Use of a Digital Modified Checklist for Autism in Toddlers – Revised with Follow-up to Improve Quality of Screening for Autism

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Objectives To assess changes in quality of care for children at risk for autism spectrum disorders (ASD) due to process improvement and implementation of a digital screening form.

Study design The process of screening for ASD was studied in an academic primary care pediatrics clinic before and after implementation of a digital version of the Modified Checklist for Autism in Toddlers – Revised with Follow-up with automated risk assessment. Quality metrics included accuracy of documentation of screening results and appropriate action for positive screens (secondary screening or referral). Participating physicians completed pre- and postintervention surveys to measure changes in attitudes toward feasibility and value of screening for ASD. Evidence of change was evaluated with statistical process control charts and χ^2 tests.

Results Accurate documentation in the electronic health record of screening results increased from 54% to 92% (38% increase, 95% CI 14%-64%) and appropriate action for children screening positive increased from 25% to 85% (60% increase, 95% CI 35%-85%). A total of 90% of participating physicians agreed that the transition to a digital screening form improved their clinical assessment of autism risk.

Conclusions Implementation of a tablet-based digital version of the Modified Checklist for Autism in Toddlers – Revised with Follow-up led to improved quality of care for children at risk for ASD and increased acceptability of screening for ASD. Continued efforts towards improving the process of screening for ASD could facilitate rapid, early diagnosis of ASD and advance the accuracy of studies of the impact of screening. *(J Pediatr 2017;183:133-9).*

Since the American Academy of Pediatrics first advocated universal screening for autism spectrum disorders (ASD) in 2007, the most widely used screening questionnaire has been the Modified Checklist for Autism in Toddlers (M-CHAT). The original M-CHAT was a 1-page questionnaire that asked about social and language behaviors such as pointing and response to name. It was administered easily in pediatric offices, but the cut-off score for a positive screen was chosen to optimize sensitivity at the expense of lower specificity, resulting in a high false-positive rate.[1] To improve specificity, the Modified Checklist for Autism in Toddlers – Revised with Follow-up (M-CHAT-R/F) was developed, which includes a set of follow-up questions for failed questions.[2] The follow-up questions consist of a flowchart of clarifying questions for each item failed, asking about aspects such as frequency and context of behaviors. Although it takes as long as 30 minutes for the physician to interview parents using the follow-up questions, they are critical to clarify parental concerns and improve the screen's positive predictive value. When implemented appropriately, children who fail the M-CHAT-R/F have an estimated 47.5%-54% risk of being diagnosed with ASD and a 94.6%-98% risk of any kind of clinically relevant developmental delay.[2,3] Therefore, children who screen positive on the M-CHAT-R/F should be referred for further evaluation by early intervention services or specialists in child development (psychologists or developmental pediatricians).

Screening with the M-CHAT-R/F allows physicians to identify children at risk for ASD earlier and more accurately than developmental surveillance alone. One study of developmental screening showed pediatricians relying on clinical judgment alone missed 50% of children who went on to receive a diagnosis of ASD.[4] In another

ASD	Autism spectrum disorders
EHR	Electronic health record
M-CHAT	Modified Checklist for Autism in Toddlers
M-CHAT-R	Modified Checklist for Autism in Toddlers – Revised
M-CHAT-R/F	Modified Checklist for Autism in Toddlers – Revised with Follow-up
PDSA	Plan Do Study Act
WECO	Western Electric Company

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study, experts on ASD missed 39% of children with ASD in assessments made from viewing tapes of 10-minute segments of child behavior during an ASD testing session.[5] Such errors can translate into delays in diagnosis and services. In one large study of children with ASD, mean lag time between first parental concern and diagnosis of ASD was 2.7 years, and proactive physician response to parent concerns was associated with a 1-year reduction in lag time.[6] Studies showing the impact of early treatment for children with ASD have led to agreement that innovation in early screening and referral practices is of high importance.[7-9] For universal screening for ASD to be feasible, however, process improvement is needed to make an acceptable and high-quality screening process.

Although the M-CHAT-R/F allows for early identification of children at risk for ASD who would otherwise be missed, its administration has proven challenging. The follow-up interview questions can take considerable time, and in the validation study this step was performed by research assistants rather than members of the clinical practices.[2] Secondary screening is not performed easily in the limited time available to a physician, nor do many pediatric offices have available staff to whom this important aspect of screening can be delegated. The extent to which pediatric practices in the US using the Modified Checklist for Autism in Toddlers – Revised (M-CHAT-R) actually use the follow-up questions as intended is not known. In our community, feedback from local physicians and preliminary records review suggest that many physicians skip this important step due to time constraints or insufficient awareness of the importance of the follow-up questions. Additional challenges in the screening process include mis-scoring of paper questionnaires, lack of awareness of the importance of screening, and a dearth of autism-specific resources for children who have screened positive for ASD.[7,10] These hindrances prevent accurate estimation of the impact of screening and impede appropriate and timely care for children with ASD.

Digital screening potentially offers an answer to the logistical challenges of administering the M-CHAT-R/F. Studies seeking to improve the ASD-screening process have shown that introduction of digital smartform technology and electronic decision support can significantly impact autism-specific and general developmental screening.[10-13] Therefore, we designed a quality improvement study to address the following questions: (1) Can digital smartform technology be used effectively to implement the M-CHAT-R/F secondary follow-up questions in routine care? (2) Does use of this technology increase the fidelity of implementation, accurate documentation, and appropriate action? (3) Does use of this technology increase the acceptability of ASD screening to physicians in a primary care practice? We monitored quality metrics prospectively during a baseline period and then during implementation of the intervention, as well as measures of feasibility and acceptability of the new screening process.

Methods

According to preliminary record review in 2014, 99% of children presenting for 18 and 24 months' well child visits at all Duke Children's Primary Care clinics were screened for ASD with the M-CHAT. Feedback from pediatricians and chart review, however, revealed that there was minimal use of the follow-up questions; most pediatricians were using clinical judgment to decide whether to take action on a positive screen, which can result in over- as well as under-referrals. We selected one clinic that agreed to undertake a quality improvement project and sought to quantify improvement in care. The selected clinic is staffed by approximately 20 resident and attending pediatricians who screen nearly 100 children for ASD each month. Demographic information on the children in our target population during the study period is presented in **Table I**. When we began planning, Duke Children's Primary Care clinics had converted to the latest version of the M-CHAT (M-CHAT-R), and the physicians were being instructed to use the follow-up interview to limit false-positive results. Many physicians did not use the follow-up questions, however, presumably because of the increased time required for implementation during routine care. Therefore, we decided to measure the impact of the intervention not only on quality metrics but also on physician-perceived feasibility and acceptability.

Table I. Demographics of children presenting for target visits in the study periods

Characteristics	Baseline period, n = 657	Intervention, n = 534	*P*
Males	321 (49%)	275 (51%)	.40
Mean age, mo (SD)	21.89 (3.38)	21.88 (3.46)	.93
Race/ethnicity			.02*
White/not Hispanic or Latino	271 (41%)	230 (43%)	
White/Hispanic or Latino	45 (7%)	26 (5%)	
African American	202 (31%)	136 (25%)	
Asian	47 (7%)	35 (7%)	
Multiracial	17 (3%)	26 (5%)	
Other†	75 (11%)	81 (15%)	

Values are n (%) unless otherwise specified.
*$P < .05$.
†Other includes American Indian, Hawaiian/Pacific Islander, and declined to state.

Planning

In September of 2014, the study team met with clinic staff to inquire about current screening practices and solicit feedback on necessary features and desired areas for improvement at the clinic. Staff requested the following process modifications: integration of follow-up questions, automatic scoring with decision support for referral action, integration of a Spanish translation, and electronic importation of results into the electronic health record (EHR). The study team immediately implemented the requested electronic decision support in physician notes to raise awareness of screening guidelines and to control for potential confounding from this facet of screening practices. All discussed features were incorporated in the intervention period except integration with the EHR, which was not possible at the time. Data on planned study measures were collected prospectively for the next 7 months, which provided a baseline period before the digital smartform intervention was implemented.

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