Developmental Screening "Preferred Tool List" for Children Birth to Three years

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Developmental Screening "Preferred Tool List"

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Overview of Developmental and Autism Tool Selection Process

Early identification of developmental disorders in the birth-to-three population has been highlighted as a priority in the Policy Statement of July 2006 from the Council on Children with Disabilities, Section on Developmental Behavioral Pediatrics, Bright Futures Steering Committee, and Medical Home Initiatives for Children with Special Needs Project Advisory Committee (Pediatrics, Vol 118, 2006). These recommendations are integrated into the Bright Futures Guidelines for Health Supervision, Third Edition. Specifically, the guidelines recommend developmental screening at 9, 18, and 30 months (or at 24 months if the 30 month visit is not yet routine), and whenever surveillance indicates a concern. In addition, autism screening is recommended at 18 and 24 month visit.

The Vermont Child Health Improvement Program (VCHIP), in collaboration with project stakeholders, researched and developed a "preferred list" of developmental screening instruments for use in primary care drawn from the American Academy of Pediatrics (AAP) policy statement Identifying Infants and Young Children with Developmental Disorders in the Medical Home: An Algorithm for Developmental Screening and Surveillance, July 2006. The AAP policy statement included an extensive listing of available screening instruments, but neither endorsed nor discussed the specific merits or limitations of the listed instruments.

VCHIP has undertaken a more thorough review of the aforementioned list of tools in order to more thoughtfully provide concrete recommendations to primary care practitioners for developmental screening in the birth to three population.

Developmental screening instruments that sufficiently met the criteria outlined under the categories of *Instrument Purpose*, *Validity*, and *Sensitivity/Specificity* are recommended to be included on the "preferred list". It should be noted that information regarding specific instruments was not always extensively or optimally available, thus decisions to include a particular tool is based on current best knowledge. Research and updated knowledge of evidence based practice regarding developmental screening will need to be reviewed regularly and integrated into the current recommendations.

Consideration of instruments meeting the approval/recommended status was based on fulfilling the criteria below:

- Instrument purpose
  The instrument was evaluated to ensure that it focused on screening and determining the presence of delays and risk status, rather than being better suited for the purposes of *surveillance or diagnostic evaluation*. Additionally, the instrument must assess the target population within the age range recommended for universal developmental and autism screening (9, 18, 24/30 months or under three years).

- Developmental domains
  The following domains must be included in developmental screening: motor, language, cognitive, and social-emotional.

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- Validity
  Validity is an indicator of the accuracy of a test [1]. The instrument should have a validity score of approximately 0.70 or above.

- Sensitivity/Specificity
  Sensitivity and specificity are the primary means of evaluating a developmental screening instrument's capacity to correctly identify children with delays. Sensitivity refers to the proportion of children who have delays and are correctly identified as such by the test. Specificity refers to the proportion of children who are not likely to have delays and are correctly excluded from further diagnostic assessment [1]. The instrument should have sensitivity and specificity scores of minimally 0.70 or above.

Additionally, the following items are important considerations in selection of an instrument. Issues related to these items did not alone contribute to a "not recommended" status, but when combined with concerns in the previously mentioned criteria relating to sensitivity and specificity, may have resulted in an instrument ultimately not being recommended.

- Practicality
  Practicality refers to the ease of administration of the screening instrument, and the amount of time needed to administer and score the screening instrument. The instrument should typically take 20 minutes or less to administer, whether completed by a parent or clinician. Physicians and staff must be able to implement the screening tool with relative ease in a primary care setting. More complex screening tools may meet other requirements but may be recommended preferentially as a second level screen.

- Ease of use (relative to office staff/MD)
  Screening instruments are designed to be administered by persons with varying levels of expertise. Some instruments allow for the screening instrument to be administered by a paraprofessional, but review by a clinician is necessary for interpretation of results and decision making regarding disposition.

- Ease of use (relative to parent/family)
  Screening tool reflects cultural sensitivity, including availability in other languages as well as the tool ability to accurately screen children from diverse cultures.

- Cost and access to the instrument

Information on developmental screening instruments was gathered from several sources, including: review of the literature, practice guidelines developed by professional societies, administration manuals, technical documents, and information from the publisher. Developmental screening tool recommendations were reviewed from selected states (OH, MA, NM, UT, MN). Additionally, VCHIP coordinated a committee of developmental and primary care pediatricians to review and comment on this information.

Ultimately, a "preferred list" of developmental screening instruments was developed based on the information gathered.

The following table is a listing of all the tools listed in the 2006 AAP Policy statement. The tools are listed by category— e.g. general screening tools vs. more domain specific tools. Within each category, those that have a gray background are tools that are *not* being endorsed by Vermont Medicaid for the *birth-three population.* The rationales for these decisions are indicated on the chart. In general, the reasons for not endorsing a tool include: the tool not appropriate for the age group being addressed, the tool is out-dated, or the tool does not show sufficient instrument purpose, validity, and sensitivity/specificity. Tools targeting only older age groups may be appropriate for those age ranges, but were not specifically researched for ages beyond birth to three years.

 For most primary care physicians, tools that fall under the general screening category are going to be most useful and appropriate—(please see the accompanying Screening Tool Selection Algorithm.) The domain specific tools may be appropriate in certain situations and clinical environments, and the decision to use such tools should be based on individual practice needs, physician experience, population needs, etc. The use of Social-Emotional screens have not been specifically addressed in terms of when or how they should be employed, however it is anticipated that recommendations and guidelines for use of these tools will be forthcoming in the future.

Developmental Screening Tools, Birth – 3 Years

	General pop	High risk pop	Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Tool type		Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
										Parent Report	Direct Admin				
Developmental Screening Tools	X	X			Ages & Stages Questionnaire (ASQ) Third Edition (2009) www.agesandstages.com	1-66 mo	10-15 min; 1-5 minutes to score	Online access and scoring; working on EMR integration	$249 starter kit–can copy forms	X		English Spanish French (French and Korean prior edition)	4-6th grade	Technical report 3rd edition—sensitivity 0.86 overall (0.75-1.0), specificity 0.85 overall (0.70-1.0)—validated on 574 children. Revisions to 3rd edition based on analysis of 18,572 questionnaires from ASQ-2 [2]. Second edition (revised) ASQ: normative data on 2008 children, with 81% at risk. Validated on subset (247) of normative set. Overall sensitivity varies per age range, with lowest obtained in 4 mo old (0.51), otherwise average was 0.72, with range up to 0.90; specificity 0.81-0.96 (higher at higher age ranges)[3]. Testing in premature/high risk population: sensitivity 0.90; specificity 0.77 [4].	**Strengths:** • Easy to use –clear drawings and instructions for families • New version covers all ages correlating with recommended WCC ages • One of the most widely used and studied tools • Asks about specific skills, in addition to parent concerns **Limitations:** • Some studies indicate good identification of severe delay in premature infants; less sensitive with mild delay • Study comparing PEDS with ASQ indicated discordance in children identified by each screen [8]

General pop	High risk pop	Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Parent Report	Direct Admin	Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
													Rydz study of psychometric properties of 18 mo ASQ showed low sensitivity and specificity (0.67 and 0.39) in Quebec population [5] Subsequent questions raised regarding conclusions, study design and abridged tool use [6, 7]	**Comments**: • Addresses five developmental areas per age assessed – communication, gross motor, fine motor, problem solving and personal-social • Cut off scores are > 2 SD below mean in one or more developmental areas. • Further evaluation recommended for 1 or more areas below cutoff • Used by community teams – coordination and avoidance of duplication needs to be addressed
X	X	X		Battelle Developmental Inventory: 2nd Edition (BDI-II) - Screening Test (2006) www.riverpub.com	Birth-8yrs	10-30 min	Scoring software	$311 add'l forms 52¢ each	X	X	English Spanish	NA	Full BDI-2nd editions – Normative data from 2500 children, demographic information matched 2000 US Census data; additional bias reviews performed to adjust for gender and ethnicity concerns; sensitivity: 0.72–0.93 ; specificity:0.79–88. BDIST consists of a subset of items from the full BDI Manual - [9] Other studies—BDIST validated on 104 children 7-86 mo, moderate sensitivity 0.75 and specificity 0.73 [10])	**Strengths:** • Well standardized • 2nd edition normalized tables cover smaller age ranges **Limitations:** • Higher level of skill needed in assessment • Can be challenging to administer • 4-6 hours of training required • Screening inventory over or under referred children who were close to the limits in age bracket • Few items per domain per age bracket

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															Comments: • Yields cutoff scores(1.0, 1.5 and 2.0 below mean) • Cutoff scores of 1.5 below mean provide best sensitivity and specificity. • Domains addressed included adaptive, personal-social, communication, motor and cognitive. • Screening test consist of subtest item from full inventory. BDIST norms and reliability derived from BDI. Scoring is similar. • May not be practical for most primary care physicians unless strong interest/training in developmental assessment • Would not be our first recommendation for an expanded developmental screener
				X	Bayley Infant Neurodevelopmental Screener (BINS) (1995)	3-24 mo	10-15 min				X	English Spanish		Manual: tested on nonclinical sample of 600 children representative of 1988 census. Sensitivity 0.75 and specificity 0.86 across ages [11] Normative data from ~1700 children, stratified on age, to match the 2000 US Census; sensitivity: 75–86%; specificity:0.75–0.86 Subsequent study found sensitivity 0.70 and specificity 0.71 in premature population at ages 12-24 months. [12]	**Comments**: • Outdated version. Update to Bayley Scales of Infant and toddler Development—III, Screener • Scoring: low, moderate, high risk by cut scores in each of 3 domains tested

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X	X	X		Bayley Scales of Infant and Toddler Development: 3rd Edition (Bayley-III) Screener (2005) www.pearsonassessments.com	1-42 mo	15-25 min	Scoring software ($208)	$209, add'l forms 60¢ each		X	English	NA	Updated from Bayley Infant Neurodevelopmental Screener Extensive validity, sensitivity and specificity studies. Specificity 0.77-1.0, Sensitivity and validity with varying correlations.	**Strengths:** • Tested in high risk populations **Limitations:** • Developmental background skills helpful • Training required **Comments:** • Screens cognitive, fine motor, gross motor, receptive and expressive communication with cut scores relating to category of risk (competent, emerging, at risk) • May not be practical for most primary care physicians unless strong interest/training in developmental assessment
X	X	X		Brigance Early Childhood Screens (2005) www.curriculumassociates.com	0-90 mo	10-15 min; 5 min to score	Online scoring and aggregate results	$279 + forms 98¢ each		X	English Spanish	NA	Manual: Full tool standardized on 1156 children from 29 clinical sites in 21 states. Overall Sensitivity: 0.82 ; specificity: 0.75 (range 0.72-1.0 across various ages) [13] Study of Brigance Infant & Toddler screens in 0-24 month olds, with validity data on	**Strengths:** • 0-2 year old can be done as all parent report • Website has training materials **Limitations:** • Developmental background skills helpful • Training required

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														408 children, found sensitivity 0.76-0.77, specificity 0.85 - 0.86 [14].	**Comments**: • 9 forms for each 12 month age range • Covers language, motor, cognitive, readiness skills, plus math/reading at older ages • Scores with overall cutoff, quotients, percentiles, and age equivalents • Separate cutoff for children with psychosocial risk who have recently entered EI programs (to avoid over referral) • Screener items taken from larger Brigance Inventory of Early Development • May not be practical for most primary care physicians unless strong interest/training in developmental assessment
				X	Child Development Inventory (1992) www.childdevrev.com Broken into Child Development Inventories (plural)— Infant Developmental Inventory (IDI) and Child Development Review (CDR) below	15 mo – 6yrs	30-50 min	None	$150 starter kit -- manual, answer forms, scoring template	X		English Spanish	7-8th grade	Normative sample included 568 children from south Saint Paul, MN [15]. In validity testing, CDI compared to BSID-II in a high-risk follow-up program of 63 toddlers (only 43 completed surveys). Sensitivity: 0.80; specificity: 0.96 for detecting delays [16].	**Strengths:** • May be more suitable for assessment versus screening **Limitations:** • Relatively high reading level required • Long administration time **Comments**: • Original tool with 300 items—very long • Measured 8 developmental domains with yes/no questions • Borderline or delayed based on scores falling 1.5 and 2.0 SD below chronologic age (25% and 30% respectively).

	General pop	High risk pop	Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Parent Report	Direct Admin	Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
	X	X			Infant Development Inventory (IDI) (1998) www.childdevrev.com	1 mo-18 mo	5-10 min	Online form and scoring	Forms 56¢ each	X		English		Studied in 86 high-risk 8-mo-olds seen in a perinatal follow-up program and compared with the Bayley scales; sensitivity: 0.85 specificity: 0.77 [17]. IDI compared to other test in 202, 8 month olds, including 48 low birth weight infants. IDI most strongly related to full Bayley test. Sensitivity 0.90 and specificity 0.93 [18]	**Strengths:** • Easy to use Developmental chart similar to Denver – "visual chart" of milestones for age **Limitations:** • Tool appropriate up to age 18 months only **Comments:** • Five domains scored as delayed if >30% below chronological age, or borderline if 25-30% below chronological age
				X	Child Development Review Parent Questionnaire (CDR-PQ) 1990	18 mo to kindergarten	12-20 min	Online form and scoring	Manual $ 40, forms 56¢ each	X		English Spanish	6th grade	Manual: CDR Standardized with 220 children aged 3-4 y; Sensitivity 0.68 and specificity 0.88 [15]	**Strengths:** • Easy to use Follows the IDI for toddlers/preschool age assessment **Limitations:** • Limited data on this tool did not find sufficient information or data meeting psychometric criteria • May not be as discriminating at older ages.

	General pop	High risk pop	Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Tool type Parent Report	Tool type Direct Admin	Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
															Comments: • Questionnaire has: 6 questions regarding parental concerns, description of child; 26 item problem checklist; and a child developmental chart covering social, self-help, gross motor, fine motor and language • Question and Problem checklist classified into "no problem" to "possible problem" to "possible major problem"; developmental chart normed by age as typical, borderline or delayed. • More data may support use of tool in future • Use is primarily in Minnesota (origin of tool)
				X	Denver-II Developmental Screening Test (1992) Initial Denver Developmental screening test introduced 1967 www.denveriionline.com	0-6 yrs	20 min	Online option with ability to import pdf reports into EMR. $49.99 per month (unlimited use)	$111; add'l forms 32¢ each	X 30%	X 70%			Denver II revised/normalized on 2096 children from Colorado aged 2-36 months—neither version published with validity data/sensitivity/specificity. Evidence of delay based on children falling outside of normal range. Revised screener incorporated increased language items (major deficit in first Denver) [19]. Other studies with Denver II: 104 children—sensitivity 0.83 and specificity 0.43. Attempts to score so that	**Strengths:** • Most commonly used tool and one most doctors are familiar with/ trained to use **Limitations:** • Low sensitivity or specificity depending on scoring method • Based on normative data (kids are identified by falling outside of normal) • Frequently used inappropriately, compromising validity

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													specificity increased to 0.80, led to unacceptable drop in sensitivity to 0.56 [20].	**Comments**: • The Denver prescreening questionnaire excerpted from DDST- same limitations and concerns • Original Denver missed up to 50% of children with MR, and 70% with language delay, multiple studies identified unacceptably low sensitivity. [21] • Tool revised but with persistent limitations. • Recognized in many states as inadequate tool and clear trend toward disuse.
X				Parents' Evaluation of Developmental Status (PEDS) (1997) www.pedstest.com	1 mo - 8 yrs	2-10 min	Online option, integrate to EMR; Includes MCHAT; $1-2 per use	$36, add'l forms 36¢ each	X		Multiple languages	4-5th grade	Standardized and validated with 771 children from diverse ethnic and socioeconomic backgrounds, including Spanish speaking; sensitivity: 0.74–0.79; specificity: 0.70–0.80 across all ages [22]. Evaluation of very preterm population (<1250gm BW) indicated at 2 years sensitivity 0.38-0.39 and specificity 0.84-0.85 [23]. Multiple studies indicate parent report of concerns can accurately predict developmental status, [22]	**Strengths:** • Easy to use and short • Strength may be as a surveillance tool **Limitations:** • Not best tool for high risk population • Secondary screener recommended if positive area of concern identified (or referral) • May not always be possible to use second level screener – creating risk for under or over referral. **Comments**: • 2 open ended & 8 yes/no questions • Scoring stratifies risk: low, medium, high • High risk requires referral for evaluation (70% found to have significant delays), medium risk requires further screening (30% have delays) [24]

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	X				PEDS: Developmental Milestones (2006) www.pedstest.com	0 -8 yrs	3-10 minutes	Online version coming soon	$275, add'l forms 32¢ each	X	X	English Spanish	< 2nd grade	Standardized on 1296 children. Sensitivity and specificity between 0.70 and 0.97 across ages; sensitivity 0.75-0.80 and specificity 0.71-0.88 across developmental domains [25]. Data from developmental testing of 1619 children mined for items best predicting performance in developmental domains. Sensitivity 0.83 and specificity 0.84 for performance <16th percentile [26].	**Strengths:** • Longitudinal scoring, can be followed over time **Limitations:** • Test materials seem somewhat cumbersome • Subject to misinterpretation with "sometime" response option **Comments:** • Intended for use in conjunction with PEDS to optimize screening • 6-8 items per visit • Performance > 16th percentile =pass
Autism Screening Tools				X	Checklist for Autism in Toddlers (CHAT) (CHAT 23)—combo of MCHAT and CHAT items—increased sensitivity and specificity, slightly longer to give, combo of report/direct	18- 24 mo	5 min		Free	X	X	English		Original standardization sample included 41 siblings of children with autism and 50 controls 18 months of age in Great Britain [27]; 6 year follow-up study on 16,235 children validated using ADI-R and ICD-10 criteria resulted in low sensitivity, high specificity; sensitivity: 0.38–0.65 specificity: 0.98–1.0 [28]	**Strengths:** • Easy to administer **Limitations:** • Low sensitivity in population-based sample • Better distinguishes *Autism versus Autism Spectrum Disorder* • No reason not to update use to MCHAT **Comments:** • ~14 items – 9 questions/parent report and 5 direct observation by clinician • Designed for use at 18 months

General pop	High risk pop	Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Parent Report	Direct Admin	Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
X	X			Modified Checklist for Autism in Toddlers (MCHAT)(1999) http://www.firstsigns.org/ screening/tools/rec.htm#asd_screens	16-30 mo	5-10 min	Forms available online	Free	X		English Spanish Turkish Chinese Japanese		Standardization sample included 1293 children screened, 58 evaluated, and 39 diagnosed with an autistic spectrum disorder; validated using ADI-R, ADOS-G, CARS, DSM-IV; sensitivity: 0.85–0.87 ; specificity: 0.93–0.99. [29]. Other studies at 27 months: sensitivity 0.95-0.99; specificity 0.95-0.99 [30]	**Strengths:** • Easy to use • Most frequently used autism screener • Intended to expand the CHAT to identify a greater range of children with ASD/PDD **Limitations:** • Over identifies children with language and developmental delays • Improved specificity with use of follow up questionnaire **Comments**: • 23 yes/no test items , 6 critical items • Refer for evaluation if two critical or three noncritical items are positive • Intended for evaluation at 18 and 24 months
		X	X	Pervasive Developmental Disorders Screening Test-II (PDDST-II), Stage 1 Primary care screener(2001)	12-48 mo	10-15 min; 5 min score	None	$155 + forms @ 63¢ each	X		English		Validated using extensive multi-method diagnostic evaluations on 681 children at risk of autistic spectrum disorders and 256 children with mild-to-moderate other developmental disorders; no sensitivity/specificity data reported for screening of an unselected sample; sensitivity: 0.85-0.92; specificity: 0.71–0.91 [31]	**Limitations:** • Not many studies comparing to other tools • Validated on children at risk, not in general population **Comments**: • 22 questions – 9 questions regarding behaviors emerging between 12-18 months, 14 questions between 18-24 months. Answered as "yes-usually true" or "no-usually not true"

		Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Tool type		Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
General pop	High risk pop								Parent Report	Direct Admin				
		X	X	Screening Tool for Autism in Two-Year-Olds (STAT) http://kc.vanderbilt.edu/triad/training/page.aspx?id+821	24-35 mo	20 min	None	$520 + forms @ $1 each		X	English		Two samples were used: for development of scoring algorithm, 7 children with autism, 33 with non autistic developmental disorders; for validation sample, 12 children with autism, 21 with non autistic developmental disorders. Validated using CARS, ADOS-G, and DSM-IV criteria. This is a second-level screen requiring training before administration; sensitivity: 0.83-0.92; specificity: 0. 85–0.86 [32]. Some potential utility in young children (14-23 months) referred because of concerns or sibling with ASD. Sensitivity 0.95 and specificity 0.73 [33].	**Limitations:** • Training required • Experience with autism important • Designed for 24-36 months • Designed to detect autism & not broad spectrum diagnosis/PDD [34] **Comments**: • An evaluation or level 2 tool, not a screener
			X	Social Communication Questionnaire (SCQ) formally ASQ (2003)	> 4 years	5-10 min	Unlimited Scoring CD ($456.56)	$105 + forms @$1.60 each	X		English		Validated using the ADI-R and DSM-IV on 200 subjects (160 with pervasive developmental disorder, 40 without pervasive developmental disorder). ; Manual: Sensitivity: 0.85 ; specificity: 0.75 [35] Lower sensitivity in younger ages and poorer specificity across ages at given cutoff score - suggested adjusting cutoff scores according to age and purpose [36].	**Strengths:** • Easy to use • Based on ADI assessment tool **Limitations:** • Awareness of tool properties and limitations very important **Comments**: • Helpful tool but not designed for use in the <4 year-old population. • Available in 2 forms: lifetime and current. • 40 yes/no answers, cut off of ≥15 for autism spectrum disorder • Indicated for children with age >4 and mental age >2 ½ years.

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Social Emotional Screening Tools	X	X	X		Ages & Stages Questionnaires: Social-Emotional (ASQ:SE) (2002) www.agesandstages.com	6-60 mo	10-15 min	Online access and scoring.	$194.95, can copy forms	X		English Spanish		Investigated with over 3,000 children across the age intervals and their families. Reliability is 94%; validity is between 75 and 89 %. Sensitivity 0.71-0.85, specificity 0.90-0.98 (ASQ Technical Report, [37])	**Strengths:** • Easy to use/understand • Follows format of the ASQ • Simply worded and appropriate for families of diverse backgrounds. **Comments:** • 30 items for each of 8 visits between 6-60 months. Items focus on self-regulation, compliance, communication, adaptive functioning, autonomy, affect, and interaction with people • Single cut-off score indicating need for referral • Designed to supplement the ASQ
		X	X		Child Behavior Checklist (CBCL) Achenbach System (rev 2000) http://www.aseba.org/	1.5-5 years		Assessment data manager, module, online manual ($255); Web based module avail Jan 2010	$160 + forms	X		Multiple languages, multi-cultural reporting feature	5th grade	Extensive study and use in multiple countries [38]	**Strengths:** • Extensive use and reporting • Multi-informant with comparative reporting **Limitations:** • Lengthy for parents to complete • Training required for interpretation

General pop	High risk pop	Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Parent Report	Direct Admin	Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
														Comments: • 100 questions and additional open ended questions divided into internalizing and externalizing problems with further breakdown into specific problem areas including emotionally reactive, anxious/depressed, somatic complaints, withdrawn, attention problems, aggressive behavior, and sleep problems. Also DSM oriented scales corresponding with DSM diagnostic categories of affective problems, anxiety, PDD, ADHD and ODD • No "gold standard" for assessing SE and behavioral disorders in young children. Tool intended to be a way to gather information from multiple sources and then integrated with other data as part of a comprehensive assessment. • Strong interest for widespread use in VT, pilot study in Burlington practice testing at 18 months and 4 years
			X	Pediatric Symptom Checklist	4-18 years		Checklist available online	Free download	X					**Limitations:** • Outside 0-3 age range
			x	Cognitive Adaptive Test/Clinical Linguistic	1-36 mo	10-20 min	Electronic format available	$375 (includes manual,		X	English Spanish Russian		Standardized on 1055 North American children aged 2–36 months; correlations high with Bayley Scales of Infant	**Strengths:** • Widely tested with many studies • Easy to administer

				Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Tool type		Language Available	Reading Level	Psychometric Properties	Strengths
General pop	High risk pop	Second level	NOT recommended						Parent Report	Direct Admin				Limitations
														Comments
				Auditory Milestone Scale [CAT/CLAMS] also known as Capute Scales (2005) http://brookespublishing.com/store/books/accardo-8167/excerpt.htm				scoring sheets, and kit)					Development. Sensitivity: 0.21–0.67 in low-risk population and 0.05–0.88 in high-risk populations; specificity: 0.95–1.00 in low-risk population and 0.82–0.98 in high-risk populations. In 328 normal children tested at 18 and 30 months, compared to Bayley; Sensitivity 0.21-67; specificity 0.95-1.0of respective ages. [39] In 61 infants and toddlers with suspected delay, compared with Bayle; Sensitivity 0.88 and specificity 0.67 for BSID <70 [40] In 12 and 18 month preterm (<31weeks) sensitivity 0.64-0.88, specificity 0.97-0.98 respectively [41] In 78 high risk or premature 6-26 month olds, cut off issue identified with poor sensitivity (0.36), but good specificity 0.95-0.98 [12] In 68 children(14-48 months) with suspected delays, high correlation with Bayley, sensitivity 0.95and specificity 0.84 [42]	**Limitations:** • Training required • Seems to be more predictive in higher risk populations & slightly older toddlers/children [43] • Issues with cutoff scores and use for primary screening [12]. **Comments**: • 100 item scale, averaging of 5 items per age level that can address global developmental delay, or dividing into tests of expressive and receptive language and visual motor functioning • Generally found to correlate with Bayley but rated ~10% higher than corresponding score, which diminished sensitivity • Issues relating to variability in age groups, population and risk makes this not desirable for primary care screening • Consists of 2 parts – CAT: visual/motor problem solving tasks and CLAMS: receptive/expressive language skills.

General pop	High risk pop	Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Parent Report	Direct Admin	Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
x	x	x		Communication and Symbolic Behavior Scale-Developmental Profile (CSBS-DP):Infant Toddler Checklist http://www.brookespublishing.com/store/books/wetherby-csbsdp/index.htm	6-24 mo	5-10 min	Easy score CD-ROM available.	Free infant checklist $399 for full tool	X		English, Spanish, Slovenian, Chinese, German		Checklist standardized on 2188 North American children aged 6-24 months; sensitivity: 0.76–0.88 in low- and at-risk children at 2 years of age; specificity: 0.82–0.87 in low-and at-risk children at 2 years of age [44]. Checklist compared to standardized testing in 232 children 12-24 months (half with language delay and half normal development): Sensitivity 0.87 and specificity 0.75 using 1.25 SD or 10th percentile below mean as criterion for risk [45]	**Strengths:** • Addresses social communication & language issues in children <24 mo. • Sensitive to communication delays and identifying children with ASD plus communication delay [46] **Comments**: • Infant checklist is one of three parts to the CBSB (Caregiver questionnaire and behavior sample are the remaining two elements of full scale.) • Checklist used alone as screener to determine if more complete evaluation needed • Intended as a first level screener for a broad array of communication delays. • 24 questions with three composite areas—social, speech, symbolic communication with scores identified as of concern/no concern (correlates with <1.25 SD below mean or 10th percentile)
x	x	x		Early Language Milestone Scale (ELM Scale-2) http://www.proedinc.com/customer/ProductLists.aspx?SearchWord=ELM	0-36 mo	1-10 min	no	$180 for initial kit, Forms @ 62¢ each		X			Small cross-sectional standardization sample of 191 children; 235 children for speech intelligibility item; sensitivity: 0.97 and specificity 0.93 in high-risk population. Sensitivity: 0.83–1.0 in low-risk and high-risk populations, specificity: 0.68–1.0 in low-risk and high-risk populations [47]. 657 children 0-36 months, compared to Sequenced Inventory of Communication	**Strengths:** • Fairly easy to administer • Format and form similar to Denver **Limitations:** • Small group of children (191) used to establish norms. Not necessarily representative of general population.

General pop	High risk pop	Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Parent Report	Direct Admin	Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
													Development. Poor correlation under 12 months. 13-24 month ELM correctly captured 0.79 and 0.89 of 25-36 month olds. Poorer results in younger age may have related to scoring format of SCID [48].	**Comments:** • The ELM Scale-2 consists of 3 items arranged in three divisions: Auditory Expressive, Auditory Receptive and Visual • Cut point is at age where 90% pass a language milestone • The ELM Scale-2 may be administered using either a pass/fail or a point scoring method. The pass/fail method yields a global "pass" or "fail" rating for the test as a whole, whereas the point scoring method yields percentiles values, standard score equivalents and age equivalents for each area of language function as well as a Global language score
x	x	x		Language Development Survey (LDS) http://www.aseba.org/	18-35 mo	10 minutes		$65	X		English, French, Italian, Romanian, Dutch, Turkish, Greek, Portuguese	5th grade	24-38 months: Sensitivity 0.53-0.89 and Specificity 0.86-1.00. Greater sensitivity with more inclusive delay criteria [49]. 18-30 months: Sensitivity 0.67-1.00; Specificity 0.90-1.00 [50] 306 infants (24-29 months) screened by mailed questionnaire with a sample of 64 undergoing clinical evaluation: Sensitivity 0.91; specificity 0.87 [51] 24-29 month olds further screened with additional questions relating to parental concern and history of chronic OM: Sensitivity 0.91; specificity 0.96 [52]	**Comments:** • Part of the Achenbach System of Empirically Based Assessment (ASEBA) inventory of tools for 1 ½ to 5 year olds • 310 words arranged in 14 semantic categories. Parent circles words child uses spontaneously, notes word combos and best phrases. • Gender specific norms provided for 3 age ranges • Scores below 15th percentile suggest delay.

	General pop	High risk pop	Second level	NOT recommended	Screening Tool Name Publisher Website	Age Range	Administration Time	Electronic Format	Cost to Practice	Parent Report	Direct Admin	Language Available	Reading Level	Psychometric Properties	Strengths / Limitations / Comments
Motor Screening Tools		x	x		Alberta Infant Motor Scale (AIMS) (1994) http://www.us.elsevierhealth.com/ product.jsp?isbn=9780721647210	0-18 mo	20-30 min		$39.95		X			Standardized on 2022 infants of Alberta, Canada for ages 1 week to 18 months 164 infants at 4 and 8 months for predication of neurologic outcome at 18 months. At 4 months (using 10th percentile as cutoff): Sensitivity 0.73 and specificity 0.80. At 8 months (using 5th percentile as cutoff): Sensitivity 0.80 and specificity 0.94 [53] 506 (0-18 mo) infants participated in reliability and validity testing. Construct validity determined by comparing 70 children at risk or with known motor delays against established norms. Concurrent validity determined by comparing 103 typically developing infants to 68 infants at risk or with known motor delays with PDMS and Bayley [54]	**Strengths:** • High risk infants • Easy to use • Predictive of developmental disability at 9 months • May increase surveillance skills indirectly • Delays in motor development often the first sign easily detectable in global developmental delay **Limitations:** • Not as discriminating after about 9 months or weight bearing well-achieved [55] • Some training required • Tested on Canadian children. Not necessarily valid for other cultures, Dutch norms significantly different [56] • Preterm infants shown to have different gross motor developmental trajectories which may vary from stated norms [57] **Comments:** • Developed for use by PT/OT to identify motor delay • 58 item observational assessment of motor performance in 4 positions: prone, supine, sitting and standing.

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Screening Tool Selection Algorithm

The following schematic/algorithm is intended to provide general guidance to a clinician for the process of selecting an appropriate developmental screening tool for use in young children. This algorithm most specifically addresses the array of tools focusing on structured developmental screening, but also recognizes the recommendations for surveillance at every well child visit as well as autism screening at specific ages (18 and 24 months). The *Bright Futures* toolkit also provides support and suggestions for surveillance.

At this point in time, the recommended screening tool for autism is the MCHAT. New tools are under development and future recommendations are likely to change as options for autism screening increase.

The selection of appropriate developmental screening tools requires a thoughtful appraisal of the intended purpose of screening, the patient population being served, the skills and interest of the clinician, and the interface with the office "system". The pathway most relevant is thus on the left of the algorithm in the "white" (unshaded) area under "general screening". For the vast majority of practices/clinicians, the tool of choice is one appropriate for general screening and addresses the level of risk within the population. Developmental risk factors are listed in a box at the side, and presence of these factors should lead to use of a tool more appropriate for a "general/high risk population".
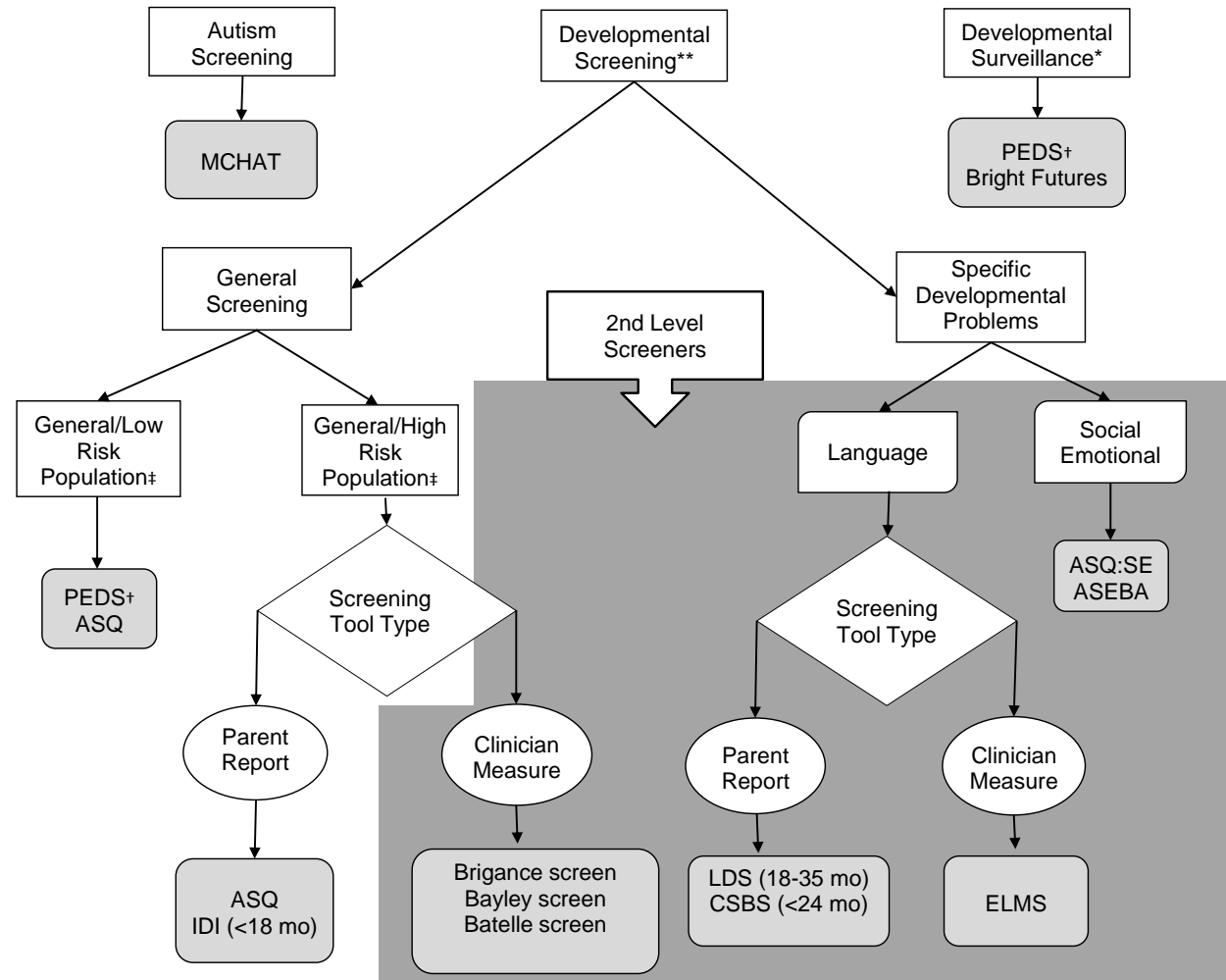
For screening a general population inclusive of children at higher risk for developmental delays, the choice to be made is between parent report tools versus clinician administered instruments. Parent report tools have shown excellent validity compared to physician/clinician administered tools and are generally easier to administer and incorporate into an office system compared to the more time-consuming clinician administered tools (which also often require some additional training).

The dark gray box highlights "second level screeners" and options for tools that *may be of interest* to clinicians with greater interest/experience in developmental assessments, or that address specific developmental areas in more detail. Tools from this latter group may be useful in further pursuing concerns identified on more general screening tools (such as the PEDS). Social emotional screens are currently listed as second level screening tools, although future recommendations are likely to endorse concrete guidelines for targeted social-emotional screening.

Screening Tool Selection Algorithm for Children: Birth - Three years

‡Developmental Risk Factors
Prematurity
Prenatal Exposure to Drugs/ETOH/Tob
Feeding/Growth Problem/Disorders
Lead/Toxin Exposure
Low Birth Weight
Genetic Disorder
Chronic Illness
Poverty
Foster Care
International Adoption
Parental depression or mental illness
Parental Substance Use
Family hx of Developmental Problems
or Disorders
Infrequent well child care
Single Parent/Multiple Care Givers
Teen Parent

Abbreviations
ASEBA: Achenbach System of
Empirically based Assessment
ASQ: Ages & Stages Questionnaire
CSBS: Communication and Symbolic
Behavior Scale Developmental
Profile
ELMS: Early Language Milestone Scale
IDI: Infant Development Inventory
LDS: Language Development Survey -
component of Achenbach Sytem
MCHAT: Modified Checklist of Autism
in Toddlers
PEDS: Parents' Evaluation of
Developmental Status

Autism Screening → MCHAT

Developmental Screening** → General Screening / Specific Developmental Problems

Developmental Surveillance* → PEDS† Bright Futures

General Screening → General/Low Risk Population‡ / General/High Risk Population‡

2nd Level Screeners

General/Low Risk Population‡ → PEDS† ASQ

General/High Risk Population‡ → Screening Tool Type → Parent Report → ASQ IDI (<18 mo)
Screening Tool Type → Clinician Measure → Brigance screen / Bayley screen / Batelle screen

Specific Developmental Problems → Language / Social Emotional

Language → Screening Tool Type → Parent Report → LDS (18-35 mo) CSBS (<24 mo)
Screening Tool Type → Clinician Measure → ELMS

Social Emotional → ASQ:SE ASEBA

Footnotes:
† If PEDS shows concern *consider*: Screen with ASQ or ASQ:SE or other second level screen.
*Developmental Surveillance: The ongoing, longitudinal, cumulative process, of recognizing children who may be at risk for developmental delays.
**Developmental Screening: Use of brief standardized tool at regular intervals to identify and refine a child's risk of developmental delay. Enhances the process of surveillance.