Outcomes of Youth Treated With Electroconvulsive Therapy: A Retrospective Cohort Study

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ABSTRACT

Background: The use of electroconvulsive therapy (ECT) in children and adolescents is based on a limited evidence base in the medical literature. We report outcomes of a cohort of youth treated with ECT at a single US academic medical center.

Methods: We conducted a retrospective chart review and analysis of all patients aged 18 years and younger who received ECT at the University of Utah from 1985 through 2016. For each patient record, 3 short-term clinical outcomes were assessed: response on the Clinical Global Impressions–Improvement scale, number of treatments administered, and reported side effects. Baseline characteristics were tested as predictors of clinical outcomes.

Results: One hundred seven youth (aged 10–18 years, 46% female) received ECT for a mood disorder, psychotic disorder, catatonia, or neuroleptic malignant syndrome. The most common diagnoses (*DSM-IV-TR* or *DSM-5*) were major depressive disorder (76 patients) and bipolar disorder (23 patients). The rate of response (much improved or very much improved) for the entire cohort was 77%. The mean number of treatments administered was 10.5. The most commonly reported side effects were headache (75%) and memory problems (65%). One patient experienced tardive seizures. There were no deaths or serious injuries. Clinical response was not predicted by age, sex, or clinical features (all $P > .05$).

Conclusions: These data suggest that ECT is a safe and effective treatment for children and adolescents with certain severe psychiatric illnesses. ECT outcomes and side effects were similar to those reported in adults, particularly for patients aged 15–18 years, for whom there are the most data.

J Clin Psychiatry 2021;82(2):19m13164

To cite: Pierson MD, Mickey BJ, Gilley LB, et al. Outcomes of youth treated with electroconvulsive therapy: a retrospective cohort study. *J Clin Psychiatry*. 2021;82(2):19m13164.

To share: https://doi.org/10.4088/JCP.19m13164

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Electroconvulsive therapy (ECT) is a well-established treatment for adults with certain severe mental disorders. A large body of research[1–3] demonstrates response rates ranging from 50%–90% for adults with severe mood disorders, with the higher response rates expected in patients who receive ECT as a first-line treatment or have shorter duration of illness. Catatonia,[4] psychosis,[5–7] and older age[8,9] in an affective disorder may also predict response. In adult patients with primary psychotic disorders, ECT response reported in the literature is more variable. When ECT is used as monotherapy, response is usually inferior to that of antipsychotic medication used as monotherapy, but in combination with antipsychotic medications, ECT seems to confer an additional benefit.[10–12] Higher response rates are predicted among patients with shorter episode duration or acute psychotic exacerbations.[13] In adults, ECT is relatively well tolerated, with typical side effects being transient cognitive problems, headache, nausea, and muscle soreness.[14]

ECT use in youth is much less common than in adults, for multiple reasons. Prior studies[15,16] have shown that a majority of child and adolescent psychiatrists have little knowledge of the use of ECT in youth and would not be confident in providing a second opinion. Few ECT providers are trained in child and adolescent psychiatry, and few child and adolescent psychiatry training programs provide experience on an ECT service.[17] Among child psychiatrists who reported they had never used ECT, the most common reason was the limited evidence base for its use.[15] In a study[16] of child psychiatrists and psychologists, respondents believed that ECT was safer in adults than in youth and safer in adolescents than in children. Finally, some states have specific legislation that prohibits the use of this treatment under certain ages. Studies[18,19] have shown that youth represent only about 1% of the patients who receive ECT.

The evidence supporting the use of ECT in youth is growing, but it remains based primarily on case reports and case series. Four relatively recent retrospective studies,[20–23] with sample sizes ranging from 13 to 51 (n = 111 total), suggest that ECT is safe and effective for youth with severe affective and psychotic disorders. What is not well described, however, is the value of demographic and baseline clinical data for predicting outcomes for youth treated with ECT. Here we assess outcomes of a cohort of children and adolescents treated with ECT at a single academic institution in the United States. We also examine associations between baseline features and clinical outcome variables.

Clinical Points

- A large body of research informs the use of electroconvulsive therapy (ECT) in adults, but there are limited data on its use in youth.
- These data suggest that youth aged 15–18 years receiving ECT for a severe affective disorder or catatonia respond similarly to adults. Clinicians should consider its use in these patients.

METHODS

Data Source

The protocol for this study was approved by the institutional review board at the University of Utah. We reviewed the charts of all patients 18 years and younger who received ECT at the University Neuropsychiatric Institute in Salt Lake City, Utah, from 1985 through 2016. Diagnoses at admission, time of ECT, and discharge were collected. When the primary diagnosis was not clear, the authors (L.B.G. and H.R.W.) independently reviewed the charts to come to a consensus. *DSM-IV-TR*[24] criteria were used for cases prior to 2013 and *DSM-5*[25] criteria were used for cases from 2013 onward. Only youth who received ECT for an affective, psychotic, or catatonic diagnosis were included for analysis, because these are the best-established indications for ECT in adults. Global Assessment of Functioning (GAF)[24] scores at time of ECT, when available, were collected. We collected demographic information, including age, sex, and ethnicity, when available.

Children and adolescents who received ECT were evaluated by at least 2 board-eligible/board-certified child and adolescent psychiatrists and, as per hospital policy, approved for ECT by the medical director of the hospital. Patients and their legal guardians were provided with information about the diagnosis, treatment options, and the risks and benefits of ECT. Written informed consent from the patients' guardians was obtained prior to starting ECT.

We collected data on ECT treatments, including number of treatments and electrode placement. For patients who received more than 1 treatment series during their adolescence, we analyzed data on the first ECT series only. ECT was administered using the spECTrum 5000Q device (MECTA Corporation, Tualatin, Oregon). Treatments were typically done every other day, 3 times per week. Motor seizure duration was measured using a blood pressure cuff on the forearm, and seizure adequacy was defined as a motor seizure of at least 30 seconds. All patients received hyperventilation before the stimulus was administered. During a course of ECT, patients who no longer had adequate seizure duration at maximum stimulus typically received caffeine intravenously, though on a few instances theophylline or aminophylline was used when caffeine was unavailable at the institution. The typical anesthetic agent for induction was methohexital, and succinylcholine was the muscle paralytic for all patients.

Outcome Measures

Response to ECT was determined by independent reviews of the charts by 2 authors (L.B.G. and H.R.W.). All patients were assigned a Clinical Global Impressions–Improvement scale (CGI-I) score.[26] If there was disagreement between the authors about the CGI-I score, they reviewed the chart together for consensus. Response was defined as a score of 1 (very much improved) or 2 (much improved) on the CGI-I. In addition, we recorded all side effects that patients endorsed or psychiatrists observed during the ECT course and the number of treatments administered in the ECT series. Generally, patients were treated until symptoms resolved, so the number of treatments in the series was considered as a proxy for speed of response.

Statistical Analyses

Analyses were performed using R statistical software, version 3.2.4 (R Foundation, 2016), and the RStudio environment, version 0.99.892.[27] Baseline variables were tested as predictors of 3 types of clinical outcome: response on the CGI-I (dichotomous), number of ECT treatments administered (continuous), and presence of reported side effects (dichotomous). Side effects were further distinguished by type: headache, nausea/vomiting, muscle soreness, and memory problems. Logistic regression (eg, glm function, logit model) was used to test baseline predictors of ECT response. To evaluate associations between dichotomous and continuous variables, the Welch unequal-variances 2-sample *t* test was used, and the standardized mean difference (Hedges *g*) was estimated as a measure of effect size. To examine associations between 2 dichotomous variables, the Fisher exact test was used, and the odds ratio was estimated as a measure of effect size. To evaluate associations between 2 continuous variables, the Pearson correlation was computed. Because the distribution of age was strongly skewed in our sample (Figure 1), age was also examined with nonparametric tests (eg, Spearman correlation, Wilcoxon rank sum test).

RESULTS

Baseline Characteristics

One hundred ten children and adolescents received ECT for a psychiatric disorder at the University Neuropsychiatric Institute during the period 1985–2016. Three patients with autism received ECT for self-injurious behavior and, because they did not have concomitant affective, psychotic, or catatonic diagnoses, were not included in the analysis. We therefore report on 107 patients. Forty-nine patients (46%) were female, and the mean age at the start of the treatment series was 16.5 years. The age range was 10–18 years (Figure 1). The most common diagnoses were major depressive disorder (MDD) and bipolar disorder (BD) (Table 1). Twelve patients had a secondary diagnosis of autism spectrum disorder, and 2 had intellectual disability.

GAF scores at the time of consultation for ECT were available for 75 patients. The mean score was 24.2, with a

Figure 1. Age Distribution by Sex of the Study Cohort

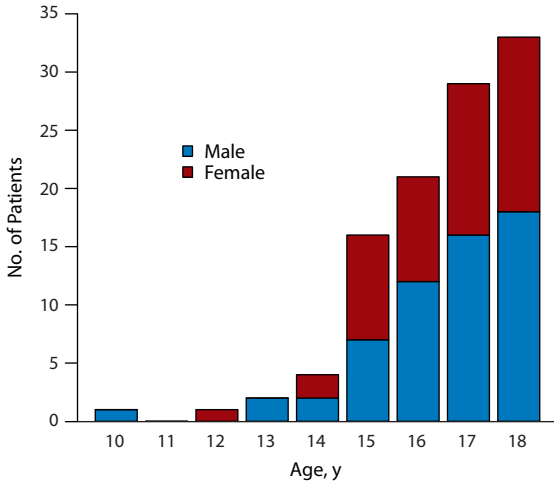

Table 1. Demographics and Baseline Characteristics

Characteristic	Value[a] (N = 107)
Age, mean (SD), y	16.5 (1.5)
Female	49 (45.8)
Diagnosis	
Major depressive disorder, without psychosis	46 (43.0)
Major depressive disorder, with psychosis	30 (28.0)
Bipolar depressive episode, without psychosis	5 (4.7)
Bipolar depressive episode, with psychosis	3 (2.8)
Bipolar mania/mixed episode, without psychosis	3 (2.8)
Bipolar mania/mixed episode, with psychosis	12 (11.2)
Schizoaffective disorder, depressive type	1 (0.9)
Schizoaffective disorder, bipolar type, depressive episode	3 (2.8)
Schizoaffective disorder, bipolar type, manic/mixed episode	1 (0.9)
Depression and psychosis secondary to Tay-Sachs disease	1 (0.9)
Catatonia secondary to *M. pneumoniae* encephalitis	1 (0.9)
Psychosis not otherwise specified with catatonia	1 (0.9)
Total with catatonia	10 (9.3)
Total with neuroleptic malignant syndrome	3 (2.8)
GAF score at start of ECT, mean (SD)[b]	24.2 (9.2)

[a]All values n (%) unless otherwise noted. [b]32 missing values.
Abbreviations: ECT = electroconvulsive therapy, GAF = Global Assessment of Functioning scale, *M.* = *Mycoplasma*.

range from 6 to 45, indicating that the patients were typically seriously impaired and unable to function in almost all social domains.

Younger patients (aged 10–14 years) had more severe symptoms and functional impairment. There was a significant association between younger age and the presence of psychosis ($P = .038$, Wilcoxon rank sum test) and catatonia ($P = .015$, Wilcoxon rank sum test). Younger age also correlated with lower GAF score ($\rho = 0.247$, $P = .032$, Spearman correlation). All of the patients in our sample under 15 years of age (n = 8) were psychotic and/or catatonic. There was no statistically significant association between sex and other baseline variables ($P > .05$).

Stimulus dosing and electrode placement reflected the changing practice at the institution over the years of the study. Earlier patients were typically administered a brief pulse waveform, and later patients primarily received ultrabrief stimulation (< 0.5 ms). Bifrontal lead placement became standard at our institution in 2001. Overall, 1 patient received right unilateral lead placement, 2 received mixed lead placement (started right unilateral and converted to bitemporal), 13 received bitemporal lead placement, and 91 received bifrontal lead placement.

Clinical Outcomes

Response. The overall response rate for the sample was 77%. The response rate was lower in patients with a schizophrenia-spectrum diagnosis than in other patients (40% vs 78%, odds ratio [OR] = 0.19), but this difference did not reach statistical significance ($P = .07$, Fisher exact test). Psychotic features did not predict response (OR = 1.0). Manic/mixed episodes, catatonia, and neuroleptic malignant syndrome (NMS) tended to respond better than other predictors, but none of these reached statistical significance (Table 2). In our sample, patients with depression (MDD or BD) had a response rate of 74%, while patients in a manic or mixed episode had a response rate of 88%. Patients who had a diagnosis of catatonia in addition to their principal mood or psychotic disorder had a response rate of 90%, and all 3 patients with NMS responded. In further analyses restricted to the subgroup of patients with affective disorders, there was similarly no significant association between baseline variables and response rate.

Number of treatments. The mean number of treatments in the acute series was 10.5. There was no statistically significant association between any baseline demographic or clinical variable and the number of treatments (Table 3), although patients with schizophrenia-spectrum illness tended to receive fewer treatments on average than other patients (mean of 8.4 vs 10.6, $P = .051$). This association was independent of the association between a schizophrenia-spectrum illness and ECT response: in a logistic regression that included both ECT response and the number of treatments as predictors, each remained associated with schizophrenia-spectrum illness ($P = .035$ and $P = .051$, respectively). Patients with catatonia received a greater number of treatments on average than other patients (mean of 13.0 vs 10.2, $P = .078$).

Side effects. Ninety percent of the sample reported at least 1 side effect during the treatment course. The most commonly reported side effect of ECT was headache (75%), followed by memory problems (65%), nausea/vomiting (50%), and muscle soreness (29%). One patient experienced tardive seizures on 2 occasions during her continuation course (not during the index series). These occurred within 30 minutes of her treatment and were resolved with propofol and midazolam. There were no other serious side effects.

In tests for associations of baseline variables with side effects, we found that muscle soreness was reported less commonly by patients with psychosis than by those without psychosis (14% vs 43%; OR = 0.22; 95% CI, 0.07–0.61; $P = .014$ after Bonferroni correction for 12 tests). No statistically significant predictors were found for memory

Table 2. Predictors of Response to ECT (N = 107)

Continuous Predictors	Nonresponders (n = 25)	Responders (n = 82)	SMD[a]	95% CI	P[b]
Age, mean (SD), y	16.5 (1.4)	16.5 (1.5)	0.005	−0.452 to 0.462	.98
GAF score, mean (SD)[c]	23.3 (8.7)	24.4 (9.4)	−0.117	−0.663 to 0.430	.66
Dichotomous Predictors	**Nonresponders[d] (n = 25)**	**Responders[d] (n = 82)**	**OR**	**95% CI**	**P[b]**
Female	11	38	1.098	0.407 to 3.022	.84
MDD diagnosis	18	58	0.940	0.293 to 2.754	.90
Bipolar diagnosis	4	19	1.577	0.450 to 7.095	.45
Affective spectrum	22	77	2.083	0.300 to 11.708	.34
Schizophrenia spectrum	3	2	0.187	0.015 to 1.739	.07
Depressed	23	66	0.362	0.038 to 1.733	.19
Manic or mixed	2	14	2.352	0.481 to 22.881	.28
Psychotic	12	40	1.031	0.382 to 2.801	.95
Catatonic	1	9	2.936	0.372 to 134.940	.32
NMS	0	3	∞	0.124 to ∞	.99

[a]Hedges *g*. [b]Logistic regression. [c]32 missing values. [d]All values shown as n values.
Abbreviations: ECT = electroconvulsive therapy, GAF = Global Assessment of Functioning scale, MDD = major depressive disorder, NMS = neuroleptic malignant syndrome, OR = odds ratio, SMD = standardized mean difference.

Table 3. Predictors of the Number of Index ECT Treatments Administered (N = 107)

Continuous Predictors	Correlation Coefficient	95% CI	P[a]
Age	−0.029[a]	−0.218 to 0.162	.77[a]
Age	−0.049[b]		.62[b]
GAF score[c]	−0.020[a]	−0.246 to 0.208	.86[a]

Dichotomous Predictors	No. of Treatments, Variable Present, Mean (SD)	No. of Treatments, Variable Absent, Mean (SD)	SMD[d]	95% CI	t[e]	P[e]
Female (n = 49)	10.9 (2.6)	10.2 (3.1)	−0.254	−0.644 to 0.136	−1.34	.18
MDD diagnosis (n = 76)	10.8 (2.7)	9.9 (3.3)	−0.302	−0.730 to 0.127	−1.31	.20
Bipolar diagnosis (n = 23)	9.9 (3.0)	10.7 (2.9)	0.253	−0.219 to 0.726	1.07	.29
Affective spectrum (n = 99)	10.6 (2.8)	9.8 (4.4)	−0.274	−1.011 to 0.462	−0.51	.62
Schizophrenia spectrum (n = 5)	8.4 (1.8)	10.6 (2.9)	0.757	−0.166 to 1.679	2.55	.05
Depressed (n = 89)	10.5 (2.8)	10.4 (3.3)	−0.043	−0.561 to 0.474	−0.15	.88
Manic or mixed (n = 16)	9.9 (2.4)	10.6 (3.0)	0.224	−0.320 to 0.767	0.97	.34
Psychotic (n = 52)	10.5 (3.3)	10.5 (2.5)	−0.029	−0.416 to 0.359	−0.15	.88
Catatonic (n = 10)	13.0 (4.3)	10.2 (2.6)	−0.977	−1.655 to −0.299	−1.97	.08
NMS (n = 3)	6.7 (3.2)	10.6 (2.8)	1.373	0.186 to 2.561	2.10	.17

[a]Pearson correlation. [b]Spearman correlation. [c]32 missing values. [d]Hedges *g*. [e]Welch 2-sample *t* test.
Abbreviations: ECT = electroconvulsive therapy, GAF = Global Assessment of Functioning scale, MDD = major depressive disorder, NMS = neuroleptic malignant syndrome, SMD = standardized mean difference.

problems, headache, nausea/vomiting, or muscle soreness (all $P > .05$ after Bonferroni correction).

Associations Between Clinical Outcomes

We performed exploratory analyses to evaluate for associations among 6 clinical outcomes: CGI-I response, number of treatments, headache, memory problems, muscle soreness, and nausea/vomiting. A positive association was found between nausea/vomiting and headache ($P = .001$, Fisher exact test, Bonferroni-corrected for 15 tests). There were no other significant associations (all $P > .05$ after Bonferroni correction). There was also no association between lead placement and clinical outcomes ($P > .05$).

DISCUSSION

This study describes, to our knowledge, the largest cohort of children and adolescents treated with ECT in the United States. The large sample size improved the estimates of short-term outcomes and allowed for an analysis of predictors of outcomes, which has not been previously well described in the literature. The highest response rates were observed in mania, catatonia, and NMS. Age and sex did not predict ECT outcomes in youth, which is notable, given that significant neurobiological changes occur between childhood and late adolescence. It also provides evidence against the notion that ECT is safer or more effective in adults than in adolescents.[16]

Although patients in this sample were typically seriously impaired in functioning, the majority experienced clinically significant improvement after a course of ECT. The response rate of this sample, 77%, is very close to those reported in other recent retrospective studies. A sample of 51 youth from the Mayo Clinic, which was similar to ours in terms of diagnoses treated, had a 77% response rate.[23] Two cohorts from tertiary care centers in India were reported to have response rates of 76%[20] and 77%,[21] although those

samples had a greater proportion of patients with psychotic and catatonic symptoms than the US sample. All 3 studies defined response identically to this study (CGI-I rating of much improved or very much improved). A sample of 13 adolescents from Canada, in which "reliable improvement" was defined as a decrease in the Beck Depression Inventory-II score of 10 points or more, demonstrated an improvement rate of 77%.[22] In older studies, the response rates were more variable.[28–31] Thus, our findings are consistent with those of more recent studies that show response rates of 76%–77% among seriously ill youth.

Previous reports of side effects are highly variable in the adolescent literature. This variability may be due to differences in how this information is collected as well as variability in the patient population and in administration of treatments. Reports of the per-person rates of memory complaints range from 0% to 85%; headaches, from 8% to 80%; nausea/vomiting, from 8% to 64%; and muscle soreness, from 0.5% to 69%.[20–23,28–35] The rates of the side effects in our study fit within these ranges.

Tardive seizures have occurred in 0%–9% of youth described in retrospective studies.[23,28,30,34,35] The 1 patient in our study who experienced tardive seizures during her continuation course represents 0.9% of our sample. Because of the large sample size, this rate most likely represents an improved estimate of the risk of tardive seizures in youth receiving ECT.

Previous studies have suggested that youth with a schizophrenia spectrum diagnosis have a lower ECT response rate than those with an affective disorder.[30,36] We observed a similar pattern in our sample, although this pattern did not reach statistical significance. Patients with a schizophrenia spectrum diagnosis received fewer treatments than other patients, independent of ECT response; this finding has not previously been reported in the literature to our knowledge. Together, these findings suggest that youth with schizophrenia spectrum disorders may have a lower chance of response relative to youth with affective disorders, but those who do respond may respond more rapidly. However, while the number of treatments may indicate speed of response, for the nonresponders, it may instead indicate when the psychiatrist determines to stop trying. It is possible that, in schizophrenia spectrum disorders, response happens quickly, or if it does not, the psychiatrist stops treating, perhaps based on knowledge from the adult literature of the lower response rate in these patients. Similarly, in catatonia and affective disorders, even in the face of nonresponse, clinicians may be more likely to continue treating based on the evidence that these disorders are highly responsive to ECT. These findings require confirmation in a larger sample.

Studies[20,36] on youth with catatonia have suggested that this disorder is highly responsive to ECT. A recent study[23] demonstrated similar changes in CGI score between patients with and without catatonia. Data on ECT response among youth with NMS are limited, with a recent case series[37] describing significant improvement in 5 youth with this condition. In our sample, patients with catatonia or NMS appeared to respond more frequently to ECT than did patients without these disorders (90% and 100%, respectively), although these differences did not reach statistical significance due to the small number of patients. Previous studies have not reported on how catatonia or NMS predict other clinical outcomes. In our study, subjects with NMS received fewer treatments on average compared with other subjects (6.7 vs 10.6), whereas patients with catatonia received a greater number of treatments (13.0 vs 10.2), although these findings did not reach statistical significance due to the small number of patients with these conditions.

In our sample, the syndrome of psychosis did not predict treatment response or number of treatments. In a meta-analysis[36] of studies from 1993 to 2003, the ECT response rate of youth with depression with psychotic features was 85%, while the response rate for youth without psychotic features was 69%. More recently, a study[22] of adolescents with depressive disorders demonstrated a 50% response rate in subjects with psychosis, compared with 67% in subjects without. Thus, psychotic features appear to be an inconsistent predictor of ECT response in youth, as similarly found in the adult literature.[3]

Our sample included 8 patients younger than 15 years old, and all of them were either psychotic or catatonic. Because of the limited evidence base for the safety and efficacy of ECT in children and the belief of many mental health professionals that ECT is safer in adolescents than in children,[16] it is possible that only those with the most severe illness are referred at a young age for ECT. In addition, many patients receive ECT only after a long depressive illness course, which is more likely to be present in older adolescents.

This sample included 16 youth in a manic or mixed episode. Few studies have assessed ECT outcomes of youth with mania, but the suggestion of the literature[29,30] is that this condition is highly responsive to ECT. A systematic review[38] done in 1997 showed an 80% response rate in youth with mania (20 subjects), compared with a 63% response rate for depression (40 subjects). Our study showed an 88% response rate in mania and a 74% response rate in depression.

This retrospective study has a number of limitations. First, without a comparison group that did not receive ECT, this study cannot determine the true incremental impact of ECT in youth. In addition, only patients who were referred for an ECT consultation by the primary psychiatrist were eligible to receive ECT, thus introducing the possibility of sampling bias. This study did not assess for many factors that may have influenced outcomes, for example, comorbid psychiatric disorders, long duration of illness, history of abuse, and family discord.[39–41] Self-injurious behavior in autism was not studied and remains an area in need of further research. As with any retrospective study, a potential for confirmation bias exists (ratings biased toward treatment response). Raters were not blinded to other variables such as diagnosis or number of treatments. Nonetheless, to improve reliability of ratings, 2 experienced independent raters reviewed each chart and came to a consensus on each case. Underreporting of side effects, particularly common or

mild ones, may underestimate their frequency. Furthermore, cognitive side effects were measured subjectively. This study reports on short-term outcomes only. Information about long-term benefits or side effects from ECT cannot be determined from these data. Finally, that these data derive from a single-site study limits the study's generalizability.

Overall, this study provides retrospective evidence suggesting ECT is a safe and effective treatment for youth with certain severe psychiatric illnesses. The data presented in this study show that, particularly for patients aged 15–18 years, for whom there are the most data, those with severe affective disorders and catatonia respond to ECT similarly to adults and that psychiatrists should consider ECT in their clinical decision making for these patients. Whether younger children, or youth with schizophrenia spectrum disorders, respond similarly to adults remains unclear.

Submitted: November 12, 2019; accepted August 5, 2020.

Published online: February 23, 2021.

Potential conflicts of interest: **Dr Mickey** has received research support from Novartis and LivaNova for unrelated work. **Drs Pierson**, **Gilley**, and **Week**s have no potential conflicts of interest.

Funding/support: None.

Acknowledgments: The authors thank Kelly Smith, MD, and Jeremy Kendrick, MD, both from the University of Utah, Salt Lake City, Utah, for providing some of the data used in the analysis. Drs Smith and Kendrick have no conflicts of interest to declare. We thank all the physicians, nurses, technicians, and administrators of the Treatment Resistant Mood Disorders clinic for providing care for our patients and families.

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Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Childhood and Adolescent Mental Health section. Please contact Karen D. Wagner, MD, PhD, at kwagner@psychiatrist.com.