Evidence-Informed Milestones for Developmental Surveillance Tools

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The Centers for Disease Control and Prevention's (CDC) *Learn the Signs. Act Early.* program, funded the American Academy of Pediatrics (AAP) to convene an expert working group to revise its developmental surveillance checklists. The goals of the group were to identify evidence-informed milestones to include in CDC checklists, clarify when most children can be expected to reach a milestone (to discourage a wait-and-see approach), and support clinical judgment regarding screening between recommended ages. Subject matter experts identified by the AAP established 11 criteria for CDC milestone checklists, including using milestones most children (≥75%) would be expected to achieve by specific health supervision visit ages and those that are easily observed in natural settings. A database of normative data for individual milestones, common screening and evaluation tools, and published clinical opinion was created to inform revisions. Application of the criteria established by the AAP working group and adding milestones for the 15- and 30-month health supervision visits resulted in a 26.4% reduction and 40.9% replacement of previous CDC milestones. One third of the retained milestones were transferred to different ages; 67.7% of those transferred were moved to older ages. Approximately 80% of the final milestones had normative data from ≥1 sources. Social-emotional and cognitive milestones had the least normative data. These criteria and revised checklists can be used to support developmental surveillance, clinical judgment regarding additional developmental screening, and research in developmental surveillance processes. Gaps in developmental data were identified particularly for social-emotional and cognitive milestones.

The American Academy of Pediatrics (AAP) recommends developmental surveillance and screening to identify children with developmental delays or disabilities (DDs) early, help to ensure timely interventions, and improve outcomes.[1] Developmental surveillance is a longitudinal process that involves eliciting concerns, taking a developmental history based on milestone attainment, observing milestones and other behaviors, examining the child, and applying clinical judgment during health supervision visits (HSVs). Developmental screening involves the use of validated screening tools at specific ages or when surveillance reveals a concern.[1] Diagnostic evaluations are conducted, typically by developmental specialists, to further evaluate and diagnose DDs in children deemed at risk through surveillance and screening processes.

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Developmental surveillance is family centered to promote conversations and trusting relationships wherein families can express concerns.[2] Surveillance involves clinical judgment about when a child may be at risk for delays and when additional developmental screening might be warranted. Milestone lists help to guide developmental surveillance, but those used for surveillance, unlike screening and evaluation tools, are not validated. Typically, lists of milestones are uncited, are based on clinical opinion, and/or report the average or median age a milestone should be achieved. Moreover, ages specified for individual milestones are inconsistent across sources.[3,4]

Lists that cite average or median ages at which children achieve milestones provide insight into typical development but do not provide clarity for parents, pediatricians, and other early childhood professionals (ECPs) about when to be concerned or when additional screening might be helpful.[4] For example, lists based on median (50th percentile) age milestones might encourage a wait-and-see[5] approach because half of children are not expected to achieve the milestone by that age. In CDC focus groups, parents of children with disabilities reported delays in identification because they were told to wait, that children develop differently, and that some take longer than others. Milestone lists need to support developmental surveillance and clinical judgment on when additional developmental screening could better assess risk for developmental delays.

In 2004, the CDC's *Learn the Signs. Act Early.* program developed free developmental surveillance milestone checklists that included developmental warning signs for parents, pediatricians, and ECPs; messaging to "act early" by addressing concerns; and developmental tips/activities. These materials were developed to help parents to recognize typical development, elicit parents' concerns about their child's development, improve discussions between parents and professionals about a child's development, and support universal developmental screening at recommended ages and additional screenings when there are concerns. The milestones were adapted from *Caring for Your Baby and Young Child: Birth to Age 5* (5th ed) to align with recommended HSVs.[6] Like most milestone lists, the original sources of the milestones were uncited, and adaptations were based mainly on clinical opinion, not on empirically informed evidence.

Based on 15 years of use, 3 areas for improving the checklists were identified by the CDC. First, criteria for checklists used for surveillance needed to be established to evaluate the existing CDC checklists. Second, milestones within checklists would represent milestones above the 50th percentile[3,4,7,8] to ensure that most children would achieve the milestone by a given age. Lastly, new checklists for the 15- and 30-month HSVs were needed to complete the series 2 months to 5 years of age to improve integration of developmental surveillance across early childhood HSVs. This article presents the results of these revisions.

METHODS

The AAP Systems of Services for Children and Youth With Special Health Care Needs team identified and convened 8 subject matter experts (SMEs) in different fields of child development. The group included developmental-behavioral, neurodevelopmental, and general pediatricians; child and developmental psychologists; and a professor of special education and early intervention. All SMEs had graduate training and experience in research methodology and medical decision-making and clinical experience in developmental surveillance, screening, and evaluation. One SME was an editor of and 2 contributed to the AAP's *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents* (4th ed).[9] Two SMEs were lead authors of the AAP's 2020 clinical report, "Promoting Optimal Development: Identifying Infants and Young Children With Developmental Disorders Through Developmental Surveillance and Screening"[1]; another had long-time experience as a developer of screening tools.

Criteria Identification

The SMEs developed 11 criteria for CDC surveillance milestones and tools (Table 1). SMEs nominated the criteria on the basis of their clinical experience and use of CDC surveillance materials. Nominations were discussed, and those that were unanimously agreed upon were included as criteria. Of note, the SMEs agreed that milestones should be easily observed in natural settings and ≥75% of children would be expected to achieve a milestone at a given age. The strategy (≥75%) was chosen to support clinical judgment regarding performing additional developmental screenings, with validated screening tools as a next step to assess a child's risk for developmental delays. This strategy may also prevent a wait-and-see approach because most children of the same age would be expected to achieve the milestone. To reduce confusion about when to be concerned, developmental warning signs were eliminated because not achieving milestones that most children (≥75%) are expected to achieve similarly warrants more in-

TABLE 1 Criteria for Developmental Milestones and Surveillance Tools.

1. Milestones are included at the age most (≥75%) children would be expected to demonstrate the milestone
2. Eliminate "warning signs"[a]
3. Are easy for families of different social, cultural, and ethnic backgrounds to observe and use
4. Are able to be answered with yes, not yet, or not sure
5. Use plain language, avoiding vague terms like may, can, and begins
6. Are organized in developmental domains
7. Show progression of skills with age, when possible
8. Milestones are not repeated across checklists
9. Include open-ended questions
10. Include information for developmental promotion
11. Include information on how to act early if there are concerns

Criteria developed by SMEs.

[a] Milestones listed separately within CDC materials with parent messaging to act early if child has not attained them.

depth surveillance and consideration for developmental screening.

Milestone Identification

Milestones for possible inclusion in CDC surveillance materials were identified by the SMEs. Existing CDC milestones were automatically included for evaluation and were the foundation for the revised checklists. Other milestones were identified by a literature review and commonly used developmental resources.

Literature Review

A broad literature search was conducted in March 2019 using MEDLINE, PsychInfo, and ERIC databases. Search terms were developed in collaboration with the CDC librarian after discussion of the objective of the literature review and comprised the following: (1) milestone, normative (data, table, range, value) or age (range, appropriate) AND (2) child development or infant development AND (3) percentile, psychometrics, predictive values, red flags, warning signs, assessment, monitor, delay, or reference (standard, values).

An article was included for evaluation if it was written in English, contained evidence that supported at least one normed individual developmental milestone or included published clinical opinion (ie, consensus milestones) that children exhibit the milestone by a specific age, and limited to children aged ≤5 years. Articles were excluded if evidence was limited to special populations (eg, preterm infants) or risk factors. Non–peer-reviewed articles, dissertations, and books were also excluded.

Articles were evaluated by the first 2 authors to determine if they met inclusion criteria. Articles chosen by both authors, either on initial review or after additional discussion and agreement between these 2 authors, had milestone data extracted for review by the SME group.

Developmental Resources

SMEs nominated several additional resources for evaluation, including parent resources, professional teaching resources, and commonly used screening and diagnostic evaluation tools (Table 2). Inclusion criteria for these resources were availability in English and contained evidence that supported at least one individual developmental milestone or included published clinical opinion (ie, consensus milestones) that children exhibit the milestone by a specific age. All nominations were accepted for additional review.

CDC Milestones

Existing CDC milestones served as a foundation for identifying milestones and were automatically evaluated.

Milestone Evaluation

The following data were extracted from existing CDC milestones, articles selected for review, and developmental resources: individual milestones, supporting references, and any normative data or published clinical opinion for the milestone. Milestones with conflicting data (eg, age at which most children should achieve the milestone) were flagged for additional discussion.

4A comprehensive database was created with information extracted from CDC milestones and resources for individual milestones from ages 2 months to 5 years, aligned with AAP HSV ages, and shared with the SME group. Original data sources, such as articles that met inclusion criteria and nominated developmental resources, were also shared with the SME group. SMEs collaborated through an in-person meeting, 6 virtual meetings, and e-mail reviews of decision summaries from January to September 2019.

During meetings, the SMEs discussed categorizing milestones into 4 developmental domains: (1) social emotional, (2) language/communication, (3) cognitive, and (4) motor. These domains were previously used in CDC materials and could help parents to learn about different areas of child development (eg, social-emotional

TABLE 2 Additional Developmental Resources Reviewed

Parent Resources	Educational/Training Resources	Developmental Screening Tools	Diagnostic Evaluation Tools[a]
AAP Bright Futures Previsit Questionnaires[10]	AAP Bright Futures guidelines (4th ed)[9]	Ages & Stages Questionnaires (3rd ed)[22]	Bayley Scales of Infant and Toddler Development (3rd ed)[27]
American Speech-Language-Hearing Association development charts[11]	AAP *Pediatrics in Review* articles[15–21]	Ages & Stages Questionnaires: Social-Emotional[23]	Beery-Buktenica Developmental Test of Visual-Motor Integration (6th ed)[28]
AAP brochure "Is Your One-Year-Old Communicating With You?"[12]		Modified Checklist for Autism in Toddlers, Revised[24]	BRIGANCE Early Childhood Screens III[29]
CDC *Learn the Signs. Act Early.* checklists[13]		Parents' Evaluation of Developmental Status With Developmental Milestones[25]	The Capute Scales: Cognitive Adaptive Test/Clinical Linguistic and Auditory Milestone Scale[30]
FIRST WORDS Project 16 × 16[14]		Survey of Well-Being in Young Children[26]	MacArthur-Bates Communicative Development Inventories (2nd ed)[31]
			Mullen Scales of Early Learning[32]
			Peabody Developmental Motor Scales (2nd ed)[33]
			Preschool Language Scale-5[34]

[a] Diagnostic evaluation tools were cross referenced when there was lack of agreement supporting a milestone or age of a milestone across other data sources. Not all milestones were cross referenced with diagnostic resources.

skills in addition to language/communication skills). Because milestones often represent skills across several domains, they were placed in the domain in which the SME group believed that parents would most likely identify them. For example, reciprocal play skills involving other people were categorized as social-emotional, and other play skills were categorized as cognitive.

Milestones were reviewed for 2 to 3 ages at a time (eg, 2, 4, and 6 months) so that skill progression could be considered. Milestones were reviewed by the SME group on the basis of the criteria outlined in Table 1. First, SMEs considered milestones with normative data that supported achievement by ≥75% of children at a particular age. Next, they considered milestones from screening and diagnostic tools. Finally, SMEs considered milestones that were based on published clinical opinion. Each of these data sources was cross referenced with the others to get a sense of the evidence base available to support inclusion of a milestone in revised CDC checklists.

If there was disagreement across sources or lack of evidence supporting a milestone for a specific age, additional research was conducted, and additional evidence was then evaluated by the SMEs according to the developed criteria. This included reviewing diagnostic evaluation tools (Table 2) and/or conducting a separate PubMed search for a specific milestone or a related skill. For example, additional evidence was sought for age-specific development of gestures like lifting arms to be picked up, waving bye-bye, and blowing a kiss.

SMEs used the available evidence base and their clinical experience to determine if and at what age a milestone would be included in the revised checklists. Only milestones with unanimous agreement were included.

During the evaluation process, SMEs denoted milestones they included for surveillance but believed that additional research could improve age placement, quality, and/or quantity of supporting evidence or better capture the underlying developmental construct of the milestone. Finally, the SMEs simplified the milestones and added examples to try to improve understanding. The CDC team then reviewed milestones from a cultural and health communication perspective (eg, family friendly, fifth- to sixth-grade reading level), and SMEs reviewed those changes again to ensure that the milestone still represented the developmental construct being assessed.

With the use of back-translation methods, the milestones were translated into Spanish by CDC Multilingual Services and reviewed by 2 native Spanish-speaking pediatricians. Cognitive testing with a diverse sample of parents located in different regions of the United States provided feedback on relatability and clarity, which led the SMEs to make additional changes to wording. Results of cognitive testing will be published separately.

RESULTS

Of the 1027 articles generated from the literature review, 34 met inclusion criteria. Of those, 24 contained normative data, and 10 contained published clinical opinion for ≥1 milestones. Six additional articles were found through

independent searches to evaluate individual milestones when SMEs determined that the milestone was appropriate but insufficient or conflicting evidence supported its use at a specific HSV age. Of the articles with normative data, 14 (58.3%) described populations within non–English-speaking countries.

Tables 3 to 6 list the milestones that SMEs included in CDC checklists after critical evaluation and unanimous decision. They are presented by domain with HSV age, references that support the inclusion of the milestone at that age, and whether the milestone was an existing or new CDC milestone. Supporting references are divided into normative data, developmental screening and evaluation tools, and published clinical opinions.

Previously, CDC had 216 milestones across 10 checklists. With the addition of 15- and 30-month checklists and the evidence review process, 159 milestones were included across 12 checklists. This represented a reduction of 57 (26.4%) CDC milestones, with the average number of milestones per checklist decreasing from 22 to 13.

Of the final 159 milestones that met the evaluation criteria, 94 (59.1%) were based on CDC original milestones and 65 (40.9%) were added on the basis of the milestone identification and evaluation process. One third of the 94 retained CDC milestones were moved to a different age on the basis of the criterion that ≥75% of children would be expected to achieve the milestone by that age. When moved, 21 of those 31 milestones were transferred to an older age. More than half (56.5%) of the original 216 milestones were eliminated (Supplemental Table 7) on the basis of SME criteria, including 25 that were duplicated across checklists at different ages. For example, Tries to use things the right way, like a phone, cup, or book" was on both the 12- and 18-month checklists; this milestone was placed only at 15 months on the basis of supporting evidence. Additionally, eliminating vague terms, such as may or begins, resulted in moving and changing milestones; for example, "Begins to pass things from one hand to another" was removed from the list of milestones at age 6 months and was included as "Moves things from one hand to her other hand" at age 9 months.

The 1-, 2-, and 3-year-old checklists had the greatest decrease in the number of milestones, with a ≥50% reduction. Approximately half of the aggregate loss for these ages was due to moving milestones to the new 15- and 30-month checklists. When combining all new and revised checklists for 1 to 3 years, the number of milestones was reduced by 25.7%, consistent with the 26.4% reduction of milestones across the other age ranges.

All 4 domains had a reduction in number of milestones. Cognitive milestones decreased by 34 (50.7%), social emotional decreased by 16 (27.5%), language decreased by 4 (9.1%), and motor decreased by 3 (6.4%). Social-emotional and cognitive domain milestones were the least likely to have normative data available. The social-emotional domain had 25 (59.5%) milestones with 0 to 1 normed references and 8 (19.0%) with ≥3 normed references. The cognitive domain had 19 (57.6%) milestones with 0 to 1 normed references and 8 (24.2%) with ≥3 references. In contrast, language and motor domains had 11 (27.5%) and 10 (22.7%) milestones with 0 to 1 normed references and 21 (52.5%) and 30 (68.1%) milestones, respectively, with ≥3 normed references.

Of the final 159 milestones, 127 (79.9%) were retained or added on the basis of normative data, whereas 32 (20.1%) milestones were included on the basis of screening and evaluation tools, published clinical opinion, and SME opinion. Of milestones with normative data, 32 had normative data from only 1 resource. The SMEs believed that 22 (13.8%) of the final milestones were candidates for additional research, as noted in Tables 3–6; this subset includes the milestone "Sings, dances, or acts for you," the only milestone included or retained without supporting evidence on the basis of SME opinion.

Of the 77 developmental warning signs listed on the old CDC checklists, 59 (76.6%) had a corresponding milestone on the new checklists.

DISCUSSION

The CDC checklists support developmental surveillance and other important components of the early identification process by pediatricians and other ECPs, including developmental promotion, parent education and engagement, communication of developmental progress and concerns, and developmental screening.[7,5,9,72–75] However, variability across surveillance resources, including the CDC's, can create confusion regarding what constitutes a concern and when developmental screening between recommended ages might be warranted.[3,4,38,76]

An expert working group convened by AAP sought to improve CDC surveillance tools by enhancing conversations among pediatricians, ECPs, and families regarding childhood development and guiding clinical judgment on when to conduct developmental screening between recommended ages. These tools are not intended to replace

TABLE 3 Social-Emotional Milestones With Supporting Normative Data, Evaluation Tools, and Published Clinical Opinion References

			Source		
Social-Emotional Milestones	Age	CDC or New	Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Calms down when spoken to or picked up[d]	2 mo	New	Ertem et al (35)	—	ASHA (11), Bright Futures (36), Dosman et al (8), Sharp et al (37)
Looks at your face	2 mo	CDC	Ertem et al (35), Sheldrick and Perrin (38)	—	Bright Futures (36), Dosman et al (8), Scharf et al (18)
Seems happy to see you when you walk up to her	2 mo	New	Ertem et al (35), Sheldrick and Perrin (38), Thalagala (39)	—	—
Smiles when you talk to or smile at her	2 mo	CDC	Bhave et al (40), Ertem et al (35), Lejarraga et al (41), Thalagala (39)	ASQ-3 (22), PEDS-DM (25)	ASHA (11)
Smiles on his own to get your attention	4 mo	CDC	Ertem et al (35)	ASQ-3, PEDS-DM	Bright Futures (36)
Chuckles (not yet a full laugh) when you try to make her laugh	4 mo	New	Accardo and Capute (30), Bhave et al (40), Ertem et al (35), Sheldrick and Perrin (38)	ASQ-3, PEDS-DM	ASHA (11), Bellman et al (42), Bright Futures (36)
Looks at you, moves, or makes sounds to get or keep your attention	4 mo	New	Ertem et al (35)	PEDS-DM	—
Knows familiar people	6 mo	CDC	Bhave et al (40), Ertem et al (35)	ASQ-3	Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Likes to look at himself in the mirror	6 mo	CDC	Bhave et al (40), Lejarraga et al (41)	ASQ-3	Bright Futures (36)
Laughs	6 mo	New	Accardo and Capute (30), Bhave et al (40), Ertem et al (35), Sheldrick and Perrin (38)	ASQ-3, PEDS-DM	Bellman et al (42), Bright Futures (36), Dosman et al (8)
Is shy, clingy, or fearful around strangers	9 mo	CDC	Ertem et al (43), Kumar et al (44), Lancaster et al (45)	—	Gerber et al (20), Scharf et al (18)
Shows several facial expressions, like happy, sad, angry, and surprised[d]	9 mo	New	Thalagala (39)	—	Gerber et al (20), Scharf et al (18)
Looks when you call his name	9 mo	CDC	Gladstone et al (46), Sheldrick and Perrin (38)	ASQ-3, PEDS-DM	Bright Futures (36) Dosman et al (8),

TABLE 3 Continued

Social-Emotional Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
					Gerber et al (20), Scharf et al (18)
Reacts when you leave (looks, reaches for you, or cries)[d]	9 mo	CDC	Ertem et al (43)	—	Dosman et al (8), Gerber et al (20), Scharf et al (18)
Smiles or laughs when you play peek-a-boo	9 mo	CDC	Ertem et al (35), Lejarraga et al (41), Sheldrick and Perrin (38), Thalagala (39)	PEDS-DM	Bellman et al (42), Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Plays games with you, like pat-a-cake	12 mo	CDC	Ertem et al (35), Fenson et al (47), Sheldrick and Perrin (38)		Bellman et al (42), Bright Futures (36), Gerber et al (20), Scharf et al (18)
Copies other children while playing, like taking toys out of a container when another child does[d]	15 mo	CDC	—	—	Bright Futures (36), Dosman et al (8)
Shows you an object that he likes	15 mo	New	Crais et al (48)	ASQ-3	Dosman et al (8), First Words (14), Gerber et al (20), Scharf et al (18)
Claps when excited	15 mo	New	Crais et al (48), Kwon et al (49)	—	—
Hugs stuffed doll or other toy	15 mo	New	Crais et al (48), Fenson et al (47)	—	Colson and Dworkin (16), Johnson and Blasco (15)
Shows you affection (hugs, cuddles, or kisses you)	15 mo	CDC	Ertem et al (43)	ASQ-SE-2 (23), Bayley III (27)	Johnson and Blasco (15), Vaughan (17)
Moves away from you, but looks to make sure you are close by	18 mo	CDC	—	ASQ-SE-2	Dosman et al (8), Gerber et al (20), Scharf et al (18)
Points to show you something interesting	18 mo	CDC	—	Bayley III, MCHAT-R (24), PEDS-DM	Bellman et al (42), Bright Futures (36), Dosman et al (8), Gerber et al

TABLE 3 Continued

Social-Emotional Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
					(20), Scharf et al (18)
Puts hands out for you to wash them	18 mo	New	Gladstone et al (46)	—	—
Looks at a few pages in a book with you[d]	18 mo	New	Ertem et al (35)	ASQ-SE-2	Behrman et al (50), Colson and Dworkin (16), Vaughan (17)
Helps you dress him by pushing arm through sleeve or lifting up foot	18 mo	CDC	—	ASQ-3, PEDS-DM	Bright Futures (36), Dosman et al (8), Johnson and Blasco (15)
Notices when others are hurt or upset, like pausing or looking sad when someone is crying	24 mo	New	—	PEDS-DM	Dosman et al (8), Scharf et al (18)
Looks at your face to see how to react in a new situation	24 mo	New	—	ASQ-SE-2, MCHAT-R, PEDS-DM	Bright Futures (36), Dosman et al (8), Johnson and Blasco (15)
Plays next to other children and sometimes plays with them	30 mo	CDC	Lancaster et al (45), Lansdown et al (51)	ASQ-SE-2, PEDS-DM	Bright Futures (36), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Shows you what she can do by saying, "Look at me!"	30 mo	New	Sheldrick and Perrin (38)	—	—
Follows simple routines when told, like helping to pick up toys when you say, "It's clean-up time."	30 mo	New	—	ASQ-SE, PEDS-DM	Colson and Dworkin (16), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18), Vaughan (17)
Calms down within 10 min after you leave her, like at child care drop off[d]	3 y	CDC	—	—	Dosman et al (8), Johnson and Blasco (15)
Notices other children and joins them to play	3 y	New	Lansdown et al (51)	ASQ-SE-2, PEDS-DM	Dosman et al (8), Gerber et al (20), Scharf et al (18)
	4 y	CDC	Ertem et al (43)	ASQ-3, PEDS-DM	

TABLE 3 Continued

Social-Emotional Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Pretends to be something else during play (teacher, superhero, dog)					Behrman et al (50), Bright Futures (36), Dosman et al (8)
Asks to go play with children if none are around, like "Can I play with Alex?"[d]	4 y	CDC	Gladstone et al (46)	—	—
Comforts others who are hurt or sad, like hugging a crying friend[d]	4 y	CDC	—	ASQ-3, PEDS-DM	Dosman et al (8)
Avoids danger, like not jumping from tall heights at the playground	4 y	New	—	ASQ-SE-2	—
Likes to be a "helper"	4 y	New	Gladstone et al (46), Haltiwanger and Coster (52)	PEDS-DM	Gerber et al (20), Scharf et al (18)
Changes behavior on the basis of where she is (place of worship, library, playground)	4 y	New	Gladstone et al (46)	ASQ-SE-2, PEDS-DM	—
Follows rules or takes turns when playing games with other children	5 y	CDC	Gladstone et al (46), Haltiwanger and Coster (52), Kumar et al (44), Sheldrick and Perrin (38)	ASQ-3, PEDS-DM	Bright Futures (36), Colson and Dworkin (16), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Sings, dances, or acts for you[d]	5 y	CDC	—	—	—
Does simple chores at home, like matching socks or clearing the table after eating	5 y	New	Gladstone et al (46), Haltiwanger and Coster (52)	PEDS-DM	—

ASHA, American Speech-Language-Hearing Association; ASQ-3, Ages & Stages Questionnaires (3rd ed); ASQ-SE-2, Ages & Stages Questionnaires: Social-Emotional (2nd ed); Bayley III, Bayley Scales of Infant and Toddler Development (3rd ed); MCHAT-R, Modified Checklist for Autism in Toddlers, Revised; PEDS-DM, Parents' Evaluation of Developmental Status With Developmental Milestones. —, Empty cells indicate that type/category of data was not available to support inclusion of that milestone.

[a] Provides baseline distribution data for age of attainment of a milestone for a given population.

[b] Some commonly used developmental screening and diagnostic evaluation tools (not all available tools are represented).

[c] Uncited on the basis of clinical opinion and/or report of the average or median age that a milestone should be achieved.

[d] SME agreement that additional research would be beneficial.

validated screening tools but instead to promote optimal child development and encourage professionals to act early through surveillance and screening as outlined in the AAP's clinical report.[1] Results indicate substantial changes were made developing and applying criteria for surveillance milestones and tools, adding 15- and 30-month checklists, and incorporating evidence-informed milestones.

Clinicians have used attainment of developmental milestones for almost a century[77] to determine if a child is developing typically. Pediatricians have reported increasing use of milestone checklists from 53.0% in 2002 to 89.6% in 2016, in addition to their report of increased developmental screening.[78] However, these surveillance milestone checklists are likely based on published clinical opinion due to the lack of published normative milestone data and the lack of citations of original sources on checklists. The domain tables generated from this work linking developmental milestones to empirically informed evidence and published clinical opinion could improve training of professionals and methods for surveillance,[4,7,8] such as incorporation of the CDC's open access milestones/checklists into electronic health records.

Milestone checklists used in surveillance are intended to prompt conversations, review developmental history and progress, and elicit concerns. The CDC checklists should not replace universal developmental screening, provide a risk categorization, or diagnose DDs. To determine if concerns about milestones should prompt a more in-depth developmental history, observation, and examination along with consideration for assessing actual risk by screening, the SMEs recommended that most children (≥75%) should be expected to achieve milestones by a given age.

SMEs believed that using 50th percentile milestones for surveillance would not support clinical decision-making for developmental screening because only half of children would be expected to achieve an individual milestone by a given age. Using milestones that 85% or 90% of children would be expected to achieve may limit opportunities for additional screening for too many children at risk for developmental delays. A ≥75% criterion was thus agreed upon to balance informed clinical decision-making regarding developmental screening and provide opportunities to identify children at risk for delays as soon as possible. Pediatricians are encouraged to follow AAP recommendations to screen a child, using validated screening tools, when surveillance reveals a concern or anytime a concern is raised, to identify and refine the risk for developmental delays.[1]

The criterion (Table 1) for milestones representing those that most children (≥75%) would be expected to achieve eliminated the need for the CDC's previous warning signs because most are now represented as milestones. Using this strategy, SMEs agreed that a child not meeting a milestone should be considered for screening similar to children demonstrating warning signs. Less than a quarter of warning signs could not be replaced with an evidence-informed milestone. Examples not represented as new milestones include subjective items such as "shows extreme behavior (unusually fearful, aggressive, shy or sad)" and items that may be better recognized during a physical examination, such as "stiff or tight muscles." Additional features of the surveillance tools may identify those types of concerns. For example, the act early message was retained, and new open-ended questions were added to encourage parents to ask about other concerns.

Use of this same strategy is intended to discourage the wait-and-see approach and could prevent worry for children older than the average age of attainment of a milestone but not likely to be at risk for delays.[1,5] It could also eliminate the confusion families had with milestones and warning signs on the same checklist and repetition of milestones across checklists.

The application of additional criteria (Table 1) to improve clarity in the revised milestones may help parents, pediatricians, and other ECPs to recognize when missing milestones might indicate the need for developmental screening. Although milestones typically span several developmental domains, SMEs believed that keeping domain labels could improve awareness of the less commonly known social-emotional and cognitive development milestones of young children. Showing progression of a skill, like walking, could demonstrate how earlier milestones lay the foundation for later ones. Adding the open-ended question, "Is there anything your child is doing or is not doing that concerns you?" may encourage parents to discuss the quality with which a child exhibits a milestone, milestones not listed within the sample, and atypical behaviors difficult to capture through a list.[42] Finally, including information on developmental promotion and acting early may empower families to support their child's development and to ask about screening if they have concerns.

Surveillance of social-emotional and cognitive milestones supports

TABLE 4 Language and Communication Milestones With Supporting Normative Data, Evaluation Tools, and Published Clinical Opinion References

Language/ Communication Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Makes sounds other than crying	2 mo	CDC	Dosman et al (8),[d] Sheldrick and Perrin (38)	ASQ-3 (22), PEDS-DM (25)	Blackwell and Baker (53), Bright Futures (36), Gerber et al (20), Scharf et al (18)
Reacts to loud sounds[e]	2 mo	New	—	—	Accardo and Capute (30), ASHA (11), Bellman et al (42), Bright Futures (36)
Makes sounds like "oooo" and "aahh" (cooing)	4 mo	CDC	Accardo and Capute (30), Ertem et al (35)	ASQ-3	ASHA (11), Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Makes sounds back when you talk to him	4 mo	New	Ertem et al (35), Den Ouden et al (54), Kumar et al (44)	ASQ-3	Bellman et al (42)
Turns head toward the sound of your voice	4 mo	CDC	Accardo and Capute (30), Bhave et al (40), Den Ouden et al (54), Sheldrick and Perrin (38)	—	Bellman et al (42), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Takes turns making sounds with you	6 mo	CDC	Kumar et al (44), Lejarraga et al (41)	—	Dosman et al (8), Gerber et al (20), Scharf et al (18)
Blows "raspberries" (sticks tongue out and blows)	6 mo	New	Accardo and Capute (30)	—	Blackwell and Baker (53), Gerber et al (20), Scharf et al (18)
Makes squealing noises	6 mo	New	—	ASQ-3	Bellman et al (42), Blackwell and Baker (53), Gerber et al (20), Scharf et al (18)
Makes different sounds like "mamamama" and "babababa"	9 mo	CDC	Accardo and Capute (30), Bhave et al (40), Den Ouden et al (54), Lancaster et al (45), Lejarraga et al (41), Sheldrick and Perrin (38)	ASQ-3, PEDS-DM	ASHA (11), Bright Futures (36)
Lifts arms up to be picked up	9 mo	New	Ertem et al (35), Fenson et al (47), Gladstone et al (46), Kwon et al (49), Sheldrick and Perrin (38)	—	ASHA (11), Bright Futures (36), Dosman et al (8), First Words (14), Gerber et al (20), Scharf et al (18)

TABLE 4 Continued

Language/ Communication Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Waves "bye-bye"	12 mo	CDC	Accardo and Capute (30), Crais et al (48), Den Ouden et al (54), Ertem et al (35), Fenson et al (47), Kwon et al (49)	—	ASHA (11), Bright Futures (36), First Words (14), Gerber et al (20), Scharf et al (18)
Calls a parent "mama" or "dada" or another special name	12 mo	CDC	Accardo and Capute (30), Crais et al (48), Sheldrick and Perrin (38)	—	AAP (12), Bright Futures (36), Gerber et al (20), Scharf et al (18)
Understands "no" (pauses briefly or stops when you say it)	12 mo	CDC	Accardo and Capute (30), Ertem et al (35), Gladstone et al (46), Lancaster et al (45), Lejarraga et al (41), Thalagala (39)	Bayley III (27)	Blackwell and Baker (53), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Tries to say 1 or 2 words besides mama or dada, like "ba" for ball or "da" for dog	15 mo	New	Gladstone et al (46), Lancaster et al (45), Tamis-Lemonda et al (55)	ASQ-3, PEDS DM	Bright Futures (36), Johnson and Blasco (15), Sharp and Hillenbrand (37)
Looks at a familiar object when you name it	15 mo	CDC	Ertem et al (35), Lancaster et al (45), Sheldrick and Perrin (38)	ASQ-3	Gerber et al (20), Scharf et al (18)
Follows directions given with both a gesture and words. For example, he gives you a toy when you hold out your hand and say, "Give me the toy."	15 mo	New	Accardo and Capute (30), Ertem et al (35), Gladstone et al (46)	ASQ-3	Bright Futures (36), Johnson and Blasco (15)
Points to ask for something or to get help	15 mo	CDC	Ertem et al (43), Kwon et al (49), Lancaster et al (45)	ASQ-3	AAP (12), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Tries to say ≥3 words besides mama or dada	18 mo	CDC	Accardo and Capute (30), Ertem et al (35), Gladstone et al (46), Lancaster et al	ASQ-3	Bellman et al (42), Blackwell and Baker (53), Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)

TABLE 4 Continued

Language/ Communication Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
			(45), Sheldrick and Perrin (38)		
Follows 1-step directions without any gestures, like giving you the toy when you say, "Give it to me."	18 mo	CDC	Accardo and Capute (30), Ertem et al (35), Gladstone et al (46), Lancaster et al (45), Sheldrick and Perrin (38)	—	ASHA (11), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Points to things in a book when you ask, for example, "Where is the bear?"	24 mo	CDC	Accardo and Capute (30), Lejarraga et al (41)	ASQ-3	ASHA (11), Bellman et al (42), Blackwell and Baker (53), Bright Futures (36), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Says at least 2 words together, like "More milk."	24 mo	CDC	Accardo and Capute (30), Den Ouden (54), Ertem et al (43), Gladstone et al (46), Sheldrick and Perrin (38)	ASQ-3	AAP (12), ASHA (11), Bellman et al (42), Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Points to at least 2 body parts when you ask him to show you	24 mo	CDC	Accardo and Capute (30), Muluk et al (56), Sheldrick and Perrin (38)	ASQ-3, PEDS-DM	ASHA (11), Bellman et al (42), Blackwell and Baker (53), Bright Futures (36), Johnson and Blasco (15)
Uses more gestures than just waving and pointing, like blowing a kiss or nodding yes	24 mo	New	Fenson et al (47), Kwon et al (49)	—	Dosman et al (8), First Words (14)
Says ~50 words	30 mo	New	Accardo and Capute (30), Lancaster et al (45), Tamis-Lemonda et al (55)	ASQ-3	AAP (12), Bright Futures (36), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Says ≥2 words, with 1 action word, like "Doggie run."	30 mo	New	Accardo and Capute (30), Ertem et al (35), Lancaster et al (45), Tamis-Lemonda et al (55)	ASQ-3, Bayley III	Blackwell and Baker (53), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Names things in a book when you point and ask, "What is this?"	30 mo	New	Lancaster et al (45), Sheldrick and Perrin (38)	ASQ-3, Bayley III	Gerber et al (20), Scharf et al (18)

TABLE 4 Continued

Language/ Communication Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Says words like I, me, or we	30 mo	CDC	Accardo and Capute (30), Ertem et al (35), Lancaster et al (45), Sheldrick and Perrin (38)	ASQ-3, Bayley III	Bright Futures (36), Colson and Dworkin (16), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Talks with you in conversation using at least 2 back-and-forth exchanges[e]	3 y	CDC	—	Bayley III	—
Asks who, what, where, or why questions, like "Where is mommy/ daddy?"	3 y	New	Ertem et al (43), Nair and Russell (57), Sheldrick and Perrin (38)	—	ASHA (11), Colson and Dworkin (16)
Says what action is happening in a picture when asked, like running, eating, or playing	3 y	New	Gladstone et al (46)	ASQ-3, Bayley III	Gerber et al (20), Knobloch et al (58), Scharf et al (18)
Says first name when asked	3 y	CDC	Gladstone et al (46), Haltiwanger and Coster (52), Lansdown et al (51), Lejarraga et al (41), Sheldrick and Perrin (38)	ASQ-3	Gerber et al (20), Knobloch et al (58), Scharf et al (18)
Talks well enough for others to understand, most of the time	3 y	CDC	Ertem et al (35), Gladstone et al (46), Lancaster et al (45)	Bayley III	ASHA (11), Bellman et al (42), Blackwell and Baker (53), Bright Futures (36), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Says sentences with ≥4 words[e]	4 y	New	—	ASQ-3	ASHA (11)
Says some words from a song, story, or nursery rhyme[e]	4 y	CDC	—	—	Colson and Dworkin (16)
Talks about at least 1 thing that happened during	4 y	New	—	—	ASHA (11)

TABLE 4 Continued

Language/ Communication Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
his day, like "I played soccer."[e]					
Answers simple questions, like "What is a coat for," or "What is a crayon for?"	4 y	New	Ertem et al (43), Gladstone et al (46), Lejarraga et al (41), Nair and Russell (57), Sheldrick and Perrin (38)	ASQ-3	ASHA (11), Gerber et al (20), Scharf et al (18)
Tells a story she heard or made up with at least 2 events, like a cat stuck in a tree and a firefighter saving it	5 y	CDC	McCabe and Rollins (59), Sheldrick and Perrin (38)	—	Gerber et al (20), Scharf et al (18)
Answers simple questions about a book or story after you read or tell it to him[d]	5 y	New	—	—	ASHA (11)
Keeps a conversation going with >3 back-and-forth exchange[e]	5 y	New	—	—	ASHA (11)
Uses or recognizes simple rhymes (bat-cat, ball-tall)	5 y	New	—	PEDS-DM	ASHA (11), Gerber et al (20), Scharf et al (18)

ASHA, American Speech-Language-Hearing Association; ASQ-3, Ages & Stages Questionnaires (3rd ed); Bayley III, Bayley Scales of Infant and Toddler Development (3rd ed); PEDS-DM, Parents' Evaluation of Developmental Status With Developmental Milestones. —, Empty cells indicate that type/category of data was not available to support inclusion of that milestone.

[a] Provides baseline distribution data for age of attainment of a milestone for a given population.

[b] Some commonly used developmental screening and diagnostic evaluation tools (not all available tools are represented).

[c] Uncited on the basis of clinical opinion and/or report the average or median age that a milestone should be achieved.

[d] Dosman et al[8] contained both published clinical opinion and normative data.

[e] SME agreement that additional research would be beneficial.

early identification of children with intellectual and social-emotional disorders, including autism spectrum disorder. In our review, milestones included in the social-emotional domain had the fewest normed references per milestone, followed by the cognitive domain, language domain, and motor domain. When social-emotional milestones were available, they were often self-help rather than social engagement and emotional regulation skills. These results highlight the need for additional research on social-emotional milestones. For example, can social-emotional function be assessed using milestones during developmental surveillance at HSVs, and what factors influence the timing and development of social-emotional skills? Despite relatively more evidence in the language domain, SMEs believed that more research is needed in the intersection of the social-emotional and language domains to recognize and monitor the development of social language in young children.

Limitations

There were limitations with the revision process. SMEs' opinions determined which HSV was most appropriate for a milestone, given existing evidence and the goal that most children (≥75%) would be expected to achieve it by that age. For example, if there was evidence that 50% of children reach a milestone at 11 months and 90% reach it at 16 months, it was placed on the 15-month checklist. Eighty percent of the revised milestones had normative data to support their inclusion on a specific HSV age checklist. However, it was necessary to use data such as published clinical opinion to represent milestones in all domains across all ages. Regardless of supporting data type, all revised milestones had unanimous SME support for their inclusion in a surveillance tool. When normative data existed, limitations remained in the availability of milestones that met other criteria. For example, sometimes it was difficult to find naturally observable milestones compared with milestones demonstrated during standardized testing. Although the milestones are evidence-informed using international sources and cognitive testing with parents was done, there is no certainty that these new milestones will resonate with all families or that they are the most relevant milestones for developmental surveillance. These checklists and others have not been tested to see whether they indeed lead to appropriate developmental screening between recommended ages and improve early identification.

There are other gaps in developmental surveillance research. Best practices for conducting the recommended 6 components[1] of surveillance are not available. There are limitations in the use of milestones, even evidence-informed ones, as the sole component of developmental surveillance. Milestones/milestone checklists can support some components, such as taking a developmental history and eliciting concerns, but surveillance also involves observation, examination, education, communication, and clinical decision-making. Moreover, trusting relationships may develop through the longitudinal process of surveillance and improve parents' confidence in sharing concerns and pediatricians' confidence to assess concerns raised.

CONCLUSIONS

Early identification and intervention for the 1 in 6 children with DDs have been shown to improve outcomes.[79–83] However, less than a quarter of children with DDs receive early intervention services before age 3 years,[84,85] and most children with emotional, behavioral, and developmental conditions, other than autism spectrum disorder, do not receive services before age 5 years.[86] Developmental surveillance is an important part of early identification[1,87] and facilitates education, communication, and relationship building among parents, pediatricians, and ECPs. Research in early identification has focused primarily on developmental screening, not surveillance. Improvements in surveillance tools and processes could help to identify concerns and support clinical judgment regarding developmental screening to allow more timely referral to early intervention services and additional evaluation. The methods described herein led to substantial revisions of CDC resources to better support developmental surveillance. Best practices for surveillance and improvements in surveillance tools could be supported by additional research on individual normed milestones, particularly social-emotional and cognitive milestones; how parents, pediatricians, and ECPs learn and understand milestones; which milestones are most likely to lead to appropriate screening; whether the use of milestones that most children (≥75%) would be expected to achieve is appropriate for surveillance; whether categorizing milestones into

TABLE 5 Cognitive Milestones With Supporting Normative Data, Evaluation Tools, and Published Clinical Opinion References

Cognitive Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Watches you as you move	2 mo	CDC	Accardo and Capute (30), Atkinson et al (60), Bhave et al (40), Ertem et al (35), Sheldrick and Perrin (38)	ASQ-3 (22)	—
Looks at a toy for several seconds	2 mo	New	Kumar et al (44)	—	Accardo and Capute (30), Bellman et al (42)
If hungry, opens mouth when she sees breast or bottle	4 mo	New	Carruth and Skinner (61), Thalagala (39)	ASQ-3, PEDS-DM (25)	Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Looks at his hands with interest	4 mo	New	Den Ouden et al (54), Ertem et al (35), Lejarraga et al (41)	—	Bellman et al (42), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Puts things in her mouth to explore them	6 mo	CDC	Ertem et al (35)	ASQ-3	Gerber et al (20), Scharf et al (18)
Reaches to grab a toy he wants	6 mo	CDC	Den Ouden et al (54), Kumar et al (44)	ASQ-3	Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Closes lips to show she does not want more food[d]	6 mo	New	—	PEDS-DM	—
Looks for objects when dropped out of sight (like his spoon or toy)	9 mo	New	Accardo and Capute (30), Ertem et al (35)	—	Bright Futures (36), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Bangs 2 things together	9 mo	CDC	Ertem et al (35), Gladstone et al (46), Sheldrick and Perrin (38)	ASQ-3	Bellman et al (42), Bright Futures (36), Gerber et al (20), Scharf et al (18)
	12 mo	CDC	Accardo and Capute (30), Gladstone et al	ASQ-3	

TABLE 5 Continued

Cognitive Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Puts something in a container, like a block in a cup			(46), Lancaster et al (45), Thalagala (39)		Bright Futures (36), Gerber et al (20), Scharf et al (18)
Looks for things he sees you hide, like a toy under a blanket	12 mo	CDC	Accardo and Capute (30), Ertem et al (35), Gladstone et al (46)	—	Bright Futures (36), Gerber et al (20), Scharf et al (18)
Tries to use things the right way, like a phone, cup, or book[d]	15 mo	CDC	—	—	Dosman et al (8), Johnson and Blasco (15)
Stacks at least 2 small objects, like blocks	15 mo	New	—	Beery VMI (28)	—
Copies you doing chores, like sweeping with a broom	18 mo	CDC	Den Ouden et al (54), Fenson et al (47)	ASQ-3, PEDS-DM	Bellman et al (42), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Plays with toys in a simple way, like pushing a toy car	18 mo	CDC	Ertem et al (43), Gladstone et al (46) Lancaster et al (45)	ASQ-3	Bellman et al (42), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Holds something in 1 hand while using the other hand, for example, holding a container and taking the lid off[d]	24 mo	New	Kimmerle et al (62)	—	—
Tries to use switches, knobs, or buttons on a toy	24 mo	CDC	Ertem et al (35)	ASQ-3	Bright Futures (36), Colson and Dworkin (16), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Plays with >1 toy at the same time, like putting toy food on a toy plate	24 mo	New	—	PEDS-DM	—
	30 mo	New	—	ASQ-3	

TABLE 5 Continued

Cognitive Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Uses things to pretend, like feeding a block to a doll as if it were food					Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Shows simple problem-solving skills, like standing on a small stool to reach something	30 mo	New	Lancaster et al (45)	ASQ-3	—
Follows 2-step instructions, for example, "Put the toy down and close the door."	30 mo	CDC	Accardo and Capute (30), Ertem et al (35), Gladstone et al (46) Lancaster et al (45)	Bayley III (27)	AAP (12), Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Shows that he knows at least 1 color, like pointing to a red crayon when you ask, "Which one is red?"	30 mo	New	Accardo and Capute (30), Sheldrick and Perrin (38)	—	Knobloch et al (58)
Draws a circle when you show him how	3 y	CDC	Accardo and Capute (30), Egan and Brown (63)	ASQ-3	Behrman et al (50), Bellman et al (42), Bright Futures (36), Colson and Dworkin (16), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Avoids touching hot objects, like a stove, when you warn her[d]	3 y	New	Haltiwanger and Coster (52)	ASQ-SE (23)	—
Names a few colors of items	4 y	CDC	Accardo and Capute (30), Lejarraga et al (41), Sheldrick and Perrin (38)	ASQ-3, Bayley III, PEDS-DM	Gerber et al (20), Scharf et al (18)
Tells what comes next in a well-known story[d]	4 y	CDC	—	—	Gerber et al (20), Scharf et al (18)
	4 y	CDC	Lejarraga et al (41),	ASQ-3, PEDS-DM	

TABLE 5 Continued

Cognitive Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Draws a person with ≥3 body parts					Bright Futures (36), Gerber et al (20), Scharf et al (18)
Counts to 10	5 y	CDC	—	ASQ-3	Dosman et al (8), Gerber et al (20), Scharf et al (18)
Names some numbers between 1 and 5 when you point to them	5 y	CDC	Williams and Lerner (64)	PEDS-DM	ASHA (11), Gerber et al (20), Scharf et al (18)
Uses words about time, like yesterday, tomorrow, morning, or night	5 y	CDC	Sheldrick and Perrin (38)	PEDS-DM	Colson and Dworkin (16), Gerber et al (20), Scharf et al (18)
Pays attention for 5–10 min during activities, for example, during story time or making arts and crafts (screen time does not count)[d]	5 y	New	—	ASQ-SE	—
Writes some letters in her name	5 y	CDC	Sheldrick and Perrin (38)	ASQ-3, PEDS-DM	Dosman et al (8), Gerber et al (20), Scharf et al (18)
Names some letters when you point to them	5 y	New	Williams and Lerner (64)	ASQ-3	Gerber et al (20), Scharf et al (18)

ASHA, American Speech-Language-Hearing Association; ASQ-3, Ages & Stages Questionnaires (3rd ed); ASQ-SE, Ages & Stages Questionnaires: Social-Emotional; Bayley III, Bayley Scales of Infant and Toddler Development (3rd ed); Beery VMI, Beery-Buktenica Developmental Test of Visual-Motor Integration; PEDS-DM, Parents' Evaluation of Developmental Status With Developmental Milestones. —, Empty cells indicate that type/category of data was not available to support inclusion of that milestone.

[a] Provides baseline distribution data for age of attainment of a milestone for a given population.

[b] Some commonly used developmental screening and diagnostic evaluation tools (not all available tools are represented).

[c] Uncited on the basis of clinical opinion and/or report the average or median age that a milestone should be achieved.

[d] SME agreement that additional research would be beneficial.

TABLE 6 Motor Milestones With Supporting Normative Data, Evaluation Tools, and Published Clinical Opinion References

			Source		
Motor Milestones	Age	CDC or New	Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
Holds head up when on tummy	2 mo	CDC	Accardo and Capute (30), Carruth and Skinner (61), Den Ouden et al (54)	—	Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Moves both arms and both legs	2 mo	New	—	ASQ-3 (22)	Bright Futures (36)
Opens hands briefly	2 mo	New	Accardo and Capute (30), Ertem et al (35), Lejarraga et al (41)	ASQ-3	Bright Futures (36)
Holds head steady without support when you are holding her	4 mo	CDC	Ertem et al (35), Lejarraga et al (41), Sheldrick and Perrin (38)	PEDS-DM (25)	Bright Futures (36), Gerber et al (20), Scharf et al (18)
Holds a toy when you put it in his hand	4 mo	CDC	Dosman et al (8)[d]	—	Bellman et al (42), Gerber et al (20), Scharf et al (18)
Uses her arm to swing at toys	4 mo	CDC	Bhave et al (40), Dosman et al (8), Ertem et al (43), Kumar et al (44)	—	Gerber et al (20), Scharf et al (18)
Brings hands to mouth	4 mo	CDC	Den Ouden et al (54), Ertem et al (35), Lejarraga et al (41), Sheldrick and Perrin (38)	—	Bright Futures (36), Dosman et al (8)
Pushes up onto elbows/forearms when on tummy	4 mo	CDC	Accardo and Capute (30), Lejarraga et al (41), Thalagala (39)	—	Gerber et al (20), Scharf et al (18)
Rolls from tummy to back	6 mo	CDC	Accardo and Capute (30), Den Ouden et al (54), Dosman et al (8), Ertem et al (35)	ASQ-3	Gerber et al (20), Scharf et al (18)
Pushes up with straight arms when on tummy	6 mo	CDC	Accardo and Capute (30), Carruth and Skinner (61), Thalagala (39)	—	Gerber et al (20), Scharf et al (18)
Leans on hands to support himself when sitting	6 mo	CDC	Accardo and Capute (30), Carruth and Skinner (61),	ASQ-3	Gerber et al (20), Scharf et al (18)

TABLE 6 Continued

Motor Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
			Dosman et al (8), Ertem et al (35), Kitsao-Wekulo et al (65), Lejarraga et al (41)		
Gets to a sitting position by herself	9 mo	CDC	Accardo and Capute (30), Bhave et al (40), Gajewska et al (66), Sheldrick and Perrin (38)	—	Gerber et al (20), Scharf et al (18)
Sits without support	9 mo	CDC	Accardo and Capute (30), Bhave et al (40), Cox et al (67), Dosman et al (8), Ertem et al (35), Gladstone et al (46), Lancaster et al (44), Lejarraga et al (41)	—	Bellman et al (42), Gerber et al (20), Scharf et al (18)
Uses fingers to "rake" food toward himself	9 mo	New	Accardo and Capute (30), Carruth and Skinner (61), Ertem et al (43), Gladstone et al (46), Sheldrick and Perrin (38)	ASQ-3	Bright Futures (36), Gerber et al (20), Scharf et al (18)
Moves things from 1 hand to her other hand	9 mo	CDC	Accardo and Capute (30), Carruth and Skinner (61), Cox et al (67), Den Ouden et al (54), Gladstone et al (46), Kitsao-Wekulo et al (65), Lancaster et al (45), Lejarraga et al (41), Sheldrick and Perrin (38), Thalagala (39)	ASQ-3	Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Pulls up to stand	12 mo	CDC	Accardo and Capute (30), Bhave et al (40), Den Ouden et al (54), Dosman et al (8), Ertem et al	—	Bellman et al (42), Gerber et al (20), Scharf et al (18)

TABLE 6 Continued

Motor Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
			(43), Gladstone et al (46), Lancaster et al (45), Lejarraga et al (41), World Health Organization (68)		
Walks, holding onto furniture	12 mo	CDC	Accardo and Capute (30), Ertem et al (43), Lejarraga et al (41), World Health Organization (68)	—	Bellman et al (42), Gerber et al (20), Scharf et al (18)
Drinks from a cup without a lid, as you hold it	12 mo	New	Gladstone et al (46), Lancaster et al (45)	ASQ-3, PEDS-DM	Bright Futures (36), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Picks things up between thumb and pointer finger, like small bits of food	12 mo	CDC	Ertem et al (43), Gladstone et al (46), Kumar et al (44), Lancaster et al (45), Lejarraga et al (41)	—	Bright Futures (36), Dosman et al (8), Gerber et al (20), Scharf et al (18)
Takes a few steps on his own	15 mo	CDC	Ertem et al (43), Gladstone et al (46), Noller and Ingrisano (69)	—	Bright Futures (36)
Uses fingers to feed herself some food	15 mo	New	Carruth and Skinner (61), Dosman et al (8), Kumar et al (44), Lejarraga et al (41)	—	Bright Futures (36), Gerber et al (20), Scharf et al (18)
Walks without holding onto anyone or anything	18 mo	CDC	Accardo and Capute (30), Bhave et al (40), Gladstone et al (46), Kitsao-Wekulo et al (65), Lancaster et al (45), Lejarraga et al (41), Sheldrick and Perrin (38)	ASQ-3, PEDS-DM	Bellman et al (42), Bright Futures (36), Dosman et al (8)
Scribbles	18 mo	CDC	Accardo and Capute (30), Ertem et al (43), Kitsao-Wekulo et al (65), Lancaster	ASQ-3	Bright Futures (36), Dosman et al (8), Gerber et al (20), Johnson and

TABLE 6 Continued

Motor Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
			et al (45), Lansdown et al (51), Lejarraga et al (41)		Blasco (15), Scharf et al (18)
Drinks from a cup without a lid and may spill sometimes	18 mo	CDC	Den Ouden et al (54), Ertem et al (43), Gladstone et al (46), Lancaster et al (45)	ASQ-3	Bright Futures (36), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Feeds herself with her fingers	18 mo	New	Carruth and Skinner (61), Dosman et al (8), Kumar et al (44), Lejarraga et al (41)	—	Bright Futures (36), Gerber et al (20), Scharf et al (18)
Tries to use a spoon	18 mo	New	Ertem et al (43), Gladstone et al (46)	ASQ-3	Bellman et al (42), Bright Futures (70), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Climbs on and off a couch or chair without help	18 mo	CDC	Carruth and Skinner (61), Kitsao-Wekulo et al (65), Lancaster et al (45), Lejarraga et al (41)	—	Bright Futures (36), Colson and Dworkin (16), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Kicks a ball	24 mo	CDC	Ertem et al (43), Gladstone et al (46), Lancaster et al (45), Lejarraga et al (41), Sheldrick and Perrin (38), Thalagala (39)	ASQ-3	Bellman et al (42), Bright Futures (36), Colson and Dworkin (16), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Runs	24 mo	CDC	Accardo and Capute (30), Gladstone et al (46), Sheldrick and Perrin (38)	ASQ-3	Bellman et al (42), Bright Futures (36), Colson and Dworkin (16), Dosman et al (8),

TABLE 6 Continued

Motor Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
					Gerber et al (20), Scharf et al (18)
Walks (not climbs) up a few stairs with or without help	24 mo	CDC	Bhave et al (40), Ertem et al (43), Sheldrick and Perrin (38)	ASQ-3, PEDS-DM	Bellman et al (42), Bright Futures (70), Colson and Dworkin (16), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Eats with a spoon	24 mo	CDC	Dosman et al (8), Ertem et al (43), Gladstone et al (46), Muluk et al (56)	—	Bright Futures (36), Colson and Dworkin (16), Dosman et al (8), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Uses hands to twist things, like turning doorknobs or unscrewing lids	30 mo	CDC	Lancaster et al (45)	MSEL (32)	Bright Futures (36), Johnson and Blasco (15)
Takes some clothes off by himself, like loose pants or an open jacket	30 mo	CDC	Dosman et al (8), Ertem et al (43), Gladstone et al (46)	ASQ-3, PEDS-DM	Bellman et al (42), Bright Futures (36), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Jumps off the ground with both feet	30 mo	New	Gladstone et al (46), Kitsao-Wekulo et al (65), Lejarraga et al (41), Sheldrick and Perrin (38)	ASQ-3	Bright Futures (36), Colson and Dworkin (16), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Turns book pages, 1 at a time, when you read to her	30 mo	CDC	—	MSEL	Bright Futures (36), Knobloch et al (58)
Strings items together, like large beads or macaroni	3 y	New	Gladstone et al (46)	ASQ-3	Gerber et al (20), Knobloch et al

TABLE 6 Continued

Motor Milestones	Age	CDC or New	Source		
			Normative Data[a]	Developmental Screening and Evaluation Tools[b]	Published Clinical Opinion[c]
					(58), Scharf et al (18)
Puts on some clothes by himself, like loose pants or a jacket	3 y	CDC	Dosman et al (8), Ertem et al (35)	ASQ-3, PEDS-DM	Bellman et al (42), Bright Futures (36), Gerber et al (20), Johnson and Blasco (15), Scharf et al (18)
Uses a fork	3 y	CDC	Dosman et al (8)	ASQ-3	Bellman et al (42), Bright Futures (36)
Catches a large ball most of the time	4 y	CDC	—	ASQ-3	Bright Futures (36), Gerber et al (20), Scharf et al (18)
Serves himself food or pours water, with adult supervision	4 y	CDC	—	ASQ-3	Gerber et al (20), Scharf et al (18)
Unbuttons some buttons	4 y	New	Ohtoshi et al (71)	—	Bright Futures (36), Gerber et al (20), Scharf et al (18)
Holds crayon or pencil between fingers and thumb (not in a fist)	4 y	New	Egan and Brown (63), Ertem et al (43)	ASQ-3	Bright Futures (36), Dosman et al (8), Knobloch et al (58)
Buttons some buttons	5 y	New	Ohtoshi et al (71)	ASQ-3	Bright Futures (36), Gerber et al (20), Scharf et al (18)
Hops on 1 foot	5 y	CDC	Gladstone et al (46), Kitsao-Wekulo et al (65), Nair and Russell (57)	ASQ-3	Bellman et al (42), Bright Futures (36), Gerber et al (20), Scharf et al (18)

ASQ-3, Ages & Stages Questionnaires (3rd ed); MSEL, Mullen Scales of Early Learning; PEDS-DM, Parents' Evaluation of Developmental Status With Developmental Milestones. —, Empty cells indicate that type/category of data was not available to support inclusion of that milestone.

[a]Provides baseline distribution data for age of attainment of a milestone for a given population.

[b] Some commonly used developmental screening and diagnostic evaluation tools (not all available tools are represented).

[c] Uncited, based on clinical opinion, and/or report the average or median age that a milestone should be achieved.

[d] Dosman et al[8] contained both published clinical opinion and normative data.

developmental domains is helpful; and whether cultural differences exist in surveillance milestones and processes.[1,3–5,7] Nevertheless, based on review of milestone data and clinical experience, the SMEs agreed that most typically developing children would achieve the developmental constructs represented. To our knowledge, this attempt is the first to align empirically informed milestones on parent-completed surveillance tools with objectively defined criteria agreed upon by SMEs. The CDC milestones and checklists can be used in continued efforts to improve developmental surveillance.

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ABBREVIATIONS

AAP: American Academy of Pediatrics
CDC: Centers for Disease Control and Prevention
DD: developmental delay or disability
ECP: early childhood professional
HSV: health supervision visit
SME: subject matter expert

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