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# Early Warning Indicators and Intervention Systems: State of the Field

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In the mid-2000s a swell of national attention developed around the disturbingly low graduation rates, and in parallel, the disturbingly high number of high school dropouts that existed in many of the nation's public schools, school districts, and states. Dubbed the "dropout crisis," this public attention and media focus helped to spur sustained efforts and the dedication of additional interventions and resources on the parts of both community and governmental organizations at all levels in order to combat this crisis (Civic Enterprises, 2010). One of the key innovations to come out of the effort to increase graduation rates has been the development of Early Warning and Intervention Systems.

An Early Warnings System (EWS) uses measures of students' behaviors in school to predict and identify which students are most likely to drop out of high school or fail to earn a high school diploma. Longitudinal analysis is used to follow cohorts of students from a given grade in school, typically the ninth grade or the start of high school, through to when they graduate or dropout, and identify which variables reliably predict who and who will not graduate absent effective interventions. The analysis further seeks to find a manageable set of variables that collectively identify a significant number of future dropouts (Balfanz, Herzog, & MacIver, 2007; Easton & Allensworth, 2007). Multiple longitudinal analyses, across multiple states and school districts, have shown that the most powerful school indicators of a student's odds of graduating are attendance, behavior, and course performance, which have become known as the ABC indicators (Civic Enterprises, 2011).

Although it may seem like common sense that a student who is not attending school, failing courses, or whose behavioral issues are leading to disciplinary actions has lower odds of graduating, the leveraging of readily available data on the part of educational organizations to systematically identify at-risk students based on these variables and flag them for preemptive intervention was an innovation. Moreover, focusing on a student's school behaviors, how often they attend school, the extent to which they are successful in their courses, and their interactions with school disciplinary systems, rather than their characteristics (race, ethnicity, gender, and parental income) represented a fundamental shift in dropout prevention strategies and tactics. Prior to the emergence of early warning indicators based on student's school behaviors, dropout prevention efforts largely relied on student demographics and characteristics (race, gender, special education status, parental income, etc.) as a guide to who should receive dropout prevention supports and who should not. This resulted in poor targeting of those efforts, leading to many students who did not need help receiving supports, and others who did need help not being supported. As a result, multiple evaluations of dropout prevention efforts prior to 2007 found no impact (Gleason & Dynarski, 1998), and consequently the significant decline of federal investment in dropout prevention happened.

Within a decade, EWSs have spread from a few middle and high schools in Chicago and Philadelphia to most of the states in the nation with a near majority of high schools reporting their use. This chapter examines the origin and research base of EWSs, their defining characteristics, their spread across the nation, the evidence of their effectiveness, and contemporary efforts to extend their use both down into elementary grades and up to and through postsecondary success.

# HISTORY AND DEVELOPMENT OF EARLY WARNING SYSTEMS

The early research upon which EWSs are based is largely linked to two seminal studies, both published in 2007 (Allensworth & Easton, 2007; Balfanz, Herzog, & MacIver, 2007) that were built on findings, first released in 2005 (Allensworth & Easton, 2005; Balfanz & Herzog, 2005). Based on data from the Chicago and Philadelphia public school districts, two of the largest in the nation, research found that using students' attendance rates, course marks, and disciplinary records from as early as the sixth and ninth grades, they could effectively and efficiently identify the majority of students who would later drop out of high school and fail to earn a high school diploma. ABC performance data proved to have the three defining characteristics of a good indicator:

1. They were parsimonious. Each of the ABC indicators identified a set of students with high odds of dropping out that were not identified by the other indicators.
2. They had utility. Collectively the indicators identified a substantial portion of future dropouts, and cut points could be determined which effectively identified students with lower and higher odds of graduating.
3. They were actionable at the school level. Schools can take actions to improve student attendance, course performance, and behavior.

The studies suggested that by identifying students who had offtrack indicators and acting upon them early to put students back on track to graduation, schools, districts, and states could engineer significant reductions in their dropout rate and gains in high school graduation rates. The foundational studies (Allensworth & Easton, 2005, 2007; Balfanz & Herzog, 2005; Balfanz et al., 2007) also used only basic methods and the types of data that were typically collected by all school districts. The significance of this was that the analytic methods used by the foundational studies could be replicated by most school districts on their own, and without the use of any additional data collection. This enabled schools, districts, and states to see with their own data the predictive power of the ABC indicators and to establish locally meaningful cut points to identify when students' ABC performance signaled they were offtrack to high school graduation.

Further, the studies found that students' academic measures were powerful predictors, while student demographic characteristics were not (Allensworth & Easton, 2005, 2007; Balfanz & Herzog, 2005; Balfanz et al., 2007). This finding, consistent in this and other early warning indicator studies, is also important as students' gender, ethnicity, or family backgrounds are factors that school practitioners can do little to nothing about, while their attendance, course performance, and classroom behavior are highly actionable at the school level. Most of the research, both the above-noted studies as well as earlier research on dropout prevention, is descriptive in nature, finding relationships between these factors and later dropout events. No evidence was found that these factors are the causes of such dropout events (Alexander, Entwisle, & Kabbani, 2001; Balfanz & Herzog, 2005; Balfanz et al., 2007; Barrington & Hendricks, 1989; Battin, Abbott, Hill, Catalano, & Hawkins, 2000; Cairns, Cairns, & Neckerman, 1989; Ensminger & Slusarcick, 1992; Janosz, Le Blanc, Boulerice, & Tremblay, 2000; Lloyd, 1974; Morris, Ehren, & Lenz, 1991; Prevatt & Kelly, 2003; Roderick, 1993). Each student's case may be different, and while for many attendance, disciplinary issues, or course marks are strong signals of their disengagement from school and proximal causes, for others, the causes will be factors that are more complex and more difficult to address. In either case, the proven indicators function as a flag to identify those students who are most likely to later dropout, and do so at a time early enough to intervene from a prevention perspective while there is still time to alter their course toward high school graduation.

Engaging with students who are identified as struggling in school is much more easily done than working with students who have already dropped out, and such preventative interventions are typically less expensive and more cost-effective than reengagement programs (Jobs for the Future, 2014). Thus EWSs have been a highly feasible method for state, district, and school officials to tackle what for many seemed on the surface to be an insurmountable challenge in terms of size and scope when looking at their low graduation rates and the number of dropouts.

# GROWTH ACROSS STATES AND DISTRICTS

Since data on student behaviors (ABC performance) are readily available at the school level, identifying the students most at risk for dropping out became significantly easier for school-level practitioners. Once identified, determining the specific difficulties facing each student and the intervention that best suits their needs remained

challenging. The better targeting afforded by the ABC indicators meant that educator time and school resources could be focused on the students who would benefit most and early enough to increase the odds of success. Identifying students who are struggling in school and helping them do better is work that makes sense to educators. The value of regular attendance, good course performance, and good behavior are clear for student success and directly influence the effectiveness of educators. They are also areas where educators can in short periods of time potentially see firsthand the impact of their efforts (Davis, Mac Iver, & Fox, 2017). It is clearly visible when students, as the result of intervention efforts, begin to attend more regularly, stop getting in trouble, and do better in their courses. Thus EWSs are relatively easy to implement, modest in cost, make sense to educators, address real needs, and are visible and rewarding to educators.

Thus while the challenge of increasing graduation rates is in itself a large and daunting task, states, districts, and schools found at their disposal a highly feasible tool through which they could start to make inroads in tackling the dropout problem. The relative ease, cost-effectiveness, and utility of implementing EWSs have led to the rapid growth and expansion in their use across the country. It is striking to note that as practitioners in the field in 2006, the modern EWSs would only be found in a few middle schools in Philadelphia, a few high schools in Chicago, and in one-off instances in scattered locals throughout the nation, where they were developed by school building personnel. Today, just a decade later, many districts and states throughout the country have engaged in the process of developing and implementing EWSs. Early adoption was promoted and supported at the local, state, and national levels through the efforts of many, including membership organizations (e.g., National Governors Association, National Association of State Legislators, and National League of Cities), national non-profits (e.g., Achieve, United Way, and Americas Promise), teachers unions (e.g., American Federation of Teachers and National Education Association), research centers (e.g., Chicago Consortium on School Research and the Everyone Graduates Center at Johns Hopkins School of Education), and federal efforts [e.g., National High School Center, What Works Clearinghouse (WWC), regional education labs, and the High School Graduation initiative] (Civic Enterprises, 2011).

A review of each state's Department of Education Website along with the information from the College & Career Readiness Center and a 2013 Data Quality Campaign report showed that at the very least, the knowledge of early warning indicators has spread throughout the country and is approaching a universal level. In total, 43 of the 50 states and the District of Columbia report that they have engaged in the development of EWSs as of Summer 2017 (Fig. 4.1). For a few of these states the process has only begun with analyses of historical data records in order to establish the indicators upon which their EWS would be based. For a few others the EWS is not statewide, but the state provides support for those districts that seek to develop an EWS on their own initiative. However, for most states the systems are statewide, providing local educators and school staff such as principals, counselors, and teachers who seek, it with information and reports on which of their students have shown signs of falling offtrack and are in need of additional support. In a small number of states where there is no known state EWS, such systems may be in development or even in use but simply not advertised publicly, and at the very least, some districts in those states are likely to have undertaken the implementation of an EWS on their own at the district level.

The growing availability of early warning indicator data, however, does not provide a measure of its actual use or the extent to which schools have moved beyond identification of students in need of creating effective intervention systems. In this regard a recent survey by the US Department of Education on dropout prevention strategies, conducted with a nationally representative sample of schools, estimated that just over half of all schools were making use of an EWS [U.S. Department of Education (USDOE), 2016].

## COMMON ELEMENTS OF EARLY WARNING SYSTEMS

### Early Warning Indicators

Across states and districts the specific indicators that best identify future dropouts have proven to be remarkably consistent. In terms of the types of measures, attendance rates, behavior data (i.e., suspensions), and course marks (i.e., the ABC's) are consistently more predictive than are demographic measures or achievement scores from standardized tests (Everyone Graduates Center (EGC), 2010a, 2010b, 2010c, 2011, 2013). Each ABC indicator captures students with high odds of not graduating that would not have been identified without it.

Across studies, ABC indicators in the ninth grade year have consistently identified 50%−75% of future dropouts before the event occurred. They are predictors, not identifiers, so it is important to remember that some
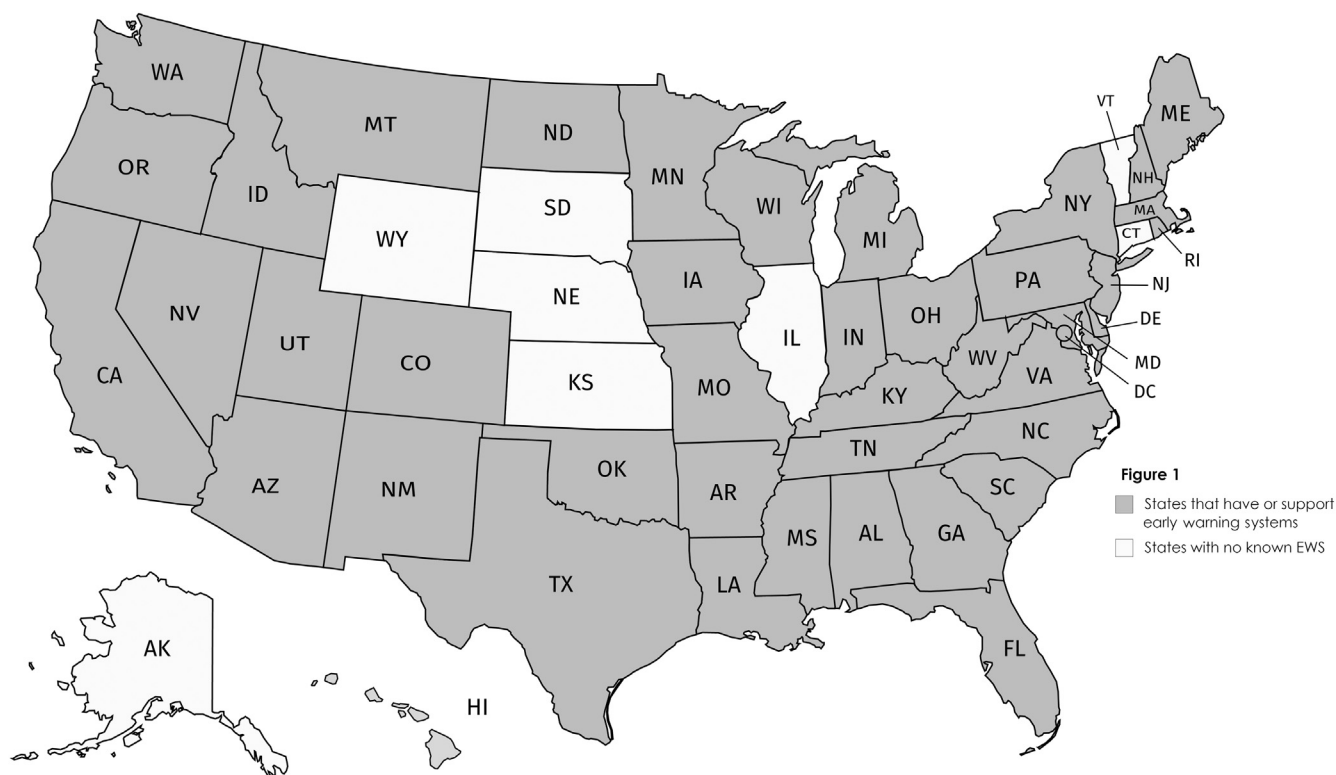
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**FIGURE 4.1**   States with early warning systems.

students with early warning indicators still do graduate, even absent intervention. What formally can be seen as false positives, students flagged in need of support, who would graduate without it, typically are in the 18%— 33% range, and roughly one out of every three to five students (EGC, 2010a, 2010b, 2010c, 2011). More and more evidence, however, is emerging that while some students with poor attendance, behavior, and grades graduate, few succeed in schooling beyond high school (EGC, 2011). As a result, the argument can be made that nearly all students flagged with an ABC indicator are in need of support to not only graduate high school but also to be prepared for succeeding in postsecondary education and beyond.

The US Department of Education's brief on EWSs reaffirmed that attendance and course-marks data along with disciplinary data are used by almost all schools making use of EWSs (USDOE, 2016). For those early warning measures, some variation can exist in how they are constructed and measured depending on the specific form in which districts and states record the data. Although attendance rates present a standard count of days (though variation does exist across locales in how attendance is measured and what counts as a day of school), educational organizations often have different ways of recording suspension data and course marks. In most cases, students' behavior is flagged through the number of out-of-school suspensions they receive, though in some places this count may include in-school suspensions or be measured instead by the number of school days missed due to suspension. Students' course work is most commonly measured through the number of course failures they experience, while variations may focus specifically on core courses, be expanded to include marks of "D" as well as failures, or instead measure course performance through students' grade point averages (GPA).

In addition to variation in how the indicators are operationalized, there can also be some variations in the ideal cut levels at which students are flagged, depending on the specific context and student populations that exist in a given state or district. For example, in locations where the student population is more disadvantaged, the cut levels might be lower, reflecting the degree to which all students struggle in school and which levels distinguish true disengagement. In such school districts the set of indicators might be attendance below 85%, three or more suspensions, and multiple semester failures. Conversely, in locations where the student population exhibits few

signs of difficulty on average, the set of indicators might be attendance below 90%, one or more suspensions, and one or more course failures. An example of two such contrasting school settings and the impact upon their resulting early warning indicators would be Philadelphia and San Jose (Balfanz et al., 2007; EGC, 2013).

However, the variation in indicators, both in terms of how they are measured and the specific cut levels, tends to be small, and in general, a consistent and predominant set has developed across the various settings and studies that is indicative of a future dropout event. *The normative set of high school early warning indicators of future high school dropout could be considered: attendance rates under 85%−90% (depending on locale); two or more suspensions; and two or more semester course failures (in any subject).* This set of predictors, examined in the ninth grade, has proven remarkably effective and efficient in identifying those students in prior cohorts who eventually dropped out of high school. They are effective in that they identify a large proportion of each district or state's total dropouts, and efficient in that the majority of students identified by the flags, absent effective intervention, ended up dropping out of high school.

Again, while a small amount of variation does exist between locations based on their unique context, early warning indicator analyses at the state level have also found that one set of indicators can be applied statewide and still be effective and efficient identifiers of high school dropout for all districts within the state (EGC, 2010a, 2010b, 2011). More specifically, the analyses have found that the sets of indicators can work statewide across districts that are both urban and rural, that vary in enrollment size, or are in communities of varying poverty levels. Similarly, analyses at the district level have found that one set of indicators can work effectively and efficiently across all schools that might vary by locale, size, or poverty level (EGC, 2016).

Recently, some state and district systems, as well as vendor-based student information systems and nonprofits, have begun to use algorithms to create overall risk calculations which combine ABC and other data in an attempt to identify relative risk across a population of students (Porter, Balu, & Hendra, 2017). Often this is promoted as a means to simplify early warning indicator data (i.e., providing one number to look at rather than outcomes across three school behaviors) or increase accuracy or timeliness. What is lost in practice is the action orientation of the ABC thresholds. A risk ranking alone does not provide any insight into what issues are putting a student offtrack or the areas where an intervention is needed. For that to occur, educators and student support personnel must first unpack what is behind the risk ranking. Thus, which method will be used should depend on what the overriding goal a school, district, state, or organization has in using early warning indicators. If very high accuracy in prediction and targeting the most in need is of the greatest value, then a continuous measure based on multiple data points (assuming they are available for all students) produces an overall risk ranking which could more effectively identify the most in need. This, in turn, could enable organizations and schools limited in their ability to support all students with lower odds of success, to focus their resources on those most at risk. On the other hand, if the greatest value is using early warning indicators to enable more effective and timely responses to students in need of them, then the ABC thresholds provide greater insight and support toward getting the right interventions, to the right students, at the right time, at the scale and intensity required. In practice, as will be detailed in the next section, experienced users of EWSs are moving toward hybrid solutions where data systems and reports provide both ABC threshold data and overall risk ratings. Also, ABC threshold data are being reported in more real-time intervals.

## Data Systems and Reports

In states and districts that have implemented an EWS the information is relayed typically to school staff through reports generated by and accessed through an online database system. These systems might represent an independent database into which staff enter students' attendance, behavior, and course information, or it might be the same student information system already employed by the state or district to store student records. In most cases an independent software program will then generate reports based on the data which teachers access to identify where their students stand and which students might be showing signs of falling offtrack and be in need of additional support. Typically, a red, yellow, green color coding or other visual means are used to focus attention on those students most in need of intervention. The color coding and visual cues also help illuminate patterns among groups of students. One of the advantages of using student attendance, suspension, and course data is that reports can be generated frequently throughout the year. Teachers can receive reports on students at the start of the year based on their prior year's data, or at any other time during the year based on year-to-date attendance, suspensions, and course marks. Thus, based on the readily available data and combined with the database and software programs, teachers can receive basic reports early and often in order to stay on top of those students showing signs of disengagement.

Until the past few years the norm had often been for schools or districts to use spreadsheet-based systems to enter and analyze early warning indicator data, and free spreadsheet systems like those made available by the National High School Center became widespread. One reason for the use of available spreadsheets is that it was not uncommon for ABC performance data to be collected at the school and district levels using different data collection systems without a simple means available to aggregate the data from these independent systems into early warning reports. Thus while schools have collected ABC performance data since their inception and nearly all student report cards contain it, the inability to readily aggregate ABC performance data at the classroom and grade level has stood in the way of schools using ABC data in predictive manners. In the past 5 years or so the widespread adoption of more modern student information systems and the inclusion of early warning modules in these systems by most of their major vendors is leading to more and more schools, districts, and states having access to early warning reports that require no additional work by school staff to create.

At present, variation across schools with regard to early warning indicator data includes who has access to it, how frequently data are updated, what additional data beyond the ABC's are provided for each student, and what levels of aggregation are allowed. In some locales, direct access to early warning indicator data is restricted to administrators and counselors, who then must download and provide the data to other school personnel. In other locales, teachers can get direct access to early warning indicator data for their students, while in others the data are provided to parents. In some of the early versions of EWSs, at both the state and district levels, early warning data were provided only on an annual basis at the start of the year, when schools were provided lists of students who in the prior year exhibited an early warning indicator.

With the movement to more modern student information systems over the past 5 years, the norm is becoming that schools have access to more real-time early warning data, in some cases with daily updates on attendance, updates on behavior as incidents occur, and course grade data entered at least on a quarterly basis. In some locales, EWSs have been linked to electronic grade books, so weekly course performance data can also be provided. Different state, district, and vendor EWSs also vary in what else they report along with data on ABC performance. Some EWSs include student achievement data, some import student survey data, in particular on social, emotional, and resiliency measures, while others include overall risk analysis. A final area of difference is the extent to which the EWSs facilitate the aggregation and disaggregation of data into different levels of analysis, for example, classroom level, grade level, student subgroup level (both by demographics and school activity participation, i.e., football team and band), school level and district level.

## Multitiered Response Systems

Although there has been a significant amount of convergence across states and districts with respect to the information contained in early warning indicator reports, there has been less explicit and implicit standardization on the response side. In short the field has made more progress in predicting who has high odds of dropping out, than in establishing what are the most effective responses and interventions when students signal they are on the path to dropping out. There are several areas on the intervention side, moreover, where consensus has not yet been formed. First, there is variation in terms of which students with early warning indicators are prioritized for intervention; as is typically the case, intervention resources are less than intervention demands. Some schools and districts focus on the students with the greatest need, others on those who are most likely to respond to the level and type of interventions the school has made available. In some locations the focus is on students with two or more indicators, in others, on those who have recently developed one. There is also variation in how schools organize response teams. Some employ or build on existing student support teams. Sometimes, these teams were initially designed to determine if students required or would benefit from special education services. Others see the work of early warning-linked intervention as the domain of the school's psychologists, counselors, and social workers. Another variation, particularly in schools with large numbers of students with offtrack indicators, is to create grade-level teacher teams who share common students, and build in time ranging from weekly to monthly for the teams to meet, review early warning indicator data, pool their insights to design interventions, assign a champion to make sure it's implemented, and then monitor the results. Yet another means some schools and districts employ is to partner with nonprofit organizations to assist with the running of early warning indicator and intervention meetings and provide additional interventions and the person power to implement them.

The emerging best practice in the field suggests that the means chosen to organize response systems should depend on the scale and intensity of student need in the school (Rumberger et al., 2017). For example, if less than

30 students in a school have an early warning indicator, a counselor, social worker, or dedicated staff member could manage a caseload of this size. If there are between 30 and 60 students, a student support team of teachers, counselors, and an administrator may be able to do it (Brown-Chidsey & Bickford, 2016). Once there is more than 60 or so students in a school with early warning indicators, a whole-school approach employing teacher teams is called for, and when the number reaches well over 100, nonprofit and community partners will likely be needed to augment teacher teams to provide the additional interventions and person power required (Corrin, Sepanik, Rosen, & Shane, 2016).

The adoption of multitiered approaches provides an example of where there is strong convergence in practice in the use of EWS. In some cases, this grows out of a school's or district's experience with response to intervention, and more recently multitiered systems of support; in others, it is rooted more in the adoption of public health models. Whatever the source, most users of EWSs seek to combine preventative strategies to reduce the number of students who develop early warning indicators, with a range of interventions that vary in intensity and group size depending on students' needs. This represents a significant shift in thinking about prior student support efforts in many schools that were largely based on remediation after student failure. EWSs attempt to intervene and put students back on course before they experience course failure, trigger grade retention, or dropout from school. The core idea is that once flagged by an early warning indicator, adults respond by gathering additional data and information on root causes, prior intervention attempts, and the student's current situation, temperament, and needs to design the most appropriate response or employ the intervention most likely to succeed. In the most effective response systems the implementation and impact of the selected intervention is tracked, and modified as needed. Overall, the use of multitiered response systems and seeking to act early and change the course of student outcomes before course failure, grade retention, and dropout, results in a much more nuanced and customized approach to the assessment to intervention interaction.

## EARLY EVIDENCE ON IMPACT OF EARLY WARNING SYSTEMS

As EWSs have quickly risen to become a key dropout prevention tool for educational organizations across the country, the research behind them has continued to develop. Direct evidence of their impact on graduation rates though is more limited. Although the use of EWSs has grown rapidly in the past several years, analysis of their impact on student outcomes is in its early stages. Partly this reflects the long time lags involved. Widespread adoption of EWSs has occurred in just the past 5 years. EWSs targeted at the ninth grade require at least 4 years to reveal impact on graduation rates, as that is the time it takes for the students to graduate. The lags for EWSs implemented in the middle grades are even longer.

Impact analysis of EWSs is typically difficult given the context of the implementation. They are implemented often in all schools simultaneously leaving no plausible control group, or implanted in tandem with several other and confounding intervention programs. Some evidence, however, is beginning to emerge. Researchers at the Chicago Consortium for School Research have shown that there is a strong correlation between schools and districts that show improvements in the percentage of students who are on track at the end of the ninth grade (fewer suspensions, fewer course failures, and regular attendance) and then gains in those same schools' and districts' graduation rates 4 years later (Easton, Johnson, & Sartain, 2017), suggesting that where EWSs are implemented with the direct goal of keeping students on track, then they are likely to be tied to the longer term goal of increased graduation rates. Further, several randomized control trials have demonstrated that implementation of EWSs had positive impacts on attendance and/or course passing, key drivers of high school success. A recent evaluation of a randomized study of high-poverty middle and high schools found that those schools implementing EWSs had significantly more students with no early warning indicators at the end of the sixth and ninth grade, with the strongest impact occurring at the sixth grade level, where positive impacts on reducing chronic absenteeism were also found. Although EWSs in this study were implemented as part of a larger whole-school improvement effort, implementation data indicated that the main difference between the treatment and control schools was primarily the components and practices associated with EWSs (Corrin et al., 2016).

A second recent study based on random assignment amongst a sample of 73 high schools found promising evidence as EWSs were found to have a significant positive impact on reducing chronic absenteeism and course failures, the two strongest indicators of future dropout events (Faria et al., 2017). Although the impact analysis of a third randomized study with a sample of 40 high schools, half of whom implemented an EWS, is not yet published, implementation results show that high schools that implemented a greater percentage of the core early

warning components and activities in the ninth grade saw greater increases in ninth grade student attendance and course performance (Davis et al., 2017).

The US Department of Education's Institute of Educational Science's WWC recently released an updated practice guide for Dropout Prevention. WWC practice guides follow a strict protocol for defining the criteria studies need to meet to be considered for the review of evidence of impact, and for how many such studies with what level of impact are needed to demonstrate evidence of effectiveness. In the most recent guide the core elements of EWSs were described as the first recommended practice, meaning that enough evidence exists to justify recommending its use but the overall evidence to support the effectiveness of the practice is rated as minimal (Rumberger et al., 2017). Even though this ranking was established prior to the aforementioned studies, it remains a good overall appraisal of the current body of research on the impact of EWS on student outcomes. Enough evidence has emerged for the WWC to offer it as key recommended practice to prevent school dropouts. Overall, evidence gathering is still in the early stages, promising but not fully confirmed.

# EMERGING DIRECTIONS FOR EARLY WARNING SYSTEMS

As the use of EWSs in grades 9−12 continues to expand and be refined, other research is also being conducted that pushes them in new directions, both upward and downward.

## Elementary and Middle Grades

One natural extension has been to see just how early students can be identified as falling offtrack. As ninth grade is typically when students struggle with the increased academic rigor of high school, and the highest number of dropouts occur, most EWSs have been designed and implemented to catch students at the start of high school. Early research into early warning indicators has also found that students' academic measures as early as the sixth grade can effectively and efficiently identify those students who will later experience dropout events. However, while student experiences in the middle grades have been found to be predictive of high school graduation and dropout, more recent research in some districts (EGC, 2010c, 2016) has found that the same measures taken from students' elementary years are not reliable for predicting their high school experiences.

With each year back in a student's educational history the effectiveness and efficiency of the indicators decrease somewhat. Although the typical set of indicators remains relatively powerful in grades 6−8, the specific cutoff levels require some adjustment. As adverse academic signals (such as suspensions and course failures) are less frequent in the middle grades, lower levels of disengagement are more indicative of future dropout events than they would be comparably in high school. A normative set of indicators for the middle grades is then more likely to include attendance rates below 90%, one or more suspensions, and a course failure in either a math or reading/English language arts course (the two core subjects).

In the elementary grades, K-5, the ABC indicators either lack the predictive power to reliably identify future dropouts, or they require adjustment to such a level that they identify far too few to be effective. One reason is simply that in the elementary grades, very few students exhibit the kinds of signs that are representative of disengagement from school, such as course failures and suspensions. Another is that the distance in terms of time and measurement between their elementary experiences and high school ones is too great for there to be a strong and direct relationship of the kind needed to predict and identify future dropout for practical intervention.

As a result, current work on early warning indicators in the elementary grades is examining the potential of a somewhat different approach. There has been some research suggesting that third grade reading levels, and in particular not being able to read well by the third grade, correlate with future school success and high school graduation (Annie E. Casey Foundation, 2010; Hernandez, 2011). The flip side of this is that some students who do well academically in elementary school still develop offtrack indicators between sixth and ninth grade. This indicates that at least in high-poverty environments, academic proficiency alone is not fully protective against other factors which can lead to poor attendance, behavior, or course performance in the middle and high school years and result in students falling offtrack to graduation. In a recent randomized study across 11 high-poverty school districts, fully 40% of students who entered the sixth grade, academically proficient in math and English, developed an offtrack indicator in the sixth grade (Corrin et al., 2016).

The one indicator, where there is perhaps the strongest evidence for a connection between behaviors in elementary school and the later development of early warning indicators for dropout, is chronic absenteeism.

Here there is evidence that early chronic absenteeism both leads to lower academic performance in elementary school and a greater likelihood of being chronically absent in the middle grades (APR, 2011; Balfanz & Byrnes, 2013; Chang & Romero, 2008; Connolly & Olsen, 2012; Ready, 2010). Finally, in the behavioral realm while suspensions and even office referrals may not be prevalent enough to serve as effective indicators, there is a growing body of research that shows some behavioral indicators which measure emotional control, and self-management attributes can be linked to both positive and negative long-term outcomes, including high school graduation.

## Postsecondary Education

Going in the other direction, there has been greater success in using EWSs as predictors of student outcomes beyond high school. Research conducted in at least one state and one large school district has found that the same set of ninth grade ABCs used to predict high school completion can be used by states and districts to predict postsecondary enrollment amongst students (EGC, 2011, 2016). The difference is that instead of identifying levels which students should not drop below in order to be on track for high school graduation, postsecondary success indicators establish the thresholds students must be above to be on track for postsecondary success. Focusing solely on postsecondary outcomes, the normative set of indicators for students who are on track to enrolling in college or university might be attendance rates of at least 90%, and at most one suspension, and at most one course failure. In other words, while students can afford one mistake in terms of behavioral discipline or course failures, they cannot develop a pattern of repeat incidents. Rather, they must be in school nearly every day in order to not only earn a high school diploma but also to be prepared for continuing their education at the next level. If the bar is raised from mere enrollment to persistence, then the students with the highest odds of multiple years of postsecondary participation, attend 95% of the time or more, have no behavioral issues, no course failures, a "B" or better GPA, and mid-level or better test scores. Due to the longitudinal limitations of the data the above-noted studies were only able to examine postsecondary enrollment as an outcome and not completion, though results were confirmed for some level of persistence in terms of the number of postsecondary semesters completed.

In comparison to research on early warning indicators of high school outcomes, standardized achievement test scores and course work are stronger predictors of postsecondary outcomes (Mac Iver & Messel, 2013). This is not surprising given that both achievement test scores and GPA are key admission components for postsecondary institutions. However, given that achievement test scores are not administered at each grade level, are often missing data for many students, and typically only given once a year toward the end of the school year, they remain a poor early warning indicator for practical reasons. Course work, however, was the strongest predictor of students' high school outcomes and is an even more critical predictor of their postsecondary enrollment. In particular a GPA of a B-average or better seems to be a key leverage point for students to continue beyond high school into postsecondary, especially in terms of enrolling in 4-year degree granting institutions versus 2-year programs (EGC, 2011, 2016). Continuing the further extension of EWSs and their use, postsecondary institutions have begun to make use of them to identify students who are falling offtrack to earn their postsecondary degree.[1]

## CONCLUSION

The growing attention to the national dropout crises, in tandem with the rise of information technology to support the development of student information system databases, helped lead to the innovation of EWSs. The dropout crisis created the need, while ease of access to readily available and actionable data provided a solution that was cost-effective and universally replicable. The result has been a quick spread of EWSs in the last decade such that they are now employed in virtually every state and in roughly half of all schools across the country.

The research backing their development has also been replicated across many districts and states across the nation and consistently confirmed the findings that a core set of measures on student academic performance (ABC marks) can efficiently and effectively identify future high school dropouts years ahead. The research has also shown that while some minor variation exists in the use of these indicators across various locales and contexts, they can reliably be used across the nation, in a variety of settings, urban or rural, and with student populations of varying backgrounds. Early indicators of the potential for future negative outcomes are only useful if

[1]http://www.sciencemag.org/news/2017/02/computerized-early-warning-system-students-academic-trouble

they are paired with appropriate and effective actions to change the student's course so the negative outcome does not occur. Fortunately, EWSs are viewed and implemented as both an indicator and response system. Building off prior exposure to the idea of multitiered responses, more and more schools and districts are seeking to combine preventative actions to reduce the number of students with early warning indicators, with a range of interventions and responses customized to student need and situations to effectively intervene before negative outcomes occur.

Although it is still too early in the use of EWSs to have evaluated their direct impact on high school graduation rates, early research that has evaluated their short-term impact has found significant and positive effects on reducing the numbers of students with early warning indicators (chronic absenteeism, suspensions, and course failures) which is directly correlated to the numbers of high school dropouts. And as they become an established tool of educators in their work to have every student achieve a high school diploma, newer research is also pushing them outward in new directions. On one hand the use of EWSs is being pushed down to the elementary grades in order to identify offtrack students at the earliest times. On the other hand, EWSs are also being pushed up into postsecondary outcomes to help students succeed not only in graduating high school but also to be well prepared for postsecondary opportunities in order to achieve the best possible lifelong and career paths.

As the support of EWSs continues to develop, and they are pushed into new directions, there are also indications that EWSs are both a part of and a potential driver of a broader realignment of how schools and school systems support student success. The dominant paradigm, especially at the secondary levels in the United States, has been that teachers teach, and it is the student's personal responsibility to attend, try, and succeed in their classes, and when this does not occur, students are retained in grade and offered remediation or second-chance opportunities often in alternative schools. With the shifting perception of US high schools, from being seen as the final end point of public education for many students, to a launching pad toward postsecondary schooling or training for all, there has come a greater recognition of the social and economic costs of high school dropouts. The US secondary schools are beginning to change their approach to student supports from one of retention and remediation to a more proactive approach based on predictive indicators and multitiered response systems. Momentum in this direction is being further fueled by a greater awareness of the tight integration of social, emotional, and academic aspects of student learning and success (National Commission on Social, Emotional, and Academic Development, 2017), as well as a deeper understanding of how poverty impacts a student's ability to succeed in school. This all speak to EWSs becoming a key tool schools and districts can use to improve how they link the assessments of student need to effective interventions to improve student outcomes. This, in turn, could enable them to become more timely and tailored in their responses to student signals, and as a result, it increases the number of engaged students, high school graduates, and students prepared for postsecondary success.

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