INTERVENTION DOSAGE IN EARLY CHILDHOOD CARE AND EDUCATION: IT'S COMPLICATED

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Barbara A. Wasik, Ph.D., is Professor and PNC Endowed Chair in Early Childhood Education at Temple University. Shira Kolnik Mattera, Ph.D., is Research Associate at MDRC. Chrishana M. Lloyd, Ph.D., is Senior Research Associate at MDRC. Kimberly Boller, Ph.D., is a Senior Fellow at Mathematica Policy Research.

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Submitted to:
Ivelisse Martinez-Beck, Ph.D., Project Officer
Office of Planning, Research and Evaluation
Administration for Children and Families
U.S. Department of Health and Human Services

Submitted by:
Barbara A. Wasik, Temple University
Shira Kolnik Mattera, MDRC
Chrishana M. Lloyd, MDRC
Kimberly Boller, Mathematica Policy Research

Contract Number: GS10F0030R
CONTRACTOR
Project Director: Tamara Halle
Child Trends
7315 Wisconsin Avenue
Suite 1200 West
Bethesda, MD 20814

Child TRENDS

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Overview for OPRE Research Brief series on Applying Implementation Science to Early Care and Education Research and Evaluation

The "science of implementation" is the study of the process of implementing programs and practices that have some evidence from the research field to suggest they are worth replicating. Implementation science is the study of how a practice that is evidence-based or evidence-informed gets translated to different, more diverse contexts in the "real world." In this way, effective implementation bridges the gap between science and practice.

There is a growing body of research looking at the processes and core components of implementing evidence-based practices to different settings and, especially, at what it takes to move an evidence-based practice from the laboratory to the field (Berkel, Mauricio, Schoenfelder, & Sandler, 2010; Durlak & Dupre, 2008; Fixsen, Naoom, Blase, Friedman, & Wallace, 2005; Meyers, Durlak & Wandersman, 2012). However, historically much of this research has focused primarily on adult services (Simpson, 2002) rather than on services for young children and evidence-based practices that support young children's growth and development.

The salience of implementation has come to the fore within the early childhood field in recent years because, increasingly, early childhood program developers are being asked not only to prove their program's efficacy before being brought "to scale" or transported to other locations, but also asked to articulate what components of their model, or the contexts in which the model is deployed, are essential for making the intervention a success. This is true of individual programs, such as discrete language and literacy interventions, as well as for larger, systems-level interventions, such as statewide initiatives to improve early childhood educators' professional development, children's school readiness, or child care quality. However, up until now, the early childhood field has lacked a common framework and language with which to examine important implementation supports for successful initiatives.

This research brief series seeks to provide early childhood researchers, program developers, and funders with an introduction to implementation frameworks and promising practices in implementation science with the aim of facilitating their use in early care and education research and program evaluation.

- The first two briefs in this series lay the groundwork for understanding the principles and frameworks of implementation science and provide a common language for key terms and constructs used throughout the research brief series. Specifically, a brief by Allison Metz, Sandra Naoom, and Tamara Halle introduces key elements of effective implementation within an integrated, stage-based framework; and a brief by Eboni Howard, Lindsey Allard Agnamba, Julia Wessel and Victoria Rankin provides a review of the terminology used in implementation research in the early care and education literature.
- The third brief (by Jason Downer and Noreen Yazejian) defines two cross-cutting themes: the quality and quantity of implementation. A review of recent empirical work provides examples of how these constructs are assessed and examined in relation to early care and education program outcomes. The authors highlight implications for researchers, purveyors, and funders of early childhood programs.
- The fourth brief (by Barbara Wasik, Shira Kolnik Mattera, Chrishana Lloyd, and Kimberly Boller) uses an implementation science lens to help readers understand the effects that dosage of interventions can have on outcomes, as well as on general implementation factors such as training and program administration.

- The fifth brief (by Diane Paulsell, Anne M. Berghout Austin, and Maegan Lokteff) introduces the importance of measuring implementation at multiple system levels and proposes tools for doing so. The benefits for practitioners, researchers, and policymakers of measuring implementation at multiple system levels are conveyed and suggestions and practical considerations are offered.
- The sixth brief (by Amy Susman-Stillman, Shannon B. Wanless, and Christina Weiland) reviews three theoretical frameworks of fidelity from the fields of prevention science, clinical psychology, and elementary education; highlights useful aspects of each framework; and offers early care and education researchers considerations for choosing a framework to use in their studies.

Implementation science offers a means by which to create a shared understanding of what it takes to have effective, replicable, and sustainable early childhood programs and systems in community-based settings. This research brief series aims to provide a useful overview of the current state of the field of implementation science research and its applications to the early care and education field. We hope that researchers, program developers, funders and other stakeholders will find this series helpful in facilitating the use of implementation science frameworks, methodologies, and analysis in early care and education research and program evaluation.

This research brief series may be found at http://www.acf.hhs.gov/programs/opre/research/project/child-care-and-early-education-policy-and-research-analysis-and-technical.

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INTERVENTION DOSAGE IN EARLY CHILDHOOD CARE AND EDUCATION: IT'S COMPLICATED

Overview

Dosage, or the amount of intervention delivered, is an important factor in understanding implementation research and practice. Research in the field of early childhood intervention is only beginning to examine in what ways dosage is important to faithful implementation of an intervention, and to the achievement of targeted outcomes. In many cases, a lack of consensus around the definition and measurement of dosage across studies has led to confusion about its importance. However, in order to replicate and scale-up interventions, understanding the dosage required to achieve specific outcomes is critical in implementation research and practice. This brief is intended to inform both researchers and practitioners about dosage and its relationship to early care and education intervention implementation in order to help establish a common language for communication of findings both within and across various fields.

Introduction

Dosage is a critical factor in both intervention research and practice, and it is intimately intertwined with other important factors related to program implementation such as fidelity, content, quality, and exposure (Daro, 2010; Paulsell et al., 2010; Downer and Yazejian, 2013). As described in this brief and defined in Box 1, in the context of early care and education interventions, dosage has multiple dimensions. Early childhood interventions are generally developed to improve child outcomes by changing the behavior of early childhood educators or parents. The implication is that dosage must be considered at two distinct levels — the program staff level meaning the individual(s) who are learning the new skill (for example, child care providers/teachers or home visitors); and the parents and children who are the intended beneficiaries of the intervention. Thus, one component of dosage, *implementation dosage*, refers to implementation activities necessary for the intervention to be carried out with fidelity. This includes dosage of the training that participants receive in preparation for them to deliver the intervention, or the amount of time that coaches spend working with teachers on an intervention. Another equally important component, *intervention dosage*, refers to the amount of an intervention that is provided to children or to the adults who care for them (for example, family members and child care providers) in order to change their behavior. Questions about how much of an intervention is necessary to achieve positive outcomes are relevant for early care and education practitioners, researchers, and policymakers because dosage affects not only outcomes but many other features of programs such as cost, staffing, replication, and scale-up.

Although issues related to dosage are gaining more attention in research, the collection and use of dosage data for program improvement is in its infancy in the early care and education field (Ammerman et al., 2007; Bagnato, Suen, & Fevola, 2011; Paulsell et al., 2010). Research in the field of early childhood intervention is only beginning to examine how and in what ways dosage is important to faithful implementation of an intervention, and to the achievement of targeted outcomes. User-friendly resources are needed to help practitioners think through practical considerations related to dosage and intervention implementation such as: (1) how can dosage be measured and monitored in early care and education programs, and (2) how can information collected about dosage be used to improve programs?

What Will this Brief Accomplish?

To address the issues described above, this brief:

- gives working definitions for dosage and other key terminology related to dosage;
- describes dosage as one aspect of fidelity of implementation of an evidence-based intervention;
- provides a rationale for why dosage is an important element of an intervention;
- highlights emerging evidence of the role of dosage in documenting and understanding program implementation;
- provides guidance on how to use dosage information for program improvement; and
- uses the existing research evidence and a hypothetical case study to illustrate the importance of dosage and dosage considerations when implementing an intervention in the early care and education field.

What is Dosage?

With its roots in medicine and clinical practice and research, dosage is emerging as a growing dimension of interest across social science disciplines including in the behavioral, prevention, and education fields. Dosage is described in many ways, sometimes using different terms for similar ideas (Berkel et al. 2010). Fundamentally, dosage means quantity or amount; however, the language used to describe the many components of dosage in the early childhood field is not standardized. Using examples from the home visiting and early care and education fields, Box 1 provides descriptions of key dosage-related terms as they are used in this brief and across the other briefs in this series.

Definitions of Key Terms[1]

- ***Dosage***. The amount of an intervention. It is important to distinguish between the intervention *dosage intended* for the program model, the *dosage offered* by the service provider, and the *dosage received* by the intervention recipient.
  - ***Dosage intended***. How much and how often an intervention is intended to be offered as per the intervention developers or funders. For example, a home visiting program may require services once a week for six months.
  - ***Dosage offered.*** How much of the required intervention a provider *actually* delivers. For example, a home visiting provider may only be able to schedule services for participants once every other week for six months because of staffing shortages.
  - ***Dosage received.*** How much of an intervention participants *actually* get. For example, a participant in the same home visiting program may have a chronic illness and only receive the services once a month for six months.
- ***Frequency***. How often the intervention is delivered. For example, programs that require one versus two home visits per month have different frequencies. Even though the total amount of time delivered for an intervention could be the same (for example, 3 hours), their frequency could differ (one three-hour visit versus two one-and-a-half-hour visits).
- ***Intensity***. The "strength" of an intervention or how much of a particular component of an intervention is delivered within each session. For example, in a prekindergarten literacy intervention focused on how many times a teacher refers to print while reading i.e. print referencing, intensity is a count of the number of times print is referenced by teachers to children during the 30-minute lesson.
- ***Intervention Duration***. The length of the full intervention. For example, if a home visiting intervention is intended to last nine months from start to finish, that is its duration.

[1] These definitions are specific to intervention dosage *not* implementation dosage.

- ***Session Duration***. The length of a session. For example, if a science curriculum requires 45 minutes per day, its session duration is 15 minutes shorter than one requiring 60 minutes per day.
- ***Threshold***. A specific dosage level at which an intervention affects outcomes. This is distinct from the dosage intended. For example, a study may find that teachers only need to attend four out of five days of training offered to achieve the intended level of change in their teaching. Although five days might originally have been intended, four may be found sufficient for changing outcomes.
- ***Cumulative dosage*.** The amount of an intervention a participant receives over the life of the program (session duration × frequency × intervention duration or length of program enrollment). For example, a pre-kindergarten curriculum that requires 30 minutes of specific literacy activities per day for one school year would have a cumulative intended dosage at the child level of 5,400 minutes (30 minutes multiplied by 5 days multiplied by 36 weeks).

In the early care and education field, there has been increased attention to the development of evidence-based interventions and how they can be taken to scale, which has resulted in more careful documentation of which components of an intervention are necessary to achieve the desired results. Within these studies however, the *content* of the intervention is most often the focus, rather than the *dosage*. Yet the two components are inextricably related. In fact, including dosage as a variable in intervention research is critical to understanding how and to what extent content is delivered within an intervention. Despite the link, developers and implementers of most evidence-based interventions have only recently begun to systematically address the role of dosage and how it might impact program outcomes. Since higher dosages often imply higher costs for delivering an intervention, understanding the dosage at which an intervention produces positive impacts also has substantial implications for developing cost-effective interventions. Without considering dosage more carefully both in research and practice, we cannot account for how much of an intervention participants actually receive, or fully understand the best delivery mechanisms for that intervention, or its precise value. Thus, understanding dosage is essential to moving research, practice, and policy in the early childhood care and education field forward.

In the context of early childhood programs, intervention research often attempts to understand how an intervention was implemented and whether or not change occurred as a result of its implementation. Dosage is important in helping to answer these questions. For example, if the research question asks, "Does a math intervention matter?" attending to dosage including, how much math was offered in the classroom, how many math activities children engaged in daily, and the length of time the intervention was received across the year, is useful and necessary for answering the primary research question, "Does a math intervention positively change child outcomes?" When evaluating the impact of an intervention on program, teacher or child outcomes, the dosage needed to replicate it with fidelity and to achieve the desired outcomes must be captured in order to fully answer the research question.

Many questions emerge when trying to understand the role that dosage plays in effective intervention implementation. Our review across a number of early childhood care and education areas identified three primary questions that are critical to understanding effective program implementation.[2]

1. How much of the intervention is required to achieve the intended outcomes? The relationship between dosage and outcomes is often unclear. Dosage in this context includes both how much support (i.e., training, coaching, or home visiting) is required to implement the intervention as designed, and how much of the intervention the receiver (i.e., teacher, child, or parent) needs in order for positive changes to occur.

[2] We reviewed research from 1990-2011 that included dosage as a variable in the areas of early intervention, professional development, and early child care, using on-line ERIC, Ebsco Host Research database and Education Research Complete. From these data, we draw on a few studies to frame the questions on dosage and to highlight the main points of the brief.

2. Is the amount of training, coaching, visits, and ongoing monitoring of the program that intervention developers are requiring based on a clear theory of change or research showing it to be beneficial (Hamre et al., 2010; Justice, Mashburn, Hamre & Pianta, 2008)?
3. Is adhering to the level of required dosage feasible for programs (Daro, 2010)?

To address these questions, we present an overview of dosage-related research findings and use them as the basis for sharing strategies to improve intervention implementation in early care and education programs. This overview includes a presentation of guidelines for practitioners who are grappling with issues related to dosage in program implementation and those interested in measuring dosage and applying such information to program improvement efforts. To make the recommendations more concrete, we present a short, hypothetical case study of an agency involved in making important decisions about intervention selection and implementation.

What is the Relationship between Dosage and Program Fidelity?

Fidelity is frequently defined as operating a practice or program as intended in order to achieve the desired outcomes. It is often depicted visually by using a logic model which represents the theory of change underlying the intervention (including the core intervention components) and the outcomes that are expected when the intervention is implemented as intended. Dosage is important to understanding how much of the core intervention components are needed to achieve the desired outcomes. For example, when implementing a teacher-focused intervention, the relationship between dosage and fidelity exists at many levels. One might be concerned with understanding dosage at the teacher level, for example, how much training is needed for teachers to implement a new intervention with fidelity or does each teacher need the same level of training? Alternately, one might be more interested in understanding what happens in a classroom after teachers are trained in an intervention. For example, how many times do children need to be exposed to an intervention concept before they understand and learn it? Dosage, therefore, is a critical component of fidelity and can be understood at multiple levels.

What do We Know from the Research on Dosage?

Because interest in collecting and using data on dosage is just beginning to gain traction among early care and education researchers, only a limited number of studies to date use dosage as a program variable. Published and ongoing empirical work on dosage highlights three salient findings:

1. Identifying the "right amount" of dosage is important - once may not be enough, but more is not always the answer.

Research in early childhood intervention and education research indicates that *one* dose of a treatment or intervention is generally not effective (Boller et al., 2004; Winton, 2008; Joyce & Showers, 1980). Specifically, research on teacher training has shown that one-day workshops do not provide the necessary dosage to affect teacher learning or to improve intervention implementation in teachers' classroom practices over the longer term (Boller et al., 2004; Joyce & Showers, 2002; Raikes, et al. 2006; Winton & McCollum, 2008). Instead, professional development interventions delivered in more intensive ways, or with longer duration or frequency, have been associated with better outcomes for teachers and for children (Halle, Zaslow, Tout, Starr, Wessel, & McSwiggan, 2010). Similar studies of parent-focused and child-focused interventions also suggest that one experience does not result in meaningful changes in targeted outcomes (Boller et al., 2004).

The early childhood care and education field has generally operated under the assumption that more of an intervention is better and will result in increased positive outcomes (Neuman, & Dywer, 2009). However, research that has systematically studied both the intensity of the intervention provided within a session and session frequency shows that increased intensity and/or more sessions do not always lead to better outcomes. Studies on print referencing, for example, have compared more versus fewer references to print within sessions. The findings suggest that a lower intensity of print referencing, meaning fewer print referencing experiences per session is associated with larger effects (Breit-Smith, Justice, McGinty & Kaderavek, 2009; McGinty, et al., 2011). Similarly, Tout et al. (2009) found that providing one coaching session per month was associated with greater improvement than four coaching sessions a month for improving both educators' skills and children's literacy outcomes. These studies point to the importance of understanding what the right dosage of an intervention might be to achieve the desired outcomes. They also illustrate that more of an intervention may not always be optimal.

2. *Dosage is not a one-size-fits-all concept – context matters.*

Dosage is also linked to the context of the intervention. Several well-designed and rigorous studies have examined the impact of dosage of instruction on children's learning in full- versus half-day kindergarten (Cannon, et al., 2006; Walston, & West, 2004). The findings have consistently shown that children who attend full-day kindergarten programs learn more in literacy and mathematics than their half-day counterparts (Cooper, Allen, Patall, & Dent, 2010; Lee, Burkam, Ready, Honigman, & Meisles, 2006. In a more recent study, Ramey, Ramey, and Stokes (2009) found a similar pattern of effects for full-day vs. half-day pre-kindergarten. Children in the full-day programs demonstrated double the literacy gains compared to children who were in half-day programs.

This research, however, exemplifies the risks of attending only to dosage, independent from other factors related to intervention research. Although the data on full- vs. half-day are compelling and suggest the benefits of more time, program quality plays an important role in these findings. If children have access to high-quality programs, full-day has a positive association with academic achievement compared to half-day kindergarten. However, if the quality of the full-day program is subpar, then greater dosage (full-day) does not have the same positive effects (Magnuson, Meyers, Ruhm & Waldfogel, 2004; Robin, Frede & Barnett, 2006). More of a program of mediocre quality does not lead to positive effects on child outcomes. In other words, the positive impact of instruction on young children is not related solely to dosage of the intervention. Dosage needs to be considered along with other factors such as quality of the intervention and fidelity of implementation.

3. *Dosage thresholds are a critical bridge between research and practice.*

In order for evaluation findings to be truly useful in real-world settings, consideration needs to be given to whether it is necessary to achieve a particular amount of dosage – or *threshold* – for the intervention to produce the desired change. Such thresholds can set an evidence-based standard against which dosage can be monitored and measured, instead of relying on the field's "best guess" of how much of the intervention is essential.

Intervention developers often point to the dosage families and children receive in research trials that show effects as one type of threshold for consideration. For example, in three randomized controlled trials conducted on the home visiting program Nurse-Family Partnership, approximately 45-62 percent of the intended visits were received by families and yet the program had impacts on targeted outcomes (Olds personal communication, 2011.)[3] However, given that the dosage of an intervention is almost always less than intended (Daro, Hart, Boller & Bradley, 2012; Durlak and Dupre, 2008), these findings do not necessarily mean that agencies should aim to conduct fewer visits than intended by program developers. In the case of the Nurse-Family Partnership, completion of 45-62 percent of visits was sufficient to move targeted outcomes, but it still may be advisable to aim for higher dosage given varying intervention contexts and the fact that programs generally have difficulty meeting prescribed benchmarks (Daro et al., 2012).

Suggested Guidelines for Practitioners/Program Implementers

The aforementioned research suggests that there are many factors related to dosage that might be considered when implementing a program. The tenets below draw on the research described above. While not all these recommendations have been rigorously tested, they are offered as suggestions for practitioners in using information about dosage for program improvement.

1. ***When implementing a new program, understand how the intervention's theory of change interacts with the intervention components and the intended dosage expectations.***

   In order to ensure that the behavior and outcomes of the targeted adults and children are improved as intended, it is important to review the dosage requirements of the intervention and to understand how dosage requirements interact with the overall theory of change as well as each intervention component. An intervention's theory of change provides a conceptual framework that lays out the activities, outputs, and expected outcomes of the intervention (Lugo-Gil et al., 2011; W.K. Kellogg Foundation, 2004; Zellman et al., 2011 and maps out what each player (community stakeholders and partners, program managers and staff, and families) has to do in order to achieve and sustain the envisioned success. Theories of change are good starting points not only for identifying and making linkages among program components, but also for understanding the dosage requirements for supporting high-quality implementation. For example, for a teacher professional development intervention that includes training and coaching, program operators and practitioners must: a) understand how much training and coaching should be delivered to best support teachers; b) document the actual amount of training and coaching received to assess whether teachers are receiving the intended level of the intervention; c) determine whether teachers are able to deliver services to children as the model intended; and d) monitor changes in children's outcomes.

   In short, a theory of change helps an organization identify what it means for an intervention to be successful (outcomes), what activities or components of the intervention are necessary to achieve this success (activities), and what those activities or components are meant to *affect* in order to be successful (outputs). In cases where there is no explicit theory of change it is advisable for program developers or implementers to develop one to guide their work, including the intended dosage (Zellman et al. 2011), and to understand whether modifications in dosage would threaten the potential for intervention success.

[3] In the Denver trial 28 of the 62 visits intended were completed on average (45 percent). In the Memphis trial 30 of the 63 intended visits (48 percent) were completed and in the Elmira trial 31 of the 50 intended were completed. The difference in the number of visits intended by the model developers across the three trials came from modifications over time to the intended visit frequency (Olds personal communication, 2012)

For example, the intensity of an intervention (the amount of information presented in a given time) might be more important than intervention duration (the length of the training) when the goal of professional development is to teach concrete skills. However, when training teachers to understand broader concepts, duration (meeting over longer periods of time) appears to be more important than intensity (presenting a lot of information in a limited amount of time) (Halle et al., 2010). Understanding the mechanisms through which different aspects of dosage are associated with each type of professional development is an important component to understanding how a change in dosage may affect outcomes.

2. ***Explicitly define what is meant by delivery of service.***

   As program operators and practitioners implement an intervention, it is also important to have a shared understanding of what delivering services means. One question programs should consider is whether they will measure service delivery as what the agency offers or what the recipient receives. For instance, some agencies delivering evidence-based home visiting services measure both the number of home visits *offered* to each participant and the number actually *completed* (Daro et al., 2012). In the early childhood care and education practice and research fields, programs often measure program compliance with regard to a minimum number of service days offered (in a center-based setting) or number of home visits provided (for a parenting-focused home visiting program) rather than tracking more nuanced influences on a child's or parent's exposure to a particular intervention. However, many factors intervene on the path from offering a certain amount of service to families receiving that service; for example, even if a program is required to be open and serving families, services may be limited because of staff shortages and illnesses, weather emergencies, pre-scheduled program closings, or a range of other issues (Zaslow et al., 2010). This means that simply adding up the days attended by a child/family and comparing that to what was intended by the intervention developers or funders may not provide a complete assessment of program dosage.

3. ***Consider three important factors - dosage intended, dosage offered, and dosage received.***

   Anecdotal evidence from the field suggests offering more of an intervention than has been demonstrated to be effective in changing outcomes might be good practice because it is nearly impossible to achieve 100% participation (Durlak & DuPre, 2008). Practitioner wisdom suggests program participants generally receive only half of an intervention at best, with some evidence in the home visiting literature supporting this assertion (Gomby, 2005). Understanding *why* this gap exists is an important first step to crafting possible solutions. For example, an administrator might create different approaches to addressing participation barriers like parent work schedules as opposed to families' not attending because of a lack of interest in the intervention. Once administrators understand the challenges specific to their program and to individual families, they can begin to identify ways to address variations in training or coaching completed by staff and in services offered and received by families and children.

To illustrate these ideas, Box 2 presents a hypothetical case study of an agency as it selects and begins to implement a new intervention—The Safe Space model.

A Hypothetical Case Study of Agency ABC and the Safe Space Model

Agency ABC, a large community-based early childhood education center in a low-income urban community, spent a considerable amount of time in recent months reviewing their vision for their center and the children in their care given a recent spike in family and community violence in the neighborhood. They had recently won a community development grant to fund efforts focused on making the neighborhood they served safer for all families. After conducting a needs assessment and consulting with staff, community members, and families, the director of the center and the management team decided that the center had a unique opportunity to move beyond its traditional focus on children's school readiness and add services designed to

promote a positive family and community climate. After reviewing a number of evidence-based programs and evaluating the requirements for staff training and ongoing support, child and family participation, and cost to the program for adding additional services, the management team selected the "Safe Space" model as the one that was most in line with their goals. As part of their discussions with the model developers, they learned that Safe Space is designed to help teachers integrate learning and safety into children's days and requires that center staff attend trainings, receive coaching, and implement lessons. Safe Space also has a supplemental parent component designed to reinforce positive guidance at home and help parents advocate for safer neighborhoods. From these early discussions with the model developers, the management team confirmed that Safe Space had a theory of change that was aligned with their goals, their preferences for how to work with children and families, and the outcomes they hoped to achieve. The management team also learned that Safe Space had been successful in changing targeted outcomes in communities like their own.

To prepare for implementation, the Agency ABC management team hosted an on-site meeting with the Safe Space training team. They carefully reviewed the staff training requirements and worked to plan sessions that would best meet staff needs and skill levels. During that meeting, the ABC management team learned more about the specific dosage intended for each component of the Safe Space curriculum, including staff training and intervention implementation with children and parents:

1. Safe Space required 35 hours of training total for each lead teacher, one member of the management team who would serve as the Safe Space coordinator, and three coaches who would work with teachers to model the intervention and support high quality implementation. There would be five staff training sessions of seven hours each spread across the nine months of the academic year.
2. Coaches would receive an additional eight hours of training on coaching strategies and techniques.
3. Coaches would be in classrooms mentoring and meeting with teachers for at least two hours per week.
4. Teachers would be expected to deliver Safe Space lessons to the children in their classrooms on a daily basis for a minimum of 15 minutes in a large-group setting.
5. The family outreach and participation component would require that a meeting be held to inform families about the model, and the expectation would be that a majority of families would agree to participate in the intervention. Family activities/newsletters would be sent home every two to three weeks with exercises that supplemented the center-based intervention. In addition, parents would attend a monthly community meeting at the center to plan advocacy efforts, and to track progress over time in violence reduction efforts and improvements in the neighborhood.

Once the ABC management team understood which aspects of dosage were most important for teacher training, coaching, and child and family services, they worked together to develop an intervention implementation plan that addressed the dosage considerations (Fixsen et al., 2005). The model developers shared that in their prior experience a primary implementation challenge was getting teachers to attend and fully engage in the training. The developer and director worked together to identify times and places for training. A decision was reached to use previously-scheduled teacher professional development days and to train in the school building, potentially leading to better participant attendance and engagement in the training. In addition, the coach schedules needed to be crafted carefully to ensure that they were able to observe the Safe Space lessons and complete their weekly two-hour coaching visits to each classroom.

The management team and developers then made a plan for intervention exposure for the children as well as their family members who visited in the center. It was clear that the center could offer the required level of classroom intervention and send home the family newsletters. It was less clear, however, whether children and parents would be able to participate at the required level. The director mentioned that in a typical week only half of the enrolled children were present during the first half of the day. Additionally, parent availability for bringing children to the center, reading the newsletters, and attending monthly meetings depended on the parents' job commitments, psychological motivation to participate, and other familial and community issues. Given the community context, the director and developer decided to focus first on making sure children received the full dosage of the Safe Space curriculum, and to launch the parent component the following year, once teachers were more comfortable and competent with the model (Clements, 2007; Landry, Anthony, Swank, & Monseque-Bailey, 2009; Bodrova & Leong, 2007). Meanwhile, the center would focus its parent outreach on getting families into the center in the morning by utilizing the time and skills of their contracted mental health consultant. This person would organize the provision of breakfast, job counseling, and transportation assistance for family members during the morning hours and would collect data about parent attendance and engagement in the new morning activities. Since parents might be more likely to come to the center in the morning for the new resources being offered, teachers would also implement their Safe Space lessons during the first half of the day, increasing the likelihood of maximum child exposure to the intervention. They also developed an alternate plan of exposing children to the intervention individually, in cases where children missed the large-group instruction. This plan would increase program costs since teachers would have to spend time with students outside of normal classroom hours to catch them up.

Practice Implications

The ABC Program case study highlights key research lessons reviewed in the brief. The director and staff at the center needed to think through the intervention theory of change including the intended dosage for each program component. They grappled with whether or not the dosage intended by the model developers was feasible given their context and decided that particular aspects were not, specifically the parent component of the intervention. So, in tandem with the Safe Space program developers, they made a decision to postpone the parent component of the intervention. This decision was made with the understanding that program impacts might be compromised in the first year since parent participation—a core intervention component—would be delayed.

In the meantime they made a plan to systematically collect information about dosage and attendance at the new morning parent program to better understand if they could indeed engage parents at the level necessary to achieve program impacts. They also recognized and agreed that a two-year implementation process might increase their chances of positively impacting children, given the potential challenges with teachers attending professional development, learning the intervention, *and* parents' needing to be more engaged with the center.

In general, attention to intervention implementation and dosage requires clear definitions and understanding about dosage requirements, and a fair amount of creativity and flexibility. When programs make trade-offs, they should be made with a clear understanding of the potential benefits and costs, including how the intervention theory of change, organizational capacity, and program participants might be impacted, and whether or not the intervention effects might be compromised. The table below outlines questions that should be considered.

Table 1. Dosage Questions to Consider

Area Affected by Dosage	Practical Concerns
Theory of Change	• Does the amount of the intervention directly affect the size of expected outcomes? • Does dosage matter for a full session or for specific strategies used within that session?
Organizational Capacity	• Can your organization support more hours or sessions? • How will your organization monitor implementation and quality? • Do you have a mechanism for providing feedback to staff using the dosage data that is being collected?
Program Participants	• Are enough staff available to ensure that dosage requirements are achieved? • How will participant absences be addressed?

Conclusion

The early research findings outlined in this brief and the ABC program case study example provide the beginning of a research-to-practice framework for how practitioners can use research on dosage for program improvement. While important, these issues represent only the tip of the iceberg. As more research findings emerge in the early care and education field, and as practitioners begin to actively apply what is learned, we expect that additional insight and answers (as well as more questions) will emerge with respect to this important topic.

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