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Creating a Patient-Based Diagnostic Checklist for Functional Tics During the COVID-19 Pandemic

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**Abstract**

**Background and Objectives:** Since the onset of the COVID-19 pandemic, there has been a dramatic change in the presentation of patients with tics. The explosive presentation of atypical tics has been noted worldwide and thought to be the manifestation of a pandemic-associated functional neurological disorder following social media exposure to tics. Nevertheless, despite the frequent diagnosis of functional tics, there is no existing formal diagnostic criteria. The primary aim of this study was to create a patient-based diagnostic checklist for making the diagnosis of a functional tic disorder during the COVID-19 pandemic.

**Methods:** A retrospective chart review at a single institution during the pandemic was performed. Based on available literature, diagnostic criteria were created for typical tics, functional tics, and patients with dramatically evolving symptoms (i.e., 'mixed' with prior history of mild tics with later fulminant functional worsening). Patient demographics, comorbidities, and tic characteristics of these groups were then compared. Following initial assessments, new diagnostic criteria were established and statistically reanalyzed.

**Results:** 198 patients underwent investigation. Significant differences in age, sex, psychological comorbidities, tic characteristics, and tic severity were found between patients with typical tics when compared to either of the two functional groups. Only the presence of rostrocaudal progression and increased obsessive-compulsive behaviors were significantly different between patients with new onset functional tics and those with functional worsening of a previous tic disorder. Results also showed that age of tic onset was not a contributing factor for group differentiation. Many patients with functional tics were not exposed to videos depicting tics on social media.

**Discussion:** This study confirms the presence of a distinct presentation of atypical tics during the pandemic period. It further establishes the validity of specific criteria useful in dividing patients with tics into three formal diagnostic criteria: 1) primary tic disorders; 2) a strictly functional tic disorder; and 3) a mixed tic disorder consisting of patients with an initial history of a primary tic disorder and the later development of functional tics. Explicit diagnostic criteria should enable clinicians and researchers to make a definitive identification and assist patients and families become more knowledgeable and accepting of the diagnosis of functional tics.

## Introduction

Tics, defined as brief, rapid, abrupt, recurrent, and nonrhythmic movements or vocalizations, are a common movement disorder in children. The COVID-19 pandemic has, however, led to a significant alteration in the clinical presentation of many patients with tics and tic-like behaviors. For example, recent studies have linked the sudden onset of atypical motor and phonic tic-like behaviors in teenaged girls to the negative psychological effects of the pandemic and social media exposure.<sup>1-3</sup> This increase in atypical tics has emphasized the need for a practical criteria to assist the treating physician in deciding whether the movement or vocalization is a “typical” tic or a “functional tic-like” behavior. An additional deficiency is the lack of information on the pandemic’s effect on the presentation, quality of symptoms, and outcome of children presenting with more typical tics.

Pre-pandemic studies have shown that tics typically present between 4-8 years of age, and 93% are symptomatic before age 10. Motor tics usually precede the appearance of phonic tics and are often localized to the face, head, or neck. Tics have a waxing and waning pattern with an evolving course along with fluctuating frequency and intensity. Brief exacerbations can be provoked by stress, anxiety, excitement, anger, fatigue, or infection. In contrast, tic suppressibility frequently occurs with concentration, participating in emotionally pleasing activities, or while asleep.<sup>4</sup> A premonitory urge/sensation occurs in up to 95% of people with tic disorders with most becoming aware of its presence by age 10.<sup>5</sup> Peak tic severity is greatest between 10-12 years of age with subsequent improvement thereafter in about 70% of affected individuals.<sup>6,7</sup> Chronic tic disorders (CTD) are more frequent in males, require the presence of tics for greater than one year, have an age of onset before age 18, a waxing and waning course, and the absence of either a substance-induced or general medical condition causation for the tics. In addition to tics, 86% of CTD patients have at least one psychiatric comorbidity with attention deficit-hyperactivity disorder (ADHD) and obsessive compulsive disorder/obsessive compulsive behaviors (OCB) being the most common.<sup>8</sup> Etiologically, tic disorders are epigenetic, and a positive family history of tics is present in about one-half of

patients. Therapeutically, beneficial tic-suppressing approaches include behavioral therapy and a variety of pharmacologic agents including alpha-adrenergic agonists, topiramate, and typical and atypical antipsychotics.<sup>9</sup>

Tics and tic-like behaviors are also seen as a manifestation of a functional (psychogenic) movement disorder. For example, pre-COVID, functional movement disorders resembling tics were observed in 4.9% of 184 patients.<sup>10</sup> More recently, during the COVID-19 pandemic, there has been a dramatic case increase of atypical tics resembling functional tic-like behaviors (FTLB) in teenagers and young adults, especially females, in numerous countries throughout the world.<sup>2,11,12</sup> This acute and fulminant rise has occurred in children and adults with a history of tics as well as in patients without preexisting tics.<sup>12,13</sup>

Despite neurologists frequently making a diagnosis of functional tics, there is, to date, no formal diagnostic criteria. Prior investigators have suggested that several features can be helpful in differentiating functional tics from organic tics. These features include a female preponderance, older age of presentation, abrupt onset, and lack premonitory sensations.<sup>10,14,15</sup> While recognizing that these and other criteria may be helpful, there remains a need for definitive and testable diagnostic criteria. Hence, recognizing the significant psychological impact of the COVID-19 pandemic, one goal of this study was to develop a diagnostic checklist to assist providers, researchers, and families in differentiating between organic and functional tics. A second major aim was to assess the effect of the COVID-19 pandemic on the presentation, comorbidities, and outcome of 198 consecutive children presenting with a chief complaint of tics.

## Methods

A retrospective chart review of one hundred and ninety-eight consecutive children (age range 3-18 years of age) presenting with a chief complaint of tics were completed by two authors (SPT and LQ). All subjects were evaluated in-person at a single institution (UNC Clinic for Tourette Syndrome and Tic Disorders) between May 1, 2020 and December 17, 2021. Data gathered at the time of initial evaluation included sex, age at onset of tics, tic characteristics, history of symptom worsening, presence of a premonitory urge and suppressibility, patient/family-reported presence of significant psychiatric comorbidities, family history of tics, and an initial Yale Global Tic Severity Score (YGTSS) and YGTSS-total tic score (YGTSS-TTS). For patients who elected to start treatment for their tics, YGTSS and YGTSS-TTS were gathered at the follow up visits. Study design is depicted in Figure 1.

a) Initial Major Group Comparisons: Initial working criteria for differentiating subjects into three categories were established by two authors (SPT and HSS) based on specific patient characteristic and specific tic characteristics from review of current literature (Table 1).<sup>14,15</sup> The categories were: 1) "typical tics" (TT); 2) "functional tics" (FT), and 3) "acutely worsened tics" (AWT, indicating patients with a prior history of typical tics and an acute, fulminant tic exacerbation following onset of the pandemic) with the criteria described in Table 2. "Fulminant" was defined as rapid progression in frequency and severity over less than one month. The analysis between these groups is presented in Table 3. A fourth "unspecified tics" group was created for patients not fulfilling criteria for any of the aforementioned groups. While coprolalia/coprophobia and self-injurious tics can occur in patients with typical tic disorders, the combination of the two is less common. Hence, this combination was used as an

exclusion criterion, labelling as “unspecified”, with subsequent revisions to be made as needed. Similarly, an age cut off of 12 years was used in the initial working criteria as functional tics have previously been noted in older children; the potential for changing this age cut off was planned for analysis in the next step. Patients whose complete tic history was unknown (for example due to adoption) were excluded.

Absolute and relative frequencies were computed for each of the categorical variables with mean and standard deviations calculated for the quantitative variables (Table 3). Mean and standard deviations were calculated for continuous variables. The three groups were then compared in terms of the collected variables using Kruskal-Wallis rank sum test for continuous variables and Pearson Chi-Square test for categorical variables. Multiple comparisons were performed using the Bonferroni correction. All statistical analyses were performed in R version 4.0.2 (R Core Team, 2020). Complete case analysis was considered, with  $P < .05$  determining statistical significance.

b) “Unspecified” Group Comparisons: Following the initial analysis, 28 patients were noted to be in the “unspecified” category. Review of these patients revealed three distinct groups who otherwise would have met one of the working criteria for TT, FT, or AWT except for the age cut off criterion: (1) patients meeting all criteria for TT except with tic age of onset  $\geq 12$  years (TT+), (2) patients meeting all criteria for FT except tic age of onset  $\leq 11$  years (FT-), and (3) patients with onset of typical tics  $\geq 12$  years with later acute worsening (AWT+). A second analysis (Table 4) was undertaken to compare these secondary groups to the initial working criteria (TT vs TT+, FT vs FT-, and AWT vs AWT+).

c) Combined Comparisons (Major Group plus Unspecified Group): Following analysis of the “unspecified group”, reanalysis was conducted to compare the initial working criteria to the final group categories (TT and TT+ [primary tic disorders], FT and FT- [functional tic disorder], AWT and AWT+ [mixed tic disorder]).

#### Standard Protocol Approvals, Registrations, and Patient Consents

The Institutional Review Board at the University of North Carolina Chapel Hill approved this study including a waiver of informed consent (IRB number 21-1907).

#### Data Availability

Anonymized data not published within this article will be made available by request to the first author.

## **Results**

Of 198 patients initially included, six patients were excluded due to lack of full tic history. 113 patients met initial criteria for typical tics (TT), 31 patients met criteria for functional tics (FT), and 20 patients met criteria for acutely worsened tics (AWT). Twenty-eight patients were initially in the unspecified group which was subsequently subdivided into three groups (TT+,  $n=6$ ; FT-,  $n=5$ , and AWT+,  $n=5$ ). Following this subdivision, 6 patients still did not meet diagnostic criteria. Five patients met all criteria for FT but were excluded as their FT started prior to onset of the pandemic.

a) Initial Major Group Comparisons: Data comparing TT, FT, and AWT are presented in Table 3. A significant difference was found between TT and FT as well as between TT and AWT with regards to sex (more frequently female with FT and AWT), family history (more frequent with TT and AWT), presence of other significant self-reported mood symptoms and disorders such as ADHD and OCB (more frequent with FT and AWT), and initial YGTSS and YGTSS-TTS (higher with FT and AWT). Rostrocaudal progression was noted to be significantly different between all groups (most commonly seen with TT and least commonly seen with FT). A significant difference was also found in the presence of a premonitory urge or suppressibility with higher frequency being seen in the AWT group when compared to TT and FT.

Additional differences in tic characteristics between the groups included coprophenomenon (less frequent with TT), broad or extended word use (less frequent with TT), self-injurious tics or tics injurious to others (less frequent with TT), throwing (completely absent with TT), and presence of other FNS (functional neurological symptoms; absent with TT). Tic attacks and blocking tics were absent from the TT group by definition. There were no patients who had both self-injurious tics and coprolalia that would otherwise have met criteria for TT. A significant difference in response to pharmacologic treatment (defined as  $\geq 25\%$  improvement between initial and subsequent YGTSS-TTS) was found between TT and AWT with a strong tendency towards lack of improvement in the FT group compared to TT.

No differences were found between FT and AWT in any categories except presence of rostrocaudal progression (more common with AWT) and presence of OCB (more common with AWT).

b) "Unspecified Group" Comparisons: During the data review, 28 patients were noted to be in the "unspecified category" with three distinct presentations noted who would have otherwise met one of the working criteria except for the age of tic onset excluding them from a group. Analysis of these three groups in comparison to patients with TT, FT, and AWT is shown in Table 4. No statistically significant differences were noted between the individually compared groups (TT vs TT+; FT vs FT-; AWT vs AWT+).

c) Combined (Major Group plus Unspecified Group Comparisons): A third comparison was undertaken to confirm that results obtained after combining the similar groups (TT combined with TT+ [primary tic disorders, PTD], FT combined with FT- [functional tic disorder, FTD], and AWT combined with AWT+ [mixed tic disorder, MTD]). Comparison of the initial groups (TT, FT, AWT) to the proposed diagnostic groups (PTD, FTD, MTD; criteria in Table 5) is presented in Table 6 and shows no statistically significant differences.

Six patients did not meet any criteria due to having only tic attacks or due to lack of adequate information to classify them into specific groups.

## Discussion

Since the onset of the COVID-19 pandemic and international lockdowns in early 2020, clinicians worldwide have reported worsening of tics in patients previously diagnosed with primary tic disorders including Tourette syndrome, chronic motor/vocal tic disorders, and provisional tic disorder. Parental reports from Italy demonstrated that 67% of children with PTD demonstrated worsening of their underlying tic disorder.<sup>1</sup> Forty-nine percent of adult patients

were noted to have “a little” worsening of their tics or “much worse” tics following the onset of the pandemic.<sup>13</sup> In addition, an explosion of tics and tic-like movements have been reported in teenagers who had never before experienced tics.<sup>11,12</sup>

Teenagers with the fulminant onset of tics following the pandemic onset were primarily females with a history of anxiety and with onset of their tics after the typical age of tic onset. It was also noted that they had very complex tic-like movements and vocalizations. This presentation also mimicked the pattern of presentation reported in pre-COVID functional tic-like disorders. Additional characteristics noted in this functional group included a reduced family history of tics, a frequently absent premonitory urge, an inability to temporarily suppress their tics, a greater tic suggestibility (i.e., an exacerbation of symptoms when discussing or observing), and a greater frequency of coprophenomenon than observed in patients with chronic tic disorders.<sup>14-17</sup> While each of these clinical characteristics is helpful in diagnosing patients with functional tics, a formal diagnostic checklist for differentiating between typical and functional tics does not yet exist.

The initial phase in this study was the gathering of information on children presenting with tics to a single Institution's pediatric neurology clinic. Using criteria suggested in the literature<sup>14,15</sup>, children were then divided into four categories (Table 2) including typical tics (TT), functional tics (FT), patients with initially typical tics and subsequent fulminant exacerbation (acutely worsened tics, AWT), and “unspecified” tics for patients who failed to fulfill the other criteria. Data from this initial comparison (Table 3), identified both similarities and differences from prior reports.

Similar to prior reports, patients with FT were overwhelmingly female as compared to TT (97% vs 35%). A greater female prevalence was also noted in 75% of children who developed functional tics after a period of typical tics. A family history of tics was present in 43% of patients with TT and 19% of FT. Family history positivity in the AWT group was similar to those with TT, likely reflecting both having a common early typical tic presentation.

Compiled movement and vocalization data (tic-attacks, coprophenomenon, extended word use, injurious behaviors, and throwing objects) were significant differentiating features between groups. No patients having both self-injurious tics and coprophenomenon met criteria for TT signifying that this criterion is useful in differentiating between typical tics and functional tics in most patients. Rostro-caudal progression was more prevalent in patients with TT when compared to FT and AWT. Furthermore, there was also a significant difference in the presence of rostrocaudal progression between AWT and FT likely attributable to patients with AWT having an initial history of typical tics. Prior publications have emphasized that teenagers with psychiatric disorders are more likely to develop functional neurological disorders.<sup>18</sup> In this report, the presence of self-reported anxiety was significantly elevated in children with FT and AWT as compared to TT, and the incidence of obsessive-compulsive behaviors was more common in AWT patients than either of the other groups which likely indicates that patients with additional psychological comorbidities are at increased risk for developing functional disorders.

Overall tic severity as judged by YGTSS and YGTSS-TTS was significantly elevated in the patients with functional tics when compared to patients with typical tics. Therapeutically, this study broadly confirmed suggestions that pharmacotherapy, using recommended tic-suppressing medications (alpha agonists, atypical antipsychotics, or topiramate), is not as beneficial in children within FT and AWT groups as compared to TT.

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Age has also traditionally been used to categorize individuals into a typical tic or functional tic diagnosis. More specifically, teenagers and adults more commonly have functional neurological disorders as compared to younger children.<sup>14,18</sup> In this study, the age of 12 years was initially used as a cut-off point to define TT and FT/AWT. Nevertheless, sixteen patients had an age of onset that resulted in them being placed in the “unspecified” category. Thus, given these results, a second analysis was performed without using age as a specifying diagnostic factor. New groups included: a) patients with TT, using the working criteria, but with age of onset  $\geq 12$  years (labeled as “TT+”, 6 patients); b) patients solely functional (FT) but with tic onset less than age 12 years (“FT-”, 5 patients), and c) patients who had their initial typical tics present after age 12 years and later developed acutely worsened tics (“AWT+”, 5 patients). A statistical comparison between these new groups and the initial groups (TT vs TT+, FT vs FT-, and AWT vs AWT+) was performed and is shown in table 4. No significant differences were found which suggest that age of tic onset should not be required as a factor in making a diagnosis of functional tics.

The premonitory urge is a vaguely defined internal tension, pressure, itch, or feeling that occurs prior to an individual’s tic.<sup>19</sup> Prior investigations in “typical” chronic tic disorders suggest that about 90% of older children/adults and 37% of younger children have a premonitory urge or sensation just prior to their motor or phonic tic.<sup>20,21</sup> This premonitory urge has been described as having several roles including being the driving force for tics, a diagnostic clue for the diagnosis of tics, a predictor in childhood of a poorer health-related quality of life as an adult with TS, and an important component of behavioral therapy.<sup>22,23</sup> In addition, many individuals with typical tics report an ability to briefly suppress their tics which has previously been reported to be reduced in patients with functional tics.<sup>15</sup> In this report, patients’ responses to questions pertaining to suppressibility indicated that children in the FT and AWT groups did show ability to temporarily suppress their tics. In this study, in distinct contrast to prior publications, children in FT and AWT categories tended to have a greater, not reduced, presence of premonitory urges or suppressibility. Therefore, it is suggested that neither premonitory urge nor tic suppressibility should be a required factor to make a formal diagnosis of functional tics.

Recognizing that a second study goal was to develop useful diagnostic criteria for separating typical tic disorders and functional tic-like disorders, the combined group of TT and TT+ was relabeled as “primary tic disorder” (PTD), the combined group of FT and FT- as “functional tic disorder” (FTD), and the combined group of AWT and AWT+ as “mixed tic disorder” (MTD). Proposed criteria listed for these disorders are listed in Table 5. After applying this new diagnostic criteria, statistical separation between PTD and FTD groups was at its maximum (Table 6). Only 6 of the 187 analyzed patients (3.2%) failed to meet specific diagnostic criteria for either the PTD, FTD, or MTD.

Etiologically, the link of FTD to the COVID-19 pandemic is not via a personal infection but rather by the pandemic’s significant negative impact on mental health and daily activities.<sup>11,24</sup> In addition, exposure to social media is proposed as a promoting factor in susceptible patients. For example, patients with functional tics following onset of the pandemic have reported high rates (up to 100%) of exposure to videos of patients with tics on social media (typically TikTok or YouTube).<sup>12,25,26</sup> This phenomenon has been attributed to as a new “mass sociologic illness” (MSI) by several authors and has even made its way into mainstream discussion.<sup>2,3,27</sup> Patients in our study were not routinely asked about exposure to online tic-containing videos until mid-August 2021. Despite the resulting reduced sample size, patients

with FTD and MTD were significantly more likely to have seen videos of tics on social media than patients with PTB. Nevertheless, eight patients with FTD (31% of those asked) reported never having seen videos of tics on social media, and one patient (8%) had seen these videos only after her tics developed. Additionally, 2 out of 5 patients with MTD reported only seeing these videos after onset of their functional worsening. In summary, while exposure to social media videos is a risk factor, recognizing that not all patients have seen these videos, the authors believe the term “TikTok tics” is inappropriate as a catch-all term. A recommended term for patients with functional tics in the setting of the pandemic (with or without exposure to videos on social media) is “COVID-19-related functional tic disorder”. Using this term describes the phenomenon more accurately and avoids any negative or pejorative connotations that the term “TikTok tics” may give to the patient or family.

Historically, it is likely that additional “outbreaks” of functional tics will occur. For example, an outbreak of functional tics occurred in Le Roy, New York in 2011-2012. Authors have also proposed that the abnormal behaviors demonstrated by the “witches” in Salem, Massachusetts in the 1690s may have represented a functional neurological disorder or functional tic disorder.<sup>28,29</sup> The term “COVID-19-related functional tic disorder” would therefore be a specific term representing functional tics brought on in the setting of the COVID-19 pandemic. Terminology in the future for such outbreaks could be determined on a case-by-case basis or could simply be referred to as “stress-related functional tic disorder”. For the individual patient with functional tics in the absence of an “outbreak”, the diagnosis of “functional tic disorder” can suffice.

Limitations of this study include its retrospective nature, relatively short longitudinal follow up period, and potential loss of subjects during the follow up. These factors, especially in patients enrolled toward the end of the recruitment period, may have limited the power to detect small clinical differences and responses to treatment. This study also used patient-reported symptoms of ADHD, anxiety, and obsessive-compulsive behaviors, rather than standardized confirmatory psychiatric questionnaires. Unfortunately, clinician-confirmed scales were not obtained at the initial visit. The retrospective nature of the study also prevented the authors from later gathering these rating scales. It is suggested that future studies determine whether self-reported symptoms are sufficient or if clinician-confirmed diagnoses are required for the diagnosis of functional tic disorder/mixed tic disorder. The manuscript was also limited by an inability to compare data prior to onset of the pandemic as the Clinic was not formed until May 1, 2020. The broad finding that many children may not have seen videos of tics and tic-like behaviors prior to onset of their tics could be limited by either poor recall or by children not being truthful during their initial visit. This may be especially true in those children whose functional tics are identical to the ones seen on such videos, but the number of such children is not easily quantifiable. In addition, many children have functional tics that have similar, but not identical, characteristics which is much more difficult to attribute strictly to social media exposure. Lastly, this study did not assess the relative benefits of different therapeutic agents nor evaluate the potential beneficial effect of behavioral therapy.

Fully recognizing these limitations, this study provides a framework for the clinical diagnosis of patients with various tic presentations. It is the first study to directly use collected patient data to create and test a framework for differentiating patients with functional tics from those with organic tics. Additionally, since the onset of the COVID-19 pandemic, it is one of the largest studies focusing on patients presenting with tics, and the only one that has directly

compared both tic and tic-like patients presenting during the pandemic period (May 1, 2020 through December 17, 2021). The newly proposed criteria also remove diagnostic uncertainty from nearly all patients in this cohort, recognizing that only 6 of 187 patients (3.2%) failed to fit into one of the three final categories. The authors are optimistic that additional studies in other Centers will confirm the validity of the presented proposed criteria for PTD, FTD, and MTD.

The Diagnostic and Statistical Manual of Mental Health, Fifth Edition (DSM-5) has diagnostic criteria for multiple typical tic disorders. These include: 1) provisional tic disorder (tics for less than one year); 2) chronic motor or vocal tic disorder (having either motor or vocal tics, but not both, for greater than one year); and 3) Tourette syndrome (requiring the presence of at least two motor tics and one vocal tic with persistence of tics for more than one year). Common to all of these previously described disorders is that the tics must not be caused by another medical condition or medication. The proposed diagnoses in this study are not designed to alter established diagnoses but rather to create criteria that can effectively differentiate between primary tics disorders and functional tic disorders. Without a diagnostic checklist, multiple patients with functional tics were likely incorrectly diagnosed with a primary tic disorder. Formal diagnostic criteria can enhance the ability of a physician or other practitioner to make a diagnosis without preexisting ambiguity.

Therapeutically, several treatment modalities are available for patients with functional neurological symptom disorder (FNSD). A recent review has summarized these treatments which are largely focused on psychological and behavioral therapies rather than medical management. Psychoeducation, cognitive behavioral therapy, behavioral modifications, family-centered therapy, and physical therapy have all been evaluated and shown to be effective. Research has also suggested that multidisciplinary and inpatient rehabilitation may be more effective in treating FNSD.<sup>30,31</sup> However, none of these treatment options have been formally assessed in patients with functional tics/functional tic disorder. The lack of response to anti-tic medications for the treatment of functional tics has been previously suggested and is confirmed in this study.<sup>12</sup> At present, recommend treatments tend to focus on psychological and behavioral modifications similar to treatment of other functional neurological symptoms. Comprehensive behavioral intervention for tics (CBIT) has also been frequently recommended.<sup>11,12,32</sup> Despite these recommendations, no studies to date have examined the effectiveness of various behavioral therapies in patients with functional tics.

The long-term outlook for patients with COVID-19-related functional tic disorder is unknown at this time. Nevertheless, based on the prior reported spontaneous resolution in other outbreaks of functional tics/neurological symptoms, the authors are optimistic regarding the long-term improvement of tics in these patients. Anecdotally, the authors have had several patients with vast improvement, if not complete resolution, of their tics associated with life returning towards “normal” and the return to school.

In summary, while the proposed criteria for distinguishing between primary tic disorders and functional/mixed tic disorders were developed during the COVID-19 pandemic, they will likely be useful in the future for FTD associated with other contributing factors. Formal criteria are essential for making a correct diagnosis, implementing appropriate therapy, and investigating the underlying pathophysiology and mechanism of treatment response. We look forward to the results of future studies designed to investigate therapeutic approaches, long-term outcomes, the influence of coexisting conditions, and pathophysiologic mechanisms. In addition, and equally important to research and treatment, the proposed diagnostic criteria can

also help patients and families become more comfortable with the diagnosis of functional tic disorder and assist patients in finding appropriate treatment for their condition.

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### Take-Home Points

- There has been an explosion of atypical tics and tic-like behaviors since the onset of the COVID-19 pandemic.
- These atypical tics have characteristics similar to those previously described as “functional tic-like behavior”.
- This is the first study to propose a diagnostic checklist for making a formal diagnosis of functional tics which could be known as “functional tic disorder”.
- Given that many patients diagnosed with functional tics during the pandemic have never been exposed to videos of influencers with tics on social media, the term “TikTok tics” may be inappropriate to describe the complete phenomenon; a preferred term is “COVID-19-related functional tic disorder”.
- For similar “outbreaks” in the future, terminology could be determined on a case-by-case basis, or the term “stress-related functional tic disorder” could be used.

### Table 1: Functional Tic Characteristics Defined in the Literature

1. “Tic attacks” (variable, very complex, and prolonged episodes of motor and vocal tic-like behavior)
2. Frequent coprolalia (obscene words or profanity) or coprophenomenon (obscene gestures)
3. Broad spectrum of word use (for example atypical vocalizations such as “beans”, “woowho”, extended sentences, speaking in different accents, changing vocal pitch, and many others)
4. “Blocking tics” (including negative symptoms such as immobility of body parts, staring, posturing)
5. Self-injurious tics or tics injurious to others
6. Presence of other functional neurological symptoms (e.g. psychogenic nonepileptic seizures)

**Table 2: Initial Working Criteria for Differentiating Between Typical Tics and Functional Tics**

Diagnostic for Typical Tics (TT):

1. Must have age of onset <12 years
2. Must not be fulminant in onset
3. Must include at least two of the following patient characteristics:
  1. Presence of a premonitory urge and/or suppressibility
  2. Rostrocaudal progression
  3. Presence of at least one cooccurring conditions (anxiety, ADHD, OCB)
  4. Positive family history
4. May only include one of the following:
  1. Coprolalia or coprophenomenon
  2. Self-injurious tics
5. Must not include:
  1. "Tic attacks"
  2. "Blocking" tics
  3. Broad spectrum of word use or frequent coprolalia
  4. Throwing
  5. Presence of other FNS
6. Must not be associated with drug use or underlying medical condition

Diagnostic for Functional Tics (FT):

1. Must have age of onset  $\geq$ 12 years
2. Must be sudden and fulminant in onset (rapid progression in frequency and severity over less than one month)
3. Must include at least one of the following patient characteristics:
  1. Comorbid anxiety
  2. Female sex
  3. Lack of family history
  4. Lack of premonitory urge and suppressibility
4. Must have at least two of the following:
  1. "Tic attacks"
  2. "Blocking" tics
  3. Frequent coprolalia or coprophenomenon
  4. Broad spectrum of word use or frequent coprolalia
  5. Self-injurious tics or tics injurious to others
  6. Throwing
  7. Presence of other functional neurological symptoms

Diagnostic for Acutely Worsened Tics (AWT)

1. Meets all criteria for TT including age of onset <12 years
2. Develops at least two of the following  $\geq$ 12 years of age
  1. "Tic attacks"
  2. "Blocking" tics
  3. Frequent coprolalia or coprophenomenon
  4. Broad spectrum of word use or frequent coprolalia
  5. Self-injurious tics or tics injurious to others
  6. Throwing

7. Presence of other functional neurological symptoms

Diagnostic for Unspecified Tics (UT): does not meet any of the above criteria

**Table 3: Analysis of the Working Criteria**

Characteristic	TT N = 113	FT N = 31	AWT N = 20	p
<b>Age of Tic Onset</b>				
Mean (standard deviation)	5 (2)	14 (2)	8 (3)	<0.001*♦♣
<b>Sex</b>				<0.001*♦
Male	73 (65%)	1 (3.2%)	5 (25%)	
Female	40 (35%)	30 (97%)	15 (75%)	
<b>Family history</b>	48 (43%)	6 (19%)	10 (50%)	0.035
<b>Premonitory urge or suppressibility</b>	76 (67%)	24 (77%)	19 (95%)	0.030
<b>Social Media Exposure</b>				0.001*♦
None	11 (92%)	4 (31%)	0 (0%)	
Yes, prior to tic onset	1 (8.3%)	8 (62%)	3 (60%)	
Yes, but only after tic onset	0 (0%)	1 (7.7%)	2 (40%)	
Unknown	101	18	15	
<b>Tic-attack</b>	0 (0%)	21 (68%)	10 (50%)	<0.001*♦
<b>Frequent coprophenomenon</b>	2 (1.8%)	8 (26%)	6 (30%)	<0.001*♦
<b>Broad/extended word use</b>	2 (1.8%)	22 (71%)	14 (70%)	<0.001*♦
<b>Blocking</b>	0 (0%)	4 (13%)	6 (30%)	<0.001*♦
<b>Self/other injurious</b>	1 (0.9%)	19 (61%)	9 (45%)	<0.001*♦
<b>Throwing</b>	0 (0%)	6 (19%)	3 (15%)	<0.001*♦
<b>Other FND</b>	0 (0%)	5 (16%)	3 (15%)	<0.001*♦
<b>Rostrocaudal progression</b>	90 (80%)	1 (3.2%)	7 (35%)	<0.001*♦♣

Characteristic	TT N = 113	FT N = 31	AWT N = 20	p
<b>Anxiety</b>	78 (69%)	28 (90%)	20 (100%)	0.001♦
<b>ADHD</b>	91 (81%)	21 (68%)	14 (70%)	0.2
<b>OCB</b>	64 (57%)	18 (58%)	19 (95%)	0.005♦♣
<b>Initial YGTSS-TTS</b>	14 (7)	30 (14)	29 (12)	<0.001*♦
<b>Initial YGTSS-TOTAL</b>	22 (15)	54 (25)	53 (27)	<0.001*♦
<b>Follow up YGTSS-TTS</b>	12 (7)	28 (13)	33 (12)	<0.001*♦
No Follow Up	95	18	13	
<b>Follow up YGTSS-TOTAL</b>	17 (13)	53 (26)	63 (25)	<0.001*♦
No Follow Up	96	18	13	
<b>Response to treatment</b>	12 (67%)	3 (23%)	0 (0%)	0.003♦
No Follow Up	95	18	13	

\* Bonferroni-adjusted p-value for comparison TT x FT < 0.05

♦ Bonferroni-adjusted p-value for comparison TT x AWT < 0.05

♣ Bonferroni-adjusted p-value for comparison FT x AWT < 0.05

TT: typical tics, FT: functional tics, AWT: acutely worsened tics, FNS: functional neurological symptoms, ADHD: attention deficit-hyperactivity disorder, OCB: obsessive compulsive behavior, YGTSS-TTS: Yale Global Tic Severity Score – Total Tic Score, Response to treatment:  $\geq 25\%$  improvement in YGTSS-TTS from initial to subsequent visit

**Table 4: Comparison of the Working Criteria Without Regards to Age**

Characteristic	TT N=113	TT+ N=6	p	FT N=31	FT- N=5	p	AWT N=20	AWT+ N=5	p
<b>Age of Tic Onset</b>	5 (2)	13 (1)	<0.001	14 (2)	11 (0)	0.027	8 (3)	12 (0)	0.002
<b>Sex</b>			>0.99			>0.99			>0.99
Male	73 (65%)	5 (83%)		1 (3.2%)	1 (20%)		5 (25%)	2 (40%)	
Female	40 (35%)	1 (17%)		30 (97%)	4 (80%)		15 (75%)	3 (60%)	
<b>Family history</b>	48 (43%)	1 (17%)	>0.99	6 (19%)	1 (20%)	>0.99	10 (50%)	2 (40%)	>0.99
<b>Premonitory urge or suppressibility</b>	76 (67%)	4 (67%)	>0.99	24 (77%)	2 (40%)	0.70	19 (95%)	5 (100%)	>0.99
<b>Social Media Exposure</b>			>0.99			>0.99			0.15
None	11 (92%)	1 (50%)		4 (31%)	0 (0%)		0 (0%)	1 (100%)	
Yes, prior to tic onset	1 (8.3%)	1 (50%)		8 (62%)	2 (67%)		3 (60%)	0 (0%)	
Yes, but only after tic onset	0 (0%)	0 (0%)		1 (7.7%)	1 (33%)		2 (40%)	0 (0%)	
Unknown	101	4		18	2		15	4	
<b>Tic-attack</b>	0 (0%)	1 (17%)	0.12	21 (68%)	3 (60%)	>0.99	10 (50%)	1 (20%)	>0.99
<b>Frequent coprophenomenon</b>	2 (1.8%)	0 (0%)	>0.99	8 (26%)	0 (0%)	>0.99	6 (30%)	0 (0%)	>0.99
<b>Broad/extended word use</b>	2 (1.8%)	0 (0%)	>0.99	22 (71%)	4 (80%)	>0.99	14 (70%)	3 (60%)	>0.99
<b>Blocking</b>	0 (0%)	0 (0%)	>0.99	4 (13%)	0 (0%)	>0.99	6 (30%)	0 (0%)	>0.99
<b>Self/other injurious</b>	1 (0.9%)	0 (0%)	>0.99	19 (61%)	2 (40%)	>0.99	9 (45%)	2 (40%)	>0.99
<b>Throwing</b>	0 (0%)	0 (0%)		6 (19%)	0 (0%)	>0.99	3 (15%)	1 (20%)	>0.99
<b>Other FNS</b>	0 (0%)	0 (0%)		5 (16%)	1 (20%)	>0.99	3 (15%)	1 (20%)	>0.99



Characteristic	TT N=113	TT+ N=6	p	FT N=31	FT- N=5	p	AWT N=20	AWT+ N=5	p
<b>Rostrocaudal progression</b>	90 (80%)	5 (83%)	>0.99	1 (3.2%)	0 (0%)	>0.99	7 (35%)	3 (60%)	>0.99
<b>Anxiety</b>	78 (69%)	5 (83%)	>0.99	28 (90%)	4 (80%)	>0.99	20 (100%)	5 (100%)	
<b>ADHD</b>	91 (81%)	5 (83%)	>0.99	21 (68%)	4 (80%)	>0.99	14 (70%)	3 (60%)	>0.99
<b>OCB</b>	64 (57%)	3 (50%)	>0.99	18 (58%)	2 (40%)	>0.99	19 (95%)	5 (100%)	>0.99
<b>Initial YGTSS-TTS</b>	14 (7)	14 (9)	>0.99	30 (14)	26 (12)	>0.99	29 (12)	21 (8)	0.57
<b>Initial YGTSS-TOTAL</b>	22 (15)	25 (16)	>0.99	54 (25)	42 (24)	0.93	53 (27)	43 (20)	>0.99
<b>Follow up YGTSS-TTS</b>	12 (7)	16 (6)	>0.99	28 (13)	0 (NA)	0.16	33 (12)	18 (4)	0.37
No follow up	95	4		18	4		13	3	
<b>Follow up YGTSS-TOTAL</b>	17 (13)	31 (13)	0.47	53 (26)	0 (NA)	0.22	63 (25)	32 (11)	0.46
No follow up	96	4		18	4		13	3	
<b>Response to treatment</b>	12 (67%)	0 (0%)	0.86	3 (23%)	1 (100%)	>0.99	0 (0%)	2 (100%)	0.13
No follow up	95	4		18	4		13	3	

TT: typical tics, TT+: typical tics  $\geq 12$  years, FT: functional tics, FT-: functional tics  $< 12$  years, AWT: acutely worsened tics, AWT+: acutely worsened tics  $\geq 12$  years, FNS: functional neurological symptoms, ADHD: attention deficit-hyperactivity disorder, OCB: obsessive compulsive behavior, YGTSS-TTS: Yale Global Tic Severity Score – Total Tic Score, Response to treatment:  $\geq 25\%$  improvement in YGTSS-TTS from initial to subsequent visit

**Table 5: Proposed Criteria for Differentiating Primary Tic Disorders from Functional Tic Disorders**

Diagnostic for Primary Tic Disorder (PTD)

6. Must not be fulminant in onset
7. Must include at least two of the following patient characteristics:
  5. Rostrocaudal progression
  6. Presence of at least one cooccurring conditions (anxiety, ADHD, OCB)
  7. Positive family history
8. May only include one of the following:
  3. Coprolalia or coprophenomenon
  4. Self-injurious tics
9. Must not include:
  7. "Tic attacks"
  8. "Blocking" tics
  9. Broad spectrum of word use or frequent coprolalia
  10. Throwing
  11. Presence of other FNS
12. Must not be associated with drug use or underlying medical condition

Diagnostic for Functional Tic Disorder (FTD)

5. Must be sudden and fulminant in onset (rapid progression in frequency and severity over less than one month)
6. Must include at least one of the following patient characteristics:
  1. Comorbid anxiety
  2. Female sex
  3. Lack of family history
7. Must have at least two of the following:
  1. "Tic attacks"
  2. "Blocking" tics
  3. Frequent coprolalia or coprophenomenon
  4. Broad spectrum of word use or frequent coprolalia
  5. Self-injurious tics or tics injurious to others
  6. Throwing
  7. Presence of other functional neurological symptoms

Diagnostic for Mixed Tic Disorder (MTD)

3. Meets all criteria for PTD with subsequent fulminant development of at least two of the following:
  8. "Tic attacks"
  9. "Blocking" tics
  10. Frequent coprolalia or coprophenomenon
  11. Broad spectrum of word use or frequent coprolalia
  12. Self-injurious tics or tics injurious to others
  13. Throwing
14. Presence of other functional neurological symptoms

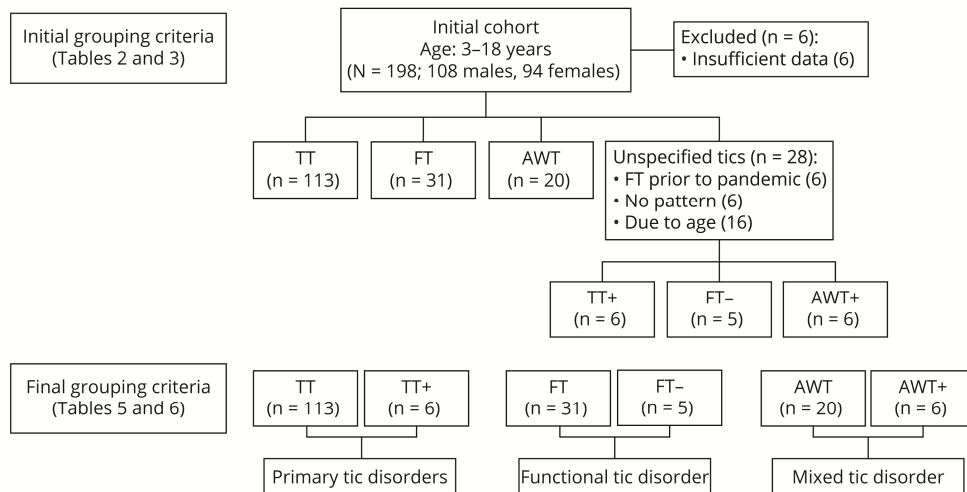
**Table 6: Comparison of the Proposed Criteria for Differentiating Primary Tic Disorders from Functional Tics Disorders**

Characteristic	PTD N = 119	FTD N = 36	MTD N = 25	p
<b>Age of Tic Onset</b>	6 (3)	14 (2)	9 (3)	<0.001
<b>Sex</b>				<0.001
Male	78 (66%)	2 (5.6%)	7 (28%)	
Female	41 (34%)	34 (94%)	18 (72%)	
<b>Family history</b>	49 (42%)	7 (19%)	12 (48%)	0.031
<b>Premonitory urge/suppressibility</b>	80 (67%)	26 (72%)	24 (96%)	0.014
<b>Social Media Exposure</b>				0.003
None	12 (86%)	4 (25%)	1 (17%)	
Yes, prior to tic onset	2 (14%)	10 (62%)	3 (50%)	
Yes, but only after tic onset	0 (0%)	2 (12%)	2 (33%)	
Unknown	105	20	19	
<b>Tic-attack</b>	0 (0%)	24 (67%)	11 (44%)	<0.001
<b>Frequent coprophenomenon</b>	2 (1.7%)	8 (22%)	6 (24%)	<0.001
<b>Broad/extended word use</b>	2 (1.7%)	26 (72%)	17 (68%)	<0.001
<b>Blocking</b>	0 (0%)	4 (11%)	6 (24%)	<0.001
<b>Self/other injurious</b>	1 (0.8%)	21 (58%)	11 (44%)	<0.001
<b>Throwing</b>	0 (0%)	6 (17%)	4 (16%)	<0.001
<b>Other FNS</b>	0 (0%)	6 (17%)	4 (16%)	<0.001
<b>Rostrocaudal progression</b>	95 (80%)	1 (2.8%)	10 (40%)	<0.001
<b>Anxiety</b>	83 (70%)	32 (89%)	25 (100%)	<0.001
<b>ADHD</b>	96 (81%)	25 (69%)	17 (68%)	0.2
<b>OCB</b>	67 (56%)	20 (56%)	24 (96%)	<0.001
<b>Initial YGTSS-TTS</b>	14 (7)	29 (13)	27 (12)	<0.001

Characteristic	PTD N = 119	FTD N = 36	MTD N = 25	p
<b>Initial YGTSS-TOTAL</b>	22 (15)	53 (25)	51 (26)	<0.001
<b>Follow up YGTSS-TTS</b>	13 (7)	26 (14)	29 (12)	<0.001
No follow up	99	22	16	
<b>Follow up YGTSS-TOTAL</b>	18 (13)	49 (29)	56 (26)	<0.001
No follow up	100	22	16	
<b>Response to treatment</b>	12 (60%)	4 (29%)	2 (22%)	0.076
No follow up	99	22	16	

PTD: primary tic disorder, FTD: functional tic disorder, MTD: mixed tic disorder, FNS: functional neurological symptoms, ADHD: attention deficit-hyperactivity disorder, OCB: obsessive compulsive behavior, YGTSS-TTS: Yale Global Tic Severity Score – Total Tic Score, Response to treatment:  $\geq 25\%$  improvement in YGTSS-TTS from initial to subsequent visit

**Figure 1: Study Design.** TT: typical tics, FT: functional tics, AWT: acutely worsened tics, TT+: typical tic characteristics with tic onset  $\geq 12$  years, FT-: functional tic characteristics with tic onset  $< 12$  years, AWT+: typical tic onset  $< 12$  years with functional worsening  $\geq 12$  years



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# Neurology® Clinical Practice

## Creating a Patient-Based Diagnostic Checklist for Functional Tics During the COVID-19 Pandemic

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