenteeism measured closer in time to the standardized assessment provided stronger diagnostic accuracy and whether empirically derived thresholds differed across grades.

Robustness Checks. We conducted several sensitivity analyses to assess whether the findings depended on particular measurement, cohort, or sample composition. First, because our study period spanned the implementation of ESSA in 2015 and related changes in how chronic absenteeism was incorporated into accountability systems[1], we examined whether the RQ2 (ROC analyses) and RQ3 (Youden's J threshold) findings were consistent across cohorts observed at the same grade level in different school years, with particular attention to fifth and sixth grades,

[1] In 2015 (when students in our sample were entering 5th-7th grade), ESSA required states to incorporate at least one indicator of school quality or student success into their accountability systems. Massachusetts subsequently adopted chronic absenteeism as its statewide attendance indicator, defining chronic absenteeism as missing at least 10% of enrolled school days regardless of whether absences were excused or unexcused. Consistent with this framework, Boston Public Schools' attendance policy since 2015 has explicitly distinguished between excused and unexcused absences for administrative purposes while recognizing that all absences contribute to chronic absenteeism. Under the district's attendance policy, excused absences include illness or injury, hospitalization, medical or dental appointments, death in the family, religious observance, court appearances, and other extraordinary circumstances approved by the school. Unexcused absences include examples such as family vacations, babysitting, cutting class, and repeated illness without appropriate documentation. Few details are available regarding BPS's attendance policies prior to 2015, but it is likely that definitions of excused and unexcused absences beforehand varied depending on local attendance policies (National Forum on Education Statistics, 2009).

where the three cohorts were observed across school years spanning this policy transition (Appendices C-D). While this is not intended to estimate a causal effect of ESSA, these sensitivity checks helped assess whether our RQ2 and RQ3 findings were consistent across groups of students exposed to different attendance-policy contexts.

Second, for RQ3, we examined whether the empirically derived thresholds were sensitive to scale of measurement by recalculating Youden's J using total days absent rather than total absence rate (Appendix D). Finally, as stated above, we repeated analyses for RQ1 through RQ4 using a common sample of students with complete attendance and standardized test data across all included grades to assess whether changes in the composition of the analytic sample across grades affected the findings (Appendix F). Our broad findings were robust across these checks; we report findings for each relevant research question in the Results section that follows.

Results

RQ1. Absence Type & Scale of Measurement: Descriptive Patterns

Figures 3A and 3B present the average excused, unexcused, and total absences from Pre-K through 8th grade, expressed as both number of days absent and absence rates, respectively. Exact means, standard deviations, and sample sizes by grade and absence type are provided in Appendix B Table 1.

As Figure 3 shows, the two scales of measurement (i.e., whether absenteeism is expressed as an absence rate or a day count) yielded similar descriptive patterns across grades. In contrast, differences emerged by absence type. In Pre-K, total absenteeism was driven almost entirely by excused absences: students averaged 13.15 excused days absent (7.99% unexcused absence rate), compared with just 0.10 unexcused days (0.06% unexcused absence rate). Excused absences then declined sharply across the early grades and levelled off after 2nd grade, while

unexcused absences steadily increased. Around 2nd grade, the excused and unexcused absence trajectories intersected; by 3rd grade, students averaged 5.16 unexcused days absent (2.94% unexcused absence rate) compared with 2.93 excused days (1.67% excused absence rate). From that point onward, unexcused absences remained more common than excused absences, and this gap persisted through the middle school grades. Total absenteeism, meanwhile, declined from Pre-K through the elementary grades before rising again in middle school. Taken together, the figures show that although rate- and day count-based measures tell a similar descriptive story, total absenteeism can mask developmental changes in the composition of students' absences for each grade.

RQ2. Absence Type & Scale of Measurement: ROC Curve Analysis

Figures 4A and 4B summarize the RQ2 results, with exact estimates reported in Appendix C Table 1. Figure 4A displays the AUCs for each of the six absenteeism measures across grades, while Figure 4B displays the corresponding pairwise AUC differences and results of the DeLong tests. In Figure 4A, higher AUC values indicate greater diagnostic accuracy in distinguishing students who later scored in the *Not Meeting Expectations* category on the eighth grade math and ELA standardized tests. In Figure 4B, positive values indicate that the first absence measure listed had the higher AUC, while negative values indicate that the second measure performed better. Statistical significance based on the DeLong test is denoted by asterisks; cell shading reflects the magnitude and direction of the AUC difference.

In the early grades, all absenteeism measures provided relatively weak signals of eighth grade academic performance. In Pre-K in Figure 4A, for example, unexcused absences performed essentially at chance (AUC ≈ 0.50), while total and excused absence measures yielded only modestly higher AUCs, ranging from approximately 0.54 to 0.57 across math and ELA.

This is not unexpected, as the time gap between Pre-K and 8th grade outcomes likely attenuates their association. In kindergarten and first grade, total absences (blue lines) became somewhat more informative, with AUCs rising to above 0.60, whereas unexcused absences (green lines) remained relatively weak.

As students progressed through elementary school, however, total and unexcused absences became increasingly informative, while excused absences remained comparatively weak. By third grade, total and unexcused measures clearly separate from excused measures. For third grade math, for example, total absence rate had an AUC of 0.646 and unexcused absence rate an AUC of 0.635, compared with 0.543 for excused absence rate. This divergence is confirmed in the DeLong comparisons in Figure 4B, where the differences between both total or unexcused absences and excused absences were statistically significant ($p < 0.001$; shown in the orange shaded cells in the first and third rows for the third grade column). This pattern generally persisted and widened through the later grades.

By eighth grade, total and unexcused absence rates provided nearly identical diagnostic accuracy, as seen in the overlapping blue and green dots in Figure 4A. For math, unexcused absence rate yielded an AUC of 0.673 and total absence rate an AUC of 0.670, with no statistically significant difference between them ($p = 0.686$; last column in the second row of Figure 4B). Similarly, for ELA, unexcused and total absence rates yielded AUCs of 0.642 and 0.639, respectively, and again did not differ significantly ($p = 0.696$). In contrast, excused absence rate remained considerably less informative, with AUCs of 0.538 for math and 0.535 for ELA. These results suggest that, by adolescence, both total and unexcused absences carried equivalent and meaningful information about students' academic risk, while excused absences provided a weaker signal.

Differences between absence rates and corresponding day count measures were much smaller. As shown in Figure 4A, the rate- and day-based trajectories for each absence type closely tracked one another across grades. Nevertheless, absence rates generally yielded slightly higher AUCs than their corresponding day count measures. Even though these differences were small in magnitude, many of them were statistically significant, as seen in the results in the last three rows for Figure 4B. For example, for eighth grade math, total absence rate had an AUC of 0.670 compared with 0.661 for total days absent, a difference of 0.009 ($p < 0.001$). Similar patterns appeared for unexcused and excused absences. This pattern indicates that absence rates, though only marginally more predictive, may offer a more consistently diagnostic operationalization of absenteeism.

Cohort-specific robustness checks were substantively consistent with the pooled RQ2 findings (Appendix C Tables 2-4). Across all three cohorts, total and excused absence rates had higher AUCs in the early grades while total and unexcused absence measures provided much greater diagnostic accuracy compared to excused absences in the later grades. Total absence rates often yielded slightly higher AUCs compared to unexcused absence rates in the later grades, particularly for math, but the magnitude, direction, and statistical significance of these differences varied across grades and cohorts. Absence rates also generally yielded slightly higher AUCs than corresponding day count measures, although these differences were small and less consistently statistically significant in the smaller cohort-specific samples.

Taken together, ROC curve analyses revealed three consistent patterns in the diagnostic accuracy of absenteeism measures. First, total and unexcused absences became increasingly more informative than excused absences as students progressed through school, with total absences being the most consistently diagnostic throughout all grades. Second, diagnostic

accuracy for total and unexcused absences increased as the timing of the absenteeism measure approached the 8th grade outcome. Third, absence rates tended to outperform corresponding number-of-days measures, although these differences were small in magnitude. These findings support total absence rate as the most parsimonious and consistently informative early warning indicator among the six absenteeism measures examined.

RQ3. Variable Type: Identifying Empirical Thresholds with Youden's J

Given that total absence rate emerged as the most consistently diagnostic absenteeism indicator in RQ1 and RQ2, we next examined how it might be translated into a binary chronic absenteeism measure for early warning purposes. In this context, the threshold would represent the point at which a student would be flagged for potential concern or additional supports. We used Youden's J to identify the total absence rate cutoff that best balanced correctly identifying students who later scored in the *Not Meeting Expectations* category with avoiding unnecessary flags among students who did not. The results are shown in Figure 5, which plots the optimal total absence rate threshold for each grade, with labels translating each rate into the approximate equivalent number of days absent in a 180-day school year. Exact Youden's J values and thresholds are reported in Appendix D Table 1.

Three broad patterns emerged from Figure 5. First, optimal thresholds were highest in Pre-K and kindergarten, around 7-8% of enrolled school days, equivalent to approximately 13-15 days absent. Beginning in 1st grade, thresholds dropped and generally clustered around 3-6%. For example, for Grade 3 math, the maximum Youden's J was 0.221, achieved at an absence rate of 4.41%, corresponding to approximately 8 missed school days. This indicates that classifying students as chronically absent at roughly 8 missed days provided the best balance of sensitivity (correctly identifying students who later scored *Not Meeting Expectations*) and specificity

(correctly identifying students who do not) for predicting later math performance. Thresholds increased slightly in the later grades, reaching 6.16% for 8th grade math and 5.54% for 8th grade ELA, or approximately 11 and 10 days absent, respectively. Second, the estimated thresholds were similar across math and ELA within most grades. Third, and most notably, across all grade-subject combinations, the optimal threshold that best balanced sensitivity and specificity occurred before students reached the conventional 10% chronic absenteeism cutoff. All thresholds ranged from 3.32% to 8.49%, corresponding to approximately 6 to 15 days absent.

Together, these patterns suggest an early warning absenteeism threshold below the common 10% cutoff throughout grade and subject, with thresholds closer to 7-8% in Pre-K and kindergarten and 3-6% throughout the elementary and middle school grades. While implementing grade-specific chronic absenteeism cutoffs would be impractical for schools and confusing for policymakers and families, these findings do highlight how a single, fixed threshold could misclassify risk across developmental stages. Additionally, these findings highlight that if chronic absenteeism is intended to serve as an early warning signal for the need for additional supports, the current policy definition of 10% of school days (about 18 days per year) is likely too high. Our findings imply that lower thresholds could better identify students at risk of poor academic performance in a more timely way while balancing sensitivity and specificity.

The RQ3 findings were robust to alternative operationalizations of absenteeism, cohort-specific analyses, and changes in sample composition across grades. When we defined absenteeism using the total number of days absent rather than total absence rate, the resulting Youden's J thresholds showed the same general pattern: optimal cutoffs were consistently below the conventional 18-day benchmark, ranging from 6 to 16 days across grades and subjects

(Appendix D Table 2). We also re-estimated the Youden's J thresholds separately by cohort within each grade (Appendix D Table 3). Although the exact optimal threshold varied across cohorts, all cohort-specific thresholds from 1st through 8th grade remained below the conventional 10% benchmark. The two exceptions occurred in the earliest grades, where one Pre-K ELA estimate and one kindergarten ELA estimate exceeded 10%. In particular, for the grades most relevant to the ESSA transition, fifth grade thresholds ranged from 2.65% to 4.46% and sixth grade thresholds ranged from 4.18% to 6.09%, all below the 10% threshold. Finally, when we repeated the analyses using the common sample of students with complete attendance and achievement data across grades, all optimal thresholds remained below 10% (Appendix F Table 2). The exact thresholds differed somewhat, most notably in kindergarten, where the common sample Youden's J thresholds were substantially lower. However, although the precise cutoff in kindergarten appeared sensitive to sample composition, the broader conclusion that empirically derived early warning thresholds fall below the conventional chronic absenteeism benchmark was consistent across robustness checks.

At the same time, the values of Youden's J themselves were modest, ranging from 0.087 to 0.262 in the main results, with a similar range in the robustness checks listed above. In medical diagnostics, where ROC methods are most commonly applied, a higher Youden's J indicates better test discrimination, but there is not a threshold universally considered clinically useful. For instance, a study diagnosing respiratory complications in preterm infants reported Youden's J values ranging from 0.207 to 0.421 (Cao et al., 2023), while a study detecting a subtype of stroke reported values from 0.277 to 0.614 (You et al., 2019). Compared with these clinical benchmarks, the values observed here are lower, which is not necessarily unexpected: standardized test performance reflects not only attendance but also prior achievement,

instructional quality, socioeconomic conditions, and other factors. Just as effect sizes in education research are typically smaller than those in clinical medicine (Kraft, 2020), even modest predictive signals may still be practically meaningful when they help schools allocate resources and identify students who may otherwise be overlooked. However, more research is needed to benchmark Youden's J in absenteeism research against other educational samples and contexts to provide additional robustness.

These findings highlight both the promise and limitations of using absence thresholds for early warning purposes. On the one hand, Youden's J offers a data-driven method for identifying empirically grounded thresholds. On the other, the relatively low J values suggest that no single absence cutoff is likely to serve as a strong standalone predictor of academic risk, underscoring the importance of integrating attendance with other measures in EWSs.

RQ4: Timing of Measurement: Temporal Proximity.

Table 2 shows the top three absence predictors based on largest AUC and corresponding Youden's J thresholds (expressed in the unit of the absence predictor) for predicting math and ELA standardized test performance in each grade from 3rd to 7th. The first column of Table 2 designates the grade level of the standardized test outcome. The table is then split into results for math and ELA separately, with the top three predictors and their corresponding AUC, Youden's J, and Youden's J threshold. Detailed results on AUCs and DeLong test comparisons of the absence predictors can be found in Appendix E Tables 1-5, with robustness checks using the common sample in Appendix F.

The results in Table 2 provide evidence of temporal proximity strengthening predictive validity. Across both ELA and math, absences measured closer in time to the grade of the standardized test provided a more reliable diagnostic signal. For example, the best predictors of

3rd grade ELA test performance were 3rd grade unexcused absence rate, number of days unexcused, and total absence rate; the best predictors of 3rd grade math test performance were 3rd grade total absence rate and total number of days absent, followed by 2nd grade total absence rate. The best absence predictors were all either total absences or unexcused absences, and the AUCs of the best absence measures were around 0.60-0.65 across all grades. These findings were consistent with the 8th grade findings for RQ2 and suggests the timing of measurement matters: absences recorded in the same or immediately preceding school year are consistently more predictive of academic performance than those measured much earlier.

Interestingly, unexcused absences emerged more frequently as top predictors of ELA performance, whereas total absences were more often the strongest predictors of math performance. This divergence may reflect underlying differences in how attendance relates to the types of skills each subject requires. ELA performance may depend more heavily on sustained engagement with classroom discourse, reading, and writing, which are activities that are more sensitive to behavioral disengagement and better captured by unexcused absences. In contrast, mathematics tends to be more cumulative and content-driven, so total instructional time missed, regardless of the reason for absence, may be the more relevant indicator. This pattern aligns with prior research suggesting that cumulative absences have a larger negative effect on math achievement (Goodman, 2014).

The Youden's J thresholds varied across absence type, standardized test, and grade level but were generally consistent with those reported in RQ3, with Youden's J values around 0.20. Notably, all Youden's J thresholds, particularly those based on the total number of days absent, were lower than the current policy benchmarks of 18 days or 10% of the school year, with optimal thresholds clustering in the 3-6% or 5-11 day, range. This finding reinforces the 8th grade

results from RQ3 and provides additional evidence supporting a lower operational threshold for a chronic absenteeism early warning indicator.

Discussion

This study provides new evidence on how chronic absenteeism can be more rigorously measured. We show that measurement choices matter: excused and unexcused absences carry different weight as early warning signals across developmental stages, and total absence rate is the most consistently diagnostic operationalization of chronic absenteeism across all grades. Because the conventional 10% benchmark misses children at risk of poor academic performance in grades 3-8, lower thresholds should be considered if chronic absenteeism is to function as an effective early warning signal.

Our results differ in important ways from Henderson and Fantuzzo (2023), who concluded that "only unexcused absences provided diagnostic accuracy in predicting later achievement in the early elementary grades" (p. 259). In contrast, we find that unexcused absences meaningfully predict outcomes starting in the later grades, and that total absence measures retain better diagnostic accuracy throughout the Pre-K to 8th grade span. We find that total absences are especially predictive for math performance compared to excused and unexcused absences as well, consistent with evidence that cumulative instructional time loss has a larger negative effect on math achievement and likely reflects the sequential nature of math learning where new concepts build directly on previously mastered material (Goodman, 2014). The divergence in our results may reflect differences in the age span in our samples, in local attendance policies (e.g., what counts as an excused absence), or in the composition of student populations across districts. These differences underscore the importance of examining attendance measures across multiple contexts before drawing generalizable conclusions.

Additionally, our empirical thresholds derived using Youden's J suggest that the widely used benchmark of 10% is set too high if the goal of using chronic absenteeism as an early warning indicator is to identify students in need of support. At the same time, the exact optimal cutoff in our analyses varies across grades and outcomes, echoing Dougherty's (2018) finding that absenteeism EWSs may need to account for differing attendance patterns across grade levels. We therefore interpret our results as support for a lower, evidence-informed range—approximately 7-8% from Pre-K to Kindergarten and 3-6% in elementary and middle school grades—rather than a single threshold. We view replication across multiple districts and student populations as essential to assess generalizability of these findings.

Our findings also highlight the importance of temporal sensitivity. Absences recorded closer in time to standardized test administration were consistently more predictive of performance than those measured several years earlier, suggesting that attendance functions primarily as a proximal behavioral indicator. This conclusion aligns with emerging evidence emphasizing the predictive value of timely attendance indicators, particularly for EWSs (Wu & Weiland, 2026). This temporal pattern suggests that EWSs are more effective when they rely on recent data, and integrating this temporal dimension into risk monitoring algorithms could help schools respond more dynamically to emerging patterns of absenteeism.

Altogether, our findings have several potential implications for research, policy, and practice. For research, these findings point to a need for more attention to measurement in studies that examine chronic absenteeism. At a minimum, researchers should probe the sensitivity of their findings to plausible alternative constructs used in the literature and consider ROC-based methods for identifying empirically grounded thresholds (Bowers & Zhou, 2019; Dougherty, 2018; Henderson & Fantuzzo, 2023). For policy and practice, attention to lower

levels of absenteeism and developmental periods may be warranted when using absenteeism as an early warning indicator for attendance interventions.

As with all research, our study is not without its limitations. First, the study is situated in one large, urban district, and findings may not generalize to suburban or rural settings, or to states with different reporting conventions. Future work should replicate these analyses across multiple districts and post-pandemic cohorts.

Second, our ROC-based thresholds rely on Youden's J, which balances sensitivity (avoiding missed students who need help) and specificity (avoiding unnecessary intervention for students not at risk). Youden's J is most useful as a cost-neutral, balanced threshold for classification, offering a valuable "first-pass" screening cutoff before factoring in more specific consequences of misclassification. At the same time, it does not account for the relative costs and benefits of false positives and false negatives, which may be especially relevant in applied contexts such as school interventions. In practice, the cost of a false negative, or overlooking a student truly at risk, may be far greater than that of a false positive, especially if interventions are light-touch supports (e.g., attendance calls). In contrast, for higher-touch or resource-intensive interventions (e.g., targeted mentoring), schools may want to prioritize another statistic such as positive predictive value (PPV) to determine the absenteeism threshold and provide greater assurance that students flagged as at risk are truly those most in need. Future research should explicitly model these trade-offs.

Relatedly, adopting a lower absenteeism threshold naturally results in a larger proportion of students being flagged for intervention. As seen in Appendix G, applying the optimal Youden's J thresholds from RQ3 flagged between 24.8% and 48.7% of students, compared with 9.3% to 26.1% under the conventional 10% threshold. The purpose of the ROC analysis was to

identify the threshold that best distinguishes students who later do and do not meet eighth grade academic expectations; if relatively modest levels of absenteeism meaningfully differentiate students' subsequent academic risk, then lower thresholds may represent the appropriate statistical signal. However, identifying as many as one-third to nearly one-half of students may be difficult to operationalize, depending on the intensity and cost of the intervention. The lower optimal thresholds should therefore be interpreted as an initial screen to identify students for lower-cost interventions or targeted prevention, incorporating additional risk indicators to prioritize more intensive services. Future research should examine how empirically derived absenteeism thresholds can be integrated with intervention capacity, the differential costs of false positives and false negatives, and multistage resource-allocation strategies.

A third limitation is that our outcome measure was limited to standardized test performance. Although academic achievement is a central educational benchmark, test scores capture only one dimension of student success. This limitation is particularly important given growing evidence that "noncognitive" skills are associated with consequential longer-term outcomes such as high school graduation even above and beyond test scores (Cleveland & Scherer, 2025; Wu et al., 2025). As our results for RQ4 suggest, different types of absences may signal risk for different domains, and those predictive of standardized test performance may differ from those associated with socioemotional development or other "noncognitive" skills. Our results therefore capture only one facet of the broader insights that attendance patterns can provide. Overall, we echo Henderson & Fantuzzo's (2023) call for additional research in this space.

Finally, it is important to recognize that even the most precise thresholds for chronic absenteeism will have limited utility unless schools have the infrastructure to respond effectively.

For an indicator to move from diagnosis to treatment, districts must be equipped with resources to address the root causes of absences. This requires asking not only who is absent, but also why (Chang & Romero, 2008; Lenhoff & Singer, 2025). Without ways to identify the underlying causes and targeted supports that align with those causes, attendance indicators risk either perpetuating structural inequities or stigmatizing students flagged as at risk (Ginsburg et al., 2014). Thus, while empirically derived thresholds can sharpen the accuracy of EWSs, their effectiveness depends on being able to translate these early signals into meaningful interventions.

Conclusion

This study underscores the importance of treating chronic absenteeism not as a fixed construct but as a measurement choice with real consequences for research and policy. By showing that total absence rate provides a reliable indicator of future academic achievement level across grades, while empirically derived thresholds suggest the conventional 10% benchmark is too high, we demonstrate both the utility and the limitations of the current chronic absenteeism operationalization as an early warning signal. Our findings point to the need for more nuanced definitions of absenteeism and for future research that connects diagnostic accuracy to the educational supports and resources required to act on these signals effectively.

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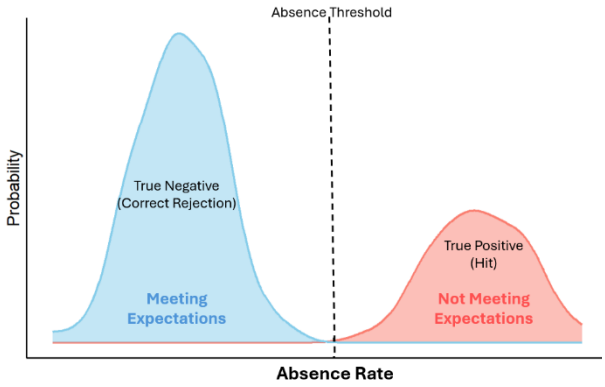
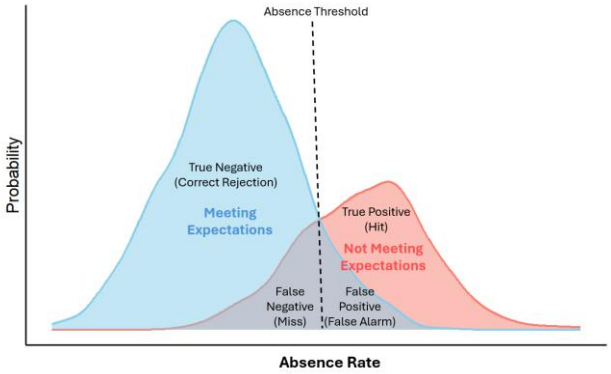
Figures & Tables

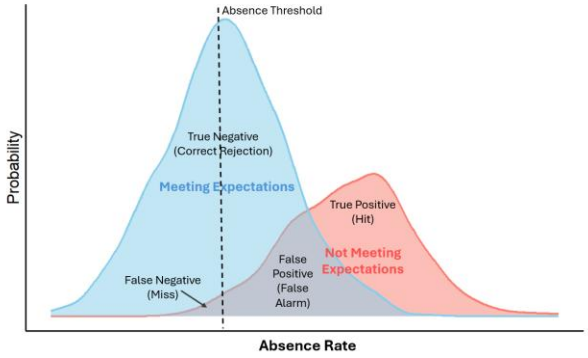
Figure 1. Hypothetical Probability of Occurrence Curves



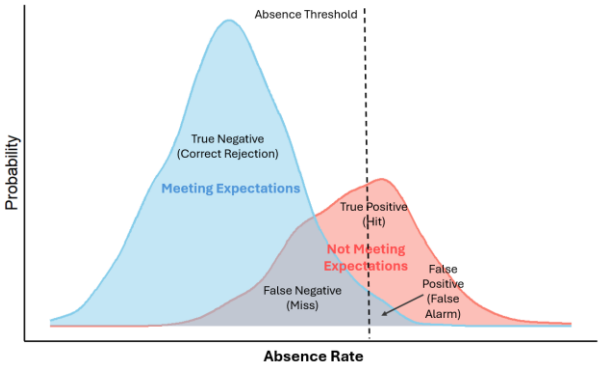
A. "Ideal" Distributions for ROC Curves



B. Actual Distributions Likely Overlap



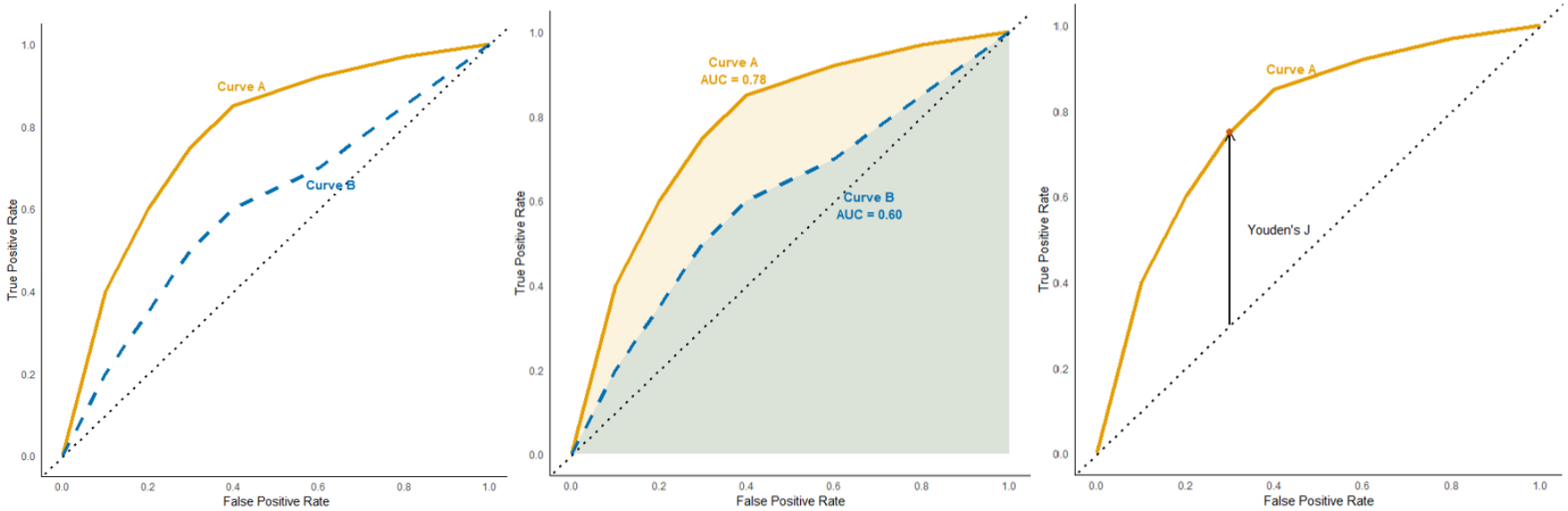
C. Absence Threshold with High True Positives and False Positives



D. Absence Threshold with Lower False Positives but Higher False Negatives

Note: In Figure 1A, we illustrate the "ideal" ROC scenario, where the distributions of students who meet expectations (in blue in Figure 1A) and those who do not meet expectations (in red in Figure 1A) would be entirely distinct on the absence rate spectrum. In this case, a single threshold on the absence rate (dotted line in Figure 1A) would perfectly separate the two groups, enabling a flawless classification: All students with an absence rate lower than the absence threshold would be correctly classified as *Meeting Expectations*, and all the students with an absence rate higher than the absence threshold would be correctly classified as *Not Meeting Expectations*. However, in reality, the actual distribution of these two groups likely overlap, as shown in Figure 1B. Notice that because the distributions overlap, there will inevitably be both false negative and false positives no matter what absence threshold we hypothetically choose. For example, setting a low threshold (Figure 1C) captures most students who are likely to not meet expectations, ensuring few students at risk of failing slip through the cracks, but also increases the number of false positives, which can lead to unnecessary interventions and stigmatization. In contrast, a high threshold (Figure 1D) minimizes false positives, meaning fewer students are incorrectly flagged. However, the lower false positive rate comes at the cost of more false negatives, potentially overlooking students who would benefit from additional supports.

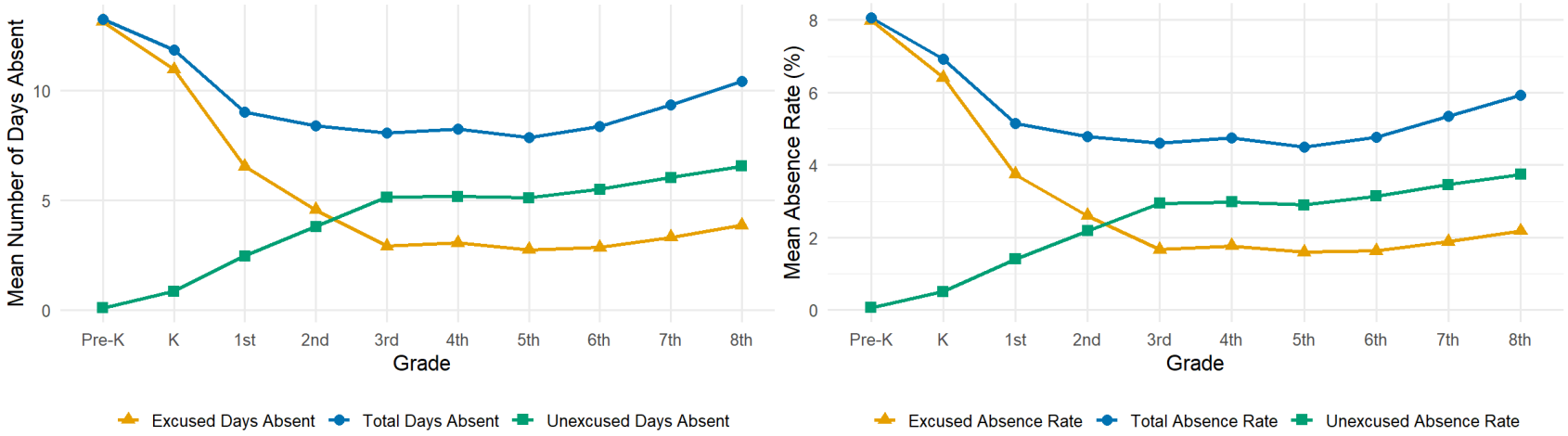
Figure 2. Hypothetical ROC Curves, AUCs, & Youden's J



A. ROC Curves **B. Area Under the ROC Curve (AUC)** **C. Youden's J Point on Curve A**

Note: In Figure 2A, each point along Curves A and B represents a possible classification threshold, such as a particular absence level. At very high thresholds (bottom-left), only the most extreme cases are flagged, yielding low rates of both true positives and false positives. At very low thresholds (top-right), nearly all students are flagged, producing high true positive rates but also high false positive rates. Curve A (yellow-orange solid line) represents a stronger classifier because it rises more quickly toward the top-left corner, capturing more true positives with fewer false alarms. Curve B (blue dotted line) lies closer to the diagonal line, where TPR = FPR, which represents random guessing (black dotted line). Figure 2B illustrates the area under each ROC curve (AUC), which summarizes diagnostic accuracy across all possible thresholds; Curve A has a larger AUC than Curve B, indicating stronger overall diagnostic accuracy. Figure 2C illustrates Youden's J for Curve A as the point farthest away from the random guessing diagonal along the True Positive Rate axis (i.e., the maximum vertical distance between the ROC curve and the random guessing diagonal). The corresponding red point identifies the threshold that maximizes the balance between sensitivity and specificity.

Figure 3. Absenteeism Patterns by Grade



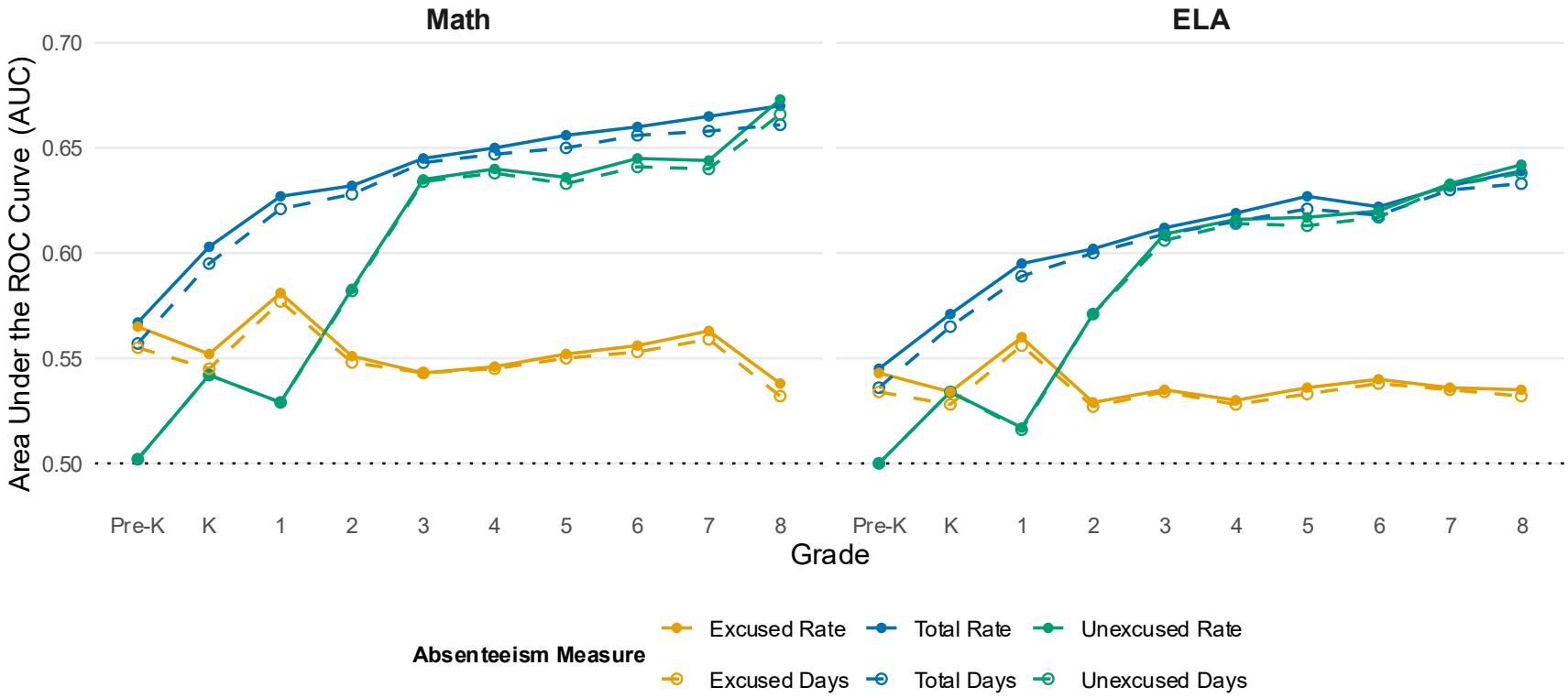
A. Number of Days Absent

B. Absence Rate

Note: $N = 6{,}226$ for Pre-K, $N = 8{,}014$ for Kindergarten, $N = 7{,}939$ for 1st grade, $N = 7{,}819$ for 2nd grade, $N = 7{,}743$ for 3rd grade, $N = 7{,}653$ for 4th grade, $N = 7{,}607$ for 5th grade, $N = 7{,}479$ for 6th grade, $N = 7{,}439$ for 7th grade, $N = 7{,}364$ for 8th grade.

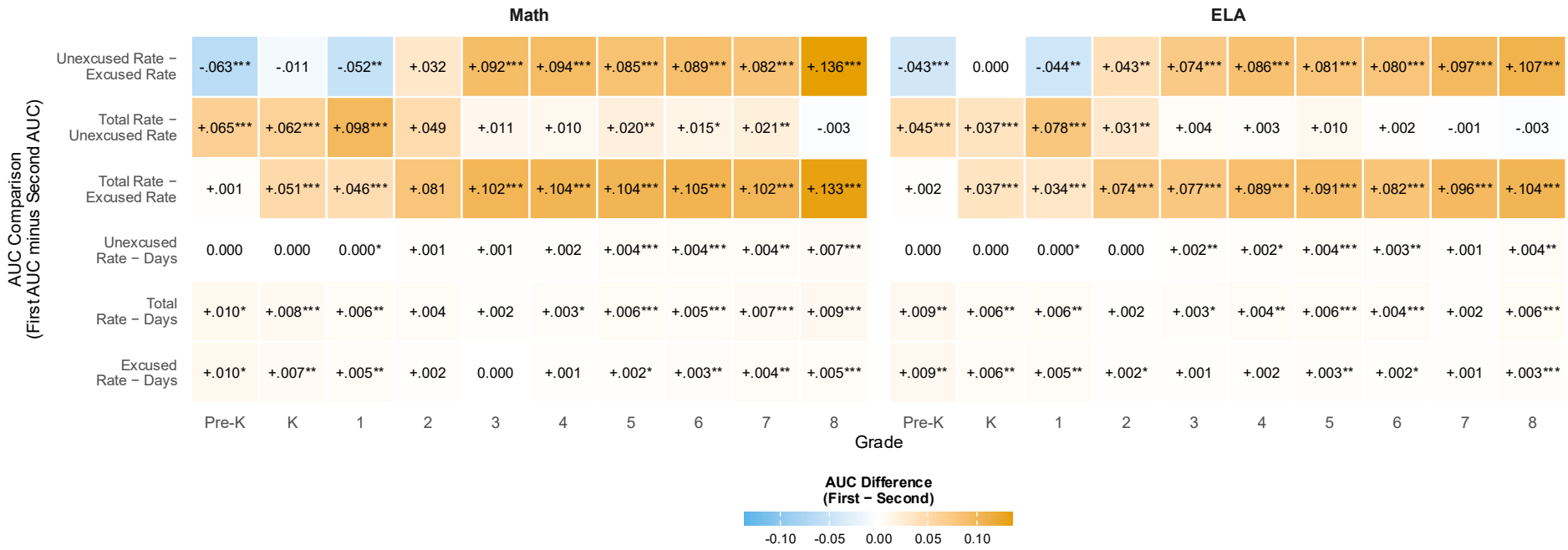
Figure 4. Diagnostic Accuracy of Absenteeism Measures for Predicting Eighth-Grade Math and ELA Outcomes

A. AUC by Grade and Absenteeism Measure



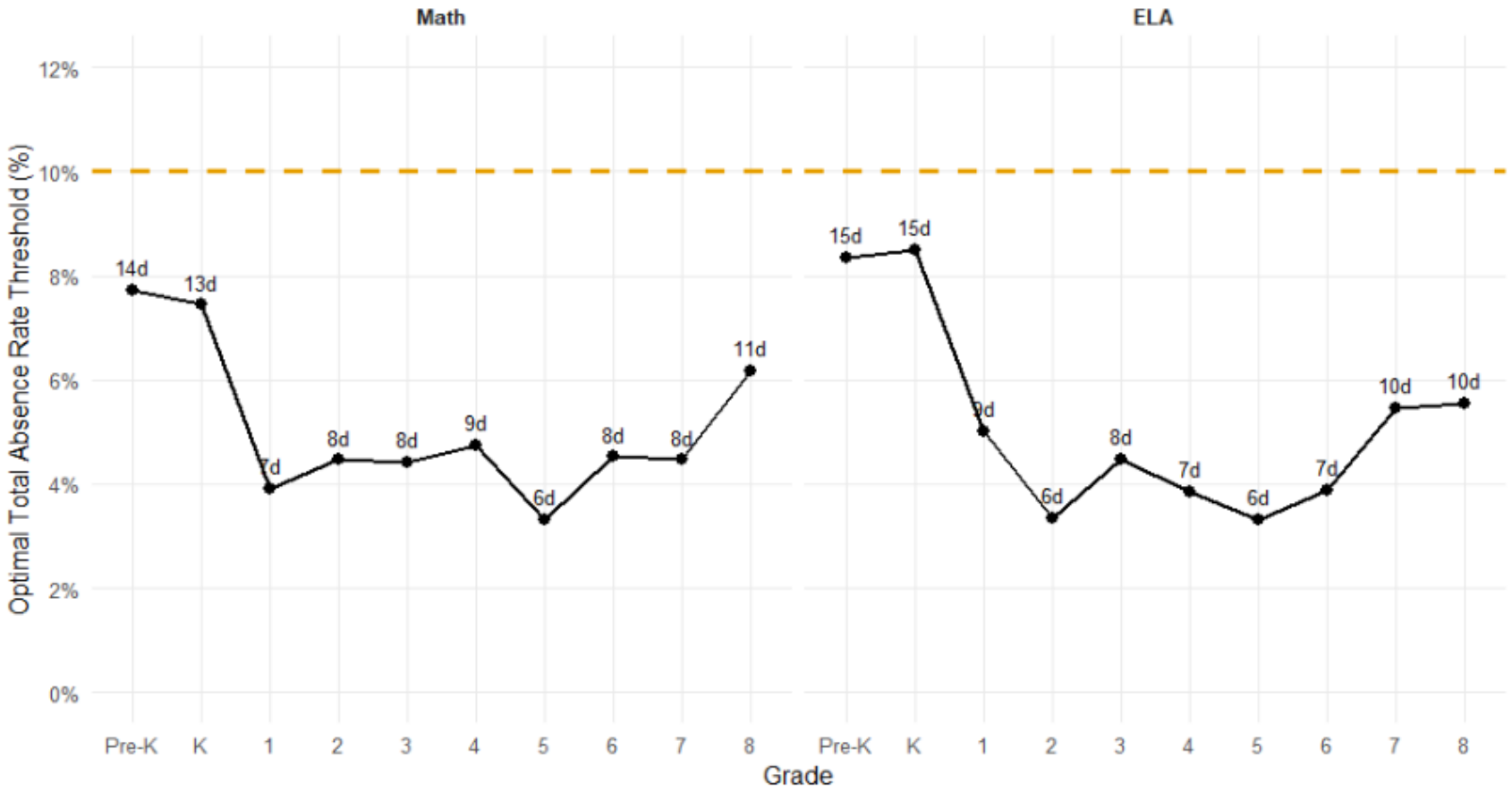
Note: Lines show the area under the ROC curve (AUC) for six absenteeism measures: excused, total, and unexcused absences, each operationalized as either number of days absent or absence rate, measured from Pre-K through eighth grade, and used to predict eighth grade math and ELA performance. Higher AUC values indicate greater diagnostic accuracy in distinguishing students who scored in the *Not Meeting Expectations* category from those who did not. The dotted horizontal line at AUC = 0.50 on the x-axis represents random guessing.

B. Pairwise DeLong Comparisons of AUCs



Note: Cells report pairwise differences in AUC between absenteeism measures, calculated as the AUC of the first measure listed minus the AUC of the second. Positive values indicate greater diagnostic accuracy for the first measure, whereas negative values indicate greater diagnostic accuracy for the second. Statistical significance was assessed using paired DeLong tests. Cell shading represents the magnitude and direction of the AUC difference, with values closer to zero indicating more similar diagnostic accuracy. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Figure 5. Optimal Total Absence Rate Thresholds Based on Youden's J



Note: Points indicate the total absence-rate threshold that maximized Youden's J for predicting whether students scored in the *Not Meeting Expectations* category on the 8th grade standardized tests. Labels above each point show the approximate equivalent number of days ("d") absent in a 180-day school year. The dashed yellow line marks the conventional chronic absenteeism threshold of 10% of enrolled school days.

Table 1. Demographic Characteristics of Analytic Samples with Standardized Test Scores by Grade

	8th grade	7th grade	6th grade	5th grade	4th grade	3rd grade	All BPS Pre-K Applicants 2007-2009
Female (%)	48.37	48.46	48.10	47.98	47.80	48.73	47.62
Race/Ethnicity (%)							
Hispanic	44.72	44.64	44.67	44.64	44.71	43.61	43.98
Black	28.52	28.59	28.67	28.48	28.57	28.50	28.39
White	15.26	15.25	15.35	15.52	15.42	15.97	16.56
Asian	8.65	8.67	8.45	8.43	8.38	8.89	8.11
Mixed/Other	2.86	2.85	2.87	2.92	2.93	3.02	2.97
Home language (%)							
English	49.30	49.29	49.41	49.46	49.54	49.93	50.64
Spanish	29.67	29.56	29.71	29.86	29.85	28.82	28.39
Other	21.03	21.15	20.88	20.67	20.61	21.25	20.70
Country of origin (%)							
USA	93.98	93.84	93.92	93.98	93.84	93.92	95.48
Other	6.02	6.16	6.08	6.02	6.16	6.08	6.52
Eligible for free/ reduced price lunch (%)	53.92	57.45	60.97	66.41	69.94	69.10	68.72
N students	7,145	7,187	7,160	7,148	7,343	6,813	8,891

Table 2. Top 3 Absence Measures and Optimal Thresholds for Predicting Math and ELA Standardized Test Performance in Grades 3-7

Standardized Test Grade	Math				ELA			
	Top Absence Predictors	AUC	Youden's J	Youden's J Threshold	Top Absence Predictors	AUC	Youden's J	Youden's J Threshold
Grade 3	Grade 3 Total Absence Rate	0.658	0.246	4.89%	Grade 3 Unexcused Absence Rate	0.619	0.179	1.68%
Grade 3	Grade 3 Total Days Absent	0.654	0.239	9 days	Grade 3 Unexcused Absence Days	0.618	0.178	5 days
Grade 3	Grade 2 Total Absence Rate	0.642	0.210	6.02%	Grade 3 Total Absence Rate	0.614	0.170	5.80%
Grade 4	Grade 4 Total Absence Rate	0.672	0.251	4.51%	Grade 4 Unexcused Absence Rate	0.642	0.220	2.62%
Grade 4	Grade 4 Total Days Absent	0.667	0.243	7 days	Grade 4 Unexcused Absence Days	0.639	0.216	5 days
Grade 4	Grade 4 Unexcused Absence Rate	0.658	0.250	2.23%	Grade 4 Total Absence Rate	0.629	0.189	3.68%
Grade 5	Grade 5 Total Absence Rate	0.644	0.208	3.86%	Grade 5 Unexcused Absence Rate	0.630	0.204	2.25%
Grade 5	Grade 4 Total Absence Rate	0.641	0.207	4.51%	Grade 5 Unexcused Absence Days	0.627	0.202	5 days
Grade 5	Grade 5 Total Days Absent	0.637	0.196	7 days	Grade 4 Unexcused Absence Rate	0.624	0.181	2.77%
Grade 6	Grade 5 Total Absence Rate	0.644	0.209	3.34%	Grade 5 Total Absence Rate	0.616	0.165	3.86%
Grade 6	Grade 5 Total Days Absent	0.636	0.198	5 days	Grade 4 Total Absence Rate	0.615	0.182	5.24%
Grade 6	Grade 4 Total Absence Rate	0.635	0.203	5.24%	Grade 6 Total Absence Rate	0.612	0.173	5.94%
Grade 7	Grade 7 Total Absence Rate	0.644	0.212	4.46%	Grade 7 Total Absence Rate	0.649	0.228	5.94%
Grade 7	Grade 7 Total Days Absent	0.638	0.204	9 days	Grade 7 Unexcused Absence Days	0.645	0.223	11 days
Grade 7	Grade 6 Total Absence Rate	0.635	0.207	3.88%	Grade 7 Unexcused Absence Rate	0.643	0.223	4.43%

Note: This table reports the top 3 absence predictors for each grade's standardized test outcome based on largest AUC. Youden's J statistics and the corresponding optimal absenteeism cutoffs are for predicting each grade's math and ELA standardized testing achievement level of *Not Meeting Expectations*. Youden's J represents the maximum vertical distance between the ROC curve and the random chance line based on the absence predictor. The Youden's J Threshold column is expressed in the units of the predictor.

Appendix

Appendix A: Cohort Map

Table 1. Grade and Year Progression for Each Cohort in Sample

Cohort	School Year											
	07-08	**08-09**	**09-10**	**10-11**	**11-12**	**12-13**	**13-14**	**14-15**	**15-16**	**16-17**	**17-18**	**18-19**
2007	Pre-K	K	1	2	3	4	5	6	7	8		
2008		Pre-K	K	1	2	3	4	5	6	7	8	
2009			Pre-K	K	1	2	3	4	5	6	7	8

Note: The vertical dashed line between the 2014-15 and 2015-16 school years marks the passage of the Every Student Succeeds Act (ESSA), which required states to incorporate at least one indicator of school quality or student success into their accountability systems. Massachusetts subsequently adopted chronic absenteeism as its statewide attendance indicator, officially defining chronic absenteeism as missing at least 10% of enrolled school days regardless of whether absences were excused or unexcused.

Appendix B: Additional Descriptive Statistics for RQ1

Table 1. Descriptive Statistics for Student Absenteeism by Grade and Absence Type

Grade	Absence Type	Days Absent, M (SD)	Absence Rate, M% (SD)	N
Pre-K	Total	13.25 (13.25)	8.06 (8.29)	6,226
	Excused	13.15 (13.29)	7.99 (8.31)	6,226
	Unexcused	0.10 (1.02)	0.06 (0.64)	6,226
Kindergarten	Total	11.85 (11.72)	6.92 (6.91)	8,014
	Excused	10.97 (11.31)	6.41 (6.66)	8,014
	Unexcused	0.88 (4.67)	0.51 (2.77)	8,014
1st Grade	Total	9.02 (8.61)	5.14 (4.95)	7,939
	Excused	6.55 (7.56)	3.74 (4.35)	7,939
	Unexcused	2.47 (5.86)	1.40 (3.36)	7,939
2nd Grade	Total	8.40 (8.08)	4.78 (4.73)	7,819
	Excused	4.58 (6.30)	2.60 (3.65)	7,819
	Unexcused	3.82 (6.27)	2.18 (3.69)	7,819
3rd Grade	Total	8.08 (8.17)	4.61 (4.85)	7,743
	Excused	2.93 (4.76)	1.67 (2.75)	7,742
	Unexcused	5.16 (6.68)	2.94 (4.02)	7,742
4th Grade	Total	8.26 (8.72)	4.75 (5.28)	7,653
	Excused	3.08 (5.98)	1.77 (3.49)	7,653
	Unexcused	5.18 (6.31)	2.98 (3.94)	7,653
5th Grade	Total	7.88 (8.90)	4.49 (5.23)	7,607
	Excused	2.76 (5.31)	1.59 (3.24)	7,607
	Unexcused	5.12 (6.87)	2.90 (3.96)	7,607
6th Grade	Total	8.37 (9.06)	4.76 (5.31)	7,479
	Excused	2.86 (4.82)	1.63 (2.83)	7,479
	Unexcused	5.51 (7.34)	3.14 (4.32)	7,479
7th Grade	Total	9.37 (10.17)	5.35 (6.04)	7,439
	Excused	3.33 (5.61)	1.89 (3.27)	7,439
	Unexcused	6.04 (8.07)	3.46 (4.87)	7,439
8th Grade	Total	10.44 (11.37)	5.93 (6.62)	7,364
	Excused	3.87 (6.40)	2.18 (3.73)	7,364
	Unexcused	6.57 (8.96)	3.74 (5.21)	7,364

Note. M = mean; M% = mean percentage; SD = standard deviation. N represents the number of students with non-missing attendance data for each grade and absence type.

Appendix C: Additional Details and Robustness Checks for RQ2

Table 1. DeLong Test Comparisons of AUCs for Various Absenteeism Measures in Predicting 8th Grade Math and ELA Outcomes

		8th Grade Math			8th Grade ELA		
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**
Pre-K	Days excused vs. Excused rate	0.555	0.565	-0.010*	0.534	0.543	-0.009**
	Days total vs. Total rate	0.557	0.567	-0.010*	0.536	0.545	-0.009**
	Days unexcused vs. Unexcused rate	0.502	0.502	0.000	0.500	0.500	0.000
	Total rate vs. Excused rate	0.567	0.565	0.001	0.545	0.543	0.002
	Total rate vs. Unexcused rate	0.567	0.502	0.065***	0.545	0.500	0.045***
	Unexcused rate vs. Excused rate	0.502	0.565	-0.063***	0.500	0.543	-0.043***
Kindergarten	Days excused vs. Excused rate	0.545	0.552	-0.007**	0.528	0.534	-0.006**
	Days total vs. Total rate	0.595	0.603	-0.008***	0.565	0.571	-0.006**
	Days unexcused vs. Unexcused rate	0.542	0.542	0.000	0.534	0.534	0.000
	Total rate vs. Excused rate	0.603	0.552	0.051***	0.571	0.534	0.037***
	Total rate vs. Unexcused rate	0.603	0.542	0.062***	0.571	0.534	0.037***
	Unexcused rate vs. Excused rate	0.542	0.552	-0.011	0.534	0.534	0.000
1st Grade	Days excused vs. Excused rate	0.577	0.581	-0.005**	0.556	0.560	-0.005**
	Days total vs. Total rate	0.621	0.627	-0.006**	0.589	0.595	-0.006**
	Days unexcused vs. Unexcused rate	0.529	0.529	0.000*	0.516	0.517	0.000*
	Total rate vs. Excused rate	0.627	0.581	0.046***	0.595	0.560	0.034***
	Total rate vs. Unexcused rate	0.627	0.529	0.098***	0.595	0.517	0.078***
	Unexcused rate vs. Excused rate	0.529	0.581	-0.052**	0.517	0.560	-0.044**
2nd Grade	Days excused vs. Excused rate	0.548	0.551	-0.002	0.527	0.529	-0.002*
	Days total vs. Total rate	0.628	0.632	-0.004	0.600	0.602	-0.002
	Days unexcused vs. Unexcused rate	0.582	0.583	-0.001	0.571	0.571	0.000
	Total rate vs. Excused rate	0.632	0.551	0.081	0.602	0.529	0.074***
	Total rate vs. Unexcused rate	0.632	0.583	0.049	0.602	0.571	0.031**
	Unexcused rate vs. Excused rate	0.583	0.551	0.032	0.571	0.529	0.043**
3rd Grade	Days excused vs. Excused rate	0.543	0.543	0.000	0.534	0.535	-0.001
	Days total vs. Total rate	0.643	0.645	-0.002	0.609	0.612	-0.003*
	Days unexcused vs. Unexcused rate	0.634	0.635	-0.001	0.606	0.609	-0.002**
	Total rate vs. Excused rate	0.646	0.543	0.102***	0.612	0.535	0.077***

	Total rate vs. Unexcused rate	0.646	0.635	0.011	0.612	0.609	0.004
	Unexcused rate vs. Excused rate	0.635	0.543	0.092***	0.609	0.535	0.074***
4th Grade	Days excused vs. Excused rate	0.545	0.546	-0.001	0.528	0.530	-0.002
	Days total vs. Total rate	0.647	0.650	-0.003*	0.615	0.619	-0.004**
	Days unexcused vs. Unexcused rate	0.638	0.640	-0.002	0.614	0.616	-0.002*
	Total rate vs. Excused rate	0.650	0.546	0.104***	0.619	0.530	0.089***
	Total rate vs. Unexcused rate	0.650	0.640	0.010	0.619	0.616	0.003
	Unexcused rate vs. Excused rate	0.640	0.546	0.094***	0.616	0.530	0.086***
5th Grade	Days excused vs. Excused rate	0.550	0.552	-0.002*	0.533	0.536	-0.003**
	Days total vs. Total rate	0.650	0.656	-0.006***	0.621	0.627	-0.006***
	Days unexcused vs. Unexcused rate	0.633	0.636	-0.004***	0.613	0.617	-0.004***
	Total rate vs. Excused rate	0.656	0.552	0.104***	0.627	0.536	0.091***
	Total rate vs. Unexcused rate	0.656	0.636	0.020**	0.627	0.617	0.010
	Unexcused rate vs. Excused rate	0.636	0.552	0.085***	0.617	0.536	0.081***
6th Grade	Days excused vs. Excused rate	0.553	0.556	-0.003**	0.538	0.540	-0.002*
	Days total vs. Total rate	0.656	0.660	-0.005***	0.618	0.622	-0.004***
	Days unexcused vs. Unexcused rate	0.641	0.645	-0.004***	0.617	0.620	-0.003**
	Total rate vs. Excused rate	0.660	0.556	0.105***	0.622	0.540	0.082***
	Total rate vs. Unexcused rate	0.660	0.645	0.015*	0.622	0.620	0.002
	Unexcused rate vs. Excused rate	0.645	0.556	0.089***	0.620	0.540	0.080***
7th Grade	Days excused vs. Excused rate	0.559	0.563	-0.004**	0.535	0.536	-0.001
	Days total vs. Total rate	0.658	0.665	-0.007***	0.630	0.632	-0.002
	Days unexcused vs. Unexcused rate	0.640	0.644	-0.004**	0.632	0.633	-0.001
	Total rate vs. Excused rate	0.665	0.563	0.102***	0.632	0.536	0.096***
	Total rate vs. Unexcused rate	0.665	0.644	0.021**	0.632	0.633	-0.001
	Unexcused rate vs. Excused rate	0.644	0.563	0.082***	0.633	0.536	0.097***
8th Grade	Days excused vs. Excused rate	0.532	0.538	-0.005***	0.532	0.535	-0.003***
	Days total vs. Total rate	0.661	0.670	-0.009***	0.633	0.639	-0.006***
	Days unexcused vs. Unexcused rate	0.666	0.673	-0.007***	0.638	0.642	-0.004**
	Total rate vs. Excused rate	0.670	0.538	0.133***	0.639	0.535	0.104***
	Total rate vs. Unexcused rate	0.670	0.673	-0.003	0.639	0.642	-0.003
	Unexcused rate vs. Excused rate	0.673	0.538	0.136***	0.642	0.535	0.107***

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant *p*-values suggest that one measure provides a significantly stronger signal for identifying students at risk on 8th grade math or ELA performance. *$p < 0.05$, **$p < 0.01$, ***$p < 0.00$

Table 2. DeLong Comparisons of Absenteeism Measures, 2007 Cohort

		8th Grade Math			8th Grade ELA		
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**
Pre-K	Days excused vs. Excused rate	0.516	0.524	-0.008	0.504	0.513	-0.009
	Days total vs. Total rate	0.516	0.524	-0.008	0.504	0.513	-0.009
	Days unexcused vs. Unexcused rate	0.500	0.500	0.000	0.500	0.500	0.000
	Total rate vs. Excused rate	0.524	0.524	0.000	0.513	0.513	0.000
	Total rate vs. Unexcused rate	0.524	0.500	0.024	0.513	0.500	0.013
	Unexcused rate vs. Excused rate	0.500	0.524	-0.024	0.500	0.513	-0.013
Kindergarten	Days excused vs. Excused rate	0.589	0.599	-0.009	0.555	0.567	-0.012*
	Days total vs. Total rate	0.612	0.622	-0.010*	0.568	0.580	-0.012*
	Days unexcused vs. Unexcused rate	0.508	0.508	0.000	0.504	0.504	0.000
	Total rate vs. Excused rate	0.622	0.599	0.023*	0.580	0.567	0.013
	Total rate vs. Unexcused rate	0.622	0.508	0.114***	0.580	0.504	0.076***
	Unexcused rate vs. Excused rate	0.508	0.599	-0.091***	0.504	0.567	-0.062**
1st Grade	Days excused vs. Excused rate	0.603	0.608	-0.005	0.566	0.571	-0.005
	Days total vs. Total rate	0.608	0.615	-0.006	0.581	0.587	-0.006*
	Days unexcused vs. Unexcused rate	0.498	0.498	0.000	0.507	0.507	0.000
	Total rate vs. Excused rate	0.615	0.608	0.006	0.587	0.571	0.016
	Total rate vs. Unexcused rate	0.615	0.498	0.117***	0.587	0.507	0.080***
	Unexcused rate vs. Excused rate	0.498	0.608	-0.110***	0.507	0.571	-0.065**
2nd Grade	Days excused vs. Excused rate	0.570	0.572	-0.002	0.558	0.561	-0.003
	Days total vs. Total rate	0.578	0.580	-0.002	0.561	0.563	-0.002
	Days unexcused vs. Unexcused rate	0.502	0.502	0.000	0.500	0.500	0.000
	Total rate vs. Excused rate	0.580	0.572	0.007	0.563	0.561	0.002
	Total rate vs. Unexcused rate	0.580	0.502	0.078***	0.563	0.500	0.064***
	Unexcused rate vs. Excused rate	0.502	0.572	-0.071**	0.500	0.561	-0.061**
3rd Grade	Days excused vs. Excused rate	0.522	0.520	0.002	0.519	0.519	0.000
	Days total vs. Total rate	0.628	0.630	-0.002	0.607	0.610	-0.003
	Days unexcused vs. Unexcused rate	0.628	0.629	-0.002	0.617	0.619	-0.003
	Total rate vs. Excused rate	0.630	0.520	0.110***	0.610	0.519	0.092***
	Total rate vs. Unexcused rate	0.630	0.629	0.000	0.610	0.619	-0.009
	Unexcused rate vs. Excused rate	0.629	0.520	0.110***	0.619	0.519	0.101***
4th Grade	Days excused vs. Excused rate	0.528	0.530	-0.001	0.516	0.517	-0.001
	Days total vs. Total rate	0.642	0.645	-0.002	0.614	0.615	-0.001
	Days unexcused vs. Unexcused rate	0.633	0.635	-0.002	0.618	0.619	-0.001
	Total rate vs. Excused rate	0.645	0.530	0.115***	0.615	0.517	0.098***
	Total rate vs. Unexcused rate	0.645	0.635	0.010	0.615	0.619	-0.004
	Unexcused rate vs. Excused rate	0.635	0.530	0.105***	0.619	0.517	0.102***
5th Grade	Days excused vs. Excused rate	0.570	0.569	0.001	0.550	0.552	-0.002
	Days total vs. Total rate	0.653	0.656	-0.003	0.636	0.639	-0.003
	Days unexcused vs. Unexcused rate	0.610	0.613	-0.002*	0.619	0.622	-0.003
	Total rate vs. Excused rate	0.656	0.569	0.087***	0.639	0.552	0.087***
	Total rate vs. Unexcused rate	0.656	0.613	0.043**	0.639	0.622	0.017
	Unexcused rate vs. Excused rate	0.613	0.569	0.044	0.622	0.552	0.070**

		8th Grade Math			8th Grade ELA		
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**
6th Grade	Days excused vs. Excused rate	0.532	0.534	-0.002	0.531	0.533	-0.002
	Days total vs. Total rate	0.656	0.660	-0.004	0.624	0.629	-0.006*
	Days unexcused vs. Unexcused rate	0.636	0.639	-0.003	0.629	0.633	-0.004
	Total rate vs. Excused rate	0.660	0.534	0.126***	0.629	0.533	0.097***
	Total rate vs. Unexcused rate	0.660	0.639	0.021	0.629	0.633	-0.003
	Unexcused rate vs. Excused rate	0.639	0.534	0.105***	0.633	0.533	0.100***
7th Grade	Days excused vs. Excused rate	0.582	0.585	-0.002	0.549	0.548	0.000
	Days total vs. Total rate	0.670	0.675	-0.005	0.632	0.635	-0.004
	Days unexcused vs. Unexcused rate	0.629	0.632	-0.003	0.621	0.625	-0.004
	Total rate vs. Excused rate	0.675	0.585	0.090***	0.635	0.548	0.087***
	Total rate vs. Unexcused rate	0.675	0.632	0.043**	0.635	0.625	0.010
	Unexcused rate vs. Excused rate	0.632	0.585	0.047	0.625	0.548	0.077**
8th Grade	Days excused vs. Excused rate	0.545	0.548	-0.003	0.536	0.535	0.001
	Days total vs. Total rate	0.662	0.669	-0.008*	0.624	0.630	-0.006
	Days unexcused vs. Unexcused rate	0.665	0.671	-0.006	0.626	0.629	-0.003
	Total rate vs. Excused rate	0.669	0.548	0.121***	0.630	0.535	0.095***
	Total rate vs. Unexcused rate	0.669	0.671	-0.001	0.630	0.629	0.001
	Unexcused rate vs. Excused rate	0.671	0.548	0.123***	0.629	0.535	0.094***

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant *p*-values suggest that one measure provides a significantly stronger signal for identifying students at risk on 8th grade math or ELA performance. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 3. DeLong Comparisons of Absenteeism Measures, 2008 Cohort

		8th Grade Math			8th Grade ELA		
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**
Pre-K	Days excused vs. Excused rate	0.568	0.583	-0.016*	0.542	0.553	-0.011
	Days total vs. Total rate	0.566	0.581	-0.015	0.542	0.553	-0.011
	Days unexcused vs. Unexcused rate	0.495	0.495	0.000	0.495	0.495	0.000
	Total rate vs. Excused rate	0.581	0.583	-0.002	0.553	0.553	0.001
	Total rate vs. Unexcused rate	0.581	0.495	0.086***	0.553	0.495	0.058**
	Unexcused rate vs. Excused rate	0.495	0.583	-0.088***	0.495	0.553	-0.058**
Kindergarten	Days excused vs. Excused rate	0.594	0.601	-0.007	0.551	0.556	-0.005
	Days total vs. Total rate	0.592	0.600	-0.008*	0.552	0.558	-0.006
	Days unexcused vs. Unexcused rate	0.492	0.492	0.000	0.496	0.496	0.000
	Total rate vs. Excused rate	0.600	0.601	-0.001	0.558	0.556	0.002
	Total rate vs. Unexcused rate	0.600	0.492	0.108***	0.558	0.496	0.062***
	Unexcused rate vs. Excused rate	0.492	0.601	-0.109***	0.496	0.556	-0.060**
1st Grade	Days excused vs. Excused rate	0.639	0.644	-0.005	0.593	0.596	-0.003
	Days total vs. Total rate	0.638	0.644	-0.006	0.589	0.592	-0.003
	Days unexcused vs. Unexcused rate	0.494	0.494	0.000	0.493	0.493	0.000
	Total rate vs. Excused rate	0.644	0.644	0.000	0.592	0.596	-0.004
	Total rate vs. Unexcused rate	0.644	0.494	0.150***	0.592	0.493	0.098***
	Unexcused rate vs. Excused rate	0.494	0.644	-0.150***	0.493	0.596	-0.103***
2nd Grade	Days excused vs. Excused rate	0.573	0.578	-0.005**	0.542	0.547	-0.005*
	Days total vs. Total rate	0.655	0.659	-0.004*	0.617	0.619	-0.003
	Days unexcused vs. Unexcused rate	0.621	0.625	-0.004*	0.608	0.609	-0.001
	Total rate vs. Excused rate	0.659	0.578	0.081***	0.619	0.547	0.073***
	Total rate vs. Unexcused rate	0.659	0.625	0.035*	0.619	0.609	0.010
	Unexcused rate vs. Excused rate	0.625	0.578	0.046	0.609	0.547	0.062*
3rd Grade	Days excused vs. Excused rate	0.568	0.572	-0.004	0.537	0.540	-0.003
	Days total vs. Total rate	0.648	0.651	-0.003	0.600	0.601	-0.001
	Days unexcused vs. Unexcused rate	0.620	0.620	0.000	0.585	0.586	-0.001
	Total rate vs. Excused rate	0.653	0.572	0.081***	0.601	0.540	0.061***
	Total rate vs. Unexcused rate	0.653	0.620	0.033*	0.601	0.586	0.014
	Unexcused rate vs. Excused rate	0.620	0.572	0.048	0.586	0.540	0.046
4th Grade	Days excused vs. Excused rate	0.566	0.568	-0.002	0.549	0.552	-0.003
	Days total vs. Total rate	0.682	0.684	-0.002	0.629	0.630	-0.001
	Days unexcused vs. Unexcused rate	0.657	0.658	0.000	0.616	0.617	-0.001
	Total rate vs. Excused rate	0.684	0.568	0.116***	0.630	0.552	0.078***
	Total rate vs. Unexcused rate	0.684	0.658	0.026	0.630	0.617	0.013
	Unexcused rate vs. Excused rate	0.658	0.568	0.090***	0.617	0.552	0.065**
5th Grade	Days excused vs. Excused rate	0.527	0.533	-0.006**	0.513	0.518	-0.005**
	Days total vs. Total rate	0.646	0.655	-0.009*	0.615	0.622	-0.007*
	Days unexcused vs. Unexcused rate	0.651	0.656	-0.006*	0.619	0.622	-0.004
	Total rate vs. Excused rate	0.655	0.533	0.122***	0.622	0.518	0.103***
	Total rate vs. Unexcused rate	0.655	0.656	-0.001	0.622	0.622	-0.001
	Unexcused rate vs. Excused rate	0.656	0.533	0.124***	0.622	0.518	0.104***

		8th Grade Math			8th Grade ELA		
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**
6th Grade	Days excused vs. Excused rate	0.542	0.546	-0.003	0.536	0.537	-0.001
	Days total vs. Total rate	0.629	0.636	-0.007*	0.614	0.618	-0.005*
	Days unexcused vs. Unexcused rate	0.619	0.624	-0.005*	0.612	0.614	-0.002
	Total rate vs. Excused rate	0.636	0.546	0.090***	0.618	0.537	0.081***
	Total rate vs. Unexcused rate	0.636	0.624	0.012	0.618	0.614	0.005
	Unexcused rate vs. Excused rate	0.624	0.546	0.079**	0.614	0.537	0.077***
7th Grade	Days excused vs. Excused rate	0.551	0.559	-0.008**	0.538	0.541	-0.003*
	Days total vs. Total rate	0.639	0.651	-0.012***	0.626	0.629	-0.003
	Days unexcused vs. Unexcused rate	0.634	0.641	-0.007**	0.632	0.633	-0.001
	Total rate vs. Excused rate	0.651	0.559	0.092***	0.629	0.541	0.088***
	Total rate vs. Unexcused rate	0.651	0.641	0.011	0.629	0.633	-0.003
	Unexcused rate vs. Excused rate	0.641	0.559	0.081***	0.633	0.541	0.092***
8th Grade	Days excused vs. Excused rate	0.520	0.526	-0.006***	0.513	0.517	-0.003
	Days total vs. Total rate	0.654	0.660	-0.006**	0.633	0.637	-0.003
	Days unexcused vs. Unexcused rate	0.668	0.672	-0.004*	0.642	0.643	-0.001
	Total rate vs. Excused rate	0.660	0.526	0.134***	0.637	0.517	0.120***
	Total rate vs. Unexcused rate	0.660	0.672	-0.012	0.637	0.643	-0.007
	Unexcused rate vs. Excused rate	0.672	0.526	0.146***	0.643	0.517	0.127***

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant *p*-values suggest that one measure provides a significantly stronger signal for identifying students at risk on 8th grade math or ELA performance. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 4. DeLong Comparisons of Absenteeism Measures, 2009 Cohort

		8th Grade Math			8th Grade ELA		
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**
Pre-K	Days excused vs. Excused rate	0.579	0.582	-0.003	0.532	0.535	-0.003
	Days total vs. Total rate	0.589	0.593	-0.003	0.541	0.544	-0.003
	Days unexcused vs. Unexcused rate	0.517	0.517	0.000	0.509	0.509	0.000
	Total rate vs. Excused rate	0.593	0.582	0.010	0.544	0.535	0.010
	Total rate vs. Unexcused rate	0.593	0.517	0.076**	0.544	0.509	0.035
	Unexcused rate vs. Excused rate	0.517	0.582	-0.066*	0.509	0.535	-0.025
Kindergarten	Days excused vs. Excused rate	0.562	0.571	-0.009*	0.556	0.559	-0.003
	Days total vs. Total rate	0.582	0.591	-0.009*	0.564	0.567	-0.003
	Days unexcused vs. Unexcused rate	0.509	0.509	0.000	0.502	0.502	0.000
	Total rate vs. Excused rate	0.591	0.571	0.020	0.567	0.559	0.008
	Total rate vs. Unexcused rate	0.591	0.509	0.083***	0.567	0.502	0.065**
	Unexcused rate vs. Excused rate	0.509	0.571	-0.062*	0.502	0.559	-0.057*
1st Grade	Days excused vs. Excused rate	0.555	0.558	-0.003	0.531	0.534	-0.004
	Days total vs. Total rate	0.608	0.612	-0.003	0.583	0.587	-0.004
	Days unexcused vs. Unexcused rate	0.571	0.573	-0.002	0.571	0.574	-0.003*
	Total rate vs. Excused rate	0.612	0.558	0.054**	0.587	0.534	0.053**
	Total rate vs. Unexcused rate	0.612	0.573	0.038*	0.587	0.574	0.014
	Unexcused rate vs. Excused rate	0.573	0.558	0.015	0.574	0.534	0.039
2nd Grade	Days excused vs. Excused rate	0.548	0.549	-0.001	0.512	0.516	-0.005
	Days total vs. Total rate	0.627	0.631	-0.004	0.587	0.590	-0.003
	Days unexcused vs. Unexcused rate	0.601	0.603	-0.001	0.587	0.588	-0.001
	Total rate vs. Excused rate	0.631	0.549	0.082***	0.590	0.516	0.074***
	Total rate vs. Unexcused rate	0.631	0.603	0.028	0.590	0.588	0.003
	Unexcused rate vs. Excused rate	0.603	0.549	0.054	0.588	0.516	0.071*
3rd Grade	Days excused vs. Excused rate	0.530	0.528	0.002	0.535	0.536	0.000
	Days total vs. Total rate	0.631	0.633	-0.002	0.592	0.599	-0.007
	Days unexcused vs. Unexcused rate	0.629	0.631	-0.002	0.596	0.600	-0.003
	Total rate vs. Excused rate	0.633	0.528	0.105***	0.599	0.536	0.064***
	Total rate vs. Unexcused rate	0.633	0.631	0.002	0.599	0.600	0.000
	Unexcused rate vs. Excused rate	0.631	0.528	0.103***	0.600	0.536	0.064*
4th Grade	Days excused vs. Excused rate	0.556	0.555	0.001	0.540	0.540	0.000
	Days total vs. Total rate	0.640	0.644	-0.004	0.613	0.623	-0.010**
	Days unexcused vs. Unexcused rate	0.631	0.633	-0.002	0.608	0.612	-0.005*
	Total rate vs. Excused rate	0.644	0.555	0.089***	0.623	0.540	0.083***
	Total rate vs. Unexcused rate	0.644	0.633	0.011	0.623	0.612	0.010
	Unexcused rate vs. Excused rate	0.633	0.555	0.078**	0.612	0.540	0.073**
5th Grade	Days excused vs. Excused rate	0.543	0.545	-0.002	0.531	0.534	-0.003
	Days total vs. Total rate	0.644	0.652	-0.008*	0.591	0.599	-0.009*
	Days unexcused vs. Unexcused rate	0.623	0.626	-0.003	0.578	0.584	-0.005*
	Total rate vs. Excused rate	0.652	0.545	0.107***	0.599	0.534	0.066***
	Total rate vs. Unexcused rate	0.652	0.626	0.026	0.599	0.584	0.016
	Unexcused rate vs. Excused rate	0.626	0.545	0.081**	0.584	0.534	0.050

		8th Grade Math			8th Grade ELA		
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**
6th Grade	Days excused vs. Excused rate	0.580	0.582	-0.002	0.559	0.562	-0.002
	Days total vs. Total rate	0.682	0.684	-0.002	0.619	0.621	-0.002
	Days unexcused vs. Unexcused rate	0.660	0.663	-0.002	0.607	0.609	-0.002*
	Total rate vs. Excused rate	0.684	0.582	0.102***	0.621	0.562	0.059***
	Total rate vs. Unexcused rate	0.684	0.663	0.021	0.621	0.609	0.012
	Unexcused rate vs. Excused rate	0.663	0.582	0.081**	0.609	0.562	0.047
7th Grade	Days excused vs. Excused rate	0.547	0.548	-0.001	0.520	0.521	-0.002
	Days total vs. Total rate	0.666	0.668	-0.002	0.619	0.621	-0.001
	Days unexcused vs. Unexcused rate	0.652	0.653	-0.001	0.627	0.627	-0.001
	Total rate vs. Excused rate	0.668	0.548	0.120***	0.621	0.521	0.099***
	Total rate vs. Unexcused rate	0.668	0.653	0.015	0.621	0.627	-0.007
	Unexcused rate vs. Excused rate	0.653	0.548	0.106***	0.627	0.521	0.106***
8th Grade	Days excused vs. Excused rate	0.538	0.538	0.000	0.561	0.562	-0.001
	Days total vs. Total rate	0.680	0.686	-0.006	0.645	0.649	-0.003
	Days unexcused vs. Unexcused rate	0.678	0.683	-0.005	0.642	0.645	-0.003
	Total rate vs. Excused rate	0.686	0.538	0.148***	0.649	0.562	0.087***
	Total rate vs. Unexcused rate	0.686	0.683	0.003	0.649	0.645	0.004
	Unexcused rate vs. Excused rate	0.683	0.538	0.145***	0.645	0.562	0.083**

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant *p*-values suggest that one measure provides a significantly stronger signal for identifying students at risk on 8th grade math or ELA performance. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Appendix D: Additional Details and Robustness Checks for RQ3

Table 1. Youden's J and Optimal Total Absence Cutoffs for Predicting 8th Grade MCAS Math and ELA Performance

Grade	8th Grade MCAS Subject	Youden's J	Corresponding Youden's J Threshold for Total Absence Rate	Equivalent Days from Total Absence Rate Threshold
Pre-K	Math	0.126	7.72%	14 days
	ELA	0.087	8.36%	15 days
Kindergarten	Math	0.172	7.44%	13 days
	ELA	0.113	8.49%	15 days
1st Grade	Math	0.184	3.92%	7 days
	ELA	0.139	5.01%	9 days
2nd Grade	Math	0.189	4.46%	8 days
	ELA	0.131	3.34%	6 days
3rd Grade	Math	0.209	4.41%	8 days
	ELA	0.158	4.48%	8 days
4th Grade	Math	0.244	4.75%	9 days
	ELA	0.191	3.86%	7 days
5th Grade	Math	0.227	3.32%	6 days
	ELA	0.187	3.32%	6 days
6th Grade	Math	0.241	4.52%	8 days
	ELA	0.184	3.88%	7 days
7th Grade	Math	0.246	4.46%	8 days
	ELA	0.196	5.45%	10 days
8th Grade	Math	0.262	6.16%	11 days
	ELA	0.214	5.54%	10 days

Note: The "Youden's J" column is the maximum value of the Youden's J statistic achieved for that grade and subject. This measures how well total absence rate distinguishes students who later experience the outcome (higher values indicate better discrimination). The "Corresponding Youden's J Threshold" column is the absence-rate cutoff at which that maximum Youden's J value occurs. The "Equivalent Days from Rate Threshold" is the absence-rate cutoff translated from a percentage into the approximate number of missed school days in a 180-day school year. For example, for Grade 3 math, the maximum Youden's J was 0.221, achieved at an absence rate of 4.41%, corresponding to approximately 8 missed school days. This indicates that classifying students as chronically absent at roughly 8 missed days provided the best balance of sensitivity (correctly identifying students who later scored Not Meeting Expectations) and specificity (correctly identifying students who do not) for predicting later math performance. MCAS = Massachusetts Comprehensive Assessment System.

Table 2. Youden's J and Optimal Total Absence Cutoffs using Total Days Absent

Grade	8th Grade MCAS Subject	Youden's J (Total Days Absent)	Youden's J Threshold (Total Days Absent)
Pre-K	Math	0.120	14 days
	ELA	0.079	15 days
Kindergarten	Math	0.154	14 days
	ELA	0.100	16 days
1st Grade	Math	0.178	8 days
	ELA	0.131	10 days
2nd Grade	Math	0.176	9 days
	ELA	0.130	7 days
3rd Grade	Math	0.205	8 days
	ELA	0.152	9 days
4th Grade	Math	0.241	9 days
	ELA	0.183	7 days
5th Grade	Math	0.215	6 days
	ELA	0.176	6 days
6th Grade	Math	0.237	9 days
	ELA	0.173	9 days
7th Grade	Math	0.237	9 days
	ELA	0.191	10 days
8th Grade	Math	0.252	12 days
	ELA	0.202	11 days

Table 3. Cohort-Specific Youden's J Thresholds for Total Absence Rate

Grade	School Year	Cohort	Subject	Youden's J	Optimal Absence Threshold	Equivalent Days
Pre-K	2007–08	2007	ELA	0.050	12.43%	22 days
	2007–08	2007	Math	0.073	8.38%	15 days
	2008–09	2008	ELA	0.104	6.23%	11 days
	2008–09	2008	Math	0.151	7.22%	13 days
	2009–10	2009	ELA	0.141	7.31%	13 days
	2009–10	2009	Math	0.173	7.80%	14 days
Kindergarten	2008–09	2007	ELA	0.147	7.50%	13 days
	2008–09	2007	Math	0.192	7.68%	14 days
	2009–10	2008	ELA	0.097	10.31%	19 days
	2009–10	2008	Math	0.154	6.88%	12 days
	2010–11	2009	ELA	0.121	8.94%	16 days
	2010–11	2009	Math	0.187	8.45%	15 days
1st Grade	2009–10	2007	ELA	0.140	4.48%	8 days
	2009–10	2007	Math	0.178	4.48%	8 days
	2010–11	2008	ELA	0.141	5.12%	9 days
	2010–11	2008	Math	0.217	3.90%	7 days
	2011–12	2009	ELA	0.150	3.36%	6 days
	2011–12	2009	Math	0.168	6.13%	11 days
2nd Grade	2010–11	2007	ELA	0.115	7.84%	14 days
	2010–11	2007	Math	0.141	4.46%	8 days
	2011–12	2008	ELA	0.171	3.90%	7 days
	2011–12	2008	Math	0.242	2.79%	5 days
	2012–13	2009	ELA	0.148	7.18%	13 days
	2012–13	2009	Math	0.199	4.31%	8 days
3rd Grade	2011–12	2007	ELA	0.177	5.01%	9 days
	2011–12	2007	Math	0.208	3.92%	7 days
	2012–13	2008	ELA	0.154	3.34%	6 days
	2012–13	2008	Math	0.232	4.43%	8 days
	2013–14	2009	ELA	0.185	4.97%	9 days
	2013–14	2009	Math	0.198	2.81%	5 days
4th Grade	2012–13	2007	ELA	0.192	3.86%	7 days
	2012–13	2007	Math	0.228	3.72%	7 days
	2013–14	2008	ELA	0.194	2.95%	5 days
	2013–14	2008	Math	0.293	4.75%	9 days
	2014–15	2009	ELA	0.207	4.49%	8 days
	2014–15	2009	Math	0.231	4.51%	8 days

Grade	School Year	Cohort	Subject	Youden's J	Optimal Absence Threshold	Equivalent Days
5th Grade	2013–14	2007	ELA	0.204	3.22%	6 days
	2013–14	2007	Math	0.236	3.87%	7 days
	2014–15	2008	ELA	0.189	2.65%	5 days
	2014–15	2008	Math	0.225	3.08%	6 days
	2015–16	2009	ELA	0.164	3.88%	7 days
	2015–16	2009	Math	0.254	4.46%	8 days
6th Grade	2014–15	2007	ELA	0.200	4.18%	8 days
	2014–15	2007	Math	0.238	4.18%	8 days
	2015–16	2008	ELA	0.192	4.99%	9 days
	2015–16	2008	Math	0.231	4.53%	8 days
	2016–17	2009	ELA	0.199	6.09%	11 days
	2016–17	2009	Math	0.302	6.09%	11 days
7th Grade	2015–16	2007	ELA	0.203	3.90%	7 days
	2015–16	2007	Math	0.253	5.09%	9 days
	2016–17	2008	ELA	0.213	6.21%	11 days
	2016–17	2008	Math	0.256	4.46%	8 days
	2017–18	2009	ELA	0.187	5.94%	11 days
	2017–18	2009	Math	0.260	3.85%	7 days
8th Grade	2016–17	2007	ELA	0.202	4.43%	8 days
	2016–17	2007	Math	0.274	5.04%	9 days
	2017–18	2008	ELA	0.233	5.71%	10 days
	2017–18	2008	Math	0.274	7.15%	13 days
	2018–19	2009	ELA	0.246	5.51%	10 days
	2018–19	2009	Math	0.281	4.47%	8 days

Appendix E: Robustness Checks for RQ4

Table 1. DeLong Test Comparisons of AUCs for Various Absenteeism Measures in Predicting 3rd Grade Math and ELA Outcomes

		Math				ELA			
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**
Pre-K Absenteeism	Days excused vs Excused rate	0.591	0.606	-0.015	<0.01	0.562	0.571	-0.009	<0.05
	Days total vs Total rate	0.589	0.604	-0.015	<0.01	0.559	0.569	-0.009	<0.05
	Days unexcused vs Unexcused rate	0.491	0.491	0.000	0.152	0.494	0.494	0.000	0.376
	Total rate vs Excused rate	0.604	0.606	-0.002	0.187	0.569	0.571	-0.002	0.185
	Total rate vs Unexcused rate	0.604	0.491	0.113	<0.0001	0.569	0.494	0.075	<0.0001
	Unexcused rate vs Excused rate	0.491	0.606	-0.115	<0.0001	0.494	0.571	-0.077	<0.0001
Kindergarten Absenteeism	Days excused vs Excused rate	0.594	0.597	-0.004	<0.05	0.593	0.598	-0.005	<0.05
	Days total vs Total rate	0.594	0.598	-0.004	<0.05	0.589	0.594	-0.005	<0.05
	Days unexcused vs Unexcused rate	0.494	0.494	0.000	0.542	0.489	0.489	0.000	0.4
	Total rate vs Excused rate	0.598	0.597	0.001	0.846	0.594	0.598	-0.004	0.485
	Total rate vs Unexcused rate	0.598	0.494	0.105	<0.0001	0.594	0.489	0.105	<0.0001
	Unexcused rate vs Excused rate	0.494	0.597	-0.104	<0.0001	0.489	0.598	-0.109	<0.0001
1st Grade Absenteeism	Days excused vs Excused rate	0.583	0.585	-0.002	0.095	0.535	0.537	-0.002	0.109
	Days total vs Total rate	0.623	0.626	-0.003	<0.05	0.590	0.593	-0.003	<0.05
	Days unexcused vs Unexcused rate	0.514	0.515	-0.001	<0.001	0.546	0.547	-0.001	<0.001
	Total rate vs Excused rate	0.626	0.585	0.041	<0.0001	0.593	0.537	0.056	<0.0001
	Total rate vs Unexcused rate	0.626	0.515	0.111	<0.0001	0.593	0.547	0.045	<0.01
	Unexcused rate vs Excused rate	0.515	0.585	-0.070	<0.001	0.547	0.537	0.011	0.603
2nd Grade Absenteeism	Days excused vs Excused rate	0.557	0.559	-0.002	0.052	0.518	0.520	-0.002	0.082
	Days total vs Total rate	0.639	0.642	-0.003	<0.05	0.593	0.593	-0.001	0.374
	Days unexcused vs Unexcused rate	0.596	0.598	-0.002	<0.01	0.586	0.587	-0.001	0.149
	Total rate vs Excused rate	0.642	0.559	0.083	<0.0001	0.593	0.520	0.074	<0.0001

	Total rate vs Unexcused rate	0.642	0.598	0.044	<0.0001	0.593	0.587	0.007	0.522
	Unexcused rate vs Excused rate	0.598	0.559	0.039	<0.05	0.587	0.520	0.067	<0.001
3rd Grade Absenteeism	Days excused vs Excused rate	0.558	0.559	-0.001	0.448	0.520	0.521	-0.001	0.606
	Days total vs Total rate	0.654	0.658	-0.004	<0.01	0.612	0.614	-0.002	0.246
	Days unexcused vs Unexcused rate	0.637	0.639	-0.002	<0.01	0.618	0.619	-0.001	0.127
	Total rate vs Excused rate	0.658	0.559	0.098	<0.0001	0.614	0.521	0.093	<0.0001
	Total rate vs Unexcused rate	0.658	0.639	0.018	<0.05	0.614	0.619	-0.005	0.573
	Unexcused rate vs Excused rate	0.639	0.559	0.080	<0.0001	0.619	0.521	0.098	<0.0001

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant p-values suggest that one measure provides a significantly stronger signal for identifying students at risk on this grade's math or ELA performance.

Table 2. DeLong Test Comparisons of AUCs for Various Absenteeism Measures in Predicting 4th Grade Math and ELA Outcomes

		Math				ELA			
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**
Pre-K Absenteeism	Days excused vs Excused rate	0.581	0.592	-0.011	<0.01	0.550	0.554	-0.003	0.217
	Days total vs Total rate	0.579	0.590	-0.011	<0.01	0.549	0.552	-0.003	0.244
	Days unexcused vs Unexcused rate	0.495	0.495	0.000	0.089	0.496	0.496	0.000	0.162
	Total rate vs Excused rate	0.590	0.592	-0.002	0.082	0.552	0.554	-0.001	0.364
	Total rate vs Unexcused rate	0.590	0.495	0.095	<0.0001	0.552	0.496	0.056	<0.0001
	Unexcused rate vs Excused rate	0.495	0.592	-0.097	<0.0001	0.496	0.554	-0.057	<0.0001
Kindergarten Absenteeism	Days excused vs Excused rate	0.609	0.615	-0.006	<0.01	0.579	0.585	-0.006	<0.001
	Days total vs Total rate	0.610	0.616	-0.006	<0.01	0.578	0.584	-0.006	<0.001
	Days unexcused vs Unexcused rate	0.493	0.493	0.000	0.257	0.492	0.492	0.000	0.188
	Total rate vs Excused rate	0.616	0.615	0.001	0.775	0.584	0.585	-0.001	0.902
	Total rate vs Unexcused rate	0.616	0.493	0.123	<0.0001	0.584	0.492	0.092	<0.0001
	Unexcused rate vs Excused rate	0.493	0.615	-0.122	<0.0001	0.492	0.585	-0.093	<0.0001
1st Grade Absenteeism	Days excused vs Excused rate	0.596	0.599	-0.003	<0.05	0.558	0.561	-0.003	<0.01
	Days total vs Total rate	0.640	0.644	-0.004	<0.05	0.595	0.598	-0.004	<0.01
	Days unexcused vs Unexcused rate	0.516	0.517	-0.001	<0.01	0.513	0.513	-0.001	<0.01
	Total rate vs Excused rate	0.644	0.599	0.045	<0.0001	0.598	0.561	0.037	<0.0001
	Total rate vs Unexcused rate	0.644	0.517	0.127	<0.0001	0.598	0.513	0.085	<0.0001
	Unexcused rate vs Excused rate	0.517	0.599	-0.081	<0.0001	0.513	0.561	-0.048	<0.001
2nd Grade Absenteeism	Days excused vs Excused rate	0.550	0.552	-0.002	<0.05	0.535	0.537	-0.002	<0.05
	Days total vs Total rate	0.635	0.640	-0.005	<0.01	0.593	0.597	-0.004	<0.01
	Days unexcused vs Unexcused rate	0.574	0.576	-0.002	<0.001	0.548	0.549	-0.001	<0.01
	Total rate vs Excused rate	0.640	0.552	0.088	<0.0001	0.597	0.537	0.060	<0.0001
	Total rate vs Unexcused rate	0.640	0.576	0.064	<0.0001	0.597	0.549	0.048	<0.0001

	Unexcused rate vs Excused rate	0.576	0.552	0.024	0.169	0.549	0.537	0.012	0.431
3rd Grade Absenteeism	Days excused vs Excused rate	0.555	0.556	-0.001	0.324	0.521	0.521	-0.001	0.488
	Days total vs Total rate	0.645	0.648	-0.003	<0.01	0.609	0.613	-0.003	<0.01
	Days unexcused vs Unexcused rate	0.626	0.628	-0.002	<0.01	0.621	0.623	-0.002	<0.01
	Total rate vs Excused rate	0.648	0.556	0.092	<0.0001	0.613	0.521	0.091	<0.0001
	Total rate vs Unexcused rate	0.648	0.628	0.019	<0.05	0.613	0.623	-0.011	0.084
	Unexcused rate vs Excused rate	0.628	0.556	0.073	<0.0001	0.623	0.521	0.102	<0.0001
4th Grade Absenteeism	Days excused vs Excused rate	0.548	0.550	-0.002	<0.05	0.521	0.520	0.000	0.769
	Days total vs Total rate	0.667	0.672	-0.005	<0.0001	0.626	0.629	-0.003	<0.01
	Days unexcused vs Unexcused rate	0.655	0.657	-0.002	<0.01	0.639	0.642	-0.002	<0.01
	Total rate vs Excused rate	0.672	0.550	0.122	<0.0001	0.629	0.520	0.109	<0.0001
	Total rate vs Unexcused rate	0.672	0.657	0.015	0.051	0.629	0.642	-0.013	<0.05
	Unexcused rate vs Excused rate	0.657	0.550	0.107	<0.0001	0.642	0.520	0.121	<0.0001

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant p-values suggest that one measure provides a significantly stronger signal for identifying students at risk on this grade's math or ELA performance.

Table 3. DeLong Test Comparisons of AUCs for Various Absenteeism Measures in Predicting 5th Grade Math and ELA Outcomes

		Math				ELA			
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**
Pre-K Absenteeism	Days excused vs Excused rate	0.564	0.574	-0.010	<0.01	0.559	0.564	-0.004	0.197
	Days total vs Total rate	0.566	0.576	-0.010	<0.01	0.560	0.564	-0.004	0.21
	Days unexcused vs Unexcused rate	0.499	0.499	0.000	0.085	0.497	0.497	0.000	0.209
	Total rate vs Excused rate	0.576	0.574	0.002	0.311	0.564	0.564	0.000	0.936
	Total rate vs Unexcused rate	0.576	0.499	0.078	<0.0001	0.564	0.497	0.066	<0.0001
	Unexcused rate vs Excused rate	0.499	0.574	-0.076	<0.0001	0.497	0.564	-0.066	<0.0001
Kindergarten Absenteeism	Days excused vs Excused rate	0.597	0.602	-0.005	<0.05	0.590	0.595	-0.005	<0.05
	Days total vs Total rate	0.600	0.605	-0.005	<0.05	0.592	0.597	-0.005	<0.05
	Days unexcused vs Unexcused rate	0.495	0.495	0.000	0.13	0.496	0.496	0.000	0.579
	Total rate vs Excused rate	0.605	0.602	0.003	0.529	0.597	0.595	0.002	0.653
	Total rate vs Unexcused rate	0.605	0.495	0.109	<0.0001	0.597	0.496	0.101	<0.0001
	Unexcused rate vs Excused rate	0.495	0.602	-0.106	<0.0001	0.496	0.595	-0.099	<0.0001
1st Grade Absenteeism	Days excused vs Excused rate	0.592	0.596	-0.004	<0.01	0.566	0.568	-0.002	0.092
	Days total vs Total rate	0.613	0.619	-0.006	<0.001	0.593	0.596	-0.003	0.06
	Days unexcused vs Unexcused rate	0.496	0.497	-0.001	<0.01	0.504	0.505	-0.001	<0.05
	Total rate vs Excused rate	0.619	0.596	0.023	<0.01	0.596	0.568	0.028	<0.01
	Total rate vs Unexcused rate	0.619	0.497	0.122	<0.0001	0.596	0.505	0.091	<0.0001
	Unexcused rate vs Excused rate	0.497	0.596	-0.099	<0.0001	0.505	0.568	-0.064	<0.001
2nd Grade Absenteeism	Days excused vs Excused rate	0.562	0.564	-0.002	0.088	0.536	0.538	-0.002	0.073
	Days total vs Total rate	0.601	0.604	-0.003	<0.05	0.581	0.584	-0.003	0.072
	Days unexcused vs Unexcused rate	0.526	0.527	-0.002	<0.01	0.539	0.541	-0.002	0.056
	Total rate vs Excused rate	0.604	0.564	0.040	<0.0001	0.584	0.538	0.046	<0.0001
	Total rate vs Unexcused rate	0.604	0.527	0.077	<0.0001	0.584	0.541	0.043	<0.001

	Unexcused rate vs Excused rate	0.527	0.564	-0.036	<0.05	0.541	0.538	0.003	0.884
3rd Grade Absenteeism	Days excused vs Excused rate	0.553	0.554	-0.001	0.353	0.532	0.532	0.000	0.81
	Days total vs Total rate	0.619	0.622	-0.003	<0.05	0.601	0.604	-0.003	<0.05
	Days unexcused vs Unexcused rate	0.603	0.605	-0.002	<0.01	0.599	0.601	-0.003	<0.05
	Total rate vs Excused rate	0.622	0.554	0.068	<0.0001	0.604	0.532	0.071	<0.0001
	Total rate vs Unexcused rate	0.622	0.605	0.017	<0.05	0.604	0.601	0.002	0.777
	Unexcused rate vs Excused rate	0.605	0.554	0.051	<0.001	0.601	0.532	0.069	<0.0001
4th Grade Absenteeism	Days excused vs Excused rate	0.550	0.551	0.000	0.72	0.527	0.528	0.000	0.746
	Days total vs Total rate	0.637	0.641	-0.004	<0.01	0.611	0.615	-0.005	<0.05
	Days unexcused vs Unexcused rate	0.623	0.625	-0.002	<0.05	0.621	0.624	-0.003	<0.05
	Total rate vs Excused rate	0.641	0.551	0.091	<0.0001	0.615	0.528	0.088	<0.0001
	Total rate vs Unexcused rate	0.641	0.625	0.016	<0.05	0.615	0.624	-0.009	0.243
	Unexcused rate vs Excused rate	0.625	0.551	0.075	<0.0001	0.624	0.528	0.096	<0.0001
5th Grade Absenteeism	Days excused vs Excused rate	0.551	0.552	-0.001	0.11	0.501	0.503	-0.002	<0.05
	Days total vs Total rate	0.637	0.644	-0.007	<0.0001	0.614	0.619	-0.005	<0.01
	Days unexcused vs Unexcused rate	0.613	0.617	-0.004	<0.0001	0.627	0.630	-0.003	<0.01
	Total rate vs Excused rate	0.644	0.552	0.092	<0.0001	0.619	0.503	0.116	<0.0001
	Total rate vs Unexcused rate	0.644	0.617	0.027	<0.001	0.619	0.630	-0.011	0.139
	Unexcused rate vs Excused rate	0.617	0.552	0.065	<0.0001	0.630	0.503	0.126	<0.0001

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant p-values suggest that one measure provides a significantly stronger signal for identifying students at risk on this grade's math or ELA performance.

Table 4. DeLong Test Comparisons of AUCs for Various Absenteeism Measures in Predicting 6th Grade Math and ELA Outcomes

		Math				ELA			
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**
Pre-K Absenteeism	Days excused vs Excused rate	0.562	0.571	-0.010	<0.01	0.526	0.534	-0.008	<0.05
	Days total vs Total rate	0.563	0.573	-0.010	<0.01	0.527	0.535	-0.008	<0.05
	Days unexcused vs Unexcused rate	0.500	0.500	0.000	0.21	0.501	0.501	0.000	0.161
	Total rate vs Excused rate	0.573	0.571	0.001	0.384	0.535	0.534	0.001	0.607
	Total rate vs Unexcused rate	0.573	0.500	0.073	<0.0001	0.535	0.501	0.034	<0.05
	Unexcused rate vs Excused rate	0.500	0.571	-0.071	<0.0001	0.501	0.534	-0.033	<0.05
Kindergarten Absenteeism	Days excused vs Excused rate	0.594	0.598	-0.004	<0.05	0.572	0.576	-0.004	0.052
	Days total vs Total rate	0.595	0.599	-0.004	<0.05	0.574	0.579	-0.004	<0.05
	Days unexcused vs Unexcused rate	0.494	0.494	0.000	0.174	0.498	0.498	0.000	0.495
	Total rate vs Excused rate	0.599	0.598	0.001	0.856	0.579	0.576	0.003	0.585
	Total rate vs Unexcused rate	0.599	0.494	0.105	<0.0001	0.579	0.498	0.081	<0.0001
	Unexcused rate vs Excused rate	0.494	0.598	-0.104	<0.0001	0.498	0.576	-0.078	<0.0001
1st Grade Absenteeism	Days excused vs Excused rate	0.609	0.612	-0.003	<0.05	0.550	0.552	-0.002	0.119
	Days total vs Total rate	0.618	0.622	-0.004	<0.05	0.594	0.597	-0.003	<0.05
	Days unexcused vs Unexcused rate	0.481	0.482	-0.001	<0.05	0.525	0.525	-0.001	<0.05
	Total rate vs Excused rate	0.622	0.612	0.010	0.174	0.597	0.552	0.045	<0.0001
	Total rate vs Unexcused rate	0.622	0.482	0.139	<0.0001	0.597	0.525	0.072	<0.0001
	Unexcused rate vs Excused rate	0.482	0.612	-0.130	<0.0001	0.525	0.552	-0.027	0.13
2nd Grade Absenteeism	Days excused vs Excused rate	0.569	0.570	-0.001	0.16	0.524	0.524	-0.001	0.569
	Days total vs Total rate	0.610	0.612	-0.002	0.09	0.593	0.594	-0.001	0.343
	Days unexcused vs Unexcused rate	0.527	0.528	-0.001	<0.05	0.565	0.566	-0.001	0.278
	Total rate vs Excused rate	0.612	0.570	0.041	<0.0001	0.594	0.524	0.070	<0.0001
	Total rate vs Unexcused rate	0.612	0.528	0.084	<0.0001	0.594	0.566	0.028	<0.05
	Unexcused rate vs Excused rate	0.528	0.570	-0.042	<0.01	0.566	0.524	0.042	<0.05
3rd Grade Absenteeism	Days excused vs Excused rate	0.555	0.557	-0.001	0.137	0.531	0.532	-0.001	0.345
	Days total vs Total rate	0.613	0.615	-0.002	0.074	0.594	0.596	-0.002	0.146
	Days unexcused vs Unexcused rate	0.586	0.587	-0.001	<0.05	0.594	0.595	-0.001	0.12
	Total rate vs Excused rate	0.615	0.557	0.058	<0.0001	0.596	0.532	0.064	<0.0001

	Total rate vs Unexcused rate	0.615	0.587	0.028	<0.001	0.596	0.595	0.001	0.949
	Unexcused rate vs Excused rate	0.587	0.557	0.030	<0.05	0.595	0.532	0.063	<0.0001
4th Grade Absenteeism	Days excused vs Excused rate	0.552	0.552	0.000	0.878	0.530	0.530	0.000	0.906
	Days total vs Total rate	0.632	0.635	-0.002	0.06	0.610	0.615	-0.005	<0.05
	Days unexcused vs Unexcused rate	0.610	0.611	-0.001	0.134	0.606	0.609	-0.003	<0.05
	Total rate vs Excused rate	0.635	0.552	0.083	<0.0001	0.615	0.530	0.085	<0.0001
	Total rate vs Unexcused rate	0.635	0.611	0.024	<0.01	0.615	0.609	0.006	0.464
	Unexcused rate vs Excused rate	0.611	0.552	0.059	<0.0001	0.609	0.530	0.079	<0.0001
5th Grade Absenteeism	Days excused vs Excused rate	0.554	0.557	-0.003	<0.01	0.524	0.527	-0.003	<0.05
	Days total vs Total rate	0.636	0.644	-0.008	<0.0001	0.609	0.616	-0.007	<0.001
	Days unexcused vs Unexcused rate	0.612	0.616	-0.005	<0.0001	0.602	0.606	-0.004	<0.0001
	Total rate vs Excused rate	0.644	0.557	0.087	<0.0001	0.616	0.527	0.089	<0.0001
	Total rate vs Unexcused rate	0.644	0.616	0.028	<0.0001	0.616	0.606	0.010	0.216
	Unexcused rate vs Excused rate	0.616	0.557	0.060	<0.0001	0.606	0.527	0.079	<0.0001
6th Grade Absenteeism	Days excused vs Excused rate	0.544	0.547	-0.002	<0.01	0.531	0.535	-0.004	<0.001
	Days total vs Total rate	0.628	0.634	-0.006	<0.0001	0.607	0.612	-0.005	<0.001
	Days unexcused vs Unexcused rate	0.615	0.619	-0.004	<0.0001	0.604	0.607	-0.004	<0.01
	Total rate vs Excused rate	0.634	0.547	0.087	<0.0001	0.612	0.535	0.077	<0.0001
	Total rate vs Unexcused rate	0.634	0.619	0.015	<0.05	0.612	0.607	0.005	0.504
	Unexcused rate vs Excused rate	0.619	0.547	0.072	<0.0001	0.607	0.535	0.072	<0.0001

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant p-values suggest that one measure provides a significantly stronger signal for identifying students at risk on this grade's math or ELA performance.

Table 5. DeLong Test Comparisons of AUCs for Various Absenteeism Measures in Predicting 7th Grade Math and ELA Outcomes

		Math				ELA			
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**
Pre-K Absenteeism	Days excused vs Excused rate	0.558	0.567	-0.009	<0.01	0.561	0.565	-0.004	0.22
	Days total vs Total rate	0.560	0.569	-0.009	<0.01	0.563	0.567	-0.004	0.224
	Days unexcused vs Unexcused rate	0.500	0.500	0.000	<0.05	0.501	0.501	0.000	0.152
	Total rate vs Excused rate	0.569	0.567	0.001	0.414	0.567	0.565	0.003	0.218
	Total rate vs Unexcused rate	0.569	0.500	0.068	<0.0001	0.567	0.501	0.066	<0.0001
	Unexcused rate vs Excused rate	0.500	0.567	-0.067	<0.0001	0.501	0.565	-0.063	<0.0001
Kindergarten Absenteeism	Days excused vs Excused rate	0.585	0.589	-0.004	<0.05	0.571	0.578	-0.007	<0.01
	Days total vs Total rate	0.593	0.597	-0.004	<0.05	0.580	0.587	-0.007	<0.01
	Days unexcused vs Unexcused rate	0.500	0.500	0.000	0.095	0.499	0.499	0.000	0.249
	Total rate vs Excused rate	0.597	0.589	0.008	0.091	0.587	0.578	0.009	0.118
	Total rate vs Unexcused rate	0.597	0.500	0.097	<0.0001	0.587	0.499	0.088	<0.0001
	Unexcused rate vs Excused rate	0.500	0.589	-0.089	<0.0001	0.499	0.578	-0.079	<0.0001
1st Grade Absenteeism	Days excused vs Excused rate	0.582	0.584	-0.002	0.051	0.544	0.546	-0.002	0.078
	Days total vs Total rate	0.606	0.609	-0.003	<0.05	0.598	0.601	-0.003	<0.05
	Days unexcused vs Unexcused rate	0.501	0.501	0.000	0.21	0.539	0.540	-0.001	<0.01
	Total rate vs Excused rate	0.609	0.584	0.025	<0.001	0.601	0.546	0.055	<0.0001
	Total rate vs Unexcused rate	0.609	0.501	0.108	<0.0001	0.601	0.540	0.061	<0.0001
	Unexcused rate vs Excused rate	0.501	0.584	-0.083	<0.0001	0.540	0.546	-0.006	0.728
2nd Grade Absenteeism	Days excused vs Excused rate	0.574	0.576	-0.002	<0.05	0.506	0.507	-0.001	0.259
	Days total vs Total rate	0.608	0.609	-0.001	0.255	0.600	0.602	-0.002	0.115
	Days unexcused vs Unexcused rate	0.514	0.515	0.000	0.36	0.598	0.598	0.000	0.435
	Total rate vs Excused rate	0.609	0.576	0.033	<0.0001	0.602	0.507	0.095	<0.0001
	Total rate vs Unexcused rate	0.609	0.515	0.095	<0.0001	0.602	0.598	0.004	0.741
	Unexcused rate vs Excused rate	0.515	0.576	-0.061	<0.0001	0.598	0.507	0.091	<0.0001
3rd Grade Absenteeism	Days excused vs Excused rate	0.543	0.543	0.000	0.942	0.536	0.537	-0.001	0.308
	Days total vs Total rate	0.622	0.622	-0.001	0.553	0.626	0.628	-0.002	0.212

	Days unexcused vs Unexcused rate	0.602	0.603	-0.001	0.124	0.618	0.620	-0.002	0.084
	Total rate vs Excused rate	0.622	0.543	0.080	<0.0001	0.628	0.537	0.092	<0.0001
	Total rate vs Unexcused rate	0.622	0.603	0.019	<0.01	0.628	0.620	0.008	0.283
	Unexcused rate vs Excused rate	0.603	0.543	0.061	<0.0001	0.620	0.537	0.083	<0.0001
4th Grade Absenteeism	Days excused vs Excused rate	0.543	0.543	0.001	0.503	0.536	0.536	0.000	0.924
	Days total vs Total rate	0.624	0.627	-0.002	0.057	0.629	0.632	-0.003	<0.05
	Days unexcused vs Unexcused rate	0.611	0.613	-0.002	<0.05	0.631	0.634	-0.002	<0.05
	Total rate vs Excused rate	0.627	0.543	0.084	<0.0001	0.632	0.536	0.096	<0.0001
	Total rate vs Unexcused rate	0.627	0.613	0.014	<0.05	0.632	0.634	-0.002	0.79
	Unexcused rate vs Excused rate	0.613	0.543	0.070	<0.0001	0.634	0.536	0.098	<0.0001
5th Grade Absenteeism	Days excused vs Excused rate	0.547	0.548	-0.001	0.522	0.532	0.534	-0.001	0.227
	Days total vs Total rate	0.625	0.631	-0.005	<0.001	0.625	0.631	-0.006	<0.01
	Days unexcused vs Unexcused rate	0.604	0.607	-0.003	<0.001	0.624	0.628	-0.004	<0.01
	Total rate vs Excused rate	0.631	0.548	0.083	<0.0001	0.631	0.534	0.097	<0.0001
	Total rate vs Unexcused rate	0.631	0.607	0.023	<0.001	0.631	0.628	0.003	0.635
	Unexcused rate vs Excused rate	0.607	0.548	0.059	<0.0001	0.628	0.534	0.094	<0.0001
6th Grade Absenteeism	Days excused vs Excused rate	0.546	0.548	-0.002	<0.05	0.534	0.536	-0.003	<0.01
	Days total vs Total rate	0.631	0.634	-0.004	<0.01	0.622	0.627	-0.005	<0.001
	Days unexcused vs Unexcused rate	0.611	0.613	-0.002	<0.01	0.619	0.623	-0.004	<0.001
	Total rate vs Excused rate	0.634	0.548	0.086	<0.0001	0.627	0.536	0.091	<0.0001
	Total rate vs Unexcused rate	0.634	0.613	0.021	<0.01	0.627	0.623	0.004	0.512
	Unexcused rate vs Excused rate	0.613	0.548	0.066	<0.0001	0.623	0.536	0.086	<0.0001
7th Grade Absenteeism	Days excused vs Excused rate	0.541	0.544	-0.003	<0.01	0.543	0.544	-0.002	<0.05
	Days total vs Total rate	0.637	0.643	-0.006	<0.0001	0.645	0.649	-0.003	<0.01
	Days unexcused vs Unexcused rate	0.628	0.632	-0.004	<0.0001	0.640	0.643	-0.002	<0.01
	Total rate vs Excused rate	0.643	0.544	0.099	<0.0001	0.649	0.544	0.104	<0.0001
	Total rate vs Unexcused rate	0.643	0.632	0.012	0.072	0.649	0.643	0.006	0.42
	Unexcused rate vs Excused rate	0.632	0.544	0.088	<0.0001	0.643	0.544	0.099	<0.0001

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant p-values suggest that one measure provides a significantly stronger signal for identifying students at risk on this grade's math or ELA performance.

Appendix F: Robustness Checks using a Common Sample

We explored whether findings were driven by different students joining or leaving the sample across the Pre-K through 8th grade years. To do so, for RQ1-RQ4, we refit our models using a common sample of students with no missing data in attendance or standardized test scores in all grades. We found our broad conclusions for all RQs were robust to a broader versus common sample approach. All findings for the common sample approach can be found here.

The analytic sample for this approach only includes students with valid attendance value from Pre-K to 8th grade (thus excluding students who did not attend Pre-K) and both a non-missing ELA and a non-missing math standardized test score for every year from 3rd-8th grade. In total, the sample size is N = 2,810 for all tables and figures below.

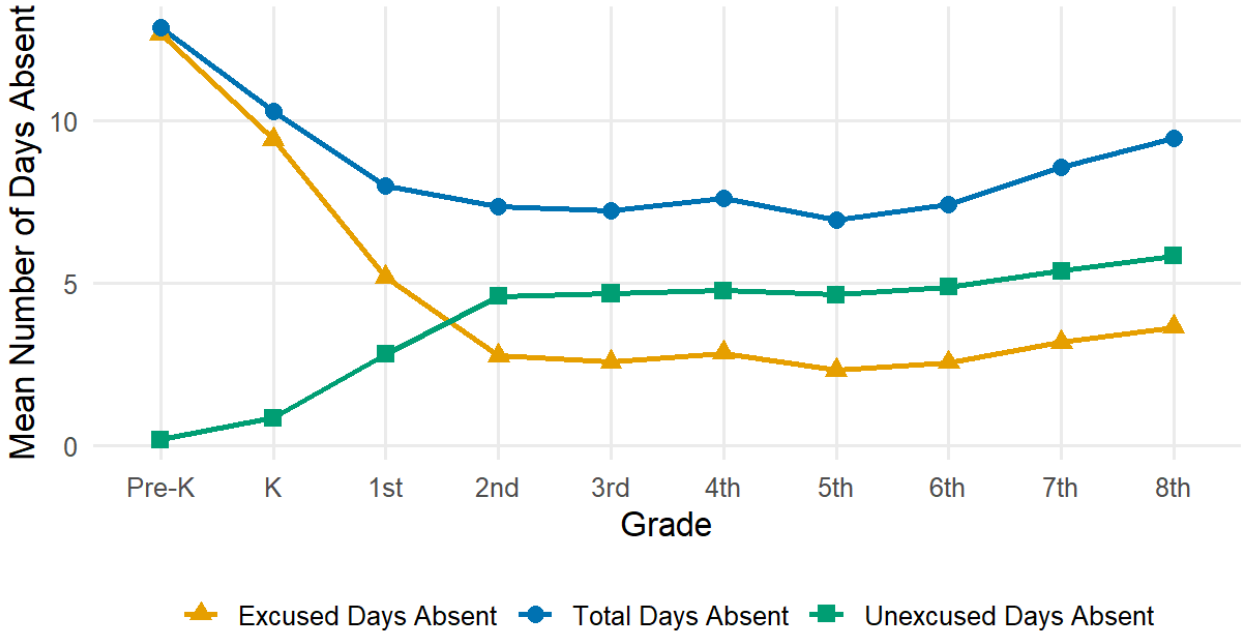
RQ1: Absenteeism Descriptive Patterns

To examine how absenteeism patterns descriptively differed by measurement choice, we generated descriptive statistics for excused, unexcused, and total absences, both in terms of absolute days missed and rates of absence (days absent divided by days enrolled). We visualized longitudinal absence trajectories using line graphs.

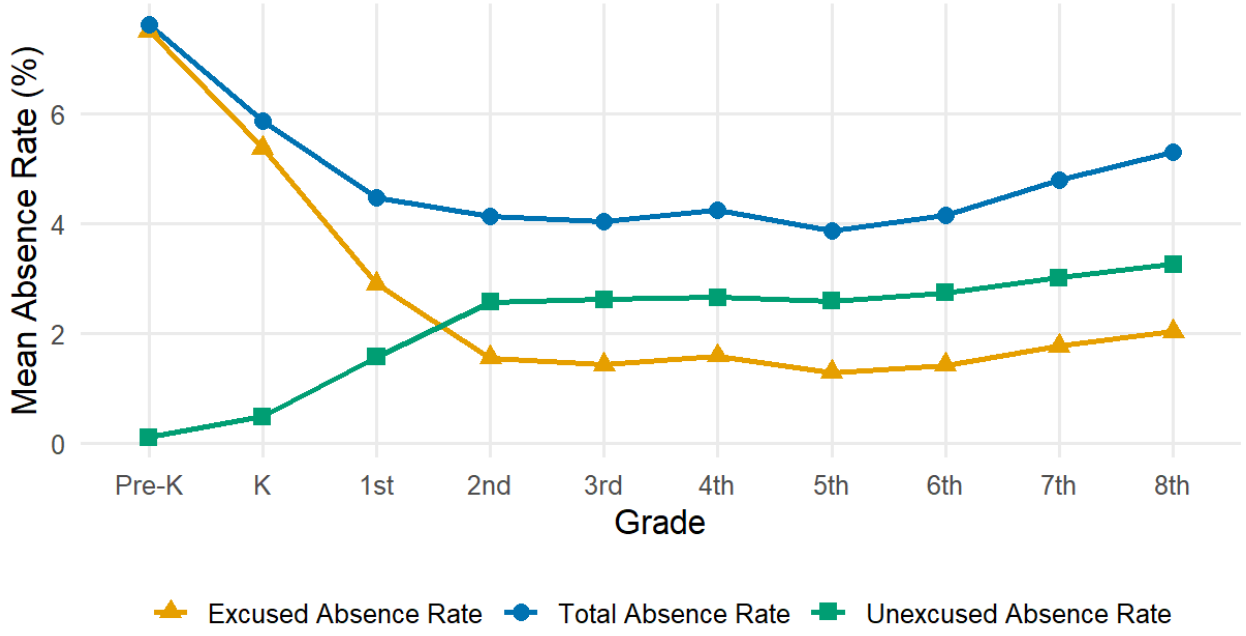
As seen in Figures 1A and 1B below, the patterns for mean absences by grade closely mirror those of Figure 3A and 3B. The only difference is that unexcused absence rate exceeds excused absence rate starting in 2nd grade instead of 3rd grade. Importantly, the overall shape, magnitude, and relative ordering of excused and unexcused absence trajectories remain nearly identical across samples. Even with this restricted analytic sample, the developmental pattern of absenteeism, with excused absences driving absenteeism in the earlier years and unexcused absences exceeding them later, remains similar. We believe this supports the robustness of our main RQ1 findings.

Figure 1. Absenteeism Patterns by Grade (Replication of Figure 3 in Main Text)

A. Mean Number of Days Absent by Grade



B. Mean Absence Rate by Grade



RQ2: ROC Curve Analysis. We used ROC curve analysis to evaluate the diagnostic accuracy of absenteeism measures in predicting whether a student would *Not Meet Expectations* on standardized math and ELA assessments in 8th grade. For each absence measure (days excused, days unexcused, days total, excused absence rate, unexcused absence rate, total absence rate), we estimated the ROC curve and computed the AUC. To test whether observed AUC differences across measures were statistically significant, we applied the DeLong test.

To test robustness using the common sample, we replicated Table 2 for 8th grade below (Table 1). We find very similar findings to Table 2 in the main paper. We see that unexcused absences show the smallest AUC in the earlier grades, with the AUC for total and excused absences marginally higher. The AUC, particularly for total and unexcused absences, increases as students approach middle school, signaling a strengthening of predictive accuracy.

Like in the main paper these results highlight the following insights: First, the predictive value of absences is weaker and largely driven by excused absences in early childhood, but by the upper elementary grades, unexcused absences become more salient. Second, predictive strength steadily increases across grades, peaking in middle school, where absence measures achieve their highest AUCs. However, we do not see that absence rates are superior to number-of-days measures. This is likely because this sample is a select group of students who remained in the Massachusetts Department of Secondary and Elementary Education dataset for ten consecutive years. Because of this, these students likely exhibit less mobility and more stable enrollment histories, so the variability in total days absent is artificially constrained, attenuating differences between rates and counts. In real-world settings where student mobility and enrollment length may vary more, absence rate remains more generalizable.

Table 1. DeLong Test Comparisons of AUCs for Various Absenteeism Measures in Predicting 8th Grade Math and ELA Outcomes

		8th Grade Math				8th Grade ELA			
Grade	**Absence Measures Compared**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**	**AUC for 1st Absence Measure**	**AUC for 2nd Absence Measure**	**AUC Difference**	**p-value**
Pre-K Absenteeism	Days excused vs Excused rate	0.579	0.584	-0.005	0.35	0.535	0.541	-0.006	0.227
	Days total vs Total rate	0.580	0.585	-0.004	0.399	0.540	0.546	-0.006	0.226
	Days unexcused vs Unexcused rate	0.502	0.502	0.000	0.096	0.500	0.500	0.000	0.478
	Total rate vs Excused rate	0.585	0.584	0.001	0.717	0.546	0.541	0.005	0.303
	Total rate vs Unexcused rate	0.585	0.502	0.082	<0.0001	0.546	0.500	0.046	<0.05
	Unexcused rate vs Excused rate	0.502	0.584	-0.081	<0.0001	0.500	0.541	-0.041	<0.05
Kindergarten Absenteeism	Days excused vs Excused rate	0.582	0.586	-0.005	0.085	0.557	0.558	-0.001	0.503
	Days total vs Total rate	0.583	0.588	-0.005	0.061	0.547	0.550	-0.002	0.302
	Days unexcused vs Unexcused rate	0.493	0.493	0.000	0.376	0.489	0.489	0.000	0.281
	Total rate vs Excused rate	0.588	0.586	0.002	0.866	0.550	0.558	-0.009	0.251
	Total rate vs Unexcused rate	0.588	0.493	0.094	<0.0001	0.550	0.489	0.061	<0.001
	Unexcused rate vs Excused rate	0.493	0.586	-0.093	<0.0001	0.489	0.558	-0.069	<0.001
1st Grade Absenteeism	Days excused vs Excused rate	0.568	0.568	0.000	0.963	0.552	0.554	-0.002	0.185
	Days total vs Total rate	0.615	0.617	-0.002	0.16	0.584	0.588	-0.004	<0.05
	Days unexcused vs Unexcused rate	0.537	0.538	0.000	0.287	0.516	0.517	-0.001	<0.05
	Total rate vs Excused rate	0.617	0.568	0.049	<0.01	0.588	0.554	0.034	<0.05
	Total rate vs Unexcused rate	0.617	0.538	0.079	<0.001	0.588	0.517	0.071	<0.001
	Unexcused rate vs Excused rate	0.538	0.568	-0.030	0.352	0.517	0.554	-0.037	0.21
2nd Grade Absenteeism	Days excused vs Excused rate	0.585	0.588	-0.003	0.192	0.540	0.545	-0.005	<0.05
	Days total vs Total rate	0.649	0.652	-0.003	0.217	0.580	0.584	-0.003	0.172
	Days unexcused vs Unexcused rate	0.608	0.610	-0.002	0.105	0.576	0.578	-0.002	0.058
	Total rate vs Excused rate	0.652	0.588	0.064	<0.001	0.584	0.545	0.039	<0.05
	Total rate vs Unexcused rate	0.652	0.610	0.042	<0.01	0.584	0.578	0.006	0.666

	Unexcused rate vs Excused rate	0.610	0.588	0.021	0.445	0.578	0.545	0.033	0.177
3rd Grade Absenteeism	Days excused vs Excused rate	0.539	0.539	0.000	0.835	0.530	0.529	0.001	0.709
	Days total vs Total rate	0.642	0.642	0.000	0.921	0.572	0.572	0.000	0.902
	Days unexcused vs Unexcused rate	0.635	0.635	0.000	0.928	0.565	0.565	0.000	0.778
	Total rate vs Excused rate	0.642	0.539	0.104	<0.0001	0.572	0.529	0.043	<0.01
	Total rate vs Unexcused rate	0.642	0.635	0.007	0.595	0.572	0.565	0.007	0.602
	Unexcused rate vs Excused rate	0.635	0.539	0.096	<0.001	0.565	0.529	0.036	0.15
4th Grade Absenteeism	Days excused vs Excused rate	0.554	0.553	0.001	0.642	0.541	0.541	0.000	0.986
	Days total vs Total rate	0.666	0.665	0.001	0.273	0.618	0.617	0.001	0.349
	Days unexcused vs Unexcused rate	0.656	0.655	0.001	0.29	0.608	0.609	-0.001	0.508
	Total rate vs Excused rate	0.665	0.553	0.112	<0.0001	0.617	0.541	0.076	<0.0001
	Total rate vs Unexcused rate	0.665	0.655	0.010	0.444	0.617	0.609	0.008	0.527
	Unexcused rate vs Excused rate	0.655	0.553	0.102	<0.001	0.609	0.541	0.068	<0.01
5th Grade Absenteeism	Days excused vs Excused rate	0.531	0.533	-0.002	0.204	0.525	0.526	-0.001	0.295
	Days total vs Total rate	0.649	0.649	0.000	0.992	0.594	0.596	-0.002	0.206
	Days unexcused vs Unexcused rate	0.652	0.652	0.000	0.969	0.584	0.585	-0.001	0.164
	Total rate vs Excused rate	0.649	0.533	0.116	<0.0001	0.596	0.526	0.070	<0.0001
	Total rate vs Unexcused rate	0.649	0.652	-0.003	0.779	0.596	0.585	0.011	0.389
	Unexcused rate vs Excused rate	0.652	0.533	0.119	<0.0001	0.585	0.526	0.059	<0.05
6th Grade Absenteeism	Days excused vs Excused rate	0.569	0.570	-0.001	0.416	0.548	0.548	0.000	0.839
	Days total vs Total rate	0.653	0.655	-0.002	0.128	0.595	0.597	-0.002	0.187
	Days unexcused vs Unexcused rate	0.633	0.634	-0.001	0.323	0.585	0.586	-0.001	0.209
	Total rate vs Excused rate	0.655	0.570	0.085	<0.0001	0.597	0.548	0.049	<0.01
	Total rate vs Unexcused rate	0.655	0.634	0.021	0.114	0.597	0.586	0.011	0.356
	Unexcused rate vs Excused rate	0.634	0.570	0.064	<0.05	0.586	0.548	0.038	0.105
7th Grade Absenteeism	Days excused vs Excused rate	0.546	0.544	0.002	0.171	0.525	0.525	0.000	0.824
	Days total vs Total rate	0.651	0.652	-0.001	0.561	0.605	0.606	-0.001	0.411

	Days unexcused vs Unexcused rate	0.644	0.644	0.000	0.844	0.620	0.620	0.000	0.913
	Total rate vs Excused rate	0.652	0.544	0.108	<0.0001	0.606	0.525	0.081	<0.0001
	Total rate vs Unexcused rate	0.652	0.644	0.008	0.58	0.606	0.620	-0.014	0.224
	Unexcused rate vs Excused rate	0.644	0.544	0.100	<0.001	0.620	0.525	0.095	<0.0001
8th Grade Absenteeism	Days excused vs Excused rate	0.514	0.513	0.001	0.559	0.511	0.513	-0.002	0.255
	Days total vs Total rate	0.677	0.680	-0.004	0.174	0.617	0.621	-0.004	0.122
	Days unexcused vs Unexcused rate	0.691	0.694	-0.003	0.249	0.639	0.641	-0.002	0.353
	Total rate vs Excused rate	0.680	0.513	0.167	<0.0001	0.621	0.513	0.108	<0.0001
	Total rate vs Unexcused rate	0.680	0.694	-0.014	0.303	0.621	0.641	-0.019	0.1
	Unexcused rate vs Excused rate	0.694	0.513	0.181	<0.0001	0.641	0.513	0.128	<0.0001

Note: This table reports results from pairwise comparisons of the area under the ROC curve (AUC) for different operationalizations of absenteeism, using the DeLong test for correlated ROC curves. Each row compares two absence measures within a given grade level cohort (e.g., days absent vs. absence rate). The first two columns for each outcome show the AUCs for the two measures being compared, followed by the difference in AUC and the corresponding p-value. A positive AUC difference indicates that the first absence measure yielded a higher predictive accuracy than the second; negative differences indicate the reverse. Statistically significant p-values suggest that one measure provides a significantly stronger signal for identifying students at risk on 8th grade math or ELA performance.

RQ3: Identifying Empirical Thresholds with Youden's J

To assess whether the RQ3 findings were sensitive to changes in sample composition across grades, we repeated the total absence rate Youden's J analyses using the common sample. Table 2 reports the resulting Youden's J values and the equivalent number of days associated with each optimal absence-rate threshold. Consistent with the main results, all empirically derived thresholds remained below the conventional chronic absenteeism benchmark of 10% of enrolled school days, or approximately 18 days in an 180-day school year. The exact thresholds differed somewhat between the main and common-sample analyses, with the largest differences occurring in kindergarten, where the common-sample thresholds were substantially lower. However, the central conclusion that the optimal early warning thresholds fall below the conventional chronic absenteeism benchmark was robust.

Table 2. Youden's J and Optimal Total Absence Cutoffs for Predicting 8th Grade MCAS Math and ELA Performance

Grade	8th Grade MCAS Subject	Youden's J	Corresponding Youden's J Threshold for Total Absence Rate	Equivalent Days from Total Absence Rate Threshold
Pre-K	Math	0.147	7.76%	14 days
	ELA	0.114	7.97%	14 days
Kindergarten	Math	0.145	3.94%	7 days
	ELA	0.075	3.34%	6 days
1st Grade	Math	0.175	3.97%	7 days
	ELA	0.142	2.81%	5 days
2nd Grade	Math	0.211	2.79%	5 days
	ELA	0.119	2.79%	5 days
3rd Grade	Math	0.211	3.20%	6 days
	ELA	0.126	4.77%	9 days
4th Grade	Math	0.248	3.65%	7 days
	ELA	0.178	2.27%	4 days
5th Grade	Math	0.214	2.65%	5 days
	ELA	0.159	2.65%	5 days
6th Grade	Math	0.257	5.39%	10 days
	ELA	0.152	3.23%	6 days
7th Grade	Math	0.257	4.79%	9 days
	ELA	0.158	3.77%	7 days
8th Grade	Math	0.278	5.51%	10 days
	ELA	0.205	5.51%	10 days

Note: This table reports Youden's J statistics and the corresponding optimal absenteeism cutoffs for predicting 8th grade math and ELA standardized testing achievement level of *Not Meeting Expectations*. Youden's J represents the maximum vertical distance between the ROC curve and the random chance line. The optimal cutoff is the absence rate at which Youden's J is maximized. To facilitate comparison, absence rate cutoffs are expressed in terms of their equivalent number of days absent (final column).

RQ4: Temporal Proximity

To assess how predictive validity varied over time, we extended the ROC curve and Youden's J analyses to standardized math and ELA assessments from grades 3-7. We used absence measures from the same academic year or earlier than the standardized assessment to ensure temporal alignment between predictor and outcome. We then compared cross-grade patterns in diagnostic accuracy and thresholds to the 8th grade results presented in RQ2 and RQ3.

To assess whether the RQ4 findings were sensitive to changes in sample composition across grades, we repeated the analyses using the common sample of students with complete attendance and standardized test data across all included grades (Appendix F Table 3). The common-sample results were broadly consistent with the main findings. Although the exact ordering and identity of the top three absence predictors varied in some grade-subject combinations, the strongest predictors continued to be drawn primarily from the same or nearby grade levels, supporting the general conclusion that more temporally proximate attendance measures provide greater diagnostic information. The threshold results were particularly consistent: all Youden's J cutoffs in the common sample remained below the conventional chronic absenteeism benchmark of 10% of enrolled school days or 18 days in an 180-day school year.

Table 3. Top 3 Absence Measures and Optimal Thresholds for Predicting Math and ELA Standardized Test Performance in Grades 3-7

	Math				ELA			
Standardized Test Grade	**Top Absence Predictors**	**AUC**	**Youden's J**	**Youden's J Threshold**	**Top Absence Predictors**	**AUC**	**Youden's J**	**Youden's J Threshold**
Grade 3	Grade 2 Absence Rate (Total)	0.643	0.217	3.36%	Grade 3 Days Absent (Total)	0.596	0.152	7 days
Grade 3	Grade 2 Days Absent (Total)	0.641	0.210	7 days	Grade 3 Absence Rate (Total)	0.595	0.153	3.88%
Grade 3	Grade 3 Absence Rate (Total)	0.639	0.228	4.89%	Grade 2 Absence Rate (Unexcused)	0.594	0.173	2.24%
Grade 4	Grade 4 Absence Rate (Total)	0.700	0.297	5.54%	Grade 4 Absence Rate (Unexcused)	0.638	0.221	2.80%
Grade 4	Grade 4 Days Absent (Total)	0.698	0.292	7 days	Grade 4 Days Absent (Unexcused)	0.636	0.218	6 days
Grade 4	Grade 4 Absence Rate (Unexcused)	0.680	0.291	2.93%	Grade 4 Absence Rate (Total)	0.630	0.192	3.36%
Grade 5	Grade 4 Days Absent (Total)	0.664	0.241	7 days	Grade 4 Absence Rate (Total)	0.616	0.179	4.36%
Grade 5	Grade 4 Absence Rate (Total)	0.664	0.240	3.86%	Grade 4 Days Absent (Total)	0.616	0.176	8 days
Grade 5	Grade 5 Absence Rate (Total)	0.651	0.219	3.84%	Grade 4 Absence Rate (Unexcused)	0.611	0.162	4.99%
Grade 6	Grade 4 Absence Rate (Total)	0.658	0.238	5.20%	Grade 4 Absence Rate (Total)	0.631	0.197	4.99%
Grade 6	Grade 4 Days Absent (Total)	0.658	0.230	10 days	Grade 4 Days Absent (Total)	0.630	0.196	9 days
Grade 6	Grade 5 Absence Rate (Total)	0.651	0.218	2.45%	Grade 4 Absence Rate (Unexcused)	0.626	0.185	3.88%
Grade 7	Grade 7 Absence Rate (Unexcused)	0.660	0.279	2.80%	Grade 7 Absence Rate (Unexcused)	0.641	0.227	2.22%
Grade 7	Grade 7 Days Absent (Unexcused)	0.660	0.274	6 days	Grade 7 Days Absent (Unexcused)	0.641	0.224	4 days
Grade 7	Grade 7 Absence Rate (Total)	0.658	0.262	3.67%	Grade 7 Absence Rate (Total)	0.639	0.206	5.94%

Note: This table reports the top 3 absence predictors for each grade's standardized test outcome based on largest AUC. Youden's J statistics and the corresponding optimal absenteeism cutoffs are for predicting each grade's math and ELA standardized testing achievement level of *Not Meeting Expectations*. Youden's J represents the maximum vertical distance between the ROC curve and the random chance line based on the absence predictor. The Youden's J Threshold column is expressed in the units of the predictor.

Appendix G: Number of Students Flagged

Table 1. Number of Students Flagged at Youden's J and 10% Absenteeism Thresholds

Grade	8th Grade MCAS Subject	Youden's J	Youden's J Threshold for Total Absence Rate	Total N	Percent Flagged at Youden Threshold	Percent Flagged at 10% Threshold
Pre-K	Math	0.126	7.72%	4968	37.1%	26.0%
	ELA	0.087	8.36%	4978	34.4%	26.1%
Kindergarten	Math	0.172	7.44%	6442	30.2%	20.2%
	ELA	0.113	8.49%	6451	24.8%	20.2%
1st Grade	Math	0.184	3.92%	6497	46.1%	12.3%
	ELA	0.139	5.01%	6508	35.6%	12.3%
2nd Grade	Math	0.189	4.46%	6479	37.0%	10.4%
	ELA	0.131	3.34%	6489	48.4%	10.5%
3rd Grade	Math	0.209	4.41%	6500	39.4%	9.3%
	ELA	0.158	4.48%	6510	34.6%	9.4%
4th Grade	Math	0.244	4.75%	6542	34.9%	10.0%
	ELA	0.191	3.86%	6552	46.0%	10.1%
5th Grade	Math	0.227	3.32%	6585	48.6%	9.3%
	ELA	0.187	3.32%	6595	48.7%	9.3%
6th Grade	Math	0.241	4.52%	6616	35.2%	10.6%
	ELA	0.184	3.88%	6626	44.0%	10.7%
7th Grade	Math	0.246	4.46%	6764	39.4%	12.4%
	ELA	0.196	5.45%	6773	33.6%	12.5%
8th Grade	Math	0.262	6.16%	6799	31.0%	14.9%
	ELA	0.214	5.54%	6809	38.6%	15.0%

Note. Youden's J identifies the total absence-rate threshold that maximized the combined sensitivity and specificity for predicting whether students scored in the Not Meeting Expectations category on the 8th grade MCAS. Analysis N reflects the number of students with non-missing attendance and outcome data for each grade-subject combination. "Percent Flagged at Youden Threshold" indicates the number and proportion of students whose total absence rate met or exceeded the empirically derived cutoff. "Percent Flagged at 10% Threshold" reports the corresponding proportion of students who would be flagged using the conventional chronic absenteeism threshold of missing 10% or more of enrolled school days. MCAS = Massachusetts Comprehensive Assessment System.