



Fairbanks North Star Borough School District, AK

The Fairbanks North Star Borough School District created an early warning system, called the Dropout Risk Model, in the 2009-10 school year to improve the effectiveness of its Graduation Success Program. The Graduation Success Program provided targeted interventions to students in kindergarten through 12th grade and received funding through the American Recovery and Reinvestment Act of 2009 in the program's last 2 years of operation. While the Graduation Success Program concluded at the end of the 2010-11 school year, the district continues to use the Dropout Risk Model as a tool to help ensure that students who are at high risk of dropping out of school receive the interventions they need to succeed.

System Planning and Implementation

In the 2006-07 school year, the Fairbanks North Star Borough School District implemented the Dropout Prevention Program (later renamed the Graduation Success Program) to address the needs of students who were at risk of dropping out of school. In the 2008-09 school year, a district researcher participated in the program's annual evaluation process. The researcher's analysis of dropout rate data showed that a statistically comparable group of students not served by the program were twice as likely to drop out of school when compared with students who were served by the program. These findings also identified an opportunity to dramatically improve the program's effectiveness in reducing dropout rates using an early warning system. The analysis showed that the district dropout rate was predicted to have been 6.0 percent had the program not been in place; 5.4 percent with the program in place; and 4.2 percent if the program had used an early warning system to make service decisions.

Based on these findings, the researcher recommended continuing the Graduation Success Program and creating a new early warning system, the Dropout Risk Model, to inform the provision of program services to students. It was predicted that changing the population of students served by the program would more than double the program's effectiveness in reducing district dropout rates. Prior to the implementation of the Dropout Risk Model, students were identified as in need of program services based on vague criteria and unsystematic referrals. District leadership decided to implement the changes recommended by the program evaluation. School and district staff and administrators, including district superintendents, assistant superintendents, school principals, data management staff, research staff, and Graduation Success Program staff participated in planning for and implementing the changes recommended in the program evaluation. The Dropout Risk Model was developed in-house by the district researcher, who had knowledge and expertise in statistical modeling. The researcher was solely responsible for creating the Dropout Risk Model, including determining which indicators would be used.

Agency Background

Fairbanks North Star Borough School District serves approximately 14,000 students enrolled in 35 public schools. The adjusted cohort graduation rate is 74 percent. Approximately 60 percent of the student population is categorized in the White racial/ethnic group, while the next largest student groups are the Two or More Races group (14 percent) and the American Indian/Alaska Native group (9 percent). Approximately 35 percent of students qualify for free or reduced lunch, 16 percent have an Individualized Education Program (IEP), and 3 percent are English learners. (Source: ED, NCES, CCD, School Year 2015-16; EDFacts, School Year 2015-16).

Note: These numbers represent the most recent ED data and do not necessarily reflect the latest district data.

Early Warning Indicators, Data, and Analytics

The Dropout Risk Model uses eight early warning indicators to calculate each student's dropout probability. These indicators focus on attendance, course and assessment performance, on-track progression, and out-of-school suspensions.

Indicator definition and determination was guided through local validation using internal agency data. Additional indicators were also suggested by staff and the published research on early warning indicators. A statistical analysis of 10 years of longitudinal data was performed to identify indicators for inclusion in the model. Several indicators were considered in this analysis, but only indicators that reduced the false positive rate and increased the true positive rate were included in the model. For example, students with high rates of tardiness showed higher dropout rates in general, but since tardiness data did not reduce the false positive rate and increase the true positive rate, these data are not included in the model.

Another important model design consideration was whether to include student demographic data. Ultimately, any indicators related to student demographics or factors outside of the control of the student or the school were excluded from the model, including data on gender, race/ethnicity, economic disadvantage, homelessness, migrant status, English learner, military connectedness, and disability status. Thus, the model determines student risk based on what students do, not who they are.

No new data collections were necessary to support the Dropout Risk Model, as all the data elements were already available. Most of the data are included in the district's annual report to the SEA. Any data not included in this report are extracted from the student information system (SIS) or sourced from preexisting data files, such as state assessment reports. Additionally, certain data are compiled and transformed for inclusion in the model. For example, kindergarten through third-grade students do not receive letter grades using the A, B, C, D, F grading system, but grading data for these students are aligned with a 4.0 grading scale for inclusion in the Dropout Risk Model.

District technology staff support the district's data processes and are involved in collecting, disseminating, and displaying the data. Additional departments and staff participate in the data collection process as appropriate; for example, student grades are submitted through the district's SIS and daily attendance is tracked by attendance secretaries in each school. Each data file used in the Dropout Risk Model is heavily vetted for accuracy and several departments participate in reviewing the district's annual report prior to submission to the state.

The analytical model was developed over a few months and implemented during the 2009-10 school year. The model assigns students a risk level of low, medium, or high using a custom analytical approach. First, an initial risk level is calculated through a logistic regression model

Early Warning Indicators

- Attendance rate
- Difference between high school credits and number of years in high school
- District assessment performance
- Former dropout
- Grade point average (GPA)
- Retention
- State test performance
- Out-of-school suspensions

Early Warning Indicator Data Elements

- Aggregate daily attendance
- Aggregate daily membership
- Accrued high school credits
- Number of years in high school
- National percentile rank for AIMSWeb reading assessment
- National percentile rank for AIMSWeb math assessment
- Former dropout
- Grades issued in each course
- Retained designation
- Proficiency on state standards-based math assessment
- Proficiency on state standards-based reading assessment
- Proficiency on state standards-based science assessment
- Proficiency on state standards-based writing assessment
- Out-of-school suspensions

of two indicators: attendance and grade point average (GPA). Then, the remaining early warning indicators, each of which have established independent cut-points, are incorporated into risk level determination using a process similar to classification trees. This custom analytical model retains the complexity necessary for sufficient reliability and validity but is easier for users and stakeholders to understand than a multivariate logistic regression model. The model is designed to increase the true positive rate and decrease the false positive rate through reliable and valid analysis, and identify a smaller number of students through increased, but understandable and transparent, model complexity. The district researcher who created the model performs all data analyses and reporting. Since initial implementation, minor changes have been made to the model based on staff feedback and impact analysis results.

Risk level data for each student in grades K-12 are stored in a data file, which technology staff upload into the SIS. The SIS's primary screen displays each student's risk level using a custom color-coded dot icon (a green dot represents low risk, yellow represents medium risk, and red represents high risk). A data file, which includes risk-level data, is also sent to each principal each year.

System Use

After the Dropout Risk Model was implemented in the 2009-10 school year, the district needed to determine how the Graduation Success Program would use the model to determine which students would receive services. At the time, 19 program staff were responsible for serving 1,000 students. The ratio of staff caseload capacity to students who would potentially benefit from program services was quite high, which limited the program's ability to serve all students identified as medium and high risk. The district's data showed high-risk students comprised only 12 percent of student enrollment but comprised roughly two-thirds of all district dropouts. Furthermore, a propensity score matching of student data showed a comparable 50 percent reduction in dropout rates across all 3 risk categories, meaning that students at high risk of dropping out were equally likely to benefit from program services as those students who were at medium and low risk. To maximize the program's effectiveness in reducing the district dropout rate, district administration set the expectation that the program was to exclusively serve students who were identified by the model as high risk. An implementation review was also conducted to verify the program's conformity with this change. This expectation helped ensure that the program's limited resources were allocated to the group of students who would have the strongest influence on district dropout rates.

School principals, social service managers, counselors, and prevention/intervention specialists use the model's risk-level data to prioritize and assign students to interventions, services, and programs. To further encourage support for and use of the model, the model creator has delivered presentations to key leaders and stakeholders, including principals, federal program staff, Graduation Success Program staff, community achievement focus groups, and the School Board. These presentations have been particularly effective at generating support for the model. As an example, a presentation to the School Board showed that focused interventions could reduce the district's dropout rate and reduce dropout rate gaps between demographic groups. Furthermore, each student that remained in school ensured continued base student allocation funding for that student, making the model a positive return on investment for the district. This presentation served as a catalyst for the Board to consider specific methods to implement targeted interventions and motivated the district to hire four new social service managers. The primary role of these new staff is to coordinate, implement, and provide interventions and services to students who are identified as high and/or medium risk.

Since the model was first implemented, its effectiveness has been evaluated based on the district dropout rate. The served student group dropout rate is compared with the dropout rate of a comparison group defined through propensity score matching. Sufficient evidence has shown that the Graduation Success Program's services to high-risk students directly reduced the districtwide dropout rate, and the district dropout rate has remained consistently lower for students who

received services than a comparable group of students who did not receive services. In the first year that data generated by the Dropout Risk Model were used to assign students to services and interventions provided by the Graduation Success Program, the district dropout rate was 4.2 percent, the lowest recorded dropout rate for the district. In the following school year (2010-11) the dropout rate was even lower, at 3.9 percent.

Lessons Learned

- **Balance complexity and transparency.** The creator of the Dropout Risk Model noted that model design choices are especially important when creating an early warning system. They found that the use of certain statistical methods can make the analytical model more complex without drastically compromising transparency, which can help overcome some of the barriers associated with using a complex analytical model.
- **Devote adequate time to model development.** The district's development and implementation of the early warning system was relatively quick, allowing only a short period of time to develop the analytical model. As a result, multiple model refinements were necessary after the Dropout Risk Model was implemented. The model creator recommended that early warning system planning teams budget a sufficient amount of time to the development of the early warning system analytical model.

Delaware Department of Education

The Delaware Department of Education (DDOE) recently created an Early Warning System (EWS) plug-in as part of the state's Education Insight (EdInsight) Program. EdInsight, which was initially funded under Race to the Top in 2010, is a collection of projects and systems that support data-driven decisionmaking throughout the Delaware education system. The EdInsight Program has been in place for several years and includes Delaware's statewide longitudinal data warehouse and statewide performance management dashboard. The EWS plug-in is one of several projects that seek to leverage the EdInsight Dashboard to improve outcomes for all Delaware students.

System Planning and Implementation

The EWS planning and development process began in September 2017. The process was a collaborative effort involving SEA and LEA staff and external organizations. DDOE information technology (IT) and program staff worked with the Ed-Fi Alliance throughout the planning and implementation process. The Ed-Fi Alliance, funded by the Michael and Susan Dell Foundation, is a community of educators, technologists, and leaders committed to ensuring that schools, districts, and states can see, secure, and use education data. The EWS plug-in was originally developed by the Pennsylvania Department of Education (PDE) and was made available to Delaware through the Ed-Fi Exchange. Delaware worked with an Ed-Fi consulting group to adopt and modify the plug-in to meet Delaware's needs. Use of the plug-in incurred no major cost to the DDOE, although there was a small cost to incorporate the plug-in into the EdInsight Dashboard.

DDOE worked with an oversight committee to help guide goal setting, project planning, communications, and product review processes. Individual SEA and LEA staff participated in the

Agency Background

The state of Delaware serves approximately 135,000 students enrolled in 227 public schools within 53 school districts. The adjusted cohort graduation rate is 86 percent. Forty-six percent of the student population is categorized in the White racial/ethnic group, while the next largest student groups are the Black or African American group (31 percent) and the Hispanic/Latino group (16 percent). Approximately 37 percent of students qualify for free or reduced lunch, 15 percent have an IEP, and 7 percent are English learners. (Source: Source: ED, NCES, CCD, School Year 2015-16; ED, OESE, School Year 2014-15).

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EWS development process through a formal stakeholder engagement program. DDOE conducted two focus groups with invited LEA representatives. These focus groups included discussion on the topic of dropout prevention, demonstration of the EWS plug-in developed by PDE, and discussion on the relevance of the system to Delaware. A dedicated EdInsight data coach also collected formative feedback on the plug-in via interviews to help identify potential enhancements to the plug-in.

System integration and testing occurred in Winter 2018 prior to statewide release. DDOE worked with an external vendor to incorporate the EWS plug-in into the EdInsight Dashboard. A DDOE IT developer is responsible for vendor coordination, and a DDOE analyst is responsible for ensuring data quality and accuracy. DDOE's established and stable software application deployment process and relationship with the Ed-Fi Alliance has resulted in faster development time and reduced cost to the agency.

Early Warning Indicators, Data, and Analytics

The indicators used in the EWS plug-in were selected based on research conducted for PDE by a leading early warning researcher. This research identified the "ABC" indicators (attendance, behavior, and course performance) as critical in the early identification of students who are at risk of dropping out of school. DDOE reviewed these indicators with district and school staff during the EWS planning process to ensure that LEAs understood how the indicators are applicable in Delaware.

The EWS requires no new data collections or data entry activities to support implementation and use. Instead, the EWS plug-in uses data that are stored in the statewide SIS. Each day, the prior day's data are extracted from the SIS, loaded into the state data warehouse, and then transformed and loaded into the EdInsight Dashboard. Several data standardization

Early Warning Indicators

- Attendance
- Behavior
- Course Grades in Language Arts
- Course Grades in Mathematics

checks are performed throughout the extract, transform, and load process. DDOE also performed a series of thorough data checks in alignment with the agency's agile system development processes.

The EWS plug-in automatically flags students as at risk of dropping out of school if student data related to at least one at-risk indicator are found to be above a predefined threshold. No additional data analytics are required for the plug-in to identify whether a student is at-risk. The EdInsight Dashboard uses course grade metrics to measure major changes in student performance, but these metrics are distinct from the course grade indicators used in the EWS.

In February 2018, the EWS plug-in was deployed statewide and made available to approximately 13,000 active EdInsight Dashboard users. The EWS will help LEAs quickly identify whether a student has been flagged as at-risk, including students who recently moved between districts and schools within the state, which will enable LEAs to provide interventions to students.

System Use

The DDOE has several mechanisms in place to support LEA use of the EWS plug-in. Documentation on how to use the EdInsight Dashboard and EWS plug-in is easily accessible online, and the DDOE has created a plan to guide the agency's EWS-related communication activities. DDOE has a dedicated EdInsight data coach who provides free on-site staff training to every LEA during professional learning community time and staff meetings; these training sessions will include information on how to use the EWS plug-in.

Presentations on the EWS plug-in will also be delivered at the DDOE's regularly scheduled monthly cadre meeting. LEA staff, including data managers, curriculum directors, school counselors, IT directors, and lead teachers, attend the monthly cadre meetings. The DDOE regularly encourages EdInsight Dashboard use during cadre meetings and often incorporates a presentation on the

Dashboard into the meeting. These meetings provide LEAs with the opportunity to share how they use data to drive local decisionmaking processes.

The DDOE anticipates LEA feedback on the EWS during future monthly cadre meetings and EdInsight training sessions. DDOE expects that this feedback will be used to inform continued developments and improvements to the EdInsight Dashboard and EWS plug-in. The DDOE hopes that LEAs will be motivated by the EWS plug-in to develop a portfolio of resources and interventions to assist students and reduce their risk of dropping out of school. In support of this goal, DDOE is considering working with the University of Delaware to provide resource recommendations and opportunities to LEAs.

Lessons Learned

- **Collaborate with trusted partners.** The time necessary for system development was greatly reduced due to the DDOE’s collaborative partnership with the Ed-Fi Alliance. The help provided by the Ed-Fi Alliance enabled the DDOE to implement the EWS plug-in in a short timeframe and at a significantly reduced cost.
- **Solicit feedback to ease system implementation.** DDOE has taken steps to support the ease and effectiveness of the system implementation process. The Department pilot tested the system with select LEAs throughout the state, and feedback from participants was used to make system changes and improvements prior to statewide release.
- **Communicate early and often.** DDOE found it useful to share information about the system with LEAs during the state’s monthly cadre meetings. This provided LEAs with the opportunity to learn about the benefits of the system, which built anticipation leading up to the EWS’s statewide release.

Appoquinimink School District, DE

The Appoquinimink School District is very focused on education and has strong support from community stakeholders, which has helped the district maintain a consistently high graduation rate. Although the district dropout rate is consistently low, district staff and administrators were interested in better understanding what factors may influence a student’s decision to drop out of high school.

System Planning and Implementation

The Delaware Department of Education (DDOE) recently developed a statewide early warning system for LEAs to use. The district used this work by the DDOE as an opportunity to explore which early warning indicators are predictive of student dropout within the district. The statewide DDOE-created early warning system uses attendance, behavior, and course grades in language arts and mathematics to predict student risk of dropout. The district has used these DDOE-developed indicators as a baseline for developing a Student Index Warning, which serves as the district’s first step in locally validating potential early warning indicators. The district is planning to locally validate these indicators, but has not yet done so. The Student Index Warning will be used to compare data from students who drop out of high school and students who graduate from high school. This comparative analysis will help determine

Agency Background

Appoquinimink School District serves approximately 10,000 students enrolled in 16 public schools. The adjusted cohort graduation rate is 90 percent. Approximately 60 percent of the student population is categorized in the White racial/ethnic group, while the next largest student groups are the Black or African American group (25 percent) and the Hispanic/Latino group (7 percent). Approximately 15 percent of students qualify for free or reduced lunch, 14 percent have an IEP, and 2 percent are English learners. (Source: ED, NCES, CCD, School Year 2015-16; EDFacts, School Year 2015-16).

Note: These numbers represent the most recent ED data and do not necessarily reflect the latest district data.

what differences exist between these two groups of students and which early warning indicators are predictive of student dropout within the district.

Early Warning Indicators, Data, and Analytics

The Student Index Warning uses attendance, discipline, academic performance, and retention indicators to calculate a dropout probability score for each student.

In addition to data used in DDOE's early warning system, such as chronic absences and course failures, the Student Index Warning also draws on data available within the district. Both Smarter Balanced and MAP® Growth™ assessment data, as well as retention data, are included in the Student Index Warning. Data on student demographics, military-connected status, choice status, and transient status are also included. The Student Index Warning also tracks each student's grade of entry into the Appoquinimink School District, with a focus on whether students attended pre-kindergarten or kindergarten in the district. These data will be used to examine whether students who begin their educational career in the district are more likely to graduate than students who move into the district at a later grade level, with the goal of understanding what factors within district schools contribute to student success.

The Student Index Warning uses student data to calculate a points-based dropout probability score for each student. Each data element has an associated point system, and points from each data element are weighted equally in calculating dropout probability scores. For example, student grades are calculated using a 4-point grade point average scale: A grades are 4 points, B grades are 3 points, C grades are 2 points, and F grades are 1 point. Attendance is weighted using an equivalent 4-point scale: Students with an attendance rate of 95-100 percent receive 4 points. By monitoring a wide variety of data over time, with each data element using a 4-point scale, the district will be able to determine which factors are valid predictive indicators of dropout for students enrolled in the district.

The Student Index Warning exists as part of the district's data files. Each school within the Appoquinimink School District has its own spreadsheet file of school-level data. The file includes 17 worksheets, one of which is the Student Index Warning worksheet. Each worksheet includes key data and statistics on a specific topic of interest, such as grade distributions, teacher evaluations, and final grade correlation data. Pivot tables in each worksheet enable connections between the file and other data sources. For example, when a user clicks on a data cell that shows a percentage figure of chronically absent students, the user can view a list of all chronically absent students and review each student's individual records.

All Delaware districts and schools (public, charter, and alternative) use the same SIS, which helps facilitate data sharing between individual schools, their district central office, and DDOE. The Appoquinimink School District's central office Assessment, Accountability, and Educational Data Department staff manage the district's data systems and assist with exporting data from the SIS and importing the data into the district's data files. The data files, including the Student Index Warning,

Early Warning Indicators

- Attendance
- Discipline
- Academic performance
- Retention

Early Warning Indicator Data Elements

- Chronic absences
- Number of discipline referrals
- Number of suspensions (in-school and out-of-school)
- Course grades and failures
- Rasch Unit (RIT) scores from MAP® Growth™ tests
- Smarter Balanced assessment scores
- Retention

Other Data Elements

- Demographics
- Choice status
- Military connectedness
- Transient status
- Grade of entry

are updated each marking period; middle schools and high schools operate on a quarter marking period system, while elementary schools use a trimester marking period system. The district has iteratively developed and refined the file format and data update process over the past few years.

System Use

The Assessment, Accountability, and Educational Data Department supports school use of the Student Index Warning through regularly scheduled “data dig” meetings. The assessment, accountability, and educational data coordinator also reviews these data in meetings with senior district administrators, including the superintendent, assistant superintendents, director of instruction, and special education supervisor.

The assessment, accountability, and educational data coordinator travels to each school in the district to review the school’s data together with the principal. Data dig meetings are held each marking period and are approximately two hours long. By providing a wide variety of data in one easy-to-view file, principals can view their school’s data in aggregate, identify their school’s strengths and challenges, and act to address issues in need of further attention.

After data dig meetings, school principals meet with school psychologists and response to intervention (RTI) teams to advise them of students who were identified by the Student Index Warning as in need of intervention. Interventions are provided by school RTI teams and student services staff.

Lessons Learned

- **Draw on community connections.** The assessment, accountability, and educational data department coordinator noted that connections within the education data community have been very helpful in developing and refining the Student Index Warning. Connecting with colleagues in the education data community has helped the Assessment, Accountability, and Educational Data Department learn about the barriers, strategies, and successes other states and districts have faced in developing, implementing, and using an early warning system.
- **Diversify data teams.** The Assessment, Accountability, and Educational Data Department staff come from diverse professional backgrounds. Some staff have professional experience in data analysis, accountability, assessment, and research, while other data staff have professional experience as educators and school administrators. This diversity of staff background has helped the Department better understand how they can help support school administrators and staff fulfill their roles and responsibilities, which has enhanced the Department’s ability to provide data that are easy to use in analysis, evaluation, and decision-making.

Montana Office of Public Instruction

The Montana state education agency, the Office of Public Instruction (OPI), was interested in lowering the state dropout rates for all students, especially among certain subgroups. To help schools lower their dropout rates and encourage data use among Montana schools, the OPI created a voluntary statewide early warning system, Montana EWS, in the 2011-12 school year. The Montana EWS was created in-house by an OPI research data analyst.

System Planning and Implementation

Montana schools are not required to use the Montana EWS; instead, each school decides whether to implement it. An organizational culture that recognizes the importance of the Montana EWS and

prioritizes its use is an important factor in whether a school decides to implement the Montana EWS.

It is sometimes challenging to convince schools that the Montana EWS is an important tool since school use of the Montana EWS is voluntary, is not required by any OPI programs, and is not attached to any funding sources. The OPI has used several strategies to encourage schools to implement and use the Montana EWS. The OPI has worked closely with several schools to help connect the Montana EWS to interventions that are currently in place in the school. Additionally, the OPI offers small grants to encourage EWS use and help schools implement student interventions. The Montana EWS was also a part of Graduation Matters Montana, a program that provided private grant money to communities for projects that encourage students to graduate from high school. Looking ahead, the Montana EWS is included in the state's Every Student Succeeds Act plan, and all schools that are identified as comprehensive or targeted support schools will be required to use the Montana EWS.

Agency Background

The state of Montana serves approximately 145,000 students enrolled in 830 public schools in 497 districts. The adjusted cohort graduation rate is 86 percent. Approximately 79 percent of the student population is categorized in the White racial/ethnic group, while the next largest student groups are the American Indian/Alaska Native group (11 percent) and the Hispanic/Latino group (4 percent). Approximately 45 percent of students qualify for free or reduced lunch and 12 percent have an IEP. (Source: Source: ED, NCES, CCD, School Year 2015-16; ED, OESE, School Year 2014-15).

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The system implementation process varies from school to school. The OPI is typically involved when schools make the initial decision to use the Montana EWS, and which OPI staff are involved is determined based on the needs of the specific school. Training is provided on-site at the school, and it addresses setting up an early warning system team, how to pull the data needed for the Montana EWS, how to read system reports, and other information. Training also includes a review of the school's analyzed early warning data, which identify student risk levels.

Montana does not have a statewide SIS that must be used by all schools across the state. This poses certain challenges in supporting statewide planning and implementation of the Montana EWS. The Montana EWS requires schools to upload data into the state data warehouse, and because schools use different SISs, system capability and data uploads can be challenging. To alleviate some of these issues, the OPI established a required format that must be used by all schools when uploading data into the Montana EWS. The OPI has also worked with schools and vendors to develop a data extract feature for the two most commonly used SISs in the state.

Early Warning Indicators, Data, and Analytics

The OPI used both external research and internal data to identify early warning indicators. OPI staff consulted external research to determine which indicators might be helpful to include in the Montana EWS. The OPI then analyzed its internal data to determine whether these research-based indicators were valid dropout predictors for Montana students. The Montana EWS includes four locally validated indicators: attendance, behavior, grades, and mobility.

No new data collections were required at the state or local level to implement the system, as most of the data required to use the Montana EWS are already collected by schools. The OPI provides roughly half of the data required to use the Montana EWS from datasets already collected and reported by schools and districts. These data are stored in the state data warehouse. Individual schools must provide the remaining data. Most of these data are already collected by schools but are not reported to the state. The Montana EWS has a feature in place to account for data elements that are not collected by the school, which reduces the potential burden associated with implementing a new data collection to specifically support EWS implementation.

The Montana EWS is stored in the state data warehouse. An overview of the Montana EWS is available to the public, but the Montana EWS results are only available through a secure, password-protected version of the site. Each user must submit authorization forms, which requires signatures from the proper school representatives, to receive a login and password for the secure version of the site. Individual schools decide which school staff are granted access to the system and OPI controls overall system access.

Several OPI staff work year-round to ensure that data are entered correctly and in a timely manner. Data that are collected by the state are updated on a nightly basis. Because the Montana EWS requires schools to upload their own data, schools control the frequency, consistency, and quality of their data. Data uploads from the schools are typically performed by data staff, while data analysis and reporting are usually completed by a curriculum director, counselor, principal, or other staff at the school. The quality of the data uploaded by the schools is the responsibility of the school, and the OPI has taken certain steps to help ensure schools report quality data. In addition to providing training to schools, the state data warehouse has several data quality checks to make sure data are formatted correctly. Data that are uploaded to the system must pass these data quality checks to be accepted; users receive an error message when data are not accepted. Most schools choose to update their data monthly, but the system's use of current data enables schools to update system data on a daily basis if they so choose.

The Montana EWS uses a logistic regression analytical model to produce a percentage chance of dropping out based on each student's current data. Students are assigned a level of risk based on their results: low risk, at risk, and extreme risk. These results are made available to schools immediately after the data upload process is complete. The system provides these results based on the student's current data and stores the dated results from the previous 12 times that data have been uploaded for that student. The Montana EWS also generates school-level reports that aggregate the results of all the students in the school or district. In these reports, schools can see what percentage of students are flagged for each of the system's four risk indicators: attendance, grades, behavior, and mobility. These data are available for all students in the school and at each grade level. The state average and the previous results for that school are also provided. Using this information, schools can see in which areas their students struggle when compared to students in other schools in the state.

System Use

Each school uses the system, its data, and results a bit differently based on their individual needs. At most schools, principals and counselors are the main users of the system's early warning data.

Early Warning Indicators

- Attendance
- Behavior
- Grades
- Mobility

Early Warning Indicator Data Elements

- Attendance rate
- Absences in the last 60 days
- Absences in the last 90 days
- Number of behavior events in the last 120 days
- Number of out of school suspension events in the last 3 years
- Credits earned per year
- Number of previous term A's
- Number of previous term F's
- On track status to graduation
- Age difference from peers*
- Previously dropped out status
- Repeating a grade in K-8 (Retention)*
- Mobility this school year*
- Mobility from out of state*
- Number of towns/districts the student has attended school in*

Other Data Elements

- Age
- Gender*

*Data are collected by OPI

Other users may include curriculum directors, data analysts, teachers, and other school staff. At certain schools, students are provided with their individual results to help them better understand why they may be at risk of dropping out of school.

Schools can use the Montana EWS's reported results to identify which students at the school may need additional help, and then design targeted interventions that address why individual students, and the school overall, are struggling. Each school is responsible for developing and assigning students to intervention programs. The system's three risk categories (low risk, at risk, and extreme risk) correspond with many of the tiered intervention programs used by schools in the state, which can help schools determine which students should receive which types of intervention (universal, targeted, or intensive intervention). To evaluate the effectiveness of interventions, schools can use the system's longitudinal data to track students who are receiving interventions and determine whether those students benefited from the interventions they received.

The OPI has made several changes to the Montana EWS since the agency first implemented the system during the 2011-12 school year. Many of these changes were made based on feedback and suggestions provided by users from the field and include modifying the early warning indicators and moving the Montana EWS into the state data warehouse. The OPI also added new system features that allow schools to view different groups of students within the school and to see previous results for students that enroll in their school from another school within the state. The effectiveness of the system's analytical model is re-evaluated annually during the summer. The OPI reviews the Montana EWS's analytical model as well as feedback from users in the field, and then implements changes based on this evaluation to improve the model's effectiveness. In addition to using the Montana EWS for evaluation purposes, OPI staff also use the Montana EWS to determine whether the schools they are working with upload data into the system, and if so, how often the system is used.

Lessons Learned

- **Training is important.** The OPI noted that providing appropriate training is helpful to schools that use an early warning system. The OPI provides training at opportune times, including prior to system implementation, and as schools start to use the Montana EWS. Training activities also incorporate early warning data from the school to help school officials better understand the effectiveness of the system, how risk level is assigned, and how the school can use the system. Schools that fully understood the results of the Montana EWS's results and how to use those results benefitted the most from the system.
- **Have a champion.** OPI found that schools with at least one champion who understands and fully believes in the early warning system benefit the most from the Montana EWS. Having a champion in place can improve the likelihood that the school will continue to use the early warning system.
- **Encourage data use.** The OPI observed that schools who regularly use the early warning system are more likely to fully benefit from the system and noted that creating an early warning system team that meets on at least a quarterly, and preferably monthly, basis to review the early warning data is helpful. Teams can review and discuss both school-level and student-level results, as well as how well current interventions are working for students who were identified as at risk of dropping out.

Bozeman School District #7, MT

The Montana EWS is a voluntary statewide early warning system developed by the Montana Office of Public Instruction (OPI) in the 2011-12 school year. The Montana EWS analyzes the risk level of students in grades 6-12 at participating schools to determine student risk of dropout. The Montana EWS is used by the OPI to measure state dropout trends, and participation in the Montana EWS is at the discretion of individual schools and districts. The system is used in schools throughout Bozeman School District #7—including the district’s high school, Bozeman High School, and one of the district’s middle schools, Chief Joseph Middle School—with the support of the district’s central office.

System Planning and Implementation

Multiple factors motivated Bozeman School District #7 to consider implementing the Montana EWS. Staff and administrators were interested in more comprehensively and holistically examining student needs. The district was also familiar with the Montana EWS through its participation in Graduation Matters Montana and relationship with REL Northwest, the Regional Educational Laboratory that promotes the use of Montana’s early warning system.

The district formed a committee to consider the feasibility and appropriateness of implementing the Montana EWS. The District EWS Committee was comprised of building and district leaders (including the deputy superintendent, director of special education, high school principal, middle school principals, and elementary school principals), IT staff, central office staff, and Graduation Matters Montana representatives. Middle and high school principals also appointed appropriate staff from their schools to the committee, including assistant principals and at least one counselor from each building. Over the course of several years, the District EWS Committee coordinated its data systems, set a schedule for reporting frequency, established targets and goals for dropout prevention strategies across the district, and vetted student intervention options.

Bozeman School District #7 joined Project Responsive Education for All Learners (REAL) during the early warning system planning process. Project REAL is a grant-funded multi-tier system of supports (MTSS). Bozeman School District #7 uses the Montana EWS as an extension of the district’s MTSS program and has used the Montana EWS consistently since the 2016-17 school year. To support planning and implementation at the school level, individual schools established teams to oversee the planning process and support the successful implementation and use of the Montana EWS. Communication with staff regarding the Montana EWS was important for creating an understanding of the system. The district also received extensive training and guidance prior to implementing the Montana EWS. The Bozeman School District #7 central office provided training before and during implementation. Additionally, the district participated in REL focus groups; organized meetings, workshops, and site visits; and consulted resources and technical assistance on early warning systems from the Montana Education Research Alliance, REL Northwest, and Graduation Matters Montana.

Early Warning Indicators, Data, and Analytics

The Montana EWS uses four early warning indicators—attendance, behavior, grades, and mobility—to calculate each student’s dropout probability. The system also monitors good standing and

Agency Background

Bozeman School District #7 serves approximately 6,500 students enrolled in 11 public schools. The adjusted cohort graduation rate is 84 percent. Approximately 89 percent of the student population is categorized in the White racial/ethnic group, while the next largest student groups are the Hispanic/Latino group (4 percent) and the Two or More Races group (2 percent). Approximately 10 percent of students have an IEP and 1 percent are English learners. (Source: ED, NCES, CCD, School Year 2015-16; EDFacts, School Year 2015-16).

Note: These numbers represent the most recent ED data and do not necessarily reflect the latest district data.

changes in student performance and dropout probability. The district uses the same indicators as the OPI-created Montana EWS.

Data on mobility, retention, and gender are collected by OPI and imported into the Montana EWS, while attendance, behavior, and course performance data are collected and uploaded by districts. These data were already available, and no new school, district, or state data collections were necessary to support the Montana EWS.

The district uses several vendor-provided information systems. The District EWS Committee developed procedures for importing district data from these systems into the Montana EWS. At Chief Joseph Middle School, behavior and academic support staff, as well as MTSS leadership teams, are responsible for inputting, analyzing, and reporting early warning data to the district. At Bozeman High School, the high school's data teams work with the early warning data. Each data team includes the school's deans, a counselor, an administrator, and, as appropriate, support personnel such as a parent liaison, school psychologist, student support specialist, or nurse. The district data specialist is responsible for importing the early warning data into the Montana EWS for each participating school in the district. The district data specialist uses Structured Query Language (SQL) code to extract and upload the data necessary for the Montana EWS. The SQL code was developed by another Montana district that uses the same vendor-provided SIS. The query necessary for data extraction is complex and required considerable time to modify and refine. District data are pulled from the SIS and uploaded to the Montana EWS three times a year in fall (October), winter (January), and spring (May). The district data specialist also analyzes the data and prepares spreadsheets and reports to share with schools within the district. Principals, counselors, and MTSS teams are responsible for analyzing student-specific information at the school level.

Early Warning Indicators

- Attendance
- Behavior
- Grades
- Mobility

Early Warning Indicator Data Elements

- Attendance rate
- Absences in the last 60 days
- Absences in the last 90 days
- Number of behavior events in the last 120 days
- Number of out of school suspension events in the last 3 years
- Credits earned per year
- Number of previous term A's
- Number of previous term F's
- On track status to graduation
- Age difference from peers*
- Previously dropped out status
- Repeating a grade in K-8 (Retention)*
- Mobility this school year*
- Mobility from out of state*
- Number of towns/districts the student has attended school in*

Other Data Elements

- Age
- Gender*

*Data are collected by OPI

Numerous steps are taken to ensure data security and protect student privacy. All data collection and reporting systems are secure, and early warning data are uploaded to OPI over Secure File Transfer Protocol. The system does not yet include automated data checks, but each data extraction includes data verification steps. Reports and student lists are shared confidentially on a need-to-know basis with administrators and counselors who hold an appropriate security clearance. Furthermore, all meetings that include reviews of the early warning data are confidential. Regular reviews of the early warning data have identified opportunities to improve data quality. Bozeman High School staff, for example, noticed that a few students identified as at risk of dropping out seemed like they should not be on the list. Administration consulted with central office staff and worked to correct historical grade issues that had impacted the accuracy of the Montana EWS's results.

The Montana EWS uses multivariate logistic regression to calculate dropout probability and identify students at risk of dropping out. Students considered at risk of dropping out typically have one or two indicators that strongly influence their risk level. Support staff analyze each student's specific results according to the student's primary risk factor(s). Analysis of the model's accuracy to predict dropout within the district occurred in the 2017-18 school year. In addition to identifying student risk level, the system flags changes in student results with an arrow to help readily identify changes or patterns in student risk level over time. Bozeman High School staff devote time during data meetings to focus on students at chronic risk, as well as students who have a change in either their EWS risk level status or at least one early warning indicator.

System Use

Implementing the Montana EWS has started important conversations within Bozeman School District #7. High-risk students are typically already known to support staff and administrators, and the Montana EWS data have helped identify students before they become high-risk, such as students who are receiving marginal, but not yet failing, grades. This supports early interventions, which are often more successful than interventions that occur late in the student's educational career when the student may be at high risk of dropping out.

Bozeman School District #7 uses multiple strategies to encourage early warning data use. The district data specialist prepares spreadsheets and reports for each school in the district that uses the Montana EWS. School-level teams receive these reports from the central office for use in their intervention programs. Principals, counselors, and MTSS teams are the primary users of the EWS results at the school level. At the district level, the central office data specialist and administrators of the School and Family Engagement - Trauma Informed grant use the Montana EWS data as one metric in determining district success in supporting students.

At Bozeman High School, the data teams review Montana EWS reports and develop an intervention plan for each student identified as at-risk. Regularly scheduled meetings occur every 3-6 weeks and attendance is non-negotiable, meaning that no other activities on a team member's schedule may take precedence over data team meetings. Typically, the data teams review the 30 students who demonstrate the highest level of risk by the Montana EWS, with special attention paid to students with credit deficiencies and students who are new to Bozeman High School. The high school has a list of interventions to help match students with interventions that will best meet the student's needs. A designated member of each data team is responsible for coordinating with all appropriate personnel who will support the intervention plan. For example, if a student has attendance issues, staff will call the student's parent, and the student's attendance data will be shared with a dean for future monitoring. Administration will notify teachers if a student's grades are a concern and when an intervention plan is in place to address academic issues. If a student who is new to the high school is at risk of dropping out, an intern calls their parent(s) or guardian(s) and a check-in postcard is mailed to the student's home.

At Chief Joseph Middle School, Montana EWS data are reviewed by MTSS leadership teams. These teams use key data elements to identify students at risk of dropping out, meet to review and discuss the progress of students and intervention programs, facilitate communication of goals and action steps for counselors and teachers, and define work tasks. Data are disseminated on a need-to-know basis and are also used by building administrators, student services staff, and counselors as a fidelity check of their schoolwide MTSS implementation. The middle school uses a three-tier MTSS to address academics and behavior as part of their participation in Project REAL 2.0, a Montana State Personnel Development Grant. Fidelity checks also include site visits and self-monitoring tools, such as rubrics. The results of the fidelity checks are used to evaluate the effectiveness of the MTSS and develop action steps to support improved MTSS implementation, sustainability, and use. Students who are identified as at risk are referred for a tier II or III intervention provided within the MTSS framework. At the tier II level, Montana EWS data are used to create problem statements

and develop plans to address the problem statement. The tier II team is part of the decisionmaking process. Tier III is a more intensive approach to meeting the needs of at-risk students, and data drive the discussion and decisionmaking process. Intervention plans are developed by teams and/or the school psychologist using a menu of interventions; these interventions include programs, literacy workshops, and math strategies. The Montana EWS has guided a schoolwide effort to increase average daily attendance, as well as identify students at risk of dropping out due to attendance concerns.

Now in its third year of implementation, the district conducted an internal validation of the system in the 2017-18 school year; the analytical model is refined on an annual basis by the OPI. Longitudinal data will show if dramatic changes within the district's student population have occurred over time, if annual seasonal patterns are impacting students, and if students experiencing significant life events or challenges with transitions are inhibited from success. Looking ahead, the district hopes to use what they learn from the Montana EWS to build a similar system to predict middle school success so that elementary school students can receive support and interventions early in their educational career. Additionally, there is a desire for the Montana EWS to be better integrated with the district's SIS to review trends in individual student risk over time.

Lessons Learned

- **Devote adequate time to planning.** The Bozeman School District #7 central office allowed adequate time to verify the accuracy of the Montana EWS data and model before implementation. The additional time devoted to verification was worthwhile, even though the Montana EWS was not available as quickly as users would have preferred. Chief Joseph Middle School also recommended developing a plan for communicating with staff throughout the development and implementation process.
- **Customize approaches.** The district found that a standardized approach may not be useful for schools or students. Bozeman High School found it challenging to assign students to one-size-fits-all interventions, and the central office noted that it was useful to find out what works best for individual schools.
- **Set clear team expectations.** Both Bozeman High School and Chief Joseph Middle School benefitted from clear expectations for team members and team meetings. Chief Joseph Middle School developed MTSS leadership teams and assigned roles to members, including facilitator, timekeeper, data analyst, and recorder. The Bozeman High School data teams have set a clear building-wide expectation that data team meetings take priority over anything else on the schedule. Their regularly scheduled meetings apply a human perspective to the Montana EWS data, which helps add important contextual factors that may not be readily apparent in the data.
- **Use data to support teams.** Both Bozeman High School and Chief Joseph Middle School found the Montana EWS data useful for ensuring students and their data are reviewed in a systematic way, and that data are useful for informing discussions, actions, and interventions.
- **Celebrate successes.** The goal of the Montana EWS is to help students graduate from high school. Bozeman High School staff noted that it is rewarding when students who were at high risk of dropping out are able to get back on track and graduate from high school. Students who are doing well are sometimes recognized with a positive postcard or gift card.

Metro Nashville Public Schools, TN

Metro Nashville Public Schools (MNPS) created an early warning system in 2010 as part of a broader commitment to encourage data-informed school improvement across the district. MNPS was interested in adopting sustainable, proven strategies to improve student achievement and graduation rates, but was challenged by a high dropout rate and a high number of discipline incidents resulting in out-of-school suspensions and expulsions. In response to these challenges, the Tennessee Department of Education encouraged the district to systematically use data to identify district, school, and student needs; prioritize actions to improve; and provide targeted interventions to students in need.

System Planning and Implementation

The early warning system planning process began when the MNPS Department of Research, Assessment, and Evaluation partnered with the Everyone Graduates Center (EGC) at John Hopkins University (JHU). The Department and Center reviewed 10 years of MNPS data to identify locally valid early warning indicators and thresholds specific to the district. Predictive indicators of student risk of dropping out were identified for students in elementary, middle, and high school. Staff in the Department of Student Support Services were also involved in reviewing how the early warning data would be translated into intervention programs and services for students flagged by the system as at risk of dropout.

At that time, MNPS was implementing a new longitudinal district data warehouse system using Race to the Top grant funding. MNPS IT staff modified and extended a vendor-created technical platform to create the district's data warehouse. These modifications supported the district's need for additional data storage and advanced data analytics for use in data-informed decisionmaking. In 2011, the data warehouse team and IT staff collaborated with Research, Assessment, and Evaluation staff over 2-3 months to develop technical guidelines and requirements for an early warning system in the district data warehouse.

District leadership was supportive of the early warning system and was also made aware of the goals of creating the system. MNPS used resources on early warning systems to ensure that development and use of the district early warning system was informed by best practices. However, there was no formal implementation plan, which slowed the adoption and use of the system districtwide.

Early Warning Indicators, Data, and Analytics

MNPS analyzed its internal longitudinal data and reviewed current research by early warning system researchers to identify and validate its early warning indicators. Research from the JHU EGC and the University of Chicago Consortium on School Research was particularly helpful during the indicator development process. The district's early warning system uses three locally validated indicators: attendance, suspensions, and GPA. These indicators are aligned with the early warning "ABCs": attendance, behavior, and course performance.

All early warning system data are collected as part of the district's regular data collection activities; no new data collections were needed to support the early warning system. All data used in the early warning system are readily available in the district data warehouse and through extracts from the

Agency Background

Metro Nashville Public Schools serves approximately 86,000 students enrolled in 167 public schools. The adjusted cohort graduation rate is 81 percent. Approximately 42 percent of the district's student population is categorized in the Black or African American racial/ethnic group, while the next largest student groups are the White group (30 percent) and the Hispanic/Latino group (22 percent). Approximately 71 percent of students qualify for free or reduced lunch, 12 percent have an IEP, and 15 percent are English learners. (Source: ED, NCES, CCD, School Year 2015-16; ED*Facts*, School Year 2015-16).

Note: These numbers represent the most recent ED data and do not necessarily reflect the latest district data.

district's SIS. The data warehouse houses the early warning system and its data, and delivers reports to school, district, and community stakeholders. System data are updated nightly with newly reported data, such as attendance and behavior data, which are recorded daily; grades are reported on a quarterly basis. Student records are protected through a custom security model. Access to data is limited by staff role: district staff can access information on all schools within the district; school staff can access information on students within their school; and classroom teachers and staff can access information on students enrolled in the courses they teach.

Early Warning Indicators

- Attendance
- Suspensions
- Grade point average

Early Warning Indicator Data Elements

- Daily attendance, year-to-date
- Number of days suspended
- Quarterly GPA (0-100)

The district's data collection and reporting processes are supported by multiple staff at the school and district levels. Each school is responsible for entering individual student data into the SIS; these data are imported into the district data warehouse nightly. IT staff are responsible for maintaining and expanding the district data warehouse, as well as supporting the development of data reports in response to stakeholder needs. Automated data checks are conducted nightly as the data warehouse receives individual student data from the SIS. The Department of Data Quality and Integrity monitors data accuracy and assists in resolving the root cause of quality issues as they arise. Data quality dashboards and reports are also made available to school and district staff to help staff monitor, identify, and correct errors that impact data quality.

The early warning system uses a multivariate analytical model to assess student risk of dropout; data on each indicator are also reviewed independently. Each indicator has a predefined threshold that flags a student as at-risk. Risk levels are automatically calculated nightly using the most current data available, which enables staff to identify students in need of intervention as soon as possible. Students that are flagged as at-risk are highlighted on data dashboards to help prioritize action and interventions. The Department of Research, Assessment, and Evaluation is responsible for ensuring analytical model validity and providing information and guidance on algorithms and analysis methods. Data warehouse development/IT staff create accurate and meaningful data reports with features that can help stakeholders act on the data. For example, data drill-downs within a dashboard feature of the system enable users to review lists of individual students.

Early warning data reports are often used in conjunction with aggregate datasets and individual student data reports. For example, data on the early warning attendance indicator are disaggregated, interpreted, and used in tandem with other attendance reports that are disaggregated across different factors. Interpreting early warning data in combination with related datasets enriches understanding of the data and can prompt more effective interventions at the student or school level. Major changes in individual student performance that do not flag a student as at risk of dropping out, such as a major decline in assessment performance, are monitored through separate reports and data systems. Positive or negative growth trends across various student achievement measures are monitored through the data warehouse, which reports trends based on different units of time: a reporting quarter, a single school year, or multiple school years.

System Use

The extent to which the system is used districtwide differs between individual schools and departments. While no formal communication plan exists, clear communication and expectations are critical to supporting districtwide use. MNPS communicates information about the early warning system through multiple channels. Information about the early warning system and its indicators are shared with stakeholders at all levels—classroom, school, district, and school board—as well as a limited number of afterschool and community-based programs. Training and

system demonstration sessions are provided during team meetings and professional development activities. Training information is tailored to the specific audience's initiatives and work processes to help make the system more relevant to specific stakeholder groups. District data coaches and school intervention staff also share information on the system with the teams and staff with which they work.

The district encourages early warning data use in a variety of ways. Rather than existing as a standalone tool or dataset, the early warning system and its data are a key component of MNPS's districtwide commitment to data use. Data use is embedded in the MNPS strategic plan and promoted through district- and school-level meetings with staff and leadership. School leaders, data champions, and staff from data-focused departments serve as role models for data use within their school and promote the early warning system as a tool that can help solve problems that district leadership care about.

The Department of Student Support Services was an early adopter of the early warning system. Support teams—which include behavior specialists, attendance specialists, family engagement specialists, social workers, psychologists, and others—use the early warning system to manage staff caseloads, identify students in need of intervention, and develop intensive intervention plans. The system helps staff identify students who are at highest risk and prioritize these students for intervention services to ensure that department resources are allocated to supporting students who are most in need of interventions.

The early warning system is also used by staff and administrators at the district and school levels. At the district level, the system helps district leaders understand the extent of student dropout risk across the district. If the system identifies a high number of students as at risk across multiple indicators, district leaders work with individual schools to understand why students are at-risk. At the school level, counselors, staff, and leadership use the system to identify which students in their school are least likely to graduate. Teachers often have a strong understanding of individual student needs and circumstances, which can be helpful when referring at-risk students for specific intervention services.

MNPS has a variety of intervention programs and services to support students who are at risk of dropping out. Families of students who exhibit risk across multiple indicators are now more likely to receive a home visit from family engagement and intervention staff. Many schools have formal partnerships with community-based agencies that work with students on a referral basis. Additionally, many schools have dedicated “intervention periods” during the school day to provide students with services or content that meet individual student needs.

The district's overall commitment to improving data use has supported sustained, incremental improvements to acting with education data at all levels. Maintaining system flexibility and using and leveraging existing resources has enabled MNPS to adapt to changes, make improvements, and meet stakeholder needs in innovative ways. The early warning system has contributed to this effort by improving the district's ability to identify and provide interventions to students who exhibit risk of dropping out of school, which has improved graduation rates over time. Since the system was first implemented, the Department of Research, Assessment, and Evaluation has twice evaluated the effectiveness of the early warning system to confirm the predictive value of the early warning indicators. The district is currently conducting an analysis of more recent data with JHU EGC to determine cut scores for the off-track (dropout) indicator and a new on-track (college and career ready) indicator. The district plans to analyze National Student Clearinghouse data to validate college readiness indicators. The district also hopes to analyze de-identified data from the state's longitudinal data system that are not currently available to the district, such as labor participation data and data from Tennessee Colleges of Applied Technology, a state-supported college system with 27 campuses.

Lessons Learned

- **Invest in adoption.** MNPS began developing its early warning system in 2010. At that time, early warning systems were not as well-known and widely used as they are today. As an early adopter, the district had minimal external encouragement and resources to support system development and use. MNPS noted that establishing an understanding of the system's purpose and value amongst staff and engaging leadership in supporting system implementation and use might have encouraged broader and timelier adoption of the system in schools across the district.
- **Implementation is an ongoing process.** MNPS's use of early warning data has advanced as changes occur in district staffing, priorities, and programming. MNPS noted that implementation is never complete, as the people and methods for using the early warning system change as the district changes. Identifying ongoing opportunities to leverage all data, including early warning system data, to inform stakeholders is part of this ongoing implementation process.
- **Encourage teacher use.** Teachers are not required to review or act upon the early warning data. The district found that it can be helpful to provide resources that encourage teacher use, such as a toolkit to assist with selecting interventions or communication materials that explain the utility of early warning indicators. The district's instructional coaches also encourage teacher data use by assisting teachers in identifying and accessing data that are useful and relevant to their area of focus.
- **Align programs with priorities.** Early warning indicators can be used to create awareness for and align community programs with district priorities to ensure that community-based organizations provide programs and services that address student and school needs. The Nashville After Zone Alliance (NAZA), for example, evaluated their impact on student behaviors that are monitored through the early warning system. This evaluation found that participation in NAZA contributed to improved student attendance and discipline, both of which reduce student risk of dropout.

Wisconsin Department of Public Instruction

The Wisconsin Department of Public Instruction (DPI) created the Dropout Early Warning System (DEWS) during the 2012-13 school year as part of the State Superintendent's Every Child a Graduate initiative. DEWS is a statewide early warning system that identifies students in grades 6-9 who are at risk of not graduating from high school on time (e.g., within four years from the start of grade 9). DPI's goal for DEWS is to support schools as they leverage data to improve student educational outcomes.

DEWS was developed to address five key goals:

- *Early* - The system identifies whether students need intervention early in their educational career.
- *Accurate* - The system accurately identifies whether students need intervention.
- *Transparent* - Predictions and the assignment

Agency Background

The state of Wisconsin serves approximately 868,000 students enrolled in 2,291 public schools within 472 school districts. The adjusted cohort graduation rate is 88 percent. Seventy-one percent of the student population is categorized in the White racial/ethnic group, while the next largest student groups are the Hispanic/Latino group (11 percent) and the Black or African American group (9 percent). Approximately 39 percent of students qualify for free or reduced lunch, 14 percent have an IEP, and 5 percent are English learners. (Source: ED, NCES, CCD, School Year 2015-16; ED, OESE, School Year 2014-15).

Note: These numbers represent the most recent ED data and do not necessarily reflect the latest district data.

- of risk status are made in a transparent manner.
- *Reproducible* - Predictions are reproducible and do not vary based on changes in the prediction models.
- *Scalable* - System scalability accommodates a diverse array of student and school contexts.

System Planning and Implementation

DPI research staff initiated the DEWS planning process in early 2012 through the exploration and prototyping of a predictive analytic model. During this process, DPI researchers partnered with the Wisconsin Educational Research Advisory Council—a council of researchers that advises the state superintendent on education research matters—and consulted research literature on early warning systems and predicting high school dropout.

After a viable analytical model was developed, DPI formed a working group to develop and implement the system. The working group included staff and subject matter experts from across the SEA, including DPI's Policy and Budget team, Student Services/Prevention and Wellness team, Data Warehouse team, Special Education team, Office of Educational Accountability, and others. A research analyst on the Policy and Budget team led the system's technical and predictive model development and implementation process. The Student Services/Prevention and Wellness team developed training materials and support documentation that address how LEAs can use DEWS as part of their student intervention programs and systems.

DPI developed DEWS using open source software. The code is available for users and stakeholders to examine how risk scores are calculated, as well as for other education agencies to use in developing their own early warning system. During the system development process, the working group conducted a pilot test to assess DEWS prior to launching the system statewide. Select middle schools across the state participated in the pilot during spring 2013. DPI surveyed participating schools on the usefulness of the system and report formats, how well the system identified students' risk levels, the value of the interpretive guide and other supporting materials, and the school's likelihood of future use. The survey feedback was used to refine the system and the training support materials prior to statewide implementation.

The working group also created a communication plan, standard presentation materials, and a suite of training tools to publicize the availability of the new system to LEAs. During the summer before DEWS was launched, DPI staff delivered presentations at professional meetings, data retreats, and conferences throughout the state. These presentations reached several stakeholder groups, including principals, school counselors, special education coordinators, Title I coordinators, regional service agencies, and statewide RTI and Positive Behavioral Interventions and Supports (PBIS) networks.

In addition to technical information and interpretive/action guides, DPI emphasized that DEWS was not part of the state's accountability system and that risk assessments were not permanent labels, but rather intended to focus action on those students who are most in need of intervention. To this end, DPI decided to include DEWS scores only on the secure data dashboard system and only at the student level. This decision meant that some of the richer reporting features from the pilot had to be excluded. These user design decisions have impacted the adoption and usage of DEWS by LEAs.

Broad collaboration across the agency was critical to ensuring that the development process produced a system that is accurate, understandable, and useful for practitioners at the district and school levels. Through the involvement of many DPI staff and a substantial commitment from DPI leadership, DEWS was launched statewide in fall of the 2013-14 school year.

Early Warning Indicators, Data, and Analytics

DPI decided to include specific early warning indicators based on the availability of data in Wisconsin's statewide longitudinal data system, internal preliminary analyses of indicator accuracy, and consultation with the research literature on early warning systems. DEWS uses multiple indicators, including attendance, discipline, mobility, test scores, and demographics. These early warning indicators are used to identify students who are at risk of not graduating from high school within four years.

The Wisconsin statewide longitudinal data system is the source for all DEWS data, which influences the inclusion and exclusion of certain indicators and data that are commonly used in district- and school-level early warning systems. For example, course-level data are often included in early warning systems, but since these data are only available for a few years and not of high quality at the state level, they are not included in DEWS. Additionally, all test scores are from statewide accountability assessments, and discipline data are limited to out-of-school suspensions and expulsion and do not include less severe actions, such as in-school suspensions or detentions. DEWS also includes grade-specific school-level characteristic data in lieu of more direct measures of school climate to provide contextual information about the schools that may impact individual student outcomes.

DEWS predictions are calculated based on a statistical model of the associations between on-time graduation and all the individual and school-level indicators for all available cohorts of students who are eligible to have completed (or not) four years of high school. Each year, separate predictive models are produced for each grade level by combining results from 3 to 8 different machine learning algorithms. For example, a current sixth-grader is assigned predictions based on the observed on-time graduation status of previous cohorts of fifth-graders whose observable characteristics are similar to their own observable characteristics from fifth grade.

The use of longitudinal data and grade-specific models maximizes the accuracy of student risk predictions and helps overcome some of the inherent limitations associated with using data from a single school year per student. DPI re-estimates new predictive models each year to ensure that risk score calculations reflect the latest information available in the data. At present, risk scores are calculated for more than 90 percent of all current sixth- through ninth-grade students using data from students' fifth through eighth grade school years. DPI is currently investigating methods for generating risk scores for students who are missing data associated with one or more indicators.

Risk scores are calculated twice each school year in alignment with when DPI receives data for the various indicators: once at the beginning of the school year and once toward the beginning of the spring semester as a new year of data become available. Risk scores may be calculated more frequently in the future as data collections within the state become more automated and real-time. A Policy and Budget team research analyst is responsible for running the model to update risk scores, and the Data Warehouse team's IT staff are

Early Warning Indicators

- Attendance
- Discipline
- Mobility
- Test scores
- Demographics and other indicators

Early Warning Indicator Data Elements

- Attendance rate
- Total days enrolled
- Number of discipline incidents
- Discipline incident type
- Removal type
- Total days removed
- Number of districts attended
- Number of schools attended
- Number of enrollment spells
- English/Language Arts test scores
- Mathematics test scores
- Full academic year indicators
- Disability status
- Economic disadvantage status
- Ever retained-in-grade
- English Learner status
- Gender
- Race-ethnicity

responsible for loading the updated scores into the state education data warehouse and secure dashboard system. Automatic reports are integrated into the risk estimation process to check data and model validity. Risk scores go through an additional quality check as they are loaded into the data warehouse. Any errors or issues are addressed before risk scores are posted to the state's secure dashboard system for use by LEAs. LEAs may access risk scores for enrolled students through the dashboard, as well as the risk scores of students who move into their district from another district within the state.

System Use

DPI offers a variety of supports to encourage LEA adoption and use of DEWS. Training materials were initially developed by the DPI working group during pilot testing and are available on the DEWS website (<https://dpi.wi.gov/ews/dropout>). Through a partnership between DPI and the state's network of cooperative educational service agencies, the WISExplore project team provides training to LEAs on how to use data to inform decisions within a cyclical continuous improvement framework, including how to use and interpret DEWS scores.

DEWS is available for use by all LEAs in the state, but not all LEAs use the system. Many of the largest districts in the state developed their own early warning systems, while other districts use the early warning system that is included as part of their vendor-provided SIS. Many of the smaller districts within the state can readily identify those students who are at risk of not graduating in four years, which also limits the use of DEWS throughout the state.

DPI has taken several steps to increase the use of DEWS scores. A DEWS Action Guide is available on the DPI website, along with other links to specific supports, resources, and interventions aimed at helping students who are at risk of dropping out of high school. The WISExplore project team provides outreach to support DEWS use, often as part of an RTI or PBIS system. DPI monitors usage of the secure dashboard system and sends announcements to LEAs when updated predictions scores are loaded to the dashboard. DPI also redesigned the dashboard to make it easier to find DEWS predictions and collaborated with REL Midwest to conduct a survey of DEWS awareness and usage in the fall of 2015, 2 years after DEWS was launched statewide.

DEWS is intended to be used by middle and high school principals, as well as school staff who are included in the student intervention process. DEWS risk scores are often used during monthly planning meetings or as part of planning meetings held at the beginning of the school year. These scores help teachers and administrators identify which students are at risk of not completing high school on time and assign those students to specific interventions based on student need. Coupling state-validated predictions with local knowledge of individual student circumstances can help schools provide interventions that will work best for their students.

Since its statewide launch in fall 2013, DEWS scores have been loaded twice per year. DPI periodically receives user feedback and has implemented system updates, improvements, and changes in response. DPI continues to maintain, refine, and improve the system. Looking ahead, DPI plans to use scores from previous cohorts who have had time to graduate within four years to evaluate the accuracy of DEWS predictions and determine whether DEWS has influenced on-time graduation rates.

Lessons Learned

- **Establish agency support.** Broad support from DPI has played an essential role in the success of DEWS. DPI enlisted SEA staff and leaders from across the agency to share information on DEWS with LEAs. Additionally, the WISExplore team is an invaluable resource for training LEAs across the state on how to interpret and act based on DEWS risk scores.

- **Be transparent.** DEWS uses a complex system of grade-specific predictive models. Rather than promoting DEWS as a one-stop solution or flawless system, DPI has found that clearly and objectively explaining the capabilities, limitations, and accuracy of DEWS and its predictions helps encourage LEA trust in the system.
- **In-house system development and maintenance is beneficial for end users.** DPI staff developed and maintain DEWS in-house, which has made it easier for DPI to refine the system, update its prediction algorithms, and modify how risk scores are disseminated to users. This flexibility has also allowed DPI to respond to feedback from LEAs. DPI identified and addressed system issues from pilot users' feedback before the system went live statewide. Additionally, a new college and career readiness early warning system was produced during the 2017-18 school year in response to user feedback.
- **Support each step of the early warning system process.** As an SEA in a local control state, DPI and the WISExplore team are removed from direct interaction with students, cannot compel LEAs to adopt intervention programs, and are unable to develop an early warning system with integrated interventions and intervention monitoring. While these limitations can be challenging, DPI is committed to promoting and building capacity in Wisconsin LEAs as they focus on the data inquiry process and continuous improvement planning.

Conclusion: Lessons Learned From Case Studies

This chapter presented seven case studies that detail the actual experiences of SEAs and LEAs that have implemented, or are in the process of implementing, an early warning system. A summary of the lessons learned from these SEAs and LEAs concludes this chapter, with the goal of helping agencies who are planning to implement, or have already implemented, an early warning system.

System Planning and Implementation

- Secure broad support from staff and leaders across the agency by establishing a common understanding of the early warning system's purpose and value.
- Draw on professional learning communities and the experiences of colleagues to learn about the barriers, strategies, and successes other states and districts have faced in developing, implementing, and using an early warning system.
- Involve individuals from diverse professional backgrounds in planning teams to ensure that early warning data are easy-to-use in analysis, evaluation, and decisionmaking.
- Collaborate with trusted partners to support the system development process and reduce development time and costs.
- Pilot test the system and solicit feedback to ease the system implementation process.
- Consider in-house system development and maintenance, which may make it easier to refine and improve the system based on user feedback.
- Develop a plan to communicate with staff throughout the system development and implementation process.
- Provide professional development to create awareness and engage stakeholders.
- Share information about the system prior to implementation to help build anticipation amongst stakeholders.
- Think of implementation as an ongoing process, not a one-time activity.
- Prepare for the system to evolve as changes occur in agency staffing, priorities, and programming.

Early Warning Indicators, Data, and Analytics

- Budget a sufficient amount of time to develop the system’s analytical model.
- Balance analytical model complexity and transparency.
- Verify the accuracy of the early warning analytical model and data prior to implementation.
- Clearly and objectively explain to users the capabilities, limitations, and accuracy of the analytical model and its predictive abilities.

System Use

- Promote and build capacity for data inquiry and continuous improvement planning.
- Provide appropriate training at opportune times to help early warning system users understand the effectiveness of the system, how risk level is assigned, and how the system can be used across the organization.
- Create resources to encourage use, such as a toolkit to assist with selecting interventions or communication materials that explain the utility of early warning indicators.
- Identify ongoing opportunities to leverage all data, including early warning system data, to inform stakeholders.
- Use early warning data to inform discussions, actions, and interventions at the school, district, and state levels.
- Establish an early warning system team to systematically review school-level and student-level early warning data and assess how well current interventions are working for students identified as at risk of dropping out.
- Prioritize regularly scheduled early warning system team meetings and develop responsibilities for each team member.
- Have an early warning system champion in place to help improve the likelihood that the system will continue to be used.
- Support each step of the early warning process by integrating early warning system use with intervention provision, assignment, and monitoring.
- Find out what works best for individual students and schools, and offer customized intervention programs and services that will best meet their needs.
- Work with community partners to align out-of-school interventions with education agency priorities to ensure that community-based programs and services address student and school needs.
- Celebrate student successes, such as recognizing formerly at-risk students when they graduate from high school.