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# The RITA-T (Rapid Interactive Screening Test for Autism in Toddlers) Community Model to Improve Access and Early Identification of Autism in Young Children

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## Abstract

**Objective:** To evaluate improved identification and the generalization of the RITA-T (Rapid interactive Screening Test for Autism in Toddlers) model through partnerships with Primary Care (PC), Early Intervention (EI), and Autism Diagnosticians. **Methods:** Over 3 years (2018-2021), 15 EI and 9 PC (MD and NP) centers participated in this project. We trained providers on the RITA-T and established screening models. We reviewed charts of all toddlers referred through this model and compared wait times, and diagnoses, to those evaluated through regular referral in a tertiary-based autism clinic. We also examined the RITA-T psychometrics. **Results:** 377 toddlers met our inclusion criteria. Wait time for diagnosis was an average of 2.8 months and led to further collaboration between community providers. RITA-T cut-off scores stayed consistent. Providers reported improved confidence and easy integration of this model. **Conclusions:** This model is generalizable and improves the Early Identification of ASD.

## Keywords

autism, children, developmental delay, neurodevelopment, other: screening

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Autism Spectrum Disorder (ASD) includes difficulties with social communication skills, restricted repetitive behaviors, rigidities and sensory sensitivities.[1] The diagnosis of ASD before 3 years of age is essential to access intensive behavioral therapies early, at a critical age of brain development,[2] and to ensure a timely transition to preschool and the development of an Individualized Educational Plan (IEP). The American Academy of Pediatrics (AAP) continues to recommend continuous developmental surveillance and ASD universal screening in Primary Care at 18 months and 24 months, if there are no concerns prior to then.[3] The CDC reports improved early diagnosis such as 1.6 times more 4 year-olds born in 2016 received an ASD diagnosis than children born in 2012.[4]Though this is a trend in the right direction, these data need to be looked at closer, and there is still a large need for early identification and diagnosis before the age of 3 years.

Children from immigrant and refugee backgrounds and those in underserved geographical areas may not have a consistent Primary Care Provider (PCP), and may have a different provider each time they receive care services.[5] This eliminates the opportunity for longitudinal follow-up that is often

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necessary for observation of development and the identification of early signs of ASD. However, young children may have been referred to early intervention (EI) for concerns of language or development delays, thus further training EI providers on autism screening and creating a stronger network of EI/PCP and diagnosticians would ensure that at risk toddlers are identified early.

Many EI programs in the US have adopted first-line screening methods such as the ASQ-SE[6] (Ages and Stages Questionnaire, Social Emotional) and/or the MCHAT-R/F[7] (Modified Checklist for Autism in Toddlers, revised with follow up interview). However, even when early screening via parent questionnaires and interview occurs in Primary Care (PC) and Early Intervention (EI) settings, there continues to be both missed cases and a significant time delay in the formal neurodevelopmental evaluation and diagnosis of ASD.[4,8]

Building capacity and skills in the early identification of neurodevelopmental disorders and ASD, and collaborating with community early childhood providers, is essential in improving the early identification of ASD.[9] We have previously published a pilot study on the integration of the RITA-T (Rapid Interactive Screening Test for Autism in Toddlers) in a two-level screening model where providers in one large EI program screen high-risk toddlers and prepare the family for a possible ASD diagnosis. The child is then referred to a diagnostic clinic where the visit is more focused, and where toddlers are evaluated faster.[10]

Our goal in this paper is to demonstrate the generalization of this two-level screening model with the RITA-T in 15 EI programs and 9 primary care settings in central MA, while preserving the robust psychometrics of the RITA-T shown in previous studies.

## Material and Methods

### *RITA-T and RITA-T Screening Model*

The RITA-T is an interactive level-2 autism screening test, which is affordable, and requires comparatively simpler training for a range of early childhood providers. This includes physicians, nurses, social workers, therapists, psychologists, community-based EI and Family Health Center paraprofessionals. These providers, with some clinical experience in ASD, can reliably train on the RITA-T in 4 hours through in-person workshops or an established online course. This leads to a more streamlined training process for providers that allows them to integrate the level-2 RITA-T screening model in their practice in an efficient and reliable way.[11,12] The RITA-T is inexpensive to train on and acquire, and relies very little on the child's language, making it a particularly relevant screening test for nonverbal and non-English speaking children. It is validated for children 18–36 months old, and cut-off scores have been established and replicated with consistency[13]. A total score of less than 12 is considered as low risk for ASD. A score within 12–16 is medium risk, and requires further investigation. And a score greater than 16 places the child at high risk for a formal diagnosis of ASD. In addition, translation and validation of the instrument is under way in a range of other countries and cultures.[14,15]

This model strongly relies on the network that it builds around EI providers, PCP, and ASD diagnosticians. Furthermore, it encourages increased collaboration between PCP and EI providers, and diagnosticians. Once a provider reliably trains to administer and score the RITA-T, they work with their team to set up a system within their program or practice to identify other providers or parents who have concerns about a particular child under their care or oversight. After the RITA-T administration, the provider then refers to the Autism diagnostic clinic that collaborates with them and that recognizes the RITA-T screening and work that went into preparing the family for the evaluation. For the purpose of this paper, we will refer to this clinic as the Autism-R Diagnostic Clinic. Providers in this clinic rely on standardized measures for the evaluation of ASD. The RITA-T is not repeated, but providers incorporate results of the screening and prioritize their diagnostic evaluation. In this study, such a clinic was located in a tertiary-level medical center. One of the important benefits of a second-level screen is that an EI provider and/or PCP can begin a conversation with the family about concerns for ASD with more confidence. They can also demonstrate and show the key behaviors displayed by a child, such as delay/absence in answering to name, or not following a point. If an EI provider initiates the referral, the PCP is informed and vice versa, increasing the communication and collaboration between the two child-focused treatment settings. The child's EI provider often accompanies the child and their parents/caregivers for the diagnostic evaluation. The child's EI provider usually has built a strong relationship with their family. This team approach increases parental support and acceptance of an eventual positive diagnosis, and more efficiently connects the family to community services.

### *Current Study*

Over the course of 3 years and two months, (October 2018-December 2021), we increased collaboration with community early childhood providers and supported EI programs, as well as several primary care settings, to establish RITA-T screening models. We trained on average 2–4 providers within each of the 15 EI programs, and 2–4 providers (MD, and NP) from 9 primary care centers (private practices, community health centers, and a hospital-based primary care center) geographically close to the site of this study, in central MA. We established an Autism-R Diagnostic Clinic dedicated for children younger than 3 years old screened on the RITA-T in early intervention programs or primary care practices. This clinic was located in an academic center in an underserved and diverse community, with 80% of referrals consisting of families receiving publicly supported health insurance.

We performed a retrospective chart review between October 1, 2018-December 1, 2021. We reviewed the charts of toddlers 18–36 months old, referred for a rule-out evaluation of ASD through

screening with the MCHAT/R and RITA-T. We included toddlers referred and diagnosed with Developmental Delay (DD)/Non-ASD to examine the psychometric features of the RITA-T in this group. We also looked at the charts of those evaluated through the regular Autism Clinic based in this center, where PCP referred young children without undergoing the RITA-T screening prior to their referral. We received approval from our Institutional Review Board to complete this review.

### Diagnostic Process

We evaluated toddlers in the Autism-R Clinic over one visit (60-90 min). Staff included a neurodevelopmental pediatrician and/or a child psychologist. Most often one diagnostic evaluation visit was sufficient. However, we scheduled a second visit if needed. Children referred with concerns of ASD through the regular Autism Clinic, were evaluated over two visits that were scheduled for one hour each by staff that included a social worker, nurse practitioner, child psychologist, and Developmental Behavioral or Neurodevelopmental pediatricians. Diagnostic evaluations in all clinics, whether or not previously screened by the RITA-T, included the DSM-5 interview/checklist,[16] Autism Diagnostic Observation Schedule – second edition[17] Toddler, Module 1 or Module 2 as indicated clinically; a checklist based on the DSM-5 developed by this team titled the Early Autism Screening Inventory (EASI),[18] and the CARS-2 (Childhood Autism Rating Scale Second Edition).[19] During the COVID-19 pandemic, we continued to complete evaluations through both clinic models and moved to complete evaluations remotely. We include in this paper only the evaluations that were completed with an in person RITA-T administration. We developed and piloted the telehealth RITA-T[20] and we will present those results in a separate manuscript.

We compared both groups of toddlers diagnosed with ASD either through the Autism-R Clinic, previously screened by the RITA-T, or through the standard Autism Clinic and examined their demographic characteristics, and wait time to a diagnosis from the time of their referral. We also looked at the final diagnosis in all those referred/evaluated with the RITA-T, whether it was Autism Spectrum Disorder (ASD) or Developmental Delay (DD)/Non-ASD, and correlated final diagnosis with RITA-T scores to examine its psychometrics in this large group.

In addition, we also surveyed those who trained on the RITA-T and implemented this screening model to assess factors such as their confidence in using the RITA-T, barriers on the implementation of its model, and the providers' overall feedback on the tool. We also surveyed families evaluated through the RITA-T model who were referred from a hospital based/academic Primary Care group to assess their satisfaction with this model of care.

### Statistical Analysis

We compared demographics and test scores between children with ASD with and without RITA-T scores, and between those with ASD versus those with a final diagnosis of Developmental Delay (DD)/Non-ASD. We reported counts and percentages for categorical variables, and for continuous variables, we calculated means and standard deviations (SD). We performed Fisher's exact test to compare categorical counts between groups. We performed the two-sample independent t-test to compare means of continuous variables. An $\alpha$-level of 0.05 was used to determine statistical significance.

To evaluate the performance of RITA-T as an autism screening tool, we estimated: sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and Youden's index[21] at different cut-off points of the RITA-T total score with their confidence intervals. We reported the receiver operating characteristic (ROC) curve of RITA-T scores, area under the curve (AUC) and confidence interval of AUC. We completed a scatterplot of RITA-T total scores by random ID assignment of each patient. We sorted the scores from highest to lowest, plotted by ID, and divided into ASD versus Non-ASD. We conducted analyses using R software version 4.2.0.

## Results

Over the course of 3 years and 3 months, 417 toddlers met our criteria. We excluded 10, as they were missing a referral date. Of the 407 remaining, our team diagnosed 38 with DD/Non-ASD and 369 with ASD. We further excluded 17 from the DD/Non-ASD group as they were missing RITA-T values. From the 369 toddlers with ASD, we excluded 13 for reasons including: 1) not attending their diagnostic evaluation, 2) the referring provider administered the RITA-T outside of the validated age range, or 3) their RITA-T was incomplete. We further looked at the 356 toddlers with ASD and identified 291 from the Autism-R Clinic and 65 from the regular Autism Clinic. From those 291, 223 received the RITA-T in person and were included in this analysis. See consort diagram in Figure 1.

Referring providers to the RITA-T Clinic, included 153 referrals from PCP from Pediatrics and Family Medicine (MD, NP). EI providers sent 169 referrals.

We compared demographics for both the DD/Non-ASD group and ASD group (see Table 1).We evaluated more girls in the ASD group, but this did not reach statistical significance. Children in the DD/Non-ASD group were older than those in the ASD group (33.5 months vs 28.8 months). Additionally, race and ethnicity were comparable and representative of the geographical area where this study was completed. As expected, RITA-T scores were significantly different between those with ASD than those without ASD with mean scores of 19.29 and 12.43 respectively ($p < 0.001$). Those in the DD/Non-ASD group waited almost double the amount of days than those in the ASD group to receive a final diagnosis. Increased time between referral to initial evaluation in the general toddler clinic in this center accounted for most of this time.

Table 2

For those within the ASD group, our team evaluated 65 in the regular Autism Clinic and 223 in the Autism-R Clinic,

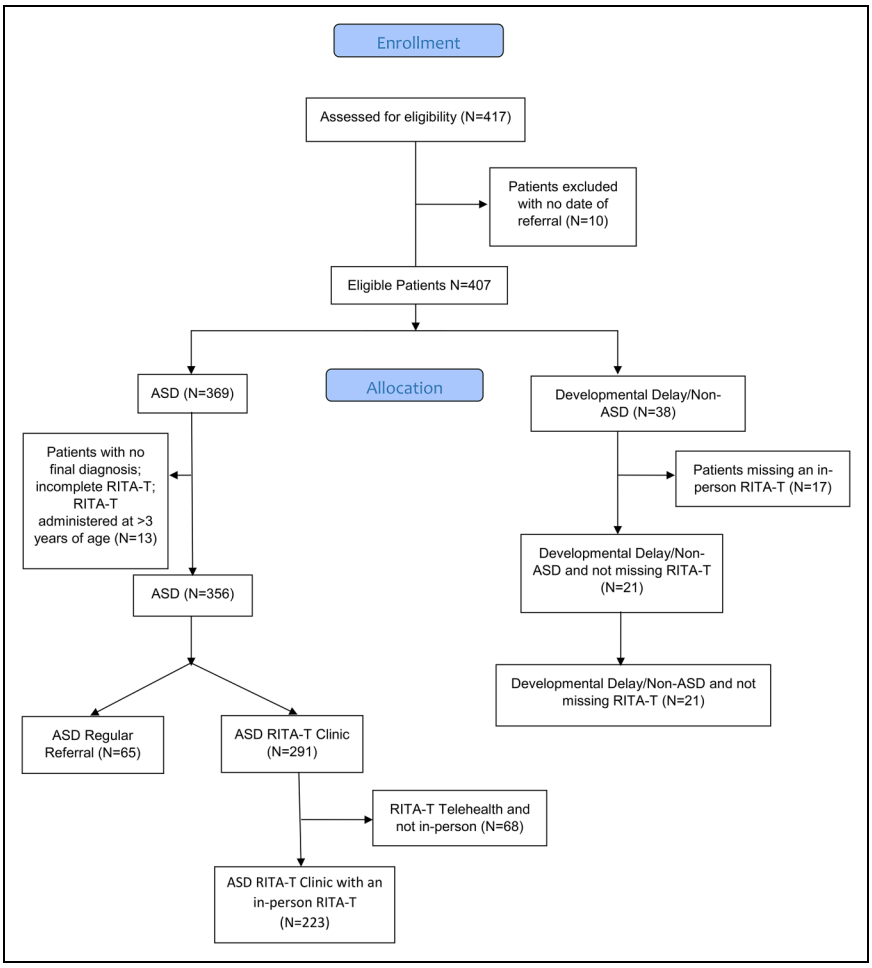


**Figure 1.** Consort diagram. We created a consort diagram to illustrate the organization of our data presented in this manuscript. Following the diagram linearly, the initial three boxes represent the data at the beginning of our data collection phase. Data was reviewed from October first, 2018 – December first, 2021. We identified 417 patients meeting our criteria. Patients who did not have a date of referral were excluded making N = 407 for eligible patients. Out of those eligible patients, we divided the group into ASD or DD/Non-ASD. We further excluded patients who were missing a referral date, had an incomplete RITA-T, or who had the RITA-T administered outside of the validated age range (18–36 months). We organized the final ASD diagnosis group to represent a group that was referred without having received the RITA-T, and another group that did receive the RITA-T. We developed a Telehealth RITA-T (manuscript in preparation) amidst the COVID-19 pandemic. Sixty-eight patients received a version of the Telehealth RITA-T. We excluded them for this study. The final number of patients with ASD who received an in-person RITA-T is N = 223.

and age at the time of evaluation and gender were comparable. Interestingly, although more families identified as Hispanic in the Autism-R Clinic, this did not reach significance, and the ethnic mix was very consistent with the geographical area where this study was completed. Average wait time was better for those seen in the Autism-R Clinic than those seen through the regular Autism Clinic (86 days vs 113 days, p = 0.027).

We evaluated cut-off scores of the RITA-T that differentiates between ASD and DD/Non-ASD. We calculated the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for each cut-off score (Table 3). We calculated the ROC curve of RITA-T scores, area under the curve (AUC) and confidence interval of AUC (Figure 2). We completed a scatterplot of RITA-T total scores by random ID assignment of each patient and sorted the scores from highest to lowest, plotted by ID, and divided into ASD versus Non-ASD (Figure 3).

Optimal cut-off score as calculated by Youden's index is a score of 17 with an index of 0.72, sensitivity of 0.77, specificity of 0.95, and a PPV of 0.99. Cut-off scores of 12–16 show an increase in PPV to 0.96 at 14 and 0.97 at 15, with sensitivity and specificity 0.91/0.57 and 0.88/0.71 respectively.

We identified 3 potential outliers. They had low risk scores (4, 6, and 9), and two of those were girls. However, the providers administering the test noted inconsistent eye contact, repetitive behaviors, developed language, and good interaction with their parents. There were still concerns about ASD, thus they referred them for a complete evaluation. Only one child evaluated had a score above 16 and did not receive an ASD diagnosis

**Table 1.** Demographics of all Patients with RITA-T (n = 244).

| Demographics | DD/Non-ASD & RITA-T (n = 21) | ASD & RITA-T (n = 223) | p-value |
|---|---|---|---|
| Female sex, n (%) | 5 (23.8%) | 73 (32.7%) | 0.472 |
| Age in months, mean (SD) | 33.57 (6.73) | 28.80 (6.00) | 0.005 |
| Race, n (%) | | | 0.566 |
| Asian | 0 (0%) | 15 (6.7%) | |
| Black/African American | 1 (4.8%) | 31 (13.9%) | |
| White non-Hispanic | 15 (71.4%) | 111 (49.8%) | |
| White Hispanic | 5 (23.8%) | 54 (24.2%) | |
| More than one race | 0 (0%) | 9 (4%) | |
| Unknown | 0 (0%) | 3 (1.3%) | |
| Ethnicity, n (%) | | | 1.000 |
| Hispanic or Latino | 5 (23.8%) | 56 (25.1%) | |
| Not Hispanic or Latino | 16 (76.2%) | 164 (73.5%) | |
| Unknown | 0 (0%) | 3 (1.3%) | |
| Test scores, mean (SD) | | | |
| RITA-T, total score | 12.43 (3.85) | 19.29 (4.40) | <.001 |
| M-CHAT, total score (n = 208*) | 5.15 (4.04) | 7.59 (4.00) | 0.054 |
| Wait time from referral to appointment in days, mean (SD) | 169.52 (135.66) | 86.00 (59.24) | 0.011 |

* n = 13 for Non-ASD; n = 195 for ASD.

**Table 2.** Demographics of all patients diagnosed with ASD (n = 288).

| Demographics | ASD & No RITA-T (n = 65) | ASD & RITA-T (n = 223) | p-value |
|---|---|---|---|
| Female sex, n (%) | 23 (35.4%) | 73 (32.7%) | 0.765 |
| Age in months, mean (SD) | 29.52 (6.37) | 28.80 (6.00) | 0.418 |
| Race, n (%) | | | 0.584 |
| Asian | 7 (10.8%) | 15 (6.7%) | |
| Black/African American | 10 (15.4%) | 31 (13.9%) | |
| White non-Hispanic | 36 (55.4%) | 111 (49.8%) | |
| White Hispanic | 11 (16.9%) | 54 (24.2%) | |
| More than one race | 1 (1.5%) | 9 (4%) | |
| Unknown | 0 (0%) | 3 (1.3%) | |
| Ethnicity, n (%) | | | 0.410 |
| Hispanic or Latino | 12 (18.5%) | 56 (25.1%) | |
| Not Hispanic or Latino | 53 (81.5%) | 164 (73.5%) | |
| Unknown | 0 (0%) | 3 (1.3%) | |
| Wait time from referral to appointment in days, mean (SD) | 113.17 (91.83) | 86.00 (59.24) | 0.027 |

at their initial diagnostic visit. He had good nonverbal communication, but had delayed language and was hyperactive. Our team made recommendations at his initial visit for intervention and continued monitoring; however, he was lost to follow up during the COVID-19 pandemic.

## *Surveys*

We received 47 surveys back from the 90 (52.2%) EI providers surveyed and 4 out of 9 PC site surveyed (44.4%). From EI: 45/47 reported that the RITA-T was easy to administer and implement in their programs. Two had difficulties using it during the COVID-19 pandemic and in person restrictions. PCP noted that as a screening tool, the RITA-T helped them clarify those with ASD versus those with non-ASD developmental delays, improved their communication with ASD diagnosticians, and allowed them to identify systems issues with referrals. They also reported that the RITA-T fit well into their clinic flow and that results aligned with their clinical impressions. One PCP reported: "Using the RITA-T has been a wonderful addition to our practice right from the start. It is reassuring for parents of low risk children, validating for those with high risk children, and enlightening for those who weren't sure what to think".

The overall feedback regarding the use of the tool was positive when assessing the provider's implementation of the tool, the ease of its use and generalizability to their work, and that using the RITA-T reduced diagnostic wait times for the young children they cared for. Primary Care sites were able to modify the templates of their RITA-T trained

**Table 3.** Sensitivity, Specificity, Positive Predictive Value, and Negative Predictive Value by RITA-T Scores (n = 244).

| RITA-T total score | Sensitivity | Specificity | PPV | NPV | Youden's index |
|---|---|---|---|---|---|
| 4 | 1.00 (0.98, 1.00) | 0.00 (0.00, 0.16) | 0.91 (0.87, 0.95) | 0.00 (0.00, 1.00) | 0.00 (0.00, 0.16) |
| 5 | 1.00 (0.98, 1.00) | 0.00 (0.00, 0.16) | 0.91 (0.87, 0.95) | 0.00 (0.00, 0.97) | 0.00 (0.00, 0.16) |
| 6 | 1.00 (0.98, 1.00) | 0.00 (0.00, 0.16) | 0.91 (0.87, 0.95) | 0.00 (0.00, 0.97) | 0.00 (0.00, 0.16) |
| 7 | 0.99 (0.97, 1.00) | 0.00 (0.00, 0.16) | 0.91 (0.87, 0.95) | 0.00 (0.00, 0.84) | 0.00 (0.00, 0.16) |
| 8 | 0.99 (0.97, 1.00) | 0.14 (0.03, 0.36) | 0.92 (0.88, 0.95) | 0.60 (0.15, 0.95) | 0.13 (0.00, 0.36) |
| 9 | 0.99 (0.97, 1.00) | 0.19 (0.05, 0.42) | 0.93 (0.89, 0.96) | 0.67 (0.22, 0.96) | 0.18 (0.02, 0.42) |
| 10 | 0.99 (0.96, 1.00) | 0.24 (0.08, 0.47) | 0.93 (0.89, 0.96) | 0.62 (0.24, 0.91) | 0.22 (0.04, 0.47) |
| 11 | 0.99 (0.96, 1.00) | 0.29 (0.11, 0.52) | 0.94 (0.90, 0.96) | 0.67 (0.30, 0.93) | 0.27 (0.07, 0.52) |
| **12** | **0.96 (0.92, 0.98)** | **0.43 (0.22, 0.66)** | **0.95 (0.91, 0.97)** | **0.50 (0.26, 0.74)** | **0.39 (0.14, 0.64)** |
| **13** | **0.92 (0.88, 0.95)** | **0.48 (0.26, 0.70)** | **0.95 (0.91, 0.97)** | **0.37 (0.19, 0.58)** | **0.40 (0.14, 0.66)** |
| **14** | **0.91 (0.86, 0.94)** | **0.57 (0.34, 0.78)** | **0.96 (0.92, 0.98)** | **0.38 (0.21, 0.56)** | **0.48 (0.21, 0.73)** |
| **15** | **0.88 (0.83, 0.92)** | **0.71 (0.48, 0.89)** | **0.97 (0.94, 0.99)** | **0.36 (0.22, 0.52)** | **0.59 (0.31, 0.81)** |
| **16** | **0.84 (0.79, 0.89)** | **0.86 (0.64, 0.97)** | **0.98 (0.95, 1.00)** | **0.34 (0.22, 0.48)** | **0.70 (0.43, 0.86)** |
| 17 | 0.77 (0.71, 0.82) | 0.95 (0.76, 1.00) | 0.99 (0.97, 1.00) | 0.28 (0.18, 0.40) | 0.72 (0.47, 0.82) |
| 18 | 0.60 (0.53, 0.66) | 0.95 (0.76, 1.00) | 0.99 (0.96, 1.00) | 0.18 (0.11, 0.27) | 0.55 (0.29, 0.66) |
| 19 | 0.53 (0.47, 0.60) | 0.95 (0.76, 1.00) | 0.99 (0.95, 1.00) | 0.16 (0.10, 0.24) | 0.49 (0.23, 0.60) |
| 20 | 0.48 (0.41, 0.54) | 0.95 (0.76, 1.00) | 0.99 (0.95, 1.00) | 0.15 (0.09, 0.22) | 0.43 (0.17, 0.54) |
| 21 | 0.41 (0.34, 0.48) | 0.95 (0.76, 1.00) | 0.99 (0.94, 1.00) | 0.13 (0.08, 0.20) | 0.36 (0.10, 0.47) |
| 22 | 0.34 (0.28, 0.41) | 0.95 (0.76, 1.00) | 0.99 (0.93, 1.00) | 0.12 (0.07, 0.18) | 0.29 (0.04, 0.41) |
| 23 | 0.25 (0.19, 0.31) | 0.95 (0.76, 1.00) | 0.98 (0.90, 1.00) | 0.11 (0.07, 0.16) | 0.20 (0.00, 0.31) |
| 24 | 0.18 (0.14, 0.24) | 1.00 (0.84, 1.00) | 1.00 (0.91, 1.00) | 0.10 (0.07, 0.15) | 0.18 (0.00, 0.24) |
| 25 | 0.12 (0.08, 0.17) | 1.00 (0.84, 1.00) | 1.00 (0.87, 1.00) | 0.10 (0.06, 0.14) | 0.12 (0.00, 0.17) |
| 26 | 0.08 (0.05, 0.12) | 1.00 (0.84, 1.00) | 1.00 (0.80, 1.00) | 0.09 (0.06, 0.14) | 0.08 (0.00, 0.12) |
| 27 | 0.05 (0.02, 0.09) | 1.00 (0.84, 1.00) | 1.00 (0.72, 1.00) | 0.09 (0.06, 0.13) | 0.05 (0.00, 0.09) |
| 28 | 0.02 (0.01, 0.05) | 1.00 (0.84, 1.00) | 1.00 (0.48, 1.00) | 0.09 (0.06, 0.13) | 0.02 (0.00, 0.05) |
| 29 | 0.01 (0.00, 0.04) | 1.00 (0.84, 1.00) | 1.00 (0.29, 1.00) | 0.09 (0.05, 0.13) | 0.01 (0.00, 0.04) |

providers so they were able to do RITA-T screening and care coordination, by creating a 45–60 min time slot weekly and billing it on time.

Sixteen families surveyed out of 30, (50%) responded that they felt supported in their evaluation and understood the different steps throughout the process. They reported an overall satisfaction with the model, but as evaluations became remote during the COVID-19 pandemic, many hoped for more in-person evaluations, as they felt an in-person visit would have provided a more accurate evaluation for their child. Additional feedback also included parents feeling disconnected in what to do after receiving a diagnosis, and wanting more information on resources.

## Discussion

We completed this study to assess the generalization of the RITA-T screening model within 9 primary care sites and 15 early intervention community programs. We were looking to confirm previous work on the consistency and predictive validity of the RITA-T cut-off scores. Further, we sought to assess improvement in patient access and wait times for those families coming through the RITA-T screening model. While a retrospective chart review is not without its limitations, there were still valuable results and important findings which inform further research.

### *Wait Times*

Wait times (in days) between date of referral and date of diagnostic evaluation in those evaluated through the Autism-R Diagnostic Clinic (toddlers previously screened by RITA-T) and those evaluated through the regular Autism Clinic were different, showing a shorter wait time for those coming through the Autism-R/RITA-T model. However, the wait times did not reach statistical significance but was close ($P = 0.02$). When we transitioned to telehealth visits during the COVID-19 pandemic, certain families initially preferred to wait to have an in-person diagnostic evaluation appointment. However, when social distancing lasted longer than expected, they later decided to schedule a telehealth evaluation. Additionally, we were also stricter in confirming appointments a week prior: such as, if a family did not confirm their appointment or if they cancelled, we took them out from the schedule and called the next family in line from either diagnostic clinic to schedule instead. This explains the large standard deviation in the wait time difference, despite the improvement of the wait time in the Autism-R Clinic group. The wait time for the regular Autism Clinic was still consistent with our then wait time of 3–5 months. The wait time for the DD/Non-ASD subjects is clearly longer than for those with ASD concerns, as improving ASD access was the priority of this particular center, after careful triaging of those who were at risk for

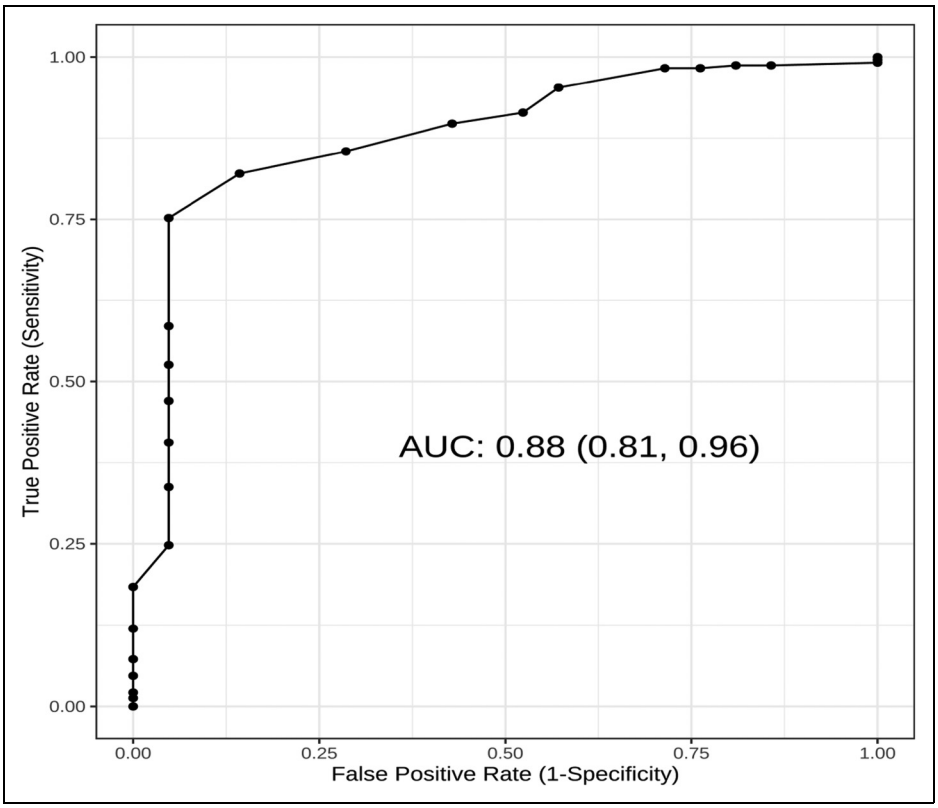


**Figure 2.** ROC curve of RITA-T scores, area under the curve (AUC) and confidence interval of AUC.

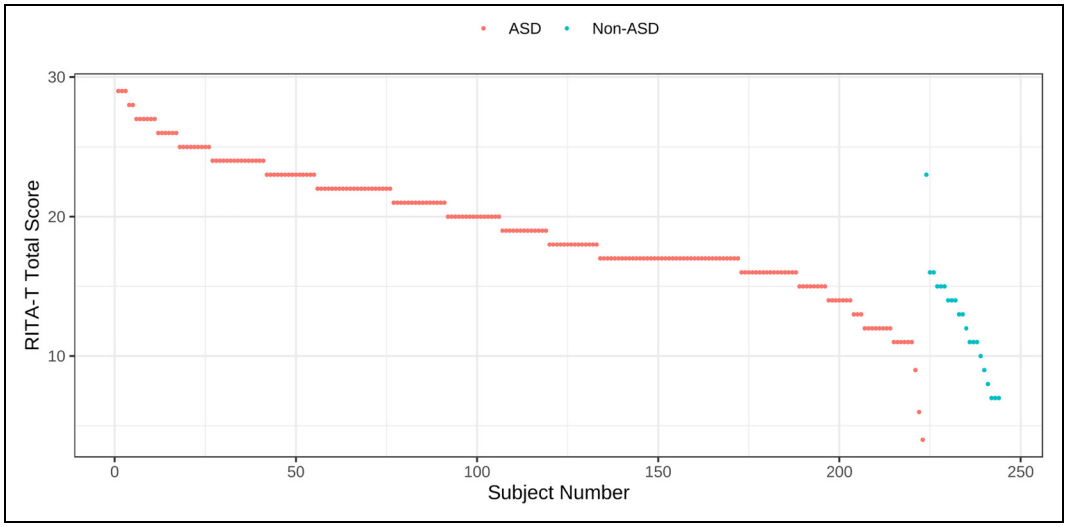


**Figure 3.** Scatterplot of RITA-T score versus subject number stratified by ASD and non-ASD.

ASD and making sure that those without ASD risk were connected to appropriate services.

## *Cut-off Scores*

Cut-off scores are still consistent with previous papers, showing excellent psychometrics, despite the small number of outliers identified and discussed in this paper. The optimal cut-off score to differentiate those with ASD versus DD/Non-ASD was identified to be 17. The current guidelines for cut-off scores based on previous papers[12,22] identify 12–16 as medium risk for ASD, and scores greater than 16 as high risk for ASD. Analyzing the table, PPV is 0.96 at 14 and 0.97 at 15.

From the nine who scored under 12 and our team diagnosed with ASD, six had scores of 11, which is just below the cut-off scores. These children were verbal, and showed joint attention skills, but still presented with certain behavioral rigidities. Thus, we considered the remaining three to be potential outliers and false negative subjects with scores of 4, 6 and 9. Two out of the three outliers were girls. Providers still referred them based on clinical impressions and further observations during testing. We identified one child with a high RITA-T score who at the time of their evaluation visit did not receive a diagnosis of ASD. We had recommended a follow up to continue to monitor him; however, this child was lost to follow-up.

These findings bring up difficulties with testing high functioning boys or girls who can present with very good connection to their family, but can present inconsistencies in their nonverbal communication and behavioral rigidities. This also brings up the need to have clear guidelines and other possible differential diagnoses for those young children coming to our attention with high scores on Autism screeners who otherwise present with other social emotional difficulties. The RITA-T is a screening test, and it is important to emphasize relying on clinical judgment and impressions during evaluations as well. Nevertheless, it was still helpful in that it offered a semi-structured observation of the child's behaviors, allowing providers to inform their clinical impressions. In addition, we also recognize the need to provide booster trainings for providers regularly and to continue to monitor their inter-rater reliability.

### *Exclusions*

As with any retrospective chart review, we excluded some patients based on incomplete data and information. Chart reviews are not perfect[23–25] and the COVID-19 pandemic made the process more complicated when taking into account all the adjustments made to clinical care. However, the information reported is still important and valuable.

### *Surveys*

The surveys provided positive feedback in that clinicians reported that the RITA-T informed their clinical impressions, and that it was easy to integrate into their respective settings. Providers expressed interest in yearly booster trainings on the administration and interpretation of the RITA-T. The surveys from parents emphasized their need for support, and connecting to community resources after receiving a diagnosis. This study was conducted in an underserved and diverse community, and these findings highlight the need for Family Navigators, or providers trained on principles of Family Navigation to further support families after a diagnosis of ASD.

## *Conclusions and Recommendations*

This retrospective study assessed the generalization of the RITA-T screening model within 15 Early Intervention programs and 9 Primary Care settings, its role in improving access and early identification in ASD, and most importantly the consistency of the cut off scores of the RITA-T. Our goal was to take advantage of two highly relevant settings where children can be screened efficiently (Primary Care and Early Intervention), and to capitalize on the preparatory work that community based settings and professionals already provide in order to develop a comprehensive path to an earlier diagnosis of ASD.

We were able to demonstrate the consistency of the RITA-T psychometrics and the improvement in wait-times, the streamlined process that the RITA-T model offers, and the increased collaboration and communication with PCP, EI and Autism diagnosticians. This is key in ensuring the early identification of young children at risk already from diverse and underserved backgrounds. Most importantly, we showed its ease in integration in different clinical and community settings. We identified the need to develop guidelines for the evaluation of young children coming to our attention because of a "positive" Autism screen, who may otherwise have other social emotional needs requiring attention and services.

In addition, the RITA-T, as any other ASD screener, is a screening test and training on the tool needs to be integrated with knowledge of child development, social emotional child status, and early signs of ASD, so that providers can develop their clinical impressions and then use the RITA-T as a facilitator to inform their assessment. We also recommend providing regular booster trainings and developing programs and resources to further support families after a diagnosis of ASD.

### *Future Directions*

We continue our collaboration with Primary Care and EI providers applying the RITA-T as a triaging mechanism. However, given the consistency of the RITA-T cut-off scores in toddlers aged 18–36 months, and its ease of training and integration in different clinical settings, further work is going into supporting and training primary care providers to complete an ASD diagnostic evaluation using standardized measures, for those who score greater than a score of 16 as their risk of having ASD is very high. Future directions also include further validating the Telehealth-RITA-T.

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#### Author Note

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We have not published the data presented in this manuscript, but we presented preliminary results at the 2022 International Society for Autism Research in Austin, Texas.

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