



Improving Child Welfare Outcomes

Balancing Investments in Prevention and Treatment

APPENDIXES

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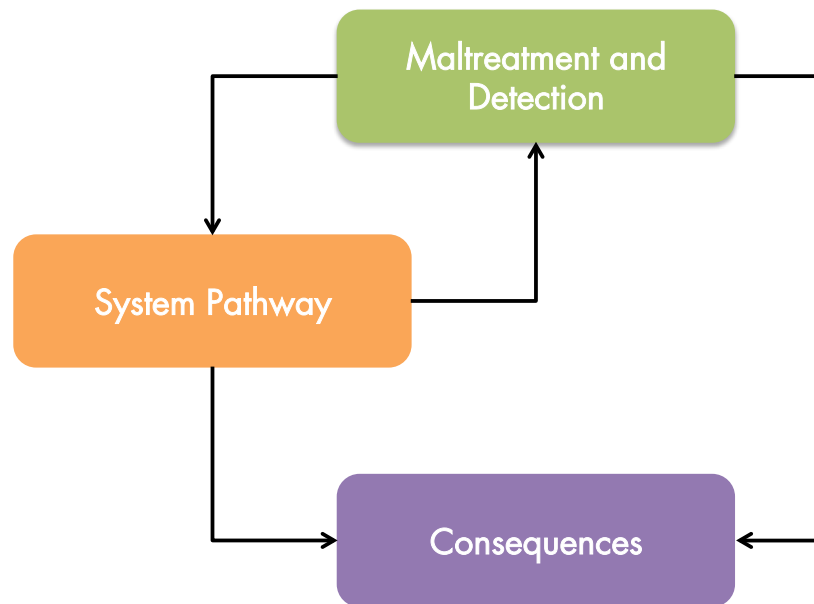
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Appendix A. Conceptual Framework

The simulation of the child welfare system is conceptualized in three modules that together represent a child's path from childhood into early adulthood and whether that path includes child welfare system involvement (Figure A.1). The first module, maltreatment and detection, represents children, families, and mandated reporters in the population at large. All children from birth to age 18 live within a local context that has the potential to influence the risk and protective factors that affect the probability of being maltreated and of having that maltreatment detected. If the child is maltreated and that maltreatment is detected, then the child's path includes movement through the child welfare system before moving into the consequences for short- and long-term outcomes. If the child is not maltreated or the maltreatment is not detected, then the child continues to the short- and long-term consequences and circles back to the maltreatment and detection state until leaving childhood.

Figure A.1. Overview of Child Welfare System Simulation



The child welfare system pathway (Module 2) represents the possible pathways through the child welfare system for a child whose suspected maltreatment comes to the attention of a local child protective services (CPS) agency. This system pathway includes a series of decision points, including a report decision, an investigation decision, a risk/safety

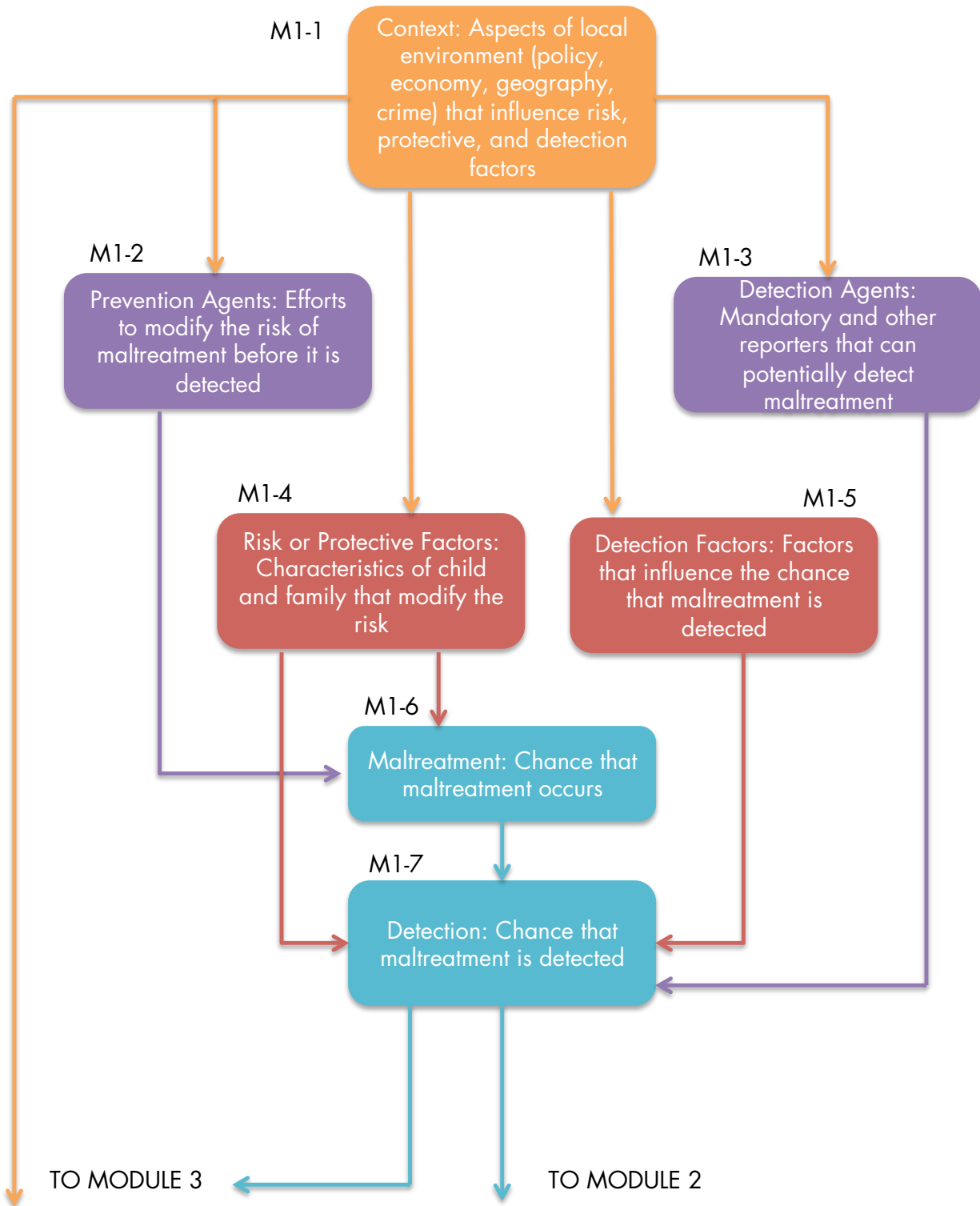
assessment decision, a response decision, a placement decision, and a permanency goal decision. At each decision point, the child has a probability of continuing further into the system pathway module or exiting the system. A variety of incident, child, family, and agency/system factors have the potential for influencing each decision point and altering a child's path through the system. Upon exiting the system, the child continues to the consequences module in the near term and circles back to the maltreatment and detection module until leaving childhood. The consequences of maltreatment, detection, and the system pathway are represented in Module 3. The possible short- and long-term outcomes in a range of outcome domains vary depending on the child's experience with maltreatment, detection, and the child welfare system pathway.

Maltreatment and Detection

The chance that child maltreatment occurs is likely due to a combination of factors (Figure A.2). These influences include the child's local environment, child and family characteristics, and the family's exposure to different preventive services. There are also factors that may impact the chance that child maltreatment is detected, which include the child's exposure to mandatory reporters (persons required by state law to report suspected maltreatment) or other adults concerned about the safety of the child and the dynamics that influence whether these mandated reporters or other concerned adults make a report of suspected child maltreatment. While the combination of these factors likely influences the child's probability of maltreatment and detection, we were unable to account for these directly in the model because of insufficient information about the nature and direction of the relationships.

Context (M1-1). Characteristics of a child's local environment, such as the state and local policies around child protection, economic conditions (e.g., poverty or employment rates of the community), geography (e.g., urbanicity of the community), and safety (e.g., neighborhood crime rates), may be correlated with the risk of child maltreatment and detection of maltreatment (Coulton et al., 2007). These characteristics may influence the likelihood that a child's family receives preventive services and may be correlated with the likelihood that maltreatment occurs and is detected.

Figure A.2. Module 1: Maltreatment and Detection



Prevention agents (M1-2). Child maltreatment prevention programs have focused either on preventing risk factors or on promoting protective factors using different approaches to modify the risk of maltreatment before it happens. The continuum of prevention approaches includes primary prevention, which focuses on raising awareness of child maltreatment and providing resources to the general public, policymakers, and people who provide services to families with children. Primary prevention efforts are meant to be universal to raise public awareness through such activities as public service announcements, information kits, and media content. Primary prevention efforts also include approaches that target those children or families with known risk factors and comprise home visitation, respite and crisis care, and family resource centers, as well as selected approaches that include skill-based curricula (such as life skills and safety) and parent education programs (such as parenting knowledge, attitudes, and skills) (Promising Practices Network, 2010). Other prevention focuses on families where maltreatment has already occurred; these efforts occur once there is some involvement with the system. In 2014, 2.9 million children received targeted primary or other prevention programs or services (U.S. Department of Health and Human Services [DHHS], 2016).

Detection agents (M1-3). Child maltreatment detection typically begins with recognition of possible maltreatment by a mandated reporter (a person required by state law to report suspected maltreatment) or by any person concerned about the safety of a child. While there is some variation across states in who is considered a mandated reporter, social workers, police officers, teachers, pediatricians, mental health professionals, and day care staff are universally considered mandated reporters (Child Welfare Information Gateway, 2016). The reporting requirements, methods of reporting, and training for mandated reporters also vary by state and county. There is some evidence that mandated reporters who receive training may be more likely to report maltreatment (Sedlak et al., 2010). Mandated reporters may also possess individual biases about child maltreatment that can change their likelihood of detecting a reportable event.

Risk or protective factors (M1-4). A number of factors at the child and family level have been linked with risk of child maltreatment. The primary child-level risk factors for maltreatment are age, race/ethnicity, gender, and special needs status (Sedlak et al., 2010). Family-level risk factors include socioeconomic status, family structure, family size, parental substance abuse, and parental mental illness (Sedlak et al., 2010). Protective factors that might mitigate risk of child maltreatment include parenting knowledge and skills, positive family relationships, access to health care and social services, and parental employment and education (Promising Practices Network, 2010).

Detection factors (M1-5). As noted above, mandated reporters are the primary mechanism through which child maltreatment is detected and reported to the local CPS agency. Child maltreatment may go undetected when a mandated reporter does not realize the circumstances that constitute child maltreatment or there are no external signs or symptoms of child maltreatment. Otherwise-undetected child maltreatment may be uncovered when unrelated situations, such as robberies, assault, homicide, or domestic violence, occur within the home. These types of situations involve investigatory agencies, such as law enforcement, that may find child maltreatment during the investigation and report it to CPS (Sedlak et al., 2010).

Maltreatment (M1-6). Child maltreatment encompasses both abuse (physical, sexual, and emotional) and neglect (physical, emotional, and educational). Two primary aspects of a child's experience influence the chance that child maltreatment occurs. The first is the presence of risk or protective factors that are related to child maltreatment risk (see M1-4). The second is the family's receipt of preventive services (see M1-2). According to the Fourth National Incidence Study of Child Abuse and Neglect, an estimated 1.26 million children experienced maltreatment that resulted in demonstrable harm (a rate of 17.1 per 1,000 children), with 44 percent of those abused and 61 percent neglected (Sedlak et al., 2010). Using a broader definition that includes those at risk of harm, an estimated 2.9 million children experienced maltreatment (a rate of 39.5 per 1,000 children), with 29 percent of those abused and 77 percent of those neglected (Sedlak et al., 2010). These estimates of maltreatment represent maltreatment that is detected (see M1-7), since it is impossible to know the true incidence of maltreatment.

Detection (M1-7). The chance that maltreatment is detected is influenced by both detection agents (e.g., social workers, police officers, teachers) and detection factors (e.g., the characteristics of each situation). Detection occurs when a mandated reporter or other concerned adult suspects or is made aware of child maltreatment. Child maltreatment is not detected when mandated reporters fail to regard the circumstances as child maltreatment or fail to recognize the maltreatment, or the maltreatment is not visible to outside observers (Sedlak et al., 2010). Maltreatment that is detected may or may not then come to the attention of the child welfare system.

System Pathway

Figure A.3 depicts the pathways through the child welfare system for maltreatment that has been detected and reported to the local CPS agency. The system pathway encompasses a series of decision points that determine a report's pathway through the system. For

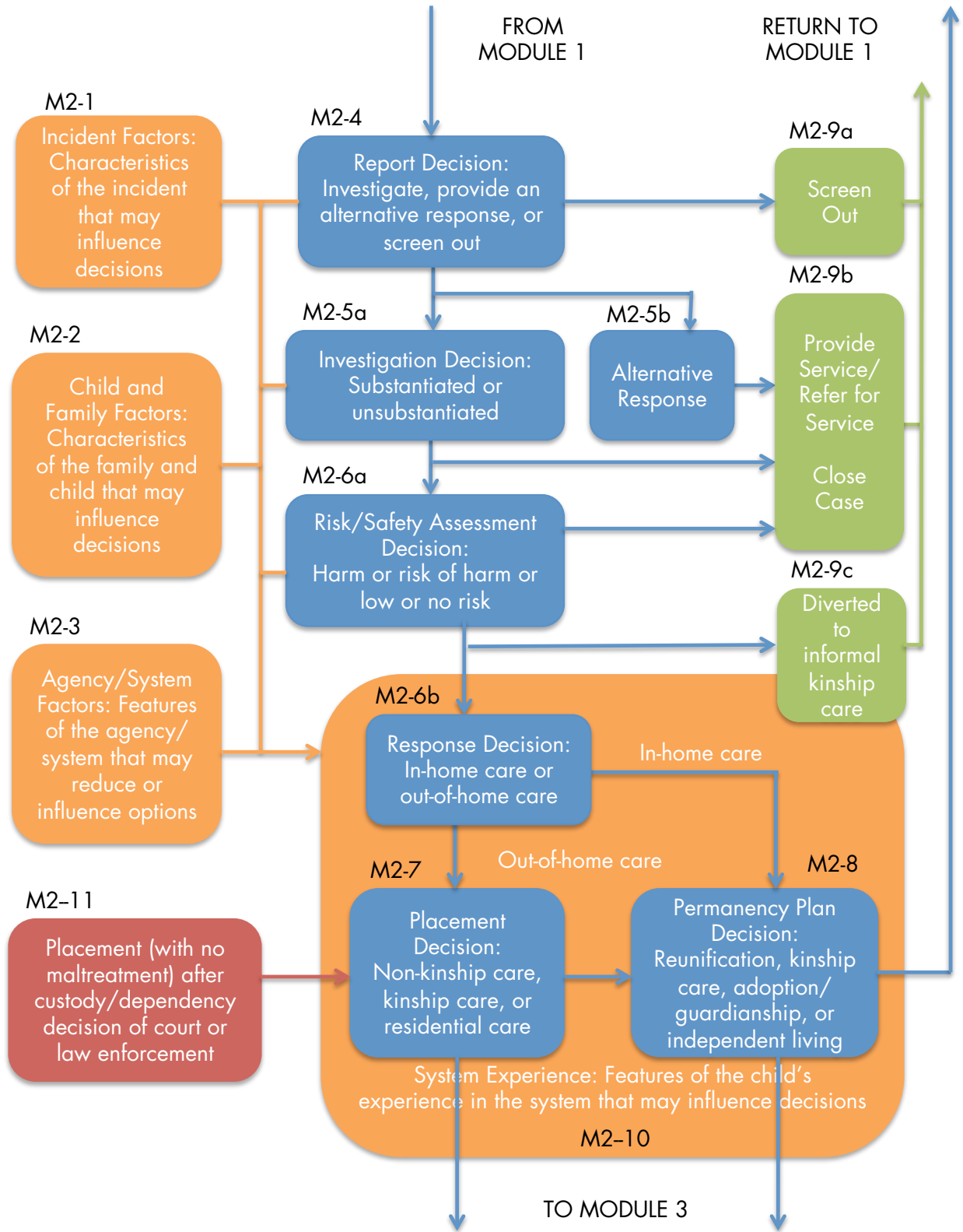
example, each report of suspected maltreatment is first screened to determine whether the circumstances warrant further investigation. Screened-in reports then undergo further assessment to determine the type of response (e.g., alternative response or investigation). When a report is investigated and then substantiated, the child's case may follow a number of pathways, depending on such factors as the assessed level of risk. There are different exit points depending on the decision made at each step. There are also different incident, child/family, and agency/system factors that may affect each decision point.

Decision Points Within the Child Welfare System

The decision points for each pathway through the child welfare system are described in detail below. When possible, we include administrative data to show how many children follow each pathway.

Report (M2-4). A family's involvement with the child welfare system typically begins with a report of suspected child maltreatment by a mandated reporter or by any person concerned about the safety of a child. In this situation, the mandated reporter detects the alleged maltreatment and makes a report to CPS. In fiscal year (FY) 2014, there were 3.6 million reports of alleged child maltreatment encompassing 6.6 million children (DHHS, 2016). Each report (called a *referral*) is screened to determine whether to investigate further, provide an alternative response, or screen out the referral.

Figure A.3. Module 2: System Pathway



If there is insufficient information, or the referral is not consistent with the state's definition of abuse or neglect, the referral is generally screened out, and the child exits the child welfare system (M2-9a). Referrals may also be screened out if the child was under the responsibility of a different agency or jurisdiction (e.g., children living on military installations; Kaplan and Morley, 2011). In FY 2014, approximately 39 percent of referrals were screened out (DHHS, 2016). Some states and jurisdictions have community response programs with services that may include case management, financial assistance, parenting supports, or mental health services (Maguire-Jack, Slack, and Berger, 2013). For example, the Colorado Community Response Program provides voluntary services to families who have been screened out, including referrals to community-based agencies and one-time financial assistance (Colorado Office of Early Childhood, 2016). Another model, the Wisconsin Community Response Program, connects families with caseworkers, who help the family to set specific goals; connect the family with services; and provide small grants to help families meet child care, housing, and education or employment needs (Bakken et al., 2014). However, most states do not have formal community response programs of this nature.

If there is sufficient information to suggest that maltreatment has occurred, a referral will be screened in for further assessment. At this point, the referral is called a *report*. In FY 2014, approximately 61 percent of referrals were screened in and had some degree of CPS involvement, though there is substantial variability in this percentage by state (DHHS, 2016). For these reports, there is typically a dual-track system—investigation decision (see M2-5a) or alternative response (see M2-5b)—with subsequent steps dependent on the risk level.

Alternative response (M2-5b). For low-risk reports, families may be assigned to an alternative response. With this alternative (or *differential*) response, CPS caseworkers generally conduct a family assessment and focus on providing needed services and connecting families with community-based services, rather than investigating the report. In FY 2014, approximately 12 percent of the children who were the subject of screened-in reports received an alternative response (DHHS, 2016).

However, there is wide variability in the approaches that jurisdictions take to alternative response, including the criteria used to assign families to an alternative or investigation response (e.g., type of maltreatment, age of the suspected victim), the party responsible for making this decision (e.g., caseworker, assessment worker), and the organization that will provide the services (e.g., child welfare staff, private agencies) (DHHS, 2016). Recently, there have been efforts to evaluate the effectiveness of alternative

response practices. There is some evidence that children who receive services through alternative response are less likely to have a new report of child maltreatment (Loman, Filonow, and Siegel, 2014), although other studies have found no substantial effect of alternative response on the likelihood of re-report (Conley and Duerr Berrick, 2010). There have also been studies suggesting that when more than one-third of reports in a jurisdiction are assigned to alternative response, children assigned to alternative response may have a greater likelihood of re-report than families assigned to an investigation (Piper, 2016). This suggests the importance of careful screening to identify the families most appropriate for an alternative response.

After an alternative response, which may include assessment, in-home services, or referrals to community-based services, the report is typically closed from the perspective of the child welfare agency, and the child exits the child welfare system (M2-9b).

Investigation (M2-5a). For higher-risk reports where the safety of the child is a concern, CPS caseworkers will conduct a full investigation. Nationally in FY 2014, approximately 89 percent of the children who were the subject of screened-in reports received an investigative response (DHHS, 2016). The investigation typically involves a CPS caseworker gathering information from the parents, child, and collateral sources who may have had contact with the family (Administration for Children and Families [ACF], 2003). When a caseworker conducts an investigation, the goal is to determine whether the report has been substantiated or indicated (i.e., there is evidence that maltreatment has occurred) or is unsubstantiated (i.e., there is not enough evidence, or the events do not meet the state's definition of maltreatment). In most states, the majority of reports (88 percent) that are screened in receive an investigation (DHHS, 2016).

After an investigation, the report is either substantiated or indicated, in which case there is continued CPS involvement (M2-6b), or unsubstantiated, in which case the child exits the child welfare system (M2-9b). In FY 2014, 18 percent of screened-in reports were investigated and substantiated, less than 1 percent were indicated, and 70 percent were unsubstantiated and the children were found to be non-victims (DHHS, 2016). For the unsubstantiated cases in which the child was considered a non-victim, CPS may provide the family with some services. In fact, the majority of states report providing some services or referrals to families in unsubstantiated cases (Office of the Assistant Secretary for Planning and Evaluation, 2003). These cases are then formally closed from the perspective of the child welfare system (M2-9b).

Risk/safety assessment (M2-6a). During the investigation stage, caseworkers not only establish whether a report has been substantiated, indicated, or unsubstantiated, but they also conduct a risk/safety assessment. As part of this process, they examine risk factors, protective factors, and community resources to determine the safety of the child's current situation. Caseworkers gather information about the nature of the maltreatment, the child and caregivers, and overall family functioning (ACF, 2003) and synthesize this information to determine the current level of risk and safety.

The results of the risk/safety assessment inform the child's pathway, with high- or medium-risk substantiated reports continuing to a post-investigation response decision (M2-6b) and low/no-risk substantiated reports and unsubstantiated reports exiting the child welfare system (M2-9b).

For some of the reports that exit the system, CPS facilitates a voluntary kinship care arrangement (M2-9c) rather than letting the child remain at home or having the child formally enter the foster care system (DHHS, 2016; Geen, 2004). Although CPS remains involved in these cases, the agency does not have legal custody of the child. Voluntary kinship care arrangements can vary by case and jurisdiction. In some instances, the court is involved in this placement decision, and in others, CPS coordinates the placement. Jurisdictions also vary in the extent to which they pursue voluntary kinship care (Geen, 2004). Although few studies have examined voluntary kinship care, estimates from the National Survey of America's Families indicated that 140,000 children were in voluntary kinship placements in 2002 (Urban Institute, 2002). Voluntary informal kinship care might be pursued when parents voluntarily place their children with a relative while receiving substance abuse or mental health treatment. Other parents may opt for voluntary kinship placements to avoid involuntary placement by the court.

Response (M2-6b). Based on the results of the investigation and risk/safety assessment, a determination about whether a child will be kept in the home or placed in out-of-home care is made. Lower-risk cases are generally provided in-home services and supports, such as family preservation, parent education, safety planning, and counseling, or are referred to community-based services, such as housing or food assistance (ACF, 2014). When the permanency goal of reunification is met, these cases are then considered closed from the perspective of the child welfare agency. In higher-risk cases, the child is removed from the home and placed in foster care (M2-7). According to the most recent data, approximately 23 percent of victims (i.e., children whose maltreatment was substantiated) received foster care services (DHHS, 2016).

Placement (M2-7). When a child is removed from the home, there are a number of placement options. These include kinship care, non-relative foster care, and residential or group care (Children's Bureau, 2013). According to the most recent data from the Adoption and Foster Care Analysis and Reporting System (AFCARS), approximately 260,000 children enter foster care (i.e., an out-of-home placement) each year, with the annual census of children in foster care reaching 415,000 in recent years (DHHS, 2015). Regarding placement type, data from AFCARS indicated that in FY 2014, 29 percent of youth were in kinship placements, 46 percent were in non-relative foster care, and 14 percent were in a group home or institution (DHHS, 2015). Other temporary placements, settings, or situations included pre-adoptive homes (4 percent), supervised independent living (1 percent), runaways (1 percent), and trial home visits (5 percent; DHHS, 2015).

In recent years, the use of kinship care has increased; however, there is considerable variation across states in their reliance on kinship care, with rates ranging from 6 to 46 percent (Annie C. Casey Foundation, 2012). By contrast, placements in group homes and institutions (which are collectively sometimes referred to as *congregate care*) have decreased over the past several years. Youth who enter congregate care placements are more likely to have mental health concerns or behavioral problems (DHHS, 2015).

It is important to acknowledge that not all children who enter out-of-home care have experienced maltreatment. Some youth are placed in out-of-home care after custody/dependency decisions made by the court or law enforcement (M2-11). For example, some children enter foster care because (1) their parents or primary caregivers are incarcerated and unable to take care of them (Annie C. Casey Foundation, 2011), (2) they have significant behavioral problems (American Academy of Child & Adolescent Psychiatry, 2013), or (3) the court places them in foster care (e.g., treatment foster care, which is care provided by foster parents with specialized training to care for children with significant psychosocial needs) as an alternative to placement in the juvenile justice system (Chamberlain, 1998).

Permanency (M2-8). As noted above, children who remain at home have reunification as their permanency goal. For children in out-of-home care, permanency planning is an essential step in the process. All of these children have a permanency goal that is reviewed by the court. Per the Adoption and Safe Families Act of 1997 (Public Law 105-89), the permanency hearing that establishes this plan must be held “no later than 12 months after the date the child is considered to have entered foster care.” Permanency options include reunification with the child’s family; kinship care; or termination of parental rights, followed by permanent legal guardianship or adoption. For a small subset of children, these

permanency options may not be feasible. These children remain in long-term foster care and then receive independent living services to assist in the transition to adulthood.

For the majority of children (55 percent) in out-of-home care, the permanency goal is reunification. Adoption is the second-most-common permanency goal (25 percent). Among the remaining cases, 3 percent have the goal of living with other relatives; 3 percent to remain in long-term foster care; 5 percent to be legally emancipated; and 4 percent to enter a guardianship (DHHS, 2015). The case plan goal had not yet been established for the remaining 5 percent. Although permanency goals are established when children enter out-of-home care, there are times that youth change their placement type or permanency goal. For example, if reunification is the initial permanency goal, parents may be provided with time-limited services; however, if they are unable to make progress toward creating a safe environment for their children, alternative permanency options may be explored (D'Andrade, Frame, and Duerr Berrick, 2006). In addition, agencies are increasingly moving toward concurrent planning, a practice by which agencies concurrently make efforts toward reunification and other permanency options (particularly adoption or guardianship) (D'Andrade, 2009). This practice is designed to move children into permanency more expediently (D'Andrade, 2009). Therefore, although reunification may be specified as the initial permanency goal, a child may end up with a different permanency outcome.

Among youth discharged from the foster care system in FY 2014, 51 percent were reunified, 21 percent were adopted, 7 percent were living with other relatives, 9 percent were in a guardianship arrangement, 9 percent were emancipated, 2 percent were transferred to another agency, and for less than 1 percent the reason for discharge was running away (DHHS, 2015). The mean length of stay in care for these youth was 19.5 months (median = 13.3 months). Though the largest proportion of youth had been in care for less than a year (46 percent), 28 percent had been in care for one or two years, and 26 percent for three or more years (DHHS, 2015).

Factors Affecting a Child's Experience in the Child Welfare System

There are different factors that may influence case flow through the child welfare system. While it is important to acknowledge that these factors may impact a child's experience in the system, we are unable to directly account for them in the model because of insufficient evidence about the nature and direction of the relationships.

Incident Factors (M2-1). There is some evidence that characteristics of the incident that led to the report can influence a child's trajectory through the child welfare system,

including the likelihood that a report is substantiated (M2-5a), as well as the likelihood of different permanency options (M2-8). For example, there is evidence that reports of physical abuse are more likely to be substantiated than reports of neglect (Zuravin, Orme, and Hegar, 1995). In addition, some research suggests that children who were removed for reasons of physical or sexual abuse are more likely to reunify with their families than children removed for neglect (Lloyd and Akin, 2014; Shaw, 2010; Webster et al., 2005), and that youth removed due to parental incarceration are also more likely to reunify (Lloyd and Akin, 2014; Akin, Brook, and Lloyd, 2015).

Child and Family Factors (M2-2). Characteristics of the family and child may also impact the trajectory through the child welfare system.

- **Report Decision.** At the stage of initial screening of a report of suspected child maltreatment, the child's race/ethnicity may influence the response to an initial report (M2-4). There is some evidence that African American children are more likely to be screened in for an investigation (Fluke et al., 2003), although this is not supported by all studies (Gryzlak, Wells, and Johnson, 2005; Wolock et al., 2001).
- **Investigation Decision.** Race/ethnicity and age may also affect substantiation (M2-5a). There is some evidence that reports are more likely to be substantiated for African American and Hispanic children (Zuravin, Orme, and Hegar, 1995; Fluke et al., 2003), although the research on factors like age has been less consistent (Zuravin, Orme, and Hegar, 1995).
- **Response Decision.** Age may play a role in response decisions (M2-6b). Research suggests that younger children are more likely to be placed in foster care, with very young children (under age 1) the most likely age group (DHHS, 2015). In addition, some studies have found that African American children are more likely to be placed into the foster care system than their white or Hispanic/Latino peers (Wulczyn et al., 2005; Hill, 2006). Children who have a history of a previous CPS report are also more likely to enter out-of-home care (Park and Helton, 2010).
- **Placement Decision.** Placement decisions may also be influenced by child and family factors (M2-7). Some research suggests that children of parents who abuse substances are more likely to be placed in kinship care (Kroll, 2007).
- **Permanency Decision.** Child and family factors, such as age, race/ethnicity, and number of children, may impact the likelihood of various permanency goals and outcomes (M2-8). There is evidence that children who are older when they enter out-of-home care are more likely to reunify (Wulczyn, Chen, and Courtney, 2011; Hayward and DePanfilis, 2007; Shaw, 2010; Webster et al., 2005), and younger

children are more likely to be adopted (ACF, 2007a). Age of entry into the system also affects the likelihood that a youth will age out of the system: Older youth are more likely to age out of the system, with the likelihood of aging out increasing significantly for youth who are 16 or 17 years of age when they enter the child welfare system (Wulczyn, Chen, and Courtney, 2011; Petersen, Joseph, and Feit, 2014). African American and Hispanic/Latino children are less likely to reunify than white children (Akin, Brook, and Lloyd, 2015; Hayward and DePanfilis, 2007; Shaw, 2010; D'Andrade, 2009; Webster et al., 2005; Lloyd and Akin, 2014). Families with multiple children involved in the foster care system are more likely to be reunified (Shaw, 2010; Marsh et al., 2006), though the research is mixed (Webster et al., 2005) and somewhat sparse.

Agency/System Factors (M2-3). Although there are certain similarities in the procedures followed and characteristics of child protective service agencies across jurisdictions, there are also agency- or system-level variations. These include such factors as whether a jurisdiction uses a hotline to screen referrals; agency staff tenure, turnover, and caseload size; caseworker licensing procedures; availability of an emergency shelter; jurisdiction-specific norms or attitudes; and the specific agency or agencies responsible for placements. These factors have the potential to affect a child's experience in the child welfare system. According to one review, such factors as turnover, the availability of subsidies for guardianship and adoption, and caseworker level of education can all affect the stability of children's placements (Carnochan, Moore, and Austin, 2013). However, little research has rigorously examined the effects of these types of agency- or system-level factors.

System Experience (M2-10). Once families are under the supervision of the child welfare system, there are a number of factors related to their experience within the system that can affect a child's trajectory. In particular, studies have examined how such factors as type of placement, placement stability, length of time in care, and treatment participation affect permanency. It is important to note that some of these factors may be considered system outcomes (e.g., length of time in care, type of placement); however, there is also evidence that these factors may shape a child's experience in the system and what happens in the longer term.

- **Placement type** may affect the likelihood of various permanency goals and outcomes. For instance, some research suggests that children placed in kinship care are less likely to reunify (Hayward and DePanfilis, 2007; Grella et al., 2009), though this effect may vary by state (Koh, 2010). In contrast, youth placed with a non-

relative foster family are more likely to be reunified with their families (Shaw, 2010; Grella et al., 2009; Webster et al., 2005).

- **Placement stability** has been defined by the U.S. Department of Health and Human Services as no more than two placements per foster care episode (DHHS, 2016). According to national data, among children who spent less than a year in foster care, nearly 86 percent experienced adequate placement stability (DHHS, 2016). However, there is evidence that certain factors increase the likelihood of placement instability, including longer duration in foster care and older age (DHHS, 2016; Petersen, Joseph, and Feit, 2014). Placement type also appears to be related to placement stability; children placed in kinship care generally experience better placement stability (O'Neill et al., 2012), whereas children who receive independent living services often have a history of significant placement instability (McMahon and Fields, 2015; Yates and Grey, 2012; White et al., 2015). In turn, placement instability is associated with increased behavioral and mental health concerns in youth and a reduced likelihood of reunification (Hayward and DePanfilis, 2007; Grella et al., 2009).
- **Length of time in care** may also affect permanency outcomes. According to national data, the mean time in care is 20.8 months (median = 12.6 months) (DHHS, 2015), and there is evidence that the longer a child has been in foster care, the lower the likelihood of reunification (Hayward and DePanfilis, 2007; Grella et al., 2009). In fact, some studies of youth who age out of the foster care system have found that the mean time in out-of-home care may be as high as seven to nine years (Powers et al., 2012; Yates and Grey, 2012; Havlicek, 2014).
- **Treatment** may also impact permanency outcomes, particularly reunification. However, studies vary widely with respect to type of intervention and the ways that “treatment participation” is operationalized. For instance, there is evidence that participation in family dependency treatment courts or family drug courts increases the likelihood of reunification (Brook et al., 2015; Chuang et al., 2012), although these types of programs may also increase the time to reunification (Chuang et al., 2012). Conversely, though, another study found that parents receiving drug or alcohol treatment services were less likely to reunify with their children (Shaw, 2010). Other studies have gone beyond examining simple treatment participation to demonstrate better outcomes for parents who are making progress in treatment, complete more of the services to which they are referred, and have higher treatment adherence (Marsh et al., 2006; Choi, Huang, and Ryan, 2012; D'Andrade and Valdez, 2012). However, the substantial variability in intervention types and study

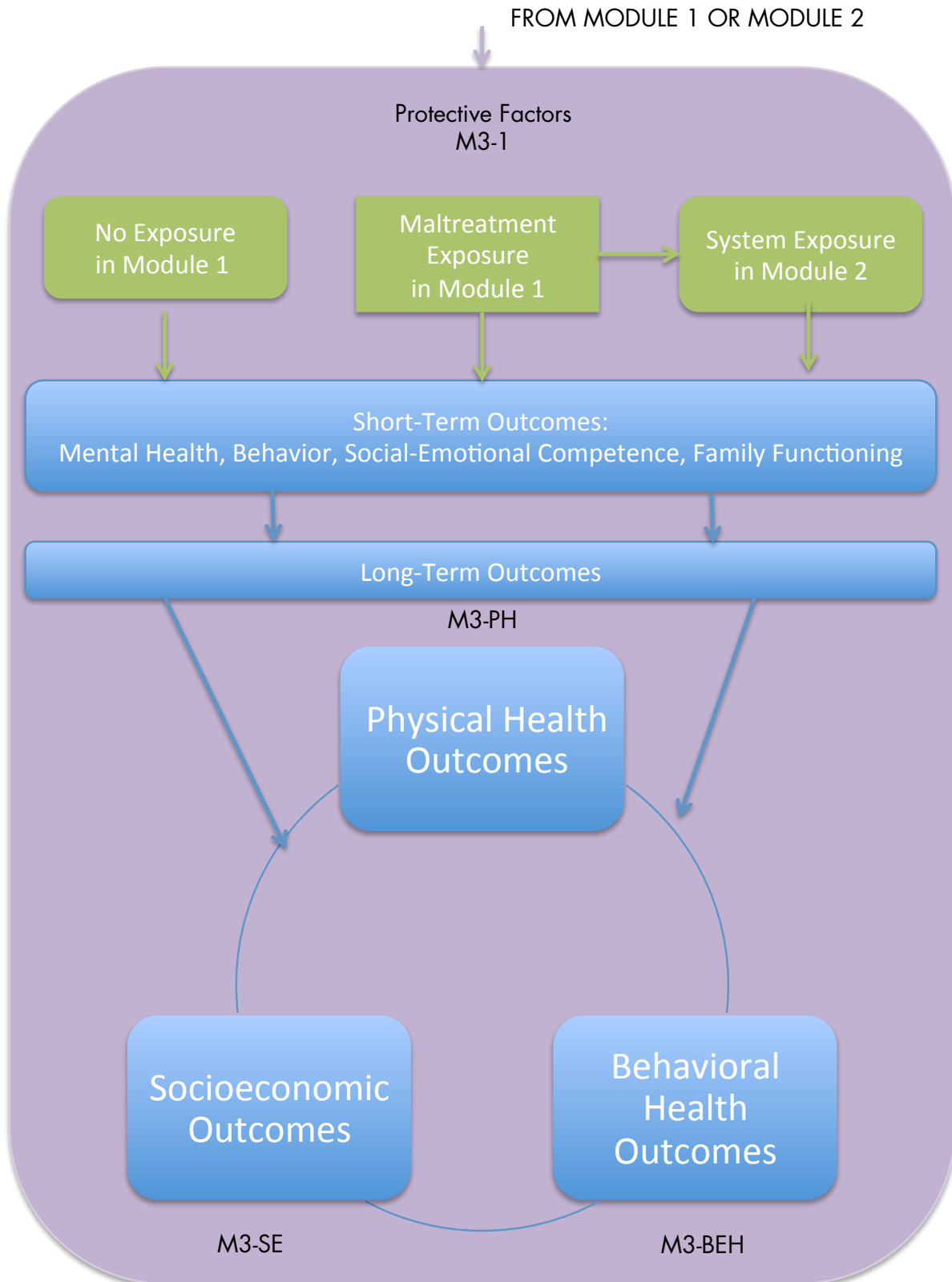
methodology makes it difficult to generalize across studies and quantify the effects of these interventions.

Consequences

Several factors impact the longer-term life trajectory of these children, including their experience with maltreatment, the detection and reporting of their maltreatment, and the pathway through the system (Figure A.4). While it might be tempting to posit a direct correlation between maltreatment, child welfare system involvement, and negative life outcomes, the nature of the relationships is complicated. All children, regardless of their exposure to maltreatment or the child welfare system, also have a host of protective factors operating in their lives, at different times and in different ways. Attention to these buffering elements is important for understanding why youth who move through the system may face different outcomes and why those outcomes may closely parallel life patterns of youth with no documented maltreatment or system exposure. In the end, it is the relative balance between protective factors, maltreatment and its detection, and system experiences that coalesce into varying long-term outcomes for youth. While the combination of these factors likely influences short- and long-term outcomes, we are unable to account for these directly in the model because of insufficient information about the nature and direction of the relationships. We are also unable to account for the protective factors, short-term outcomes, and many of the long-term outcomes in the model because of a lack of data.

Protective Factors (M3-1). A child's maltreatment and involvement with the child welfare system does not always lead to negative outcomes. In fact, approximately half of the children who have experienced multiple risks, including maltreatment and other violence exposure, will match peers who have not experienced similar disadvantage on a wide range of developmental outcomes (Rutter, 2000). To improve outcomes for maltreated children, it is important to understand how these children become resilient in the face of adversity. *Resilience* is considered a process of positive adaptation in the face of adversity that works through protective factors at the individual, family, and community levels (Luthar, Cicchetti, and Becker, 2000; Bronfenbrenner and Ceci, 1994). Strategies that work to bolster protective factors at all levels can help children and families overcome the negative consequences of maltreatment exposure and improve outcomes in both the short and long term.

Figure A.4. Module 3: Consequences



- **Individual factors** include such child-level assets or skills as emotion regulation, problem-solving skills, social-emotional competence, appropriate and positive interactions with others, engagement in personally fulfilling activities, and a positive future orientation (Child Welfare Information Gateway, 2014).
- **Family/relational factors** include aspects of the parent-child relationship, family support and cohesion, parental monitoring and discipline, parental knowledge of child development, and positive family communication, as well as caring adults and positive peer and social relationships (Child Welfare Information Gateway, 2014).
- **Community factors** include neighborhood quality and safety, positive school climate, social support networks, access to community-based services and activities, and social norms (Child Welfare Information Gateway, 2014).

Short-Term Outcomes. Child development is a dynamic and diverse process that involves biological, psychological, cognitive, and social changes at different stages of childhood (infancy, early childhood, and adolescence). At each stage, children experience outcomes in the areas of cognitive development, social and emotional competence, psychological and behavioral health, and physical health. There is evidence that children with child welfare system involvement, including those placed in foster care, are at risk for certain negative outcomes in the near term within different outcome domains (ACF, 2007d; Jones Harden, 2004; Bass, Shields, and Behrman, 2004). For instance, these youth have higher rates of developmental delays early in life and poorer academic performance (ACF, 2007a). They have an increased risk of behavioral issues and mental health problems during childhood (ACF, 2007b), enter the system with more health issues (Szilagyi et al., 2015), and exhibit high rates of multiple chronic medical conditions (ACF, 2007a; Jee et al., 2006). They are also more likely to engage in high-risk behaviors, including substance use and delinquent or criminal activity (ACF, 2007c). In addition, girls in foster care are less likely to use contraception and more likely to become pregnant than girls not in foster care (Szilagyi et al., 2015). Girls with a history of foster care involvement also report higher rates of sexually transmitted infections, earlier onset of sexual activity, earlier age for sexual intercourse, and more frequent participation in riskier sexual activities (e.g., transactional sex) than their peers with no history of foster care (Kott, 2010). For different placement types, there is some evidence that youth in kinship care have better overall well-being than youth in non-kinship care placements, including fewer behavioral and mental health problems (Winokur, Holtan, and Batchelder, 2014). More generally, children in foster care and those adopted from foster care had higher rates of depression and anxiety than children living with their biological parent(s) (Zill and Bramlett, 2014).

Long-Term Outcomes. The effects of child maltreatment and child welfare system response persist into early adulthood (current studies are tracking youth into their mid-20s, with some data for adults moving into their 30s) and have long-term outcomes in the domains of physical health (M3-PH), behavior (M3-BEH), and socioeconomic factors (M3-SE). A number of factors may influence these outcome domains, including length of time in care, number of placements, and type of placement. Youth who age out of the child welfare system often enter adulthood without the skills, services, and supports in place to overcome challenges related to their maltreatment and system experience (Avery and Freundlich, 2009). It is imperative to note, however, that we have few truly longitudinal studies of former foster youth, and thus little ability to assess the impact of specific interventions on specific youth under specific conditions. The gaps in data and research make it challenging to assess the consequences of maltreatment and/or system exposure.

Physical health outcomes (M3-PH) include risk to health and physical functioning as a result of maltreatment (e.g., functional limitations caused by repeated bone breaks), system exposure (e.g., metabolic consequences of chronic stress resulting from placement instability), or combined pathways. For young adults with a history of child maltreatment and child welfare system involvement, physical health outcomes may include increased risk for a number of different chronic health conditions. Comparisons of former foster youth with those from economically fragile homes during childhood found higher rates of such health conditions as hypertension, diabetes, and heart disease (Ahrens, Garrison, and Courtney, 2014; Kessler et al., 2008). Former foster youth are also less likely to have health insurance as young adults than those who came from economically unstable homes (Ahrens, Garrison, and Courtney, 2014). Decreased access to medical care can exacerbate underlying conditions, thus compounding health consequences over time.

Behavioral outcomes (M3-BEH) include diagnosed mental health disorders, such as depression, anxiety, and post-traumatic stress disorder (PTSD). While data on mental health outcomes for foster care alumni are somewhat limited, there is some evidence that former foster youth have higher rates of PTSD and depression as young adults than comparable young adults in the general population (Pecora et al., 2009). However, the type of placement (kinship versus non-kinship care) does not appear to impact mental health outcomes (Fechter-Leggett and O'Brien, 2010). It remains to be studied how changes in access to mental health counseling, public attitudes toward mental health care, and access to psychiatric medications impact psychological well-being over the longer term among young adults with a history of child maltreatment or system exposure.

Behavioral outcomes may also include the likelihood of a young adult exhibiting risky, harmful, or otherwise negative behaviors. Foster care alumni are more likely to have alcohol or drug dependence than comparable young adults in the general population without a history of foster care (Pecora et al., 2009). Child welfare system experience may also increase risk for later criminal justice system involvement (Courtney et al., 2009). In addition, young adults with CPS involvement during childhood were two to three times more likely to have been incarcerated or have a criminal conviction than those with no CPS involvement (Mersky and Janczewski, 2013).

Socioeconomic outcomes (M3-SE) represent long-term financial health and stability, including educational attainment, employment, and income. Involvement with the child welfare system is correlated with poor educational outcomes, such as high school completion, postsecondary attendance or completion, and overall educational attainment (Mersky and Janczewski, 2013; Courtney et al., 2009). Among former foster youth who did attend college, they evidenced greater difficulty completing their degrees within six years (26 percent versus 56 percent of all students), likely due to a lack of structured support systems (Davis, 2006). As young adults, former foster youth are much less likely to have a job than peers without a history of foster care (Courtney et al., 2009). Young adults with CPS involvement during childhood also had lower incomes than comparable youth without CPS involvement (Mersky and Janczewski, 2013). Socioeconomic outcomes also include homelessness or housing instability and the need for and use of public assistance (e.g., Temporary Assistance to Needy Families [TANF]). Looking at housing instability over time, estimates of homelessness among former foster youth range from 30 to 40 percent (Courtney et al., 2009; Dworsky, Napolitano, and Courtney, 2013). In terms of receipt of public assistance, youth in foster care were less likely to receive TANF than youth with a reported maltreatment background who did not reside in foster care (Mersky and Janczewski, 2013). Some studies suggest that youth in robust residential independent living programs, which continue past age 18, tend to fare best in terms of educational achievement, employment, economic stability, and housing security when compared with other transition-age youth who receive less-intensive independent living services (Georgiades, 2005).

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Appendix B. Methods

The results in the report have been updated to incorporate feedback we received on the prior version regarding the choice of model inputs used to produce the baseline results. We also used the opportunity to make several additional improvements. The changes we have made are outlined below and point the reader to the section of the appendix that describes the approach that is now used.

- We updated calibration targets for the model. We had previously used annual rates as proxies for the lifetime rates (between birth and age 18) of events along the child welfare system pathway (e.g., referral to the child welfare system, investigation of maltreatment report). We now use a combination of literature and secondary data analysis to generate model inputs that more closely reflect lifetime rates. See the “Ensuring Model Accuracy” section for a detailed description of how the new calibration targets were developed.
- We improved the process used to calibrate the model. Model calibration involves an iterative process of testing different permutations of model parameters in order to find which sets make the model most closely mimic empirical statistics. We updated the formula used to suggest new calibration parameter sets. See the “Ensuring Model Accuracy” section for a description of the formula used.
- We refined the cost calibration targets. We made two key changes. The model focuses on children who are in the child welfare system because they have been maltreated. We removed costs associated with out-of-home placements not due to maltreatment from the child welfare system cost calibration target. We also identified more-detailed data on expenditures on preventive services and updated the cost calibration target accordingly. The cost calibration targets are described in detail in the “Ensuring Model Accuracy” section.
- We used a different discount rate to calculate lifetime costs. We have updated the cost estimates using a discount rate of 3.0 percent rather than 1.2 percent, which discounts future savings more heavily. For more information on the cost calculations, see the “Financial Costs and Summary of Key Costs” section.
- We corrected minor programming errors. As we revised the model, we reviewed all programming code. We found and addressed two errors. The first led to an overcount in the original model of the number of preventive services being

provided. The second affected the cost calibration targets, causing them to be too low.

We implemented each change incrementally so that we were able to understand the impact of each individually on the model results. Of all the changes, the effect of moving to lifetime rates as calibration targets had the largest impact on the model results. The updated model generates a new baseline with much higher levels of each event (e.g., maltreatment, preventive services, investigations). However, the percentage changes due to the different policy options are, in most cases, smaller than what we found in the prior version of the model. Though the magnitude of the estimates changes, sometimes considerably, no parameter estimates change signs, so the basic pattern of results and the story they tell are similar.

Several changes were made that affect costs in the model. After all changes were made, the estimated total cost in the baseline was very similar to the prior version of the model. The estimated percentage changes in cost due to the policy options, however, were smaller than what we found in the prior version.

The effects of the other changes (i.e., the calibration improvements, addressing programming errors) were relatively small in comparison, generally resulting in differences of less than 1 percentage point for the estimated effects of the policy options.

Approach

Our technical approach to addressing the policy questions included conducting a literature review, developing diagrams to depict pathways through the child welfare system after maltreatment, identifying existing administrative data sources, analyzing outcome data, and building a simulation model of the child welfare system that combines estimates from the different data sources to assess the individual and societal costs and benefits associated with different policy scenarios.

Literature Review

The literature review was conducted to compile the existing evidence on the different pathways through the child welfare system; the effects of each pathway on individual-level outcomes; the costs of each pathway; and different policy, program, or policy options that might affect entry into or experience with the child welfare system.

The literature review identified relevant journal articles, “gray literature” (e.g., reports not found through conventional peer reviewed search engines, reports from both government and nongovernmental bodies), policy documents, and websites. We used

databases reflecting a wide range of disciplines, including Psychinfo, ERIC (Education Resources Information Center), PubMed, Web of Science, and Social Services Abstracts, and searched for gray literature using databases such as OAISter and IssueLab. In order to create a cohesive and integrated literature review, it was critical to scan literature from the multiple sectors that serve children, adolescents, and young adults. Our search focused on English-language publications from 2000 through January 2016.

In consultation with a RAND librarian, we built search statements for each database to help ensure that the search identified a broad array of articles that were relevant to child and family experiences with the child welfare system. We included three categories of keywords: child welfare system–related keywords, outcome-related keywords, and pathway-related keywords (Figure B.1).

Figure B.1. Keyword Categories

Category 1: Child Welfare System Keywords	Category 2: Outcome Keywords	Category 3: Pathway-Specific Keywords
<ul style="list-style-type: none"> • Child maltreatment, child abuse, child neglect • Child welfare system • Child protective services • Foster care 	<ul style="list-style-type: none"> • Outcome, outcomes, effect, impact 	<ul style="list-style-type: none"> • Reunification, reunified • Kinship care, relative care • Adoption, guardianship, subsidized guardianship • Independent living, transition-age, age out, long term foster care, foster care alumni, former foster care youth

The search yielded a total of 1,711 publications across the four pathways (Table B.1). For each pathway search, two members of the research team reviewed the titles of the articles identified during the literature search to remove articles that were clearly irrelevant. Overall, the level of agreement about whether to screen in the publication after the initial title review ranged from 84 percent to 88 percent. For publications on which there was disagreement, the two research team members discussed the publication to resolve the discrepancy. Two members of the research team also reviewed the abstracts for all screened-in publications to identify those publications for full-text review. Again, the level of agreement was high (ranging from 74 percent to 91 percent); discrepancies were discussed among the team, and a consensus was reached about whether to include or

exclude the article for full-text review. After the initial literature screening identified sources for full-text review, we abstracted data to record information from the 344 citations included in the full-text review. The full-text review focused on abstracting quantitative information for each pathway, including estimates of the prevalence, child and family characteristics, predictors, system experience (e.g., number of placements, length of stay, reentry), and outcomes.

Table B.1. Results of Title and Abstract Review for Each Pathway Search

	Reunification	Kinship Care	Adoption/ Guardianship	Independent Living
Number of articles identified	344	296	723	348
Number (%) screened in after initial title review	104 (30%)	107 (36%)	127 (18%)	205 (59%)
Number (%) retained after abstract review for full-text review	77 (74%)	66 (62%)	67 (53%)	134 (65%)

We also conducted additional searches as part of the model development process. These included a more-general search of the databases above for articles on the foster care and child welfare system more generally; a search of the gray literature of information not published in academic journals, such as reports from government and nongovernmental bodies; a search of the costs of involvement in the child welfare system; and a search of different practice or policy options that might influence a child’s or family’s experience with the child welfare system.

- For the general foster care search, we identified 97 additional articles, with 60 of them screened in for full-text review.
- The gray literature review found 81 reports or publications related to the child welfare system, with 33 of them screened in for full-text review.
- For the cost search, we identified 40 articles, with 25 of them screened in for full-text review.
- For the practice and policy option literature review, we identified and reviewed 45 publications that described some type of practice, policy, or program for child welfare-involved families.

As with the other screened-in articles, we abstracted quantitative information from these articles to inform the development of the simulation model.

Development of Module Diagrams

The results of the literature review were used to develop module diagrams that depict the different paths into and through the child welfare system. We used the information from the literature review for each pathway to map out how children are recognized and reported, how they move through the child welfare system once reported, and what happens to them after they exit the system. These flow diagrams formed the basis of the simulation model. We conceived of the simulation as divided into three modules.

- **Module 1: Maltreatment and detection** simulates children, families, and mandated reporters in the population at large. Given their situation, different children have differing probabilities of maltreatment, of being recognized as maltreated, and of being reported to the child welfare system. If they are reported, they advance to Module 2. If no report occurs before age 18, they advance directly to Module 3.
- **Module 2: System pathway** simulates the decision points and pathways through and out of the child welfare system once a report is made. The diagram depicts the different pathways at each decision point and response option and includes different factors that might influence those decision points or response options. Once moving through and exiting the system, children will return to Module 1 if they are under 18. If the child turns 18 or exits through emancipation, he or she advances directly to Module 3.
- **Module 3: Consequences** simulates the likely young adult outcomes, as well as the likely costs to the system based on the child's starting situation, experiences with maltreatment, and the child welfare system pathway.

Once the module diagrams were developed, we conducted a series of subject-matter expert interviews to gather input and further refine the diagrams. We worked together with the Pritzker Foster Care Initiative to identify subject-matter experts with different roles in and perspectives regarding the child welfare system. We invited eight subject-matter experts to participate, and all agreed to do so. The experts included academic researchers, practitioners, policy advocates, and foundation leaders and staff. The collective knowledge of the experts reflects experience with a broad array of jurisdictions and different subpopulations within the child welfare system.

We scheduled 60-minute telephone interviews with each participant and shared a project description and the draft module diagrams for them to review. During the meeting, we focused on three basic questions.

- Does the logic of the module diagrams make sense?
- Does it reflect your experience with the system?
 - If not, how should the diagrams be changed?
- Is there anything important missing from the diagrams?
 - If so, how should the diagrams be changed?

Two RAND team members participated in each interview. One person led the interview while the other took notes. After each interview, we reviewed and finalized the notes, identifying all of the specific changes that were needed. We then revised the module diagrams to reflect the subject-matter expert input.

The detailed module diagrams are described in Appendix A.

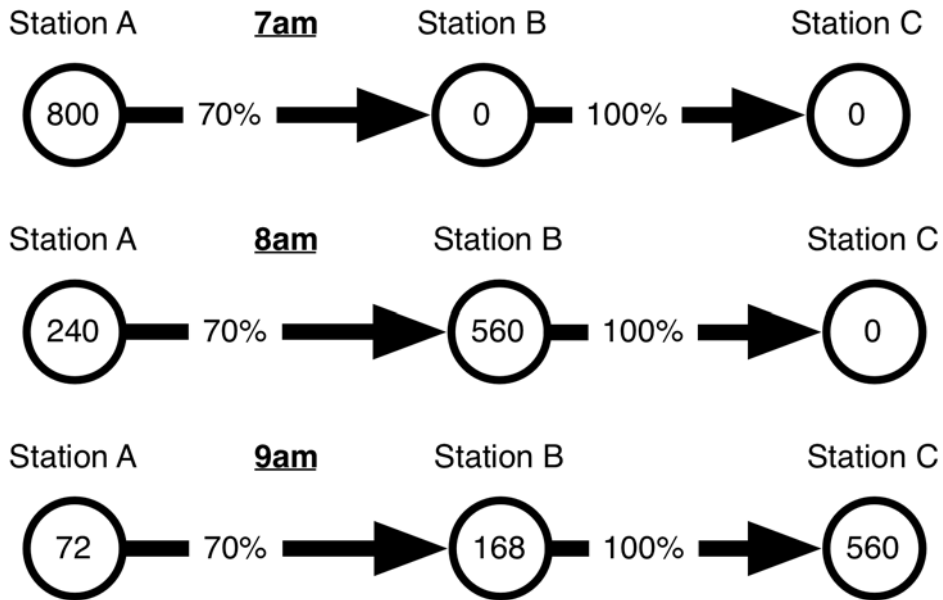
Model Design

Model Structure

Our simulation follows a state transition modeling approach. In such an approach, the world is divided into a number of states, each of which represents a life circumstance that could occur to a person. Depending on the current circumstance of the individual, there is a probability of transitioning from his or her current circumstance to new circumstances. The simulation moves people from state to state according to these probabilities until a specified ending condition is reached.

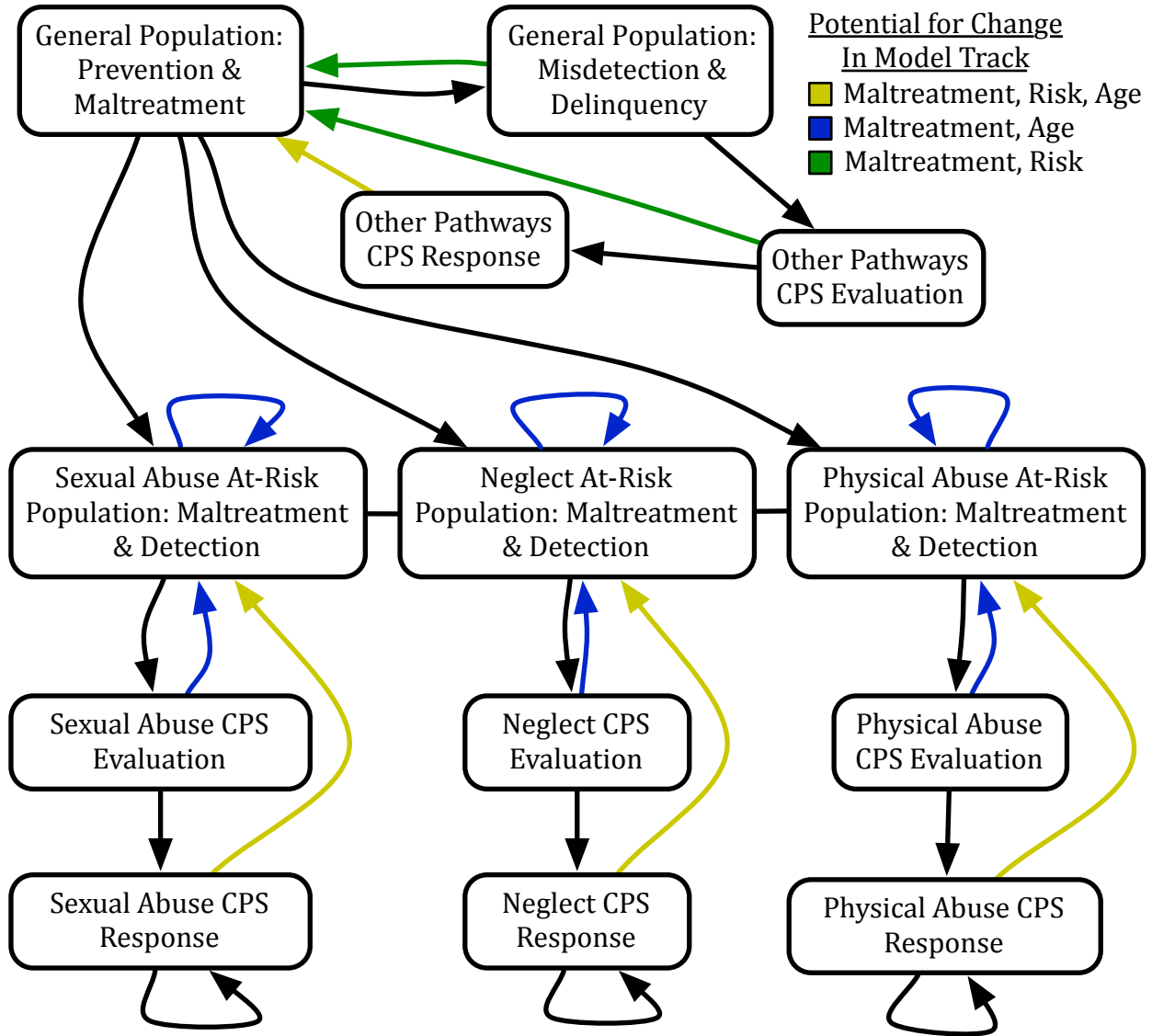
To make this more concrete, imagine a subway station (Figure B.2). People start at stations, which represent their current situation in life, and then have some probability of getting on trains that take them to other stations. Each time-step in the model changes the number of people at each station, based on their transition (train-boarding) probabilities. Figure B.2 illustrates this process with a simple example. At the beginning of the model, 800 people start in Station A at 7 a.m. Because people in Station A have a 70-percent chance of moving to Station B within an hour, Station B contains 70 percent of 800 (560) by 8 a.m., while Station A keeps the remaining 30 percent (240). Because people in Station B have a 100-percent chance of moving to Station C within an hour, all 560 of those people at Station B at 8 a.m. move to Station C by 9 a.m. At the same time, 70 percent of the people remaining at Station A at 8 a.m. (168) transition to Station B by 9 a.m.

Figure B.2. Subway Station Example



Now imagine that Station A is the number of maltreated children in America; Station B is the number that have been referred to the child welfare system, or child protective services (CPS); and Station C is the number screened in for further action (investigation or alternative response) by CPS staff. Our model is composed entirely of compartments and transitions just like these. Moreover, our model also has separate transitions for different kinds of children, such as a transition for females that has different maltreatment risk probabilities. Taken together, our model consists of 25,248 states, linked together with 116,856 possible transitions. Figure B.3 illustrates a high-level simplification of our model blueprint.

Figure B.3. Model Blueprint



At the start of the model, all children start in the component labeled “General Population: Prevention & Maltreatment” in compartments for the 0–5 age group. They have some probability of receiving preventive services (higher for high-risk children) and some probability of experiencing three kinds of maltreatment (somewhat lower if they received preventive services; somewhat higher for high-risk children). If they experience maltreatment, they move to one of the three At-Risk Population components, depending on which form of maltreatment is the primary form they experience.

If maltreatment does not occur, they move to the General Population: Misdetection & Delinquency model component. Here they have some probability of being reported to CPS for delinquent behavior (nearly zero for nonadolescents) and some probability of being mistakenly reported as having experienced maltreatment. In those circumstances, they move to the Other Pathways: CPS Evaluation component. Otherwise, they are returned to the General Population: Prevention & Maltreatment component.

Children who experience their first incident of maltreatment move to the At-Risk Population: Maltreatment & Detection component corresponding to the primary form of maltreatment that defines their experience. They immediately have a probability of being referred to CPS. If this occurs, they move to the CPS Evaluation component for their maltreatment type. Otherwise, they remain in the At-Risk Population component. This component essentially mimics the General Population components, except that the risks of maltreatment are much higher. This corresponds to the assumption that a child who has been maltreated in the past faces greater risk of being maltreated in the future when remaining with the family. A child in the At-Risk Population component has probabilities of receiving preventive services, experiencing maltreatment, and being reported to CPS (which can happen even if a new maltreatment incident did not occur).

Children who are referred to CPS move to one of the four CPS Evaluation components. In each, children have a (large) probability of having their report screened out or investigated but unsubstantiated. If their report is screened out or unsubstantiated, they return to the At-Risk Population component if they have been victims of maltreatment or to the General Population component otherwise. If their report is investigated and substantiated, they move to the corresponding CPS Response component.

Children who move to one of the CPS Response components have a probability of remaining in the home or experiencing several varieties of out-of-home placement while CPS determines a permanency goal and then attempts to move the child toward it. This includes probabilities of moving between temporary placements, simulating how some children bounce around in the system instead of finding a quick resolution. However, it also includes probabilities of moving from temporary placement to four kinds of permanent placements: parental reunification, adoption/guardianship, kinship care, or independent living (adolescents only). Once permanent placement has been achieved, they return to the At-Risk Population component, albeit with different household characteristics.

In total, these components sum to 88 unique model states, connected with 274 possible state transitions. However, this core system of states and transitions is replicated across 288 different model tracks, which adjust probabilities to account for different life courses.

Model Tracks

This model structure is replicated across a number of “tracks” to capture important considerations. Each track replicates the same states and transition pathways but alters the probabilities that specific activities occur.

One set of tracks concerns the characteristics of children of families. Our review of the literature highlighted gender, race, and special needs as three child characteristics most often cited as having a significant bearing on maltreatment and CPS response. For this prototype simulation,¹ we assigned elevated maltreatment risk and decreased delinquency risk to females. Future model versions will incorporate race and special needs. Our review of the literature highlighted poverty, cohabitation status, and addiction as the characteristics of families most often cited as having a significant bearing on maltreatment and CPS response. For this simulation, we assigned elevated maltreatment risk and elevated risk of receiving income-targeted preventive services to impoverished families. All tracks are cumulative, so these characteristics added four separate tracks to our model: female child/impoverished family, male child/impoverished family, female child/non-impoverished family, and male child/non-impoverished family.

Another set of tracks concerns age and risk progressions. Our model divides childhood into three periods (ages 0–5, 6–11, and 12–17). During specific state transitions (the green, blue, and gold lines in Figure B.3), children experience a probability of moving to the next age group. When they progress, they enter a new track with different risk probabilities. For example, independent living permanency goals and delinquency CPS involvement both become much more likely for children in the 12–17 age tracks. When the children transition out of the 12–17 age group, they exit the simulation. During specific transitions, children can also progress to tracks where their risk of maltreatment is smaller. However, once an incident of maltreatment has occurred, the risk no longer decreases over time. This corresponds to the general notion that parents who have not maltreated their children in the past are less likely to do so in the future. It also allows preventive services and CPS interventions to have a lasting impact through decrements to the child’s future

¹ Each additional personal attribute increases the complexity of the simulation significantly and requires progressively more-complex data to properly quantify the interactions of the attributes. We limited the simulation to fewer personal attributes to better facilitate testing, validation, and model development.

maltreatment chances. Our model segments risk into four tiers, each of which has lower maltreatment probabilities than the last. The risk track probabilities are calibrated such that, on average, children's risk of maltreatment has decreased two-thirds by the time they age out of childhood. Once a child has been maltreated, this risk generally does not decrease further. However, there is one exception: placement tracks. If a child is adopted or is otherwise moved to a new home, the child moves to a new track in which the risk probabilities diminish somewhat, because the rates of repeated maltreatment in foster care and adopted care are lower than the rate of repeated maltreatment among reunified families.

A final set of tracks concerns experimental and control groups. The goal of this simulation is to test how variations in policy can potentially impact childhood maltreatment and life outcomes. Consequently, the entire model is run in parallel, with one group of children serving as a control group and the other experiencing some change in probabilities that corresponds to a policy interaction of interest. Taken together, this model consists of 25,248 states and 116,856 state transition pathways that connect those 25,248 states together into a system. The states are calculated as follows:

- 86 life events that may occur for each child (e.g., removal from home)
- multiplied by three home environments:
 - lives with birth parents
 - lives with kin
 - lives with non-kin adoptive parent(s) or legal guardian(s)
- multiplied by four demographic groups:
 - male from impoverished birth family
 - female from impoverished birth family
 - male from non-impoverished birth family
 - female from non-impoverished birth family
- multiplied by three age groups:
 - ages 0–5 (all children start in this group and age into other groups over time)
 - ages 6–11
 - ages 12–17
- multiplied by four risk brackets:
 - risk multiplied by 100 percent (all children start in this bracket and move into other groups over time)
 - risk multiplied by 75 percent

- risk multiplied by 50 percent
- risk multiplied by 25 percent
- multiplied by two experimental conditions:
 - control conditions (baseline probabilities)
 - experimental conditions (probabilities modified for scenario)
- plus an additional 480 ways to exit states. Most of these states are duplicates of each other, except that they apply to children with a different combination of home, demographic, and cohort characteristics. They all reflect one of three mechanisms of exit:
 - transitioning from states corresponding to the 12–17 age group to states corresponding to an 18+ age group. This 18+ age group exists only for exit states and ends a child's journey through the model. There are 120 model exit states for 18+ age exit, excluding 24 that overlap with 0 percent risk exit (discussed in the next bullet).
 - transitioning from states corresponding to 25 percent risk to states corresponding to 0 percent risk. This 0 percent risk group exists only for exit states and ends a child's journey through the model. There are 96 model exit states for 0 percent risk exit, including 24 that overlap with 18+ age exit.
 - being discharged to independent living. There are separate independent living discharge states for each maltreatment pathway (neglect, physical abuse, sexual abuse, no abuse) and each combination of home and demographic characteristics. The exit states total to 288. However, many of these exit states are rarely, if ever, used, because the probability of an independent living discharge for younger age groups is virtually zero.

A typical simulation run goes through about 90 iterations to fully model a cohort's childhood experience and generally completes in under four minutes of run time, including scenario compilation and calculation of detailed outputs.

Conditionality

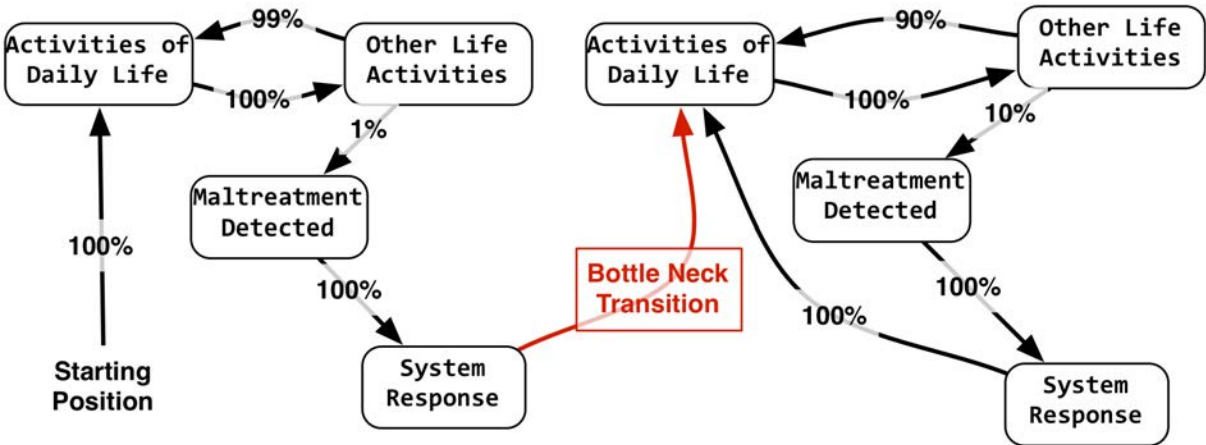
The transitions are modeled as Markov random walks. As such, all of the information necessary to understand a walker's behavior is (1) the walker's current location in state space and (2) the probabilities that any walker at the given state will progress to specific other states. That is, a Markovian random walker effectively has no memory. It does not

matter where the walker has been before; the transition probabilities depend only on the walker’s current location. Therefore, Markov random walks have, by definition, low conditionality. However, many processes of interest to modelers have some measure of conditionality—the probability that a walker moves from one state to another is, at least partly, conditional on some other aspect. This can include states previously traversed (path dependency), time elapsed (time dependency), and occupancy of other states in the model (state space dependency).

We use one-way bottlenecks in the state transition network to model path dependency and time dependency. These bottlenecks are transitions that, once made, result in the walker being permanently unable to return to the states on the other side of the bottleneck.

For example, Figure B.4 illustrates a very simple, hypothetical transition system. In this system, each child oscillates between the activities of daily life and other life activities at the left of the figure until an incident of maltreatment is detected (at which time the child moves to the “Maltreatment Detected” state on the left). If this occurs (1-percent chance), the child moves into and through the system before being moved back to the “Activities of Daily Life” box. However, the child does not return to the same “Activities of Daily Life” box on the left but, instead, to another similar state on the right. In fact, a child who passes through the “System Response” state will never be able to return to any of the boxes to the left of the bottleneck. In this example, once the child has been exposed to CPS, the child permanently moves to a different part of state space. In the new space (right-hand side), the child now has a 10-percent chance of CPS detecting an incident of maltreatment, instead of the 1-percent chance that the child had previously.

Figure B.4. Hypothetical Example of a Transition System



We use bottlenecks in this way to ensure that when a child has a defining life event, that child's future experiences shift to capture the long-term significance of that event. For example, a child's first maltreatment incident is a bottleneck transition. After that transition, the child's probability of future maltreatment incidents increases sharply.

We also use bottlenecks to mark the passage of time and its effects on a child's experiences. We built two kinds of "clock bottlenecks" into our state space. One gradually increases the child's age. As children move into new eras of childhood, the probabilities of various risks, services, and system responses change. The other type of clock bottleneck gradually decreases the child's risks. As the child accumulates years as a never-maltreated child (which is itself influenced by preventive services, as well as risk factors), the child passes through successive risk brackets, each of which offers lower probabilities of maltreatment and slight changes to system response.

Costs and Consequences

The progression of children through the simulation implies both personal and societal costs and consequences. We used the results of how children move through the system to estimate monetary costs of CPS and four outcomes in young adulthood: homelessness, underemployment, substance abuse, and criminal conviction.

Monetary costs are the most straightforward. Relevant model transitions are assigned a dollar cost that reflects the per-case cost of performing certain CPS activities. For example, imagine that CPS entities collectively accrue an average of \$437.73 in expenses for every child who receives a particular service. If, over the course of the model, 100 children transitioned into the state corresponding to receiving that service, we would estimate that CPS entities accrued \$437.73 multiplied by 100, or \$43,773 in costs, due to the provision of that service.

For the outcomes in young adulthood, the link between cause and effect is less direct and, therefore, requires more assumptions. We assume that the effect of negative experiences, such as maltreatment, is roughly equal to the difference in life outcomes for people having or not having those experiences multiplied by the ratio of the two groups in our population. For example, imagine that 40 people per 1,000 were underemployed in the general population, but 44 per 1,000 maltreatment victims were underemployed. We would assume that the effect of maltreatment on underemployment is an extra four underemployed persons per 1,000. As the ratio of maltreatment victims to children in our model rises, we would expect the predicted rate of future underemployed among our cohort to rise by four persons per 1,000. Finkelhor et al. (2014) estimate that 116 children

will experience neglect by age 18 for every 1,000 children in the population. Therefore, we might estimate that an effect of neglect is 116 divided by 1,000 and then multiplied by 4—an additional 0.46 underemployed persons per 1,000 people when the children reach young adulthood.

Model Parameterization

Transition Probabilities

Because of the number of states and transitions involved in the process and the different numerical scales on which various processes occur, we pooled information from administrative data, survey data, agency reports, and research statistics to estimate transition probabilities. The research and data we used most frequently came from the following data repositories:

- Finkelhor et al. (2014) for maltreatment
- the National Child Abuse and Neglect Data System (NCANDS) for detection and investigation of maltreatment
- the Adoption and Foster Care Analysis and Reporting System (AFCARS) for movement through the foster care system
- the Multistate Foster Care Data Archive (FCDA), also for movement through the foster care system
- the National Longitudinal Study of Adolescent to Adult Health (Add Health) for outcomes in young adulthood.

In total, our model simulates the outcomes for approximately 23,891,281 children moving among 25,248 model states via 116,856 possible transitions. Over the course of a typical (baseline) model run, our simulated children experienced 900,401,236 transitions—an average of 37.7 transitions per child over the course of childhood. For each time increment of the simulation, the number of children in each model state and transitioning between states was logged. After the simulation concluded, these logs were examined to understand the performance of the simulation and the potential consequences that might result from the dynamics simulated.

In modeling the transition from child entry to a prevention type, we estimated the probability that a child faces either selected or targeted prevention approaches or no prevention at least once within a specific age group. However, there are many different prevention programs, all of which have unique features and emphases. We modeled our simulated preventive services on the Positive Parenting Program (Triple P) and the Nurse-

Family Partnership (NFP) because (1) the body of research on them was sufficient for us to simulate their effects, and (2) both programs had some evidence of their effectiveness. We obtained our estimates on the prevalence of preventive services from NCANDS, which reported 2.3 million preventive services in 2015 (U.S. Department of Health and Human Services [DHHS], 2016). We combined the data on prevention prevalence with Triple P and NFP figures on age-eligibility criteria, effectiveness, and population served to estimate how preventive services may be affecting our population. In our model, we made a distinction between preventive services targeted narrowly based on risk and those targeted more broadly. NFP was weighted more highly in simulating the former, while Triple P was more influential in simulating the latter.

Next, children transition from prevention into a maltreatment or no-maltreatment pathway. Given that a child faces a type of prevention or no prevention, we estimated the probability that he or she faces either sexual or physical abuse, neglect, or no maltreatment at all. *Child Maltreatment 2014* (DHHS, 2016) provides counts of child maltreatment by maltreatment type for each group. In addition, our extensive literature review provided estimates of the relative effectiveness of targeted and selected prevention in reducing the risk of maltreatment. Using this information, we calculated the relevant conditional probabilities weighted by the relative effectiveness of the programs to account for the effect of prevention on the risk of maltreatment.

In modeling CPS referral rates, we assumed that the risk of referral varied systematically by age. We further assumed that referrals were more likely if maltreatment occurred but could also occur by mistake (or intentional false reporting). In the Fourth National Incidence Study of Child Abuse and Neglect (NIS-4), only cases screened in for investigation are submitted to the NIS reports as cases reported to CPS, so we did not have complete visibility on the chances that maltreatment leads to referral. However, an NIS-4 supplementary study investigates how sentinels respond to various scenarios and enabled us to approximate the scale of underreporting (Sedlak et al., 2010). For the baseline (no-maltreatment) pathway, a representative child will either transition into delinquency, have maltreatment reported, or return to model entry. We used counts of juvenile incarceration within each age group from Office of Juvenile Justice and Delinquency Prevention (OJJDP) statistics and U.S. Census data to estimate the probability of CPS-reported delinquency (Sedlak and McPherson, 2010). The remaining children simply return to the entry point of the model.

Following the maltreatment referral to CPS, all children transition to the evaluation process. For simplicity, we assume that children evaluated experience a substantiated

investigation, an unsubstantiated investigation, an alternative response, or a screened-out referral. We obtained these probability estimates from NCANDS (DHHS, 2016). Based on the evaluation, some children transition into the foster care system. We assumed four types of temporary foster care placements: kinship care, non-kinship care, residential, and in-home.

There are many possible trajectories that children can take through the system and toward permanency. On the one hand, they may never be removed from home and will then quickly exit the system. On the other hand, they may follow a circuitous course through multiple temporary out-of-home placements and multiple failed attempts to reunify. Because of its detailed longitudinal nature, we used statistics from the Multistate FCDA, a longitudinal data set of foster care trajectories in 21 states, to determine the transition state probabilities used in the model. However, cumulative model outputs were later calibrated to AFCARS-based cumulative placement statistics. This approach blends the strengths of both data sets: FCDA's detailed accuracy and AFCARS' census-like nationwide scope.

Financial Costs and Summary of Key Costs

To estimate the monetary costs to the government of providing services to children and families through the child welfare system, we first identified the states within the model where government costs would be incurred. We then developed an average cost per case for each of these model states (Table B.2). The cost for a state is accumulated as the child transitions out of that state.

The average cost per case for each model state was estimated by combining information from studies and reports identified through our comprehensive literature review. For states in Module 1 where preventive services are provided, we modeled our cost estimates on information provided by the Blueprints for Healthy Youth Development initiative (Blueprints for Healthy Youth Development, 2016). Blueprints for Healthy Youth Development promotes child and adolescent well-being by maintaining a database of evidence-based youth development programs typically evaluated by academic institutions and research organizations. Specifically, we based our estimates on the process costs of the NFP and Triple P programs, our representative programs for targeted and selected preventive services, respectively. The Washington State Institute for Public Policy provided estimates for NFP and Triple P programs, which we adjusted to 2016 dollars (Blueprints for Healthy Youth Development, 2017). The NFP costs were also adjusted downward to reflect one year of program costs rather than two (the typical program length). We made

this adjustment because our source for the number of preventive services provided was based on the number of children served in a year. Therefore, children in NFP for more than one year were counted in both years. We adjusted the program cost to avoid double-counting the cost of NFP services.

Table B.2. Estimates of Direct Costs to the Government Associated with Model States

Module 1: Maltreatment and Detection	Cost
Selected prevention (Triple P)	\$153
Targeted prevention (NFP)	\$5,259
Module 2: System Pathway	Cost
Evaluation process	\$1,057
Alternative response	\$1,057
Family preservation	\$1,867
Action decision	\$198
Temporary kinship placement transitioning to:	
Permanent kinship	\$41,672
Adoption	\$41,672
Reunification	\$15,507
Independent living	\$96,794
Temporary out-of-home placement with non-kin transitioning to:	
Permanent kinship	\$85,232
Adoption	\$85,232
Reunification	\$27,692
Independent living	\$206,456
Temporary out-of-home placement in residential care transitioning to:	
Permanent kinship	\$639,887
Adoptions	\$639,887
Reunification	\$182,841
Independent living	\$1,602,792
Temporary in-home care transitioning to:	
Permanent kinship	\$38,360
Adoption	\$38,360
Reunification	\$14,581
Independent living	\$88,458
Independent living	\$13,075

NOTE: Cost figures are presented in 2016 dollars.

For states in Module 2 where children are moving through the child welfare system, we based our cost estimation methods on those outlined by Ward, Holmes, and Soper (2008). This method estimates the cost of eight distinct processes that underpin the system response. For each process, the method estimates the unit cost by combining detailed information on time spent by different types of workers, the wages of those workers, equipment and supplies that are used, and any payments to families. This method was developed in the United Kingdom, but subsequent studies have concluded that the

processes are comparable to those in the United States and can be used with some adaptation (Holmes et al., 2014).

We mapped the eight processes onto our model states and adapted the unit cost estimates from Ward, Holmes, and Soper (2008) where applicable. To translate the unit costs into values appropriate for our model, we adjusted for wage differences between the United Kingdom and the United States in 2006 and then inflated the estimated unit cost to 2016 dollars using the Consumer Price Index.

For the costs associated with temporary placements in the child welfare system, Ward, Holmes, and Soper (2008) estimated monthly costs. We combined these monthly costs with estimates of duration in care to generate a total cost per case. Estimates in the literature on duration in care are typically provided by permanency outcome. That is, we found information on the typical duration in care for children who were ultimately reunified with their families (eight months), adopted (by kin or non-kin) (28.6 months), or discharged to independent living (72 months) (Children's Bureau, 2014b, Powers et al., 2012). We could not find information on the average duration in care for those that are discharged to permanent kinship care. We assumed that the average duration in care for this category was the same as for those who are ultimately adopted. We generated four separate cost-per-case estimates for each temporary placement that reflect the average monthly cost of the temporary placement (e.g., out-of-home care with non-kin) and the different durations associated with the permanent placement. For example, for children in a temporary out-of-home placement with non-kin who are ultimately adopted, the cost (\$85,232) is calculated as the average monthly cost of that type of temporary placement (\$2,980.13) multiplied by the typical duration for children whose permanency outcome is adoption (28.6 months). The costs accrue when the child transitions into a permanent placement and represent the total cost of the episode in care.

For temporary kinship care, we did not use the Ward, Holmes, and Soper (2008) unit cost. Instead, we combined information from the New York State Kincare Coalition (2011) and the Urban Institute (Murray, Macomber, and Geen, 2004) to generate the monthly cost per case that reflected administrative costs and payments to families, where applicable.

For a permanent outcome of independent living, we calculated the monthly cost of providing services and supports to participating youth. These estimates are based on a National Youth in Transition Data Brief (Children's Bureau, 2014a) and costs associated with maintenance payments and educational vouchers. The costs were adjusted to account for the fact that only a proportion of youth will receive such services.

We used a real discount rate of 3 percent to discount costs that occur in the future as the cohort ages (National Academies of Sciences, Engineering, and Medicine, 2016).² The costs of each transition for each child are aggregated to generate the total monetary cost to the government directly associated with the child welfare system. The costs do not include other government costs that may be indirectly associated with the system (e.g., juvenile justice, Medicaid), nor do they include costs to the individuals or families associated with their involvement in the system (e.g., time spent in meetings, travel costs associated with meetings).

Adult Outcomes

Both the child maltreatment and the child welfare system pathways may alter the development of the children involved and the sets of life skills and experiences they carry with them into early adulthood. The consequences of child maltreatment and child welfare system pathway stem from how these experiences may alter the life trajectory of affected children. In the model, we estimate how relevant childhood experiences, as operationalized through simulated state transitions, might potentially alter the odds of four kinds of negative life outcomes in early adulthood:³ underemployment, homelessness, criminal conviction, and substance abuse.

Maltreatment and involvement with the child welfare system do not necessarily translate into poor outcomes in adulthood. But the overwhelming majority of children who are alumni of the system are also maltreatment survivors, and both alumni and survivors are statistically dissimilar to the general population. This makes it difficult to make comparisons among groups, as the latter pair is too distinct for comparison, and the former is not distinct enough. Our approach was to apply a two-stage binomial regression model to the Add Health Wave III data set.⁴ In stage one, we calculated four models (demographic, personal attributes, worldview/beliefs, and physical/mental health), each of which used a different set of variables to predict our outcomes, but none of which used features related to child maltreatment or child welfare system pathway. Each of the four models measured a different kind of *propensity* to experience one of the four negative life outcomes,

² In the prior version of the report, we used a lower discount rate of 1.2 percent. Using a higher discount rate discounts costs that occur further in the future more heavily. This generally leads to reductions in the net cost savings estimated from this model relative to the estimates in the prior version.

³ We define *early adulthood* as ages 23 to 25. We chose this age range because it is young enough that childhood experiences are still the dominant influence on each person's life skills and circumstances, but it is old enough for the consequences of such experiences to have manifested themselves.

⁴ For more information on the Add Health data, see Add Health, undated.

regardless of the experiences simulated in our model. In stage two, we predicted the four outcomes using features of the childhood life course that correspond to life circumstance states within our model (e.g., maltreatment, response, placement). To these variables, we added our predicted probabilities from the stage one models, each of which provides an estimate of the underlying propensity of each child to experience the negative life outcomes, regardless of model relevant life events. The resulting coefficients served as our projection about how maltreatment (and system pathway) alters the odds of negative outcomes in adulthood. Following each simulation run, we tallied the percentage of the population experiencing each negative childhood experience and increased the average negative outcome odds of the population proportionally. Table B.3 reports how different life course events may alter the odds of these four negative life outcomes.

Each of our negative events is a rare outcome. Even underemployment, by far the most common, affects fewer than one in three people in our age group. Consequently, we used these coefficients to project the aggregate, population-wide change in the number of people experiencing these outcomes, rather than the small increases in individual risk. To do this, we increased the population-wide baseline risk of a negative outcome according to the aggregate number of exposures that occurred to people within that population.

For example, Table B.3 indicates that the chances of experiencing a criminal conviction are about 6 percent for young adults in our age group of interest who experience no adverse childhood events and are 5.720 times higher for children who lived in a foster care setting, compared with children who did not live in a foster care setting and after being controlled for other factors. Assume that children have a 0.58-percent lifetime chance of being in foster care and that children in foster care experience an average of 1.1 placements.

Table B.3. Effect of Life Course Events on the Odds of Four Outcomes

	Criminal Conviction	Substance Abuse	Homelessness	Underemployment
Percentage of population at baseline	6.0%	18.6%	3.9%	15.7%
Odds ratios				
Neglect	2.272	2.028	3.105	1.246
Physical abuse	1.100	1.100	1.100	1.438
Sexual abuse	1.100	1.403	2.928	1.100
Removal from home	2.017	1.247	2.771	1.809
Placement in foster home	5.720	2.130	7.010	2.120
Adoption	1.020	1.260	1.159	0.790
Emancipation	1.420	2.480	1.780	2.100
Kinship care	0.200	0.809	0.304	0.200
Reunification	0.742	0.577	0.970	2.904

At baseline, we would assume that the population-wide rate of criminal conviction in our age group of interest is $\{0.06 \times [1 - (0.0058 \times 1.1)]\} + [(0.06 \times 5.720) \times (0.0058 \times 1.1)] = 0.061806816$, or 6.18 percent, meaning that foster home exposure increased the population-wide risk of criminal conviction in our age group of interest by 0.18 percent (6.18 – 6.0). Given a cohort of 23.9 million children, this would amount to approximately 43,000 additional criminal convictions (23.9 million \times 0.0018).

Ensuring Model Accuracy

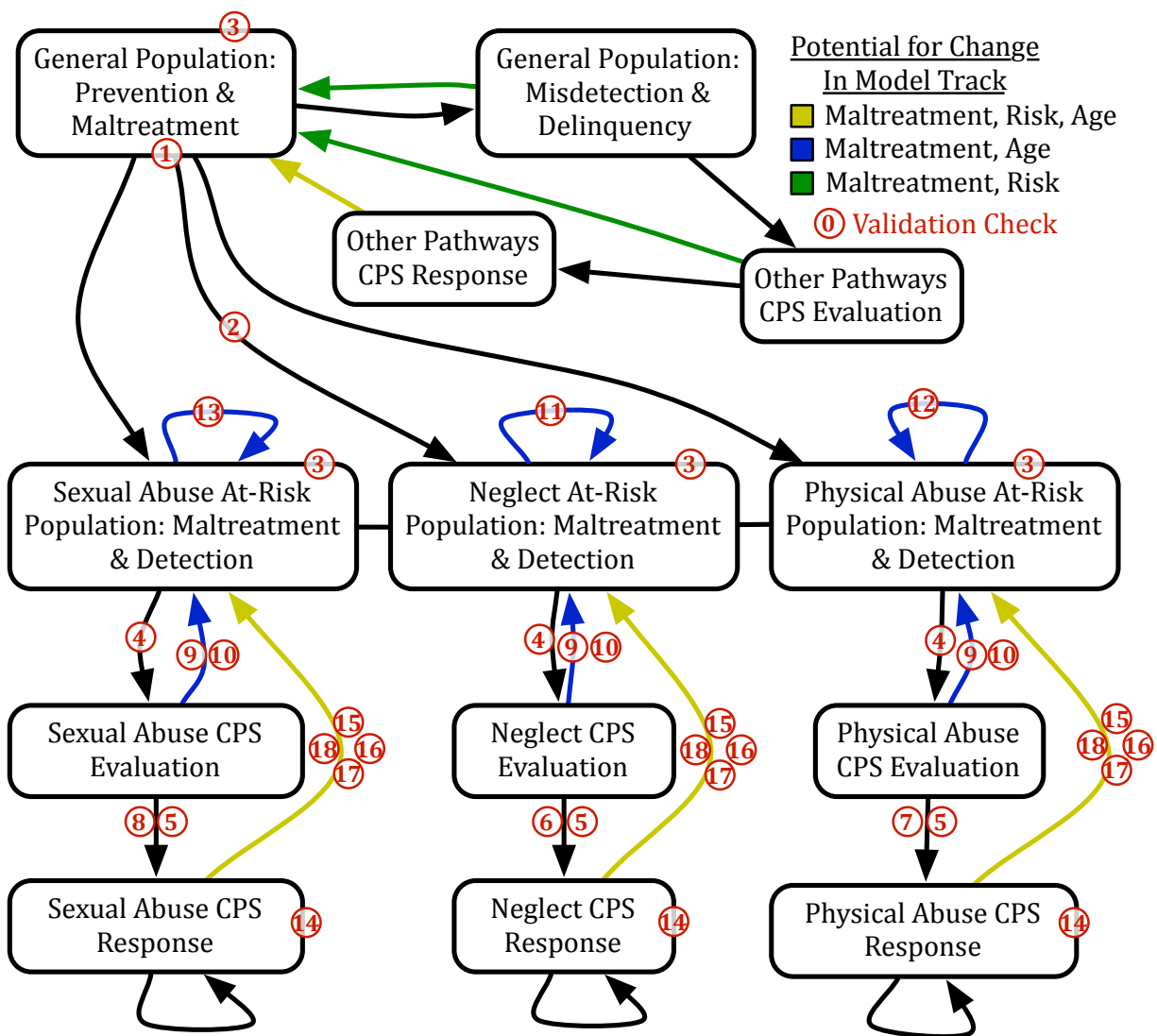
Calibration: Tuning Model Behavior to Match Empirical Statistics

We identified 18 key metrics on which we could compare model behavior to the empirical world. Figure B.5 displays the simplified model blueprint from the previous section, marking the location of each calibration point. We adjusted model behavior and refined our parameters (a process called *calibration*) until the model produced figures that fell within 1 percent of our empirical data on these targets. Specifically, we used a formal process for suggesting parameter changes to improve the match of the model output to a calibration target. The process uses the formula $X(E/A)$ to propose new calibration coefficients, where X is the current calibration coefficient, E is the calibration target, and A is the current value generated by the model.⁵ Table B.4 reports each point, which value we

⁵ In the prior version of the model, we had used a method referred to as *interval halving*. It involved taking the range of possible calibration coefficients and testing a coefficient halfway between the maximum and

used as a benchmark, which empirical source was the origin of that benchmark, and how simulated values compared to it.⁶

Figure B.5. Model Blueprint Calibration Points



minimum values. If that produced an output value that was above (below) the calibration target, then that parameter value became the maximum (minimum) of the range and a new calibration point, in the midpoint of the range, was tried. Using the improved process of calibration, we were able to produce a baseline model that more precisely matched the calibration targets. In the prior version of the report, we were generally able to calibrate within 0.5 percent of the target. With the new process, the model output generally comes within 0.3 percent or less of the target (see Table B.4).

⁶ In the prior version of the report, we used annual rates taken as proxies for the lifetime rates. In this version, we have used a combination of literature review and secondary data analysis to generate estimates that more closely reflect lifetime rates.

Table B.4. Model Calibration Results

Benchmark	Benchmark Value	Output Value	Discrepancy	Benchmark Source
1) Chances of >0 maltreatment incidents during childhood	188 per 1,000	188 per 1,000	<0.1%	Publication: Finkelhor et al., 2014
2) Chances of >0 neglect incidents during childhood	103 per 1,000	103 per 1,000	0.1%	Publication: Finkelhor et al., 2014
3) Number of preventive services funded per child	469 per 1,000	469 per 1,000	<0.1%	Publication: NCANDS (DHHS, 2016)
4) Number of referrals per child	1,456 per 1,000	1,456 per 1,000	<0.1%	Publication: NCANDS Synthetic Cohort
5) Substantiations per child	192 per 1,000	183 per 1,000	-4.7%*	Data set: NCANDS Synthetic Cohort
6) Neglect substantiations per child	137 per 1,000	138 per 1,000	-0.2%	Data set: NCANDS Synthetic Cohort
7) Physical abuse substantiations per child	30 per 1,000	30 per 1,000	-0.1%	Data set: NCANDS Synthetic Cohort
8) Sexual abuse substantiations per child	15 per 1,000	15 per 1,000	-0.1%	Data set: NCANDS Synthetic Cohort
9) Unsubstantiations + screen-outs per child	1,183 per 1,000	1,201 per 1,000	1.5%*	Data set: NCANDS Synthetic Cohort
10) Alternative responses per child	74 per 1,000	74 per 1,000	-0.1%	Data set: NCANDS Synthetic Cohort
11) Maltreatment episodes per neglect case	4,318 per 1,000	4,321 per 1,000	-0.1%	Data set: Add Health, Wave 3: H3MA1, H3MA2 (benchmark discounted 10 percent due to survey imprecision)
12) Maltreatment episodes per physical abuse case	4,350 per 1,000	4,360 per 1,000	0.2%	Data set: Add Health, Wave 3: H3MA3 (benchmark discounted 10 percent due to survey imprecision)
13) Maltreatment episodes per sexual abuse case	3,199 per 1,000	3,209 per 1,000	-0.3%	Data set: Add Health, Wave 3: H3MA4 (benchmark discounted 10 percent due to survey imprecision)
14) Average number of placements per substantiation	322 per 1,000	322 per 1,000	-0.1%	Publication: Casanueva et al., 2012
15) Reunifications per discharge	525 per 1,000	525 per 1,000	<0.1%	Data set: AFCARS Synthetic Cohort
16) Guardianships/adoptions per discharge	317 per 1,000	317 per 1,000	0.1%	Data set: AFCARS Synthetic Cohort
17) Kinship care per discharge	83 per 1,000	83 per 1,000	-0.3%	Data set: AFCARS Synthetic Cohort
18) Independent living per discharge	75 per 1,000	75 per 1,000	-0.3%	Data set: AFCARS Synthetic Cohort
* Our model is able to depict false positives at all levels of the system with perfect knowledge. In contrast, empirical statistics are not able to capture many of these situations, such as when an investigation determines that maltreatment has occurred, but maltreatment did not actually occur. Consequently, there is some level of discrepancy between our substantiation/unsubstantiation rates and the empirical rates.				

Calibration Targets: Maltreatment Incidents (#1 and #2)

Our maltreatment calibration targets come from Finkelhor et al.'s (2014) analysis of the Second National Survey of Children Exposed to Violence, conducted in 2011. Table 1 in Finkelhor et al. (2014) reports the findings from this national household survey on the total percentage of children experiencing maltreatment of various forms over the course of childhood. Specifically, they found that 116, 89, and 7 per 1,000 children had cumulatively experienced at least one incident of neglect, physical abuse, and sexual abuse, respectively. However, they also noted that 23 percent of maltreated children experienced two or more forms of maltreatment. Consequently, we deflated these statistics to avoid double counting:

$$\begin{aligned} & (116 + 89 + 7) \cdot \frac{100\% - 23\%}{1} + (116 + 89 + 7) \cdot \frac{23\%}{2} \\ & \qquad = 187.62 \text{ maltreatment incidents per 1,000 children} \\ 116 \cdot \frac{100\% - 23\%}{1} + 116 \cdot \frac{23\%}{2} & = 102.66 \text{ neglect incidents per 1,000 children} \end{aligned}$$

In a cohort of 4 million children, this would amount to 750,480 children experiencing one of the three forms of maltreatment examined at some point in their childhood. Of those children, 410,640 of them would experience neglect as their primary form of maltreatment.

Calibration Targets: Preventive Services (#3)

Child Maltreatment 2015 (DHHS, 2017), DHHS's annual report on the previous year of NCANDS data, indicates that 2,297,446 preventive services were received in 2015, and that NCANDS report includes states that contain a total of 67,739,494 of the nation's 72,927,722 children. Other documentation suggests that 76.9 percent of the preventive services funded are targeted prevention, rather than services administered to families after maltreatment has already occurred. We assumed that the total number of preventive services administered to 18 cohorts during a single year was roughly equivalent to the number of preventive services that a single cohort might expect to receive over the course of 18 years. Then we deflated that total to account for the proportion of targeted preventive services and inflated that total to account for states missing from the NCANDS data set:

$$\begin{aligned} & 2,297,446 \cdot \frac{18}{72,927,722} \cdot 76.855\% \cdot \frac{72,927,722}{67,739,494} \\ & \qquad = 469.19 \text{ preventive services per 1,000 children} \end{aligned}$$

In a cohort of 4 million children, this would amount to 1,876,000 preventive services. However, some children may receive multiple preventive services, so this does not

necessarily imply that 1.876 million *children* in a cohort of 4 million will be exposed to preventive services by age 18.

It should be noted that some preventive services provided by other agencies or community-based organizations not receiving federal funding may not be included in the NCANDS estimate of the maltreatment preventive services provided. We were unable to find any other information on total preventive services provided to supplement these data.

Calibration Targets: Referrals (#4)

Our calculations, based on the NCANDS 2013 data set, indicated that there were 3,427,678 reports to child welfare agencies in the corresponding year. However, we know from *Child Maltreatment 2015* that only 58.1 percent of referrals are screened in to become reports (DHHS, 2017). We assumed that the total number of screened-in referrals (or reports) on 18 cohorts over the course of a single year would be roughly equivalent to the number of screened-in referrals that a single cohort might expect to experience over the course of 18 years.⁷ We then inflated this figure to include screened-out referrals, which do not go on to become reports:

$$3,427,678 \cdot \frac{18}{72,927,722} \cdot \frac{100\%}{58.1\%} = 1,456.14 \text{ referrals per 1,000 children}$$

This figure amounts to a cohort of 4 million children being subject to a total of 5,824,568 referrals over the course of their childhood. However, several factors should be kept in mind. First, a given referral can pertain to multiple children (especially cohabitating siblings), and each child on that referral would count separately for modeling purposes. Second, multiple referrals can result from a single maltreatment incident, such as when both teachers and neighbors report suspicious bruising on a child. Third, nearly half of all referrals to CPS are screened out at the referral stage because there is insufficient information, or the referral is not consistent with the state’s definition of abuse or neglect. Fourth, these counts are duplicative, meaning that a single child may be the subject of multiple referrals over the course of childhood.

⁷ This is called a *synthetic cohort* approach. The approach is most well known as the strategy underlying life expectancy. In life expectancy calculations, it is assumed that a cohort of newborn children will experience, at every age, the same rate of risk that people currently at that age experience. The method is quite time-tested, with early (published) examples dating back at least as far as Edmond Halley’s 1693 article, “An Estimate of the Degrees of the Mortality of Mankind, Drawn from Curious Tables of the Births and Funerals at the City of Breslaw; with an Attempt to Ascertain the Price of Annuities upon Lives.” A more modern example, applying the synthetic cohort approach to child welfare, can be found in Kim et al., 2017.

Calibration Targets: Substantiations (#5-#8)

Our calculations, based on the NCANDS 2013 data set, indicate that approximately 352,000, 241,000, and 179,000 substantiated referrals occurred for children aged 0–5, 6–11, and 12–17, respectively. This includes all cases in the data set that list “Substantiated,” “Indicated or Reason to Suspect,” or “Alternative Response Disposition—Victim” for the variable “RptDisp.”

U.S. Census Bureau data indicate a total of 24 to 25 million children in each of these age groups at the time. We made the same synthetic cohort assumption that we have made elsewhere—adjusted for differences in cohort sizes, that the total number of substantiations for 18 cohorts over the course of a single year will be roughly equivalent to the number of substantiations that a single cohort might expect to experience over the course of 18 years.

$$352,250 \cdot \frac{6}{23,719,661} + 241,139 \cdot \frac{6}{24,382,514} + 178,930 \cdot \frac{6}{24,825,547} \\ = 191.69 \text{ substantiations per 1,000 children}$$

For a cohort of 4 million children, this would total to 766,749 substantiations. However, we have perfect knowledge of what happens in the model, and empirical statistics do not have perfect knowledge of the real world. Consequently, we know exactly how often case workers and sentinels in the model make mistakes in referring, screening in, substantiating, and removing from the home, but published statistics generally cannot. We also excluded some of the less well-measured maltreatment types from our model, such as emotional abuse, but all maltreatment types count toward the substantiation rate. These two differences lead to a small incompatibility between model and empirics. Our total substantiation rate runs about 5 percent too low, even though we achieved each of the maltreatment specific substantiation targets exactly. For similar reasons, our unsubstantiation rate runs 1.5 percent too high.

To calculate the number of neglect, physical abuse, and sexual abuse substantiations, we start from the total number of substantiations per 1,000 children (191.69), deflate it to roughly compensate for the number of substantiations not due to any of the three types examined and for double counting of substantiations that list two or more maltreatment types, and then multiply it by the proportion of substantiations due to each of the three maltreatment types. The proportions are based on NCANDS’ reported rates averaged across multiple years. The deflation factor is slightly steeper for sexual abuse because

current reporting guidelines in some jurisdictions allow for the inference of physical abuse in cases of severe sexual abuse.

$$191.69 \cdot 93.1\% \cdot 76.936\% \\ = 137.30 \text{ substantiations per 1,000 children primarily due to neglect}$$

$$191.69 \cdot 93.1\% \cdot 16.942\% \\ = 30.24 \text{ substantiations per 1,000 children primarily due to physical abuse}$$

$$191.69 \cdot 91.2\% \cdot 8.443\% \\ = 14.76 \text{ substantiations per 1,000 children primarily due to sexual abuse}$$

For a cohort of 4 million children, this would total to 549,212 substantiations that are primarily due to neglect, 120,940 substantiations that are primarily due to physical abuse, and 59,047 substantiations that are primarily due to sexual abuse. This count does not correspond to unique children, as a child may be the subject of multiple substantiations over the course of his or her lifetime.

Calibration Targets: Screened-Out Referrals + Unsubstantiated Investigations

Our calculations, based on the NCANDS 2013 data set, indicate that approximately 2,320,824 reports were unsubstantiated in the corresponding year. This includes all data entries that had “Unsubstantiated,” “Unsubstantiated due to intentionally false,” or “Closed-No Finding” listed for the variable “RptDisp.” However, we also know from *Child Maltreatment 2015* that only 58.1 percent of 5.9 million referrals become reports (about 3.4 million), so we included the other 41.9 percent (the screened-out referrals) in this target as well (DHHS, 2017). Since we lack sufficient data on how screen-outs vary by age group, we did not calculate the rates separately for each age group.

$$3,427,678 \cdot \frac{100\%}{58.1\%} \cdot 41.9\% \cdot \frac{18}{72,927,722} \\ = 610.12 \text{ screened out referrals per 1,000 children}$$

$$2,320,824 \cdot \frac{18}{72,927,722} = 572.83 \text{ unsubstantiations per 1,000 children}$$

$$572.83 + 610.12$$

$$= 1,182.95 \text{ total screened out referrals and unsubstantiated investigations per 1,000 children}$$

For a cohort of 4 million children, this would cumulate to 2,440,480 screened-out referrals and 2,291,320 unsubstantiations by the time the cohort aged into adulthood. A

child may be the subject of multiple screened-out referrals and unsubstantiated investigations over the course of his or her lifetime.

Calibration Targets: Alternative Response (#10)

Our calculations, based on the NCANDS 2013 data set, indicate that approximately 105,800, 109,800, and 82,900 reports were diverted to alternative response in the corresponding year for children aged 0–5, 6–11, and 12–17, respectively. This includes all data entries that had “Alternative Response” as part of the listing for the variable “RptDisp.” We used the synthetic cohort approach to derive rates from these figures.

$$105,751 \cdot \frac{6}{23,719,661} + 109,755 \cdot \frac{6}{24,382,514} + 82,889 \cdot \frac{6}{24,825,547} \\ = 73.79 \text{ alternative responses per 1,000 children}$$

This would cumulate to 295,167 alternative responses for a cohort of 4 million children.

Calibration Targets: Maltreatment Episodes per Victim (#11–#13)

Recurrence of maltreatment is an important component for building a model of maltreatment. If maltreatment tends to consist primarily of one-time incidents, then interventions conducted after the incident are unlikely to have much effect on maltreatment rates, and prevention needs to be distributed very widely throughout the population. In contrast, if maltreatment primarily consists of the same children being repeatedly maltreated, then post-incident intervention may be decisive in lowering maltreatment rates, and prevention needs to be narrowly targeted at high-risk families. However, maltreatment reoccurrence is difficult to quantify. It happens over a long period of time and may consist of both continuous low-level household dynamics and discrete incidents. We used the National Longitudinal Study of Adolescent to Adult Health (Add Health) 1994–2008 [Public Use] data set to estimate how many incidents of maltreatment a victim might experience over the course of childhood. Items H3MA2, H3MA3, and H3MA4 ask respondents to estimate the number of times they experienced physical neglect, physical abuse, or sexual abuse, respectively. Respondents may choose from six responses:

- (1) one time
- (2) two times
- (3) three to five times
- (4) six to ten times
- (5) more than ten times
- (6) This has never happened.

Because these items encompass a range of numerical values, we interpolate a value to each item, assuming that the lower end of the range is more likely to occur than the higher end. We make this assumption because the distribution of the number of times experiencing abuse is long-tailed. For example, more people will experience neglect three times than five times, so taking the midpoint of the range would overstate the average number of times represented by that range. For each range, we choose a value within the range that is closer to the low end of the range.

- (1) one time = 1
- (2) two times = 2
- (3) three to five times = 3.333
- (4) six to ten times = 7.333
- (5) more than ten times = 13.333
- (6) This has never happened. = 0

We then calculated the (survey-weighted) average for all respondents who reported that at least one incident occurred. These calculations suggested that the average victim experienced 4.798, 4.834, and 3.554 incidents of neglect, physical abuse, and sexual abuse, respectively. However, we recognize that some of these incidents could occur on the same time step in our model, so we discounted each target by 10 percent.

$$4.798 \cdot 90\% = 4,318.2 \text{ neglect incidents per 1,000 victims}$$

$$4.834 \cdot 90\% = 4,350.6 \text{ physical abuse incidents per 1,000 victims}$$

$$3.554 \cdot 90\% = 3,198.6 \text{ sexual abuse incidents per 1,000 victims}$$

Given the maltreatment occurrence rates discussed in Finkelhor et al. (2014), this suggests that 1,773,174 neglect incidents would happen to victims by the time a cohort of 4 million children reaches adulthood. Victims would also experience 1,370,598 physical abuse incidents and 79,263 sexual abuse incidents.

Calibration Targets: Average Number of Placements per Investigation (#14)

We used the Casanueva et al. (2012) analysis of Wave II of the National Survey of Child and Adolescent Well-Being (NSCAW) to estimate the average number of out-of-home placements that occurred for each investigation. Casanueva et al. (2012) placed the average number of placements *per child placed out of home* at 1.4. They broke this down as 72.6, 18.9, 5.3, and 3.2 percent being placed one, two, three, or more than three times, respectively. They also calculated that 77 percent of substantiated children received no

out-of-home placements. To determine the average number of placements per child, we first determined the average number among those receiving more than three placements.

$$1.4 = 1 \cdot 72.6\% + 2 \cdot 18.9\% + 3 \cdot 5.3\% + X \cdot 3.2\%$$

$$\frac{1.4 - (1 \cdot 72.6\% + 2 \cdot 18.9\% + 3 \cdot 5.3\%)}{3.2\%} \approx 4.3 \text{ placements}$$

Then, we calculated the average number of placements, including those who received zero placements (to include children who remain with their families).

$$(0 \cdot 77\%) + (1 \cdot (1 - 77\%) \cdot 72.6\%) + (2 \cdot (1 - 77\%) \cdot 18.9\%) + (3 \cdot (1 - 77\%) \cdot 5.3\%) + (4.3 \cdot (1 - 77\%) \cdot 3.2\%) = 322.14 \text{ placements per 1,000 investigations}$$

For a cohort of 4 million children, this would total to 294,839 placements.

Calibration Targets: Discharges from Foster Care (#15-#18)

Our calculations, derived from the AFCARS 2013 data set, suggest that 230,634 children were discharged from foster care, of whom 154,551 had entered care due to maltreatment. Of these children, 80,803 were reunified with previous caregivers; 48,775 were adopted (or placed with legal guardians); 12,791 were discharged to the care of relatives; and 11,524 were emancipated, aged out of foster care, or otherwise left foster care to live independently. The remaining cases were transferred to other institutions or experienced other rare outcomes. This is based on the “disreasn” variable in the AFCARS data set, with “neglect,” “phyabuse,” and “sexabuse” used to assess whether maltreatment had occurred. Applying a synthetic cohort approach, we calculated the discharge rates for each discharge type.

$$80,803 \cdot \frac{18}{72,927,722} = 19.94 \text{ reunifications per 1,000 children}$$

$$48,775 \cdot \frac{18}{72,927,722} = 12.04 \text{ adoptions/guardianships per 1,000 children}$$

$$12,791 \cdot \frac{18}{72,927,722} = 3.16 \text{ kinship discharges per 1,000 children}$$

$$11,524 \cdot \frac{18}{72,927,722} = 2.84 \text{ independent living care discharges per 1,000 children}$$

For a cohort of 4 million children, this would total to 79,755 reunifications, 48,154 adoptions/guardianships, 12,628 kinship care discharges, and 11,377 independent living discharges.

However, questions have been raised about the accuracy of cross-sectional AFCARS statistics (Courtney, Needell, and Wulczyn, 2004). Rather than match the exact number of discharges in this round of modeling, we instead matched the proportion of discharges exiting with each discharge reason. We also excluded some of the rarer discharge codes as our model focuses primarily on the main discharge pathways.

$$\frac{80,803}{(80,803 + 48,775 + 12,791 + 11,524)} = 52.51\% \text{ reunification}$$

$$\frac{48,775}{(80,803 + 48,775 + 12,791 + 11,524)} = 31.69\% \text{ adoptions/guardianships}$$

$$\frac{12,791}{(80,803 + 48,775 + 12,791 + 11,524)} = 8.31\% \text{ kinship care discharges}$$

$$\frac{11,524}{(80,803 + 48,775 + 12,791 + 11,524)} = 7.49\% \text{ independent living discharges}$$

Calibration Targets: Cost Targets

We also calibrated the total costs to match published totals. Our research indicated that six cohorts of children should generate approximately \$155.90 billion in child welfare costs over the course of their lifetimes, with \$11.77 billion going toward preventive services administered before any instance of maltreatment has occurred and \$144.13 billion going toward all other child welfare services modeled in our simulation. These estimates are derived from annual child welfare expenditures reported in *Child Welfare Financing SFY 2014: A Survey of Federal, State, and Local Expenditures* (Rosinsky and Connelly, 2016). We assumed that the total expenditures for 18 cohorts during a single year (i.e., an annual expenditure) were roughly equivalent to the total expenditures on a single cohort over the course of 18 years. Based on Rosinsky and Connelly (2016), total expenditures in 2014 were \$29.1 billion. Because our model only includes out-of-home placements that result from a maltreatment report (about 76 percent of the total), we subtracted a proportion of the out-of-home placement costs included in the total. This brings the annual total expenditure to \$26 billion. We multiplied this cost by the number of cohorts in the model (six) to get the estimate of total costs (\$155.9 billion) for the six birth year cohorts between age 0 and age 18.

We broke this total expenditure down into the total spent on maltreatment preventive services and the total spent on treatment (child welfare system response). To do this, we used data from state CFS-101 reports to DHHS to identify expenditures on preventive services (DHHS, 2016). The states report spending by type of service (i.e., maltreatment prevention) for federal programs (e.g., Title IV-B, waivers) and state and local programs.

We aggregated the expenditures for prevention across sources. We then added in spending on two federal programs not included in the CFS-101 data that provide funding for maltreatment prevention: the Maternal, Infant, and Early Childhood Home Visiting program (MIECHV) and the Social Services Block Grant (SSBG). Based on these data, we estimated a total of \$1.96 billion spent on prevention per year. That translates to \$11.77 billion in prevention spending on the six cohorts included in the model. The remainder of the total expenditures, \$144.13 billion, is attributed to treatment (or child welfare system response).⁸

To calibrate our costs, we ran the model in its entirety and tabulated the total costs for prevention and nonprevention. We then calculated a scaling factor to apply to individual prevention and nonprevention costs so that the total costs matched our targets. We then performed all necessary cost calculations on the scaled numbers. For example, imagine that the raw model output for baseline conditions suggested \$200 billion in costs, with \$50 billion going toward prevention:

$$\frac{155.90 - 11.77}{(200 - 50)} = 0.960867 \text{ nonprevention scaling factor}$$

$$\frac{11.77}{50} = 0.235400 \text{ prevention scaling factor}$$

We would then multiply all prevention-related costs by the prevention scaling factor and all other costs by the nonprevention scaling factor for both the baseline and scenario conditions. The adjusted costs would then be summed as needed to create cost summary statistics for model outputs.

Analysis of Placement Trajectories, Post-Calibration

We used the longitudinal FCDA to estimate the probability that children make various kinds of transfers between foster placement settings and eventual discharge. However, we calibrated these statistics to synthetic cohort calculations based on the AFCARS records on discharges, as well as foster care placement distributions reported in NSCAW Wave II. Each of these data sets has unique advantages, and we attempted to blend them in a way that leveraged these strengths. FCDA is a private database maintained by the Center for State Child Welfare Data and is supplied with data through a 21-state public/private partnership. AFCARS is a public database into which states are legally required to contribute data. FCDA

⁸ In the prior version of the report, the total cost calibration target was \$150 billion, with \$13.2 billion for prevention and \$136.7 billion for child welfare system response.

has superior data depth and longitudinal tracking. AFCARS has superior breadth and makes this research comparable with the main foster care database used in research in this field. However, debate exists on the compatibility of these data sets, with scholars such as Courtney, Needell, and Wulczyn (2004) arguing that the AFCARS approach overrepresents the most successful cases and obscures those who linger in the system. Given the debate, we analyzed the simulation log files to understand how our FCDA-fueled, AFCARS-calibrated simulation behavior compared with the FCDA data on which it is based.

Compared with FCDA, our model

- moves more children to discharge through adoption/legal guardianship
- moves fewer children between temporary placement settings
- discharges fewer children to independent living
- discharges fewer children from in-home temporary placements to reunification (however, this is largely a definitional issue, as the way our model handles these children is difficult to compare directly with FCDA).

These differences are consistent with arguments that AFCARS underrepresents children who move between many temporary placements and age out instead of finding a permanent placement. However, it is difficult to say how much of the discrepancy represents real differences in the sources and how much is simply the result of trying to make an inappropriate comparison between empirical data and the internal calculations by which a simulation model mimics them.

In order to understand the potential consequences of using different sets of transition probabilities, we also tried fueling the model solely on AFCARS probabilities. Lacking FCDA components, net costs to the system actually rose by about 1.5 percent because of increases in eventual reunifications. However, the effect on our projections of long-term outcomes was negligible—less than 1 percent for all outcomes.

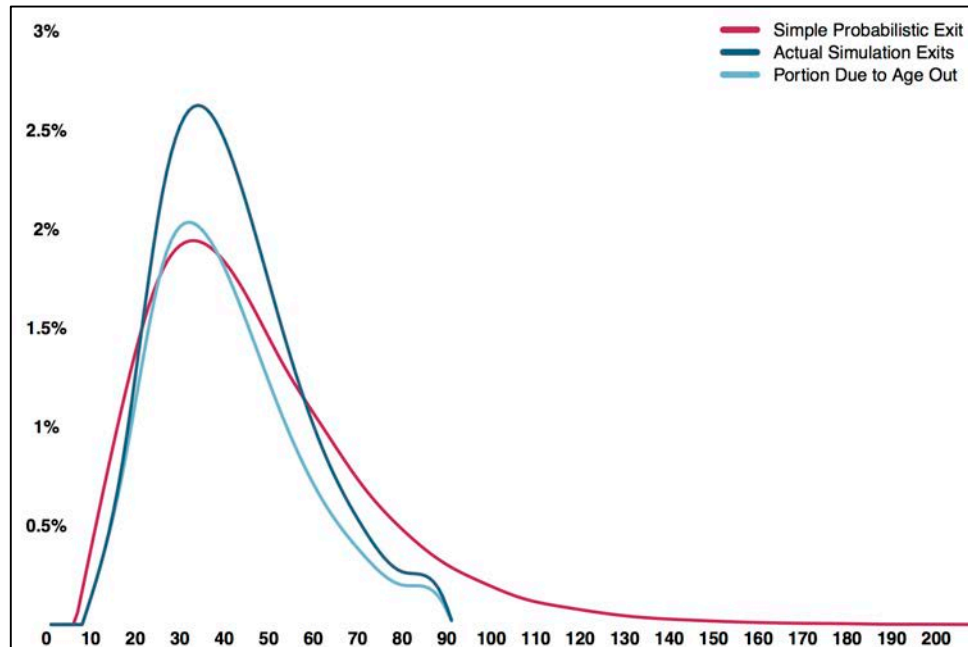
Analysis of Dwell Times, Post-Calibration

As a transition-state model, cumulative binomial probabilities are the driving mathematics of this model, including the way that children age. However, simple binomial distributions can be difficult to use for timing purposes because (1) children can progress too quickly, aging out of the model without having had any chance for maltreatment exposure, or (2) children can progress too slowly, remaining in the model indefinitely if they never can have a successful age-up event. Our model uses several tactics to achieve robustness against such issues and accomplish all modeling tasks within 91 iterations. First, we use three age compartments instead of a simple age-to-adulthood probability.

This three-compartment strategy means that the soonest a child could age out is nine iterations into the model run, having experienced three chances to have been maltreated. Only 1 percent of children in the model do so. Most age-related model exits occur between iteration 20 and iteration 50. Second, we have a separate “risk” counter that decrements over time as a child has an increasing number of model iterations without having experienced maltreatment or with experiencing a child welfare intervention that lowers the probability of future maltreatment. When children reach zero risk, they are treated as having completed the rest of their childhood without any future maltreatment incidents. About one in five children exits the model this way. Most risk-related model exits occur between iteration 25 and iteration 50. Third, the children likely to dwell the longest are those who experience deep involvement with the child welfare system, such as multiple rounds of investigation or multiple foster care placements following removal. However, the probability that a child will be discharged to independent living rises sharply (from virtually zero in preadolescent children) once the child reaches adolescence. This further reduces the risk that the child will remain in the model too long. Most independent living-related discharges occur between iteration 30 and iteration 80. Fourth, our model is deterministic, not probabilistic. That is to say, we calculate the proportion of children moving to states, rather than drawing random numbers from a binomial distribution for each child. Implementing these probabilities deterministically at the level of the population, instead of probabilistically at the level of the child, reduces the chances that a statistical outlier event will occur.

Figure B.6 charts the portion of the population exiting the model on any given iteration (dark blue) compared with what that distribution would look like if we used a simple, constant “age-out” probability (red). It also reports on the portion of model exits that are due to aging out (light blue). Our exit distribution is much more normal, compared with the binomial distribution that would result in a simple probability model. Our model succeeds at preventing both the early exits and the late exits observed in the simple probability distribution. While aging out is the primary reason for exit between iteration 10 and iteration 30, other exit dynamics become major influences between iteration 30 and iteration 60.

Figure B.6. Comparison of Dwell Times: Simulation Versus Simple Binomial
Probability



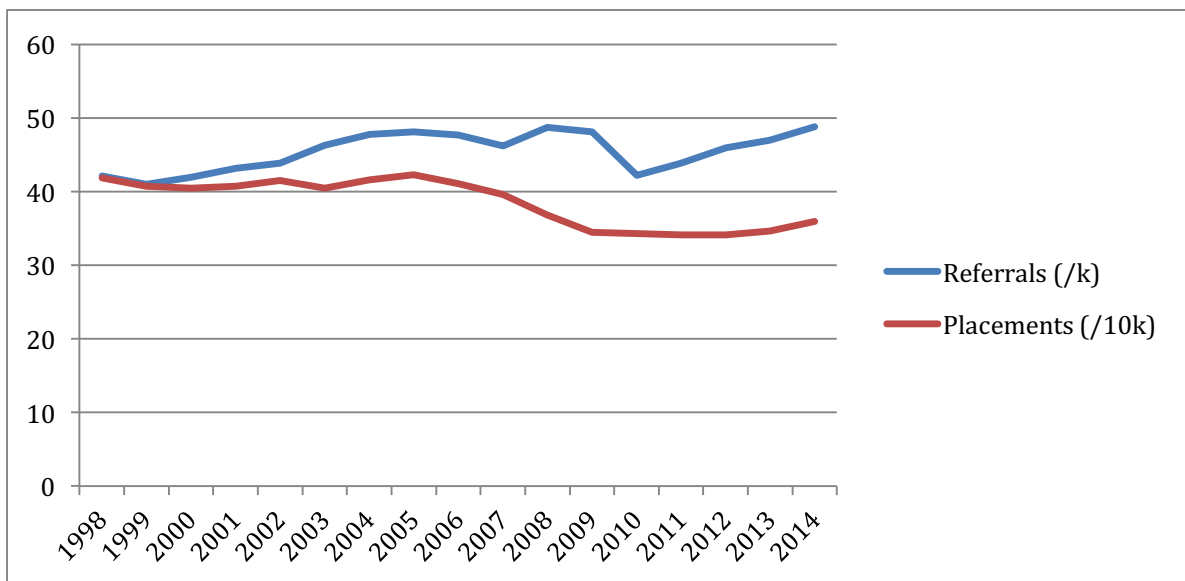
Validation: Searching for Natural Experiments to Test the Model

Typically, simulations are tested against past data to confirm that they respond realistically to changes in inputs. This process is called *validation*. However, conducting validation with this model proved problematic for three reasons. First, the key driver of model behavior is the total risk of facing childhood maltreatment, but this risk has only been measured nationally four times since 1981, of which only one measurement occurred during our window of available data for other data sets. Second, it takes 25 years of data to actually follow a cohort from birth through early adulthood, and no available data combined the size necessary to examine a rare outcome like maltreatment, the length necessary to measure longitudinal effects, and the breadth necessary to place maltreated children in the context of the general population. Third, it is difficult to identify exogenous shocks that have a measurable effect on child maltreatment rates. Even economic downturns, the most commonly cited exogenous influence, fail to correlate strongly with referral rates—referral rates *dropped* during the recent recession.

The best validation we could have managed would be demonstrating that we could give our simulated child welfare system the same inputs (i.e., referrals) and return the same

outputs (i.e., foster care placements). However, the actual, empirical correlation between child welfare system referrals and foster care placements is weak and negative ($r = -0.17$). That is, the overall trend was that when more children were referred to child protective services, slightly *fewer* foster care placements resulted (Figure B.7).

Figure B.7. Model Validation



Given these constraints, we were able to calibrate our model to match the available existing data, but we were unable to do a full validation test to confirm that changes in key inputs would produce changes in outputs that matched the historical trend.

Error Estimation: Estimating Sensitivity of Results to Specification Error

The primary purpose of this simulation model is to assess the potential consequences of different child welfare policy options. To do this, the model creates a mathematical system with features that correspond to a highly stylized, simplified representation of child maltreatment in the population. In this sense, the model is a tool of deduction that takes our literature-derived understandings of how the world works and carries them forward to their logical conclusions. For example, the literature leads us to expect that preventive services decrease the number of maltreated children. The model is able to deduce mathematically that, given this starting assumption:

1. Increases in prevention should correspond to decreases in maltreatment cases, but also to an increase in costs.

2. Decreases in maltreatment cases should lead to fewer referrals to child welfare agencies.
3. Fewer referrals mean fewer investigations, removals from the home, and out-of-home placements.
4. Fewer agency actions of these types lead to a decrease in agency costs.

All of these statements can be derived from the causal logic operationalized as math in the model, almost without regard to the specific probability figures used to represent that causal logic. That is to say, regardless of whether ten preventive services eliminate one maltreatment case or five cases, all of the deductions above will still be valid and will still be illuminated as the simulation processes an “increased prevention” scenario. However, some model results depend more heavily on the specific statistics used to condition the model. For example, the decreased costs of agency action can potentially offset the increased costs of preventive services, but this depends strongly on what statistics we use to condition the effectiveness of preventive services, as well as the relative cost structures. In these cases, our level of quantitative uncertainty can become a key factor in deciding how much credence to place in our model results. This section contains our analysis of those uncertainties.

There are two primary sources of quantitative uncertainty that affect our model: data uncertainty and measurement uncertainty. Data uncertainty refers to sources of model uncertainty that stem from imperfections in the data used to condition the model. Measurement uncertainty includes sources of model uncertainty that stem from difficulties in interpreting the available data. These types of uncertainty include the following seven (among others):

1. Sampling uncertainty: Some of our parameter estimates are based on population samples, so they will be vulnerable to sampling error. For example, our estimates of child maltreatment probabilities are based on NIS-4, which samples 10,791 sentinels in 126 counties.
2. Missingness uncertainty: Most of our parameters come from complete federal databases of the populations of interest, but even these may still suffer from data missingness. Not every jurisdiction collects data with equal thoroughness or fully complies with reporting requirements. For example, entire states are missing from some of the statistical tables in NCANDS reports.
3. Temporal uncertainty: Child maltreatment requires a very long time horizon, including 18 years of childhood and additional time for consequences to manifest themselves in young adulthood. Most of our statistics of interest change from year to

year. Even with sophisticated trend modeling, it is not necessarily the case that statistics gathered in 2010 (for instance) will adequately capture realities in 2035. For example, significant advances in addiction treatment could render our addiction projections completely wrong. Likewise, cultural shifts in parenting norms could change the society-wide average risk of child maltreatment.

4. Active attempts to conceal the dependent variable: Perpetrators often try to conceal child maltreatment. Consequently, it is not entirely clear how much of child maltreatment is captured in the available information. If maltreatment takes a very different form for perpetrators who are skilled at concealment, that aspect of maltreatment is completely lost to the available data.
5. Operationalization uncertainty: Key concepts in child maltreatment are general concepts that do not lend themselves to precise definition. For example, child maltreatment is difficult to quantify, and every state has its own definition of child abuse and neglect. Moreover, severity can be difficult to quantify in a standardized way because of the large variety of forms that maltreatment can take.
6. Variation in experimental design: Studies of child maltreatment frequently use different methodologies, and they come to very different conclusions as a result. For example, the effects of foster care on long-term outcomes can vary. Some studies find that foster care has negative long-term effects on children, while others find that the long-term effects are a selection effect of which children end up in foster care. Whether a research team deploys propensity controls and how they deploy them make a large difference in what conclusions they reach.
7. Ambiguity about long-term effects: Child maltreatment is a rare event that likely contributes to poor adult outcomes. However, that causal relation is difficult to establish because (1) child maltreatment does not always lead to measurably worse adult outcomes; (2) most negative adult outcomes correlate with many other factors, not just child maltreatment; and (3) adult outcomes may happen decades after the last incident of maltreatment.

In short, this simulation model attempts to build a useful, simplified representation of the world from multiple sources of information, each of which potentially contaminates the model with uncertainties of various kinds. These uncertainties can be understood as adding error to some of the more than 116,000 probabilities that condition what happens to our simulated cohort of children. However, the simulation is highly robust to error, so these errors may or may not have a significant detrimental effect on our ability to draw conclusions from the model. To quantify our uncertainty risks, we ran the simulation 400

times, using a scenario that corrupted baseline probability with random error. While simulation uncertainty is not the same as sampling error, we corrupted each coefficient with error equivalent to the sampling error that one would expect in a survey sample of size 100,000. To be precise, for each scenario model transition, we drew a random number from the binomial, $N = 100,000$ standard error distribution, added it to the transition probability, and then re-divided the probabilities emanating from each state to ensure they summed to 1. That error adds up quickly due to the large number of transition probabilities in this model, totaling approximately 3,568 percentage points worth of error distributed across the model.

After generating 400 error-corrupted scenarios, we calculated the percentage change in model outputs between the scenarios and the baselines—the same process we used to calculate the impact of any other scenario. We then averaged the percentage difference across scenario runs for each model output and multiplied by 1.96 to determine the 95-percent confidence interval. Table B.5 reports the scenario effect confidence interval for each baseline statistic and whether each scenario effect is statistically significant by that metric (depicted in bold black font) or not statistically significant (depicted in gray font). The table suggests that, for the majority of model outputs, a scenario change of more than 0.3 percent is larger than what we might expect to occur due to random error alone, and for all but the most uncertain outputs, a 1-percent change is much larger than what could plausibly be attributed to uncertainty alone. However, the table also suggests that statistics on childhood chances of non-neglect abuse, statistics on sexual abuse victims alone, and delinquency probabilities have relatively high susceptibility to random error.

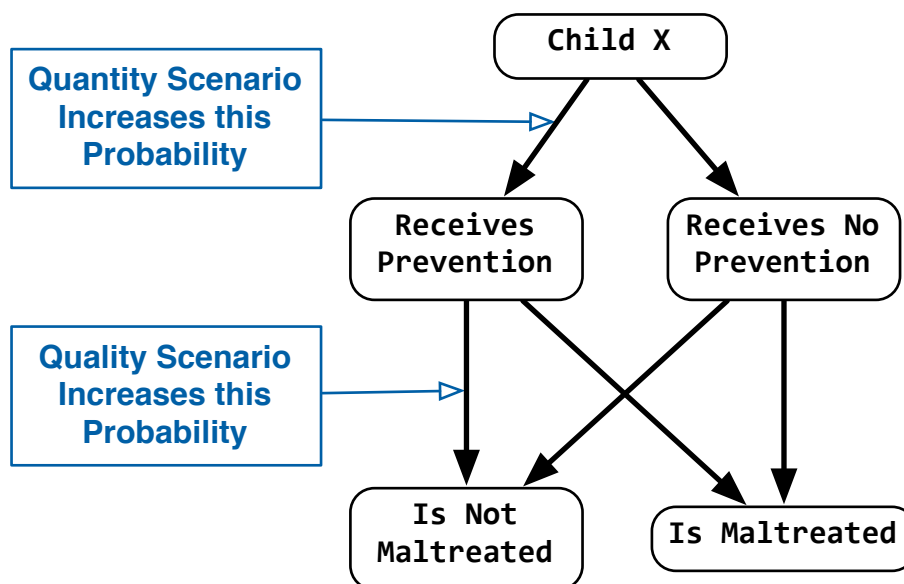
Table B.5. Simulated Confidence Bounds of Scenario Change from Baseline

Measure	95% Confidence Interval	Prevention Quantity	Prevention Quality	Prevention Quantity and Quality	Family Preservation Quantity	Family Preservation Quality	Family Preservation Quantity and Quality	Kinship Quantity	Kinship Quality	Kinship Quantity and Quality	Combined Quantity	Combined Quality	Combined Quantity and Quality
Maltreatment rate	±0.5%	-0.6%	-0.7%	-1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.6%	-0.7%	-1.7%
Maltreatment episodes	±0.2%	-1.4%	-1.9%	-4.2%	2.0%	-0.7%	1%	-0.1%	0.4%	0.2%	-1.5%	-1.6%	-4.1%
Preventive services rate	±0.8%	48%	-0.1%	48%	0.2%	-0.2%	-0.1%	0.0%	1.0%	1.0%	48.0%	1.0%	50.0%
Referral rate	±0.3%	-0.2%	-0.3%	-0.6%	0.3%	-0.1%	0.2%	0.0%	0.1%	0.0%	-0.2%	-0.2%	-0.6%
Investigation—unsubstantiated	±0.3%	-0.1%	-0.1%	-0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.2%
Screened out	±0.3%	-0.1%	-0.1%	-0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.2%
Investigation—substantiated	±0.3%	-1.1%	-1.5%	-3.4%	2.0%	-0.6%	1.0%	-0.1%	0.3%	0.2%	-1.3%	-1.2%	-3.3%
Alternative response	±0.3%	-0.1%	-0.1%	-0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.2%
Temporary placements	±0.1%	0.0%	0.0%	0.0%	-22.5%	-3.6%	-26.1%	-7.1%	-1.1%	-8.2%	-7.1%	-1.1%	-8.2%
In-home placements	±0.3%	-1.1%	-1.5%	-3.4%	12.0%	-0.7%	11.0%	3.0%	0.2%	3.0%	2.0%	-1.3%	-0.4%
Out-of-home placements	±0.3%	-1.1%	-1.5%	-3.3%	-20.9%	-4.2%	-25.1%	-7.3%	-0.8%	-8.1%	-8.3%	-2.3%	-11.2%
Reunification	±0.3%	-1.1%	-1.5%	-3.4%	6.0%	9.0%	14.0%	1.0%	-1.3%	0.1%	0.1%	-2.8%	-3.4%
Adoption/guardianship	±0.3%	-1.2%	-1.7%	-3.7%	21.0%	-11.0%	7.0%	-2.6%	3.0%	0.2%	-3.9%	1.0%	-3.6%
Independent living	±0.4%	-1.2%	-1.6%	-3.6%	5.0%	-13.4%	-8.8%	-2.0%	4.0%	5.0%	0.3%	2.0%	1.0%
Kinship care	±0.3%	-0.6%	-0.7%	-1.6%	1.0%	-10.5%	-8.0%	0.6%	-4.7%	-4.9%	-1.1%	-5.4%	-6.4%
Prevention costs	±0.3%	45.4%	-0.3%	44.7%	0.2%	-0.3%	-0.1%	0.0%	1.6%	1.6%	45.3%	1.3%	47.1%
Child welfare system costs	±0.2%	-1.0%	-1.3%	-2.8%	-9.9%	-6.7%	-13.7%	-6.4%	-1.9%	-8.1%	-7.3%	-3.6%	-11.1%
Total costs	±0.2%	2.5%	-1.2%	0.8%	-9.1%	-6.2%	-12.7%	-5.9%	-1.6%	-7.3%	-3.3%	-3.2%	-6.7%
Criminal conviction	±0.3%	-1.2%	-1.6%	-3.6%	-3.6%	-7.3%	-11.2%	-2.1%	-0.7%	-2.9%	-3.3%	-2.4%	-6.4%
Substance abuse	±0.2%	-1.2%	-1.6%	-3.6%	0.4%	-9.8%	-9.8%	-1.1%	-0.8%	-2.0%	-2.3%	-2.5%	-5.6%
Homelessness	±0.5%	-1.2%	-1.6%	-3.5%	-2.0%	-6.3%	-8.6%	-1.6%	-0.6%	-2.2%	-2.8%	-2.2%	-5.8%
Underemployment	±0.2%	-1.1%	-1.5%	-3.4%	0.2%	-3.7%	-3.9%	-0.4%	-1.4%	-1.8%	-1.6%	-3.0%	-5.2%

Scenarios

Each scenario involves changing the probability that a specific set of state transitions occurs and then adjusts competing probabilities to ensure that the sum of probabilities continues to equal 1. Figure B.8 presents a highly simplified chart of the state transitions involved in the prevention scenario. Every preadolescent child has some probability of being exposed to preventive services and then, contingent on whether the child received preventive services, has some probability of being mistreated. Our quantity scenario multiplies the probability that the child receives preventive services by 1.5 percent and then decreases the chances that the child did not receive preventive services so that the sum of probabilities equals 1.00. Our quality scenario increases the chances that children who received preventive services were not subsequently maltreated. We assume that preventive services decrease a child's chances of maltreatment to 0.7 of what they were previously, which roughly corresponds to the median estimate of prevention effectiveness found in our literature review. In the quality scenario, we multiply the chances of maltreatment by 0.58 instead of 0.7, which roughly corresponds to the largest credible effectiveness estimate found in our review of the literature.

Figure B.8. Simplified State Transition Map of the Prevention Scenario



Figures B.9 and B.10 present highly simplified charts of the state transitions involved in the kinship and family scenarios, respectively. When a maltreatment report is

substantiated, the responding agency may choose to remove the child from the home or to keep the child in the home while it searches for a sustainable permanent solution. The child may move between various temporary placements before achieving a permanent outcome. Our quantity scenarios increase the chances that these temporary placements involved kinship care or in-home trials, respectively. Each multiplies the existing probability by 1.25 and then decreases all competing probabilities to ensure that the sum equals 1.00. Eventually, a permanent solution will be decided for the child, and he or she will be discharged accordingly. The child will return to the general population, may receive some form of support services, and may subsequently experience another incident of maltreatment. In the case of family preservation, the support services may include some form of extended monitoring. Our quality scenarios increase (i.e., multiply by 1.25) the chances that the permanent discharge will involve kin care or family preservation, respectively. They also increase (i.e., multiply by 1.25) the chances that the child will receive support services after discharge, which may lower the chances of being subsequently maltreated. All competing transition probabilities are decreased proportionally to ensure that transition probabilities emanating from a node sum to 1. For the family preservation scenario, there is an extra pathway, by which maltreatment may be detected through post-discharge monitoring.

Figure B.9. Simplified State Transition Map of the Kinship Care Scenario

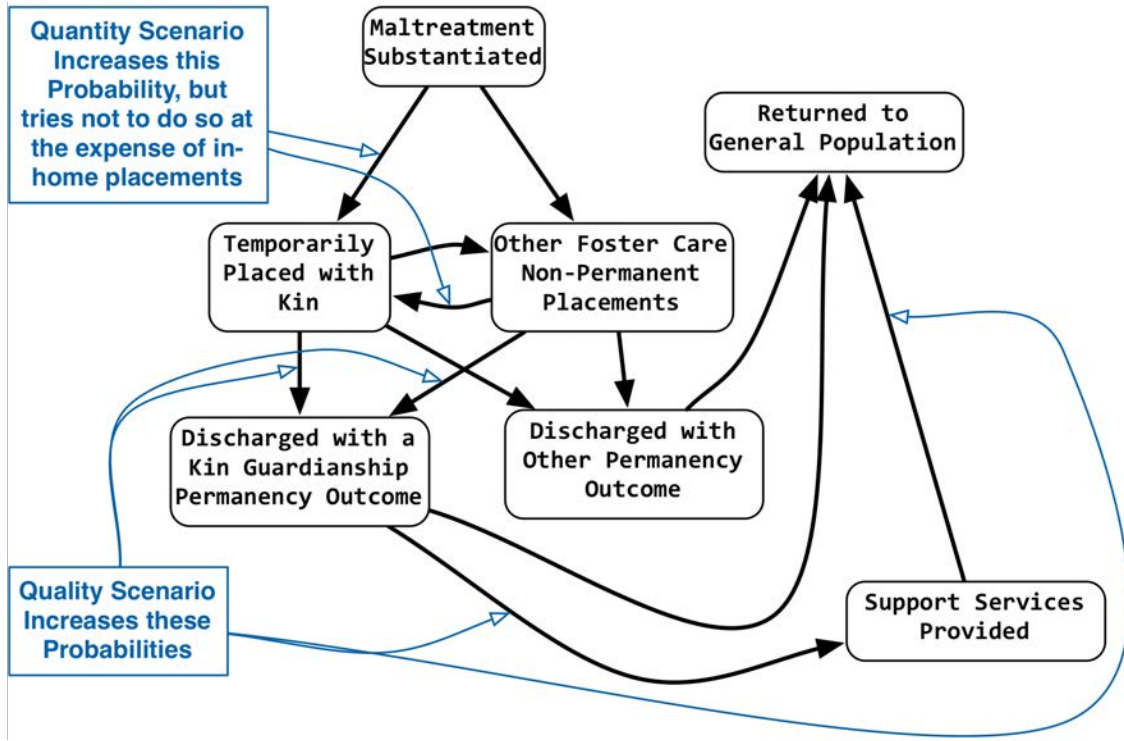
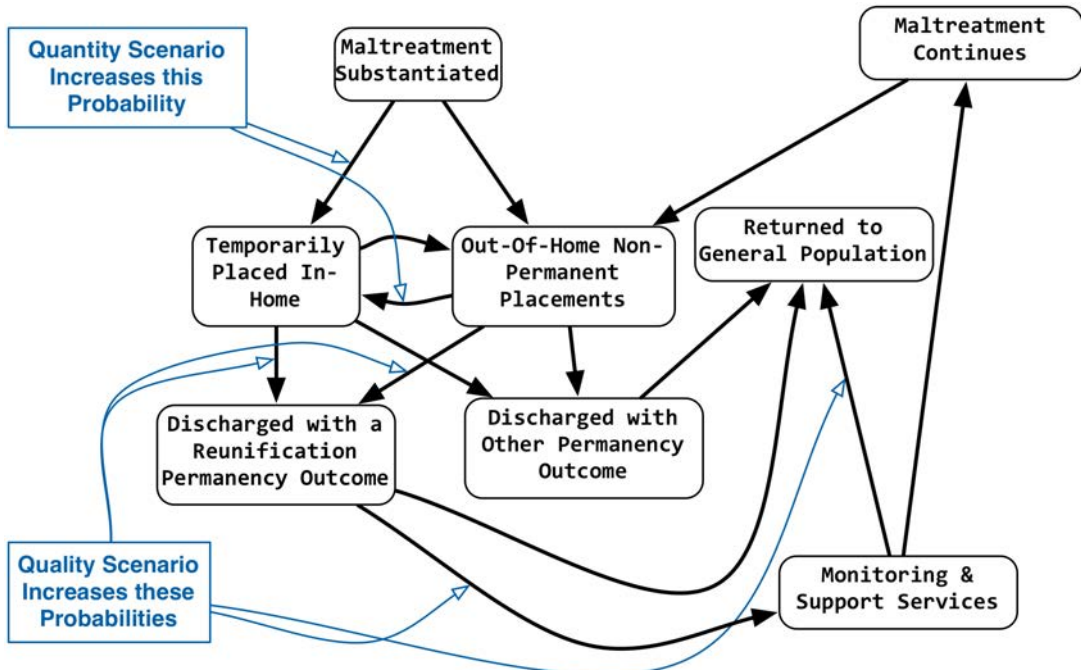
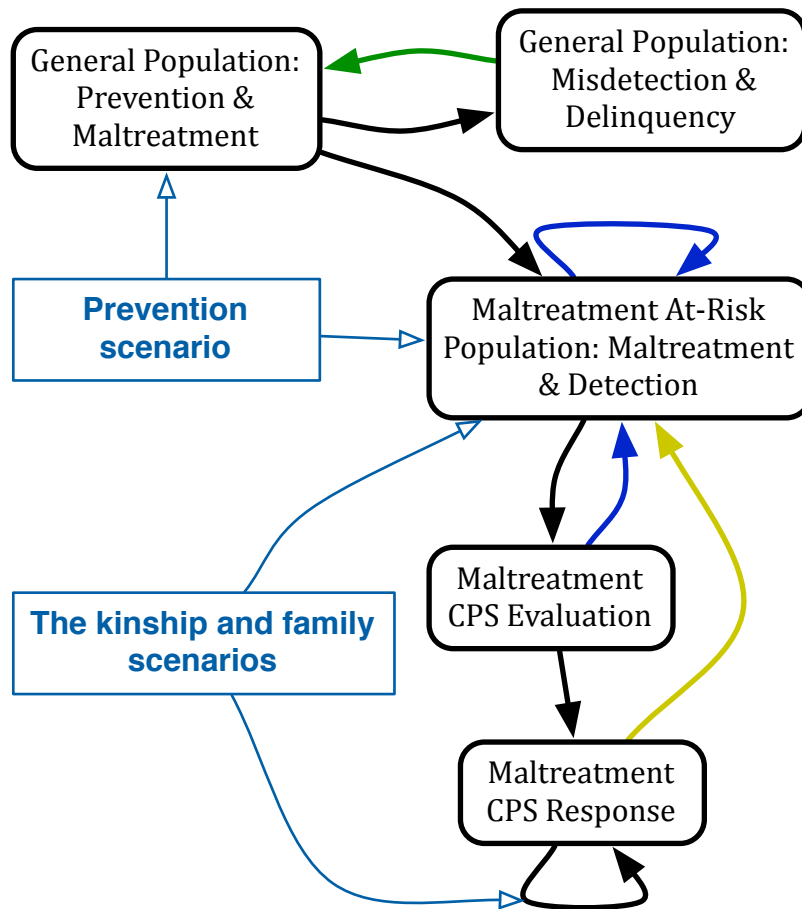


Figure B.10. Simplified State Transition Map of the Family Preservation Care Scenario



Thinking of our scenarios in terms of the high-level map presented earlier (and below), preventive services act on the probability that a child receives services that lower his or her maltreatment risk and how much that risk decreases (Figure B.11). Kinship and family preservation scenarios act on how agencies place children and what kinds of after-care services are provided to lower their risk of subsequent maltreatment.

Figure B.11. Simplified State Transition Map Showing Which Components of the Model Are Affected by the Policy Options



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Appendix C. Policy Option Scenario Results

The specifics regarding how each scenario is implemented are described in Appendix B.

Table C.1. Preventive Services Scenario Results

Measure		Baseline	Increase Quantity	Increase Quality	Increase Both Quantity and Quality
Maltreatment rate per 1,000		188	-0.6%	-0.7%	-1.7%
Maltreatment episodes (average)		4.23	-1.4%	-1.9%	-4.2%
Preventive services rate per 1,000		469	48%	-0.1%	48.0%
Referral rate per 1,000		1,457	-0.2%	-0.3%	-0.6%
Referral outcomes, rate per 1,000	Investigation—unsubstantiated	733	-0.1%	-0.1%	-0.2%
	Screened out	469	-0.1%	-0.1%	-0.2%
	Investigation—substantiated	183	-1.1%	-1.5%	-3.4%
	Alternative response	74	-0.1%	-0.1%	-0.2%
Temporary placements	Average number of placements	0.32			
In-home placements, rate per 1,000		140	-1.1%	-1.5%	-3.4%
Out-of-home placements, rate per 1,000		59	-1.1%	-1.5%	-3.3%
Permanency outcome, rate per 1,000	Reunification	97	-1.1%	-1.5%	-3.4%
	Adoption/guardianship	59	-1.2%	-1.7%	-3.7%
	Independent living	15	-1.2%	-1.6%	-3.6%
	Kinship care	14	-0.6%	-0.7%	-1.6%
Cost in billions	Prevention	11.8	45.4%	-0.3%	44.7%
	Child welfare system	144.1	-1.0%	-1.3%	-2.8%
	Total	155.9	2.5%	-1.2%	0.8%
Outcome age 23–25, rate per 1,000	Criminal conviction	60	-1.2%	-1.6%	-3.6%
	Substance abuse	186	-1.2%	-1.6%	-3.6%
	Homelessness	7	-1.2%	-1.6%	-3.5%
	Underemployment	157	-1.1%	-1.5%	-3.4%

Table C.2. Family Preservation Scenario Results

Measure		Baseline	Increase Quantity	Increase Quality	Increase Both Quantity and Quality
Maltreatment rate per 1,000		188			
Maltreatment episodes (average)		4.23	2.0%	-0.7%	1.0%
Preventive services per 1,000		469	0.2%	-0.2%	-0.1%
Referral rate per 1,000		1,457	0.3%	-0.1%	0.2%
Referral outcomes, rate per 1,000	Investigation—unsubstantiated	733	0.1%		
	Screened out	469	0.1%		
	Investigation—substantiated	183	2.0%	-0.6%	1.0%
	Alternative response	74	0.1%		
Temporary placements	Average number of placements	0.32	-22.5%	-3.6%	-26.1%
In-home placements, rate per 1,000		140	12.0%	-0.7%	11.0%
Out-of-home placements, rate per 1,000		59	-20.9%	-4.2%	-25.1%
Permanency outcome, rate per 1,000	Reunification	97	6.0%	9.0%	14.0%
	Adoption/guardianship	59	21.0%	-11.0%	7.0%
	Independent living	15	5.0%	-13.4%	-8.8%
	Kinship care	14	1.0%	-10.5%	-8.0%
Cost in billions	Prevention	11.8	0.2%	-0.3%	-0.1%
	Child welfare system	144.1	-9.9%	-6.7%	-13.7%
	Total	155.9	-9.1%	-6.2%	-12.7%
Outcome age 23–25, rate per 1,000	Criminal conviction	60	-3.6%	-7.3%	-11.2%
	Substance abuse	186	0.4%	-9.8%	-9.8%
	Homelessness	7	-2.0%	-6.3%	-8.6%
	Underemployment	157	0.2%	-3.7%	-3.9%

Table C.3. Kinship Care Scenario Results

Measure		Baseline	Increase Quantity	Increase Quality	Increase Both Quantity and Quality
Maltreatment rate per 1,000		188			
Maltreatment episodes (average)		4.23	-0.1%	0.4%	0.2%
Preventive services per 1,000		469		1.0%	1.0%
Referral rate per 1,000		1,457		0.1%	
Referral outcomes, rate per 1,000	Investigation—unsubstantiated	733			
	Screened out	469			
	Investigation—substantiated	183	-0.1%	0.3%	0.2%
	Alternative response	74			
Temporary placements	Average number of placements	0.32	-7.1%	-1.1%	-8.2%
In-home placements, rate per 1,000		140	3.0%	0.2%	3.0%
Out-of-home placements, rate per 1,000		59	-7.3%	-0.8%	-8.1%
Permanency outcome, rate per 1,000	Reunification	97	1.0%	-1.3%	0.1%
	Adoption/guardianship	59	-2.6%	3.0%	0.2%
	Independent living	15	-2.0%	4.0%	5.0%
	Kinship care	14	0.6%	-4.7%	-4.9%
Cost in billions	Prevention	11.8	0%	1.6%	1.6%
	Child welfare system	144.1	-6.4%	-1.9%	-8.1%
	Total	155.9	-5.9%	-1.6%	-7.3%
Outcome age 23–25, rate per 1,000	Criminal conviction	60	-2.1%	-0.7%	-2.9%
	Substance abuse	186	-1.1%	-0.8%	-2.0%
	Homelessness	7	-1.6%	-0.6%	-2.2%
	Underemployment	157	-0.4%	-1.4%	-1.8%

Table C.4. Combined Preventive Services and Kinship Care Scenario Results

Measure		Baseline	Increase Quantity	Increase Quality	Increase Both Quantity and Quality
Maltreatment rate per 1,000		188	-0.6%	-0.7%	-1.7%
Maltreatment episodes (average)		4.23	-1.5%	-1.6%	-4.1%
Preventive services per 1,000		469	48.0%	1.0%	50.0%
Referral rate per 1,000		1,457	-0.2%	-0.2%	-0.6%
Referral outcomes, rate per 1,000	Investigation—unsubstantiated	733	-0.1%	-0.1%	-0.2%
	Screened out	469	-0.1%	-0.1%	-0.2%
	Investigation—substantiated	183	-1.3%	-1.2%	-3.3%
	Alternative response	74	-0.1%	-0.1%	-0.2%
Temporary placements	Average number of placements	0.32	-7.1%	-1.1%	-8.2%
In-home placements, rate per 1,000		140	2.0%	-1.3%	-0.4%
Out-of-home placements, rate per 1,000		59	-8.3%	-2.3%	-11.2%
Permanency outcome, rate per 1,000	Reunification	97	0.1%	-2.8%	-3.4%
	Adoption/guardianship	59	-3.9%	1.0%	-3.6%
	Independent living	15	0.3%	2.0%	1.0%
	Kinship care	14	-1.1%	-5.4%	-6.4%
Cost in billions	Prevention	11.8	45.3%	1.3%	47.1%
	Child welfare system	144.1	-7.3%	-3.6%	-11.1%
	Total	155.9	-3.3%	-3.2%	-6.7%
Outcome age 23–25, rate per 1,000	Criminal conviction	60	-3.3%	-2.4%	-6.4%
	Substance abuse	186	-2.3%	-2.5%	-5.6%
	Homelessness	7	-2.8%	-2.2%	-5.8%
	Underemployment	157	-1.6%	-3.0%	-5.2%