



Does an Autism Spectrum Disorder Care Pathway Improve Care for Children and Adolescents with ASD in Inpatient Psychiatric Units?

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Abstract

Youth with autism spectrum disorder (ASD) are psychiatrically hospitalized at high rates. Though specialized psychiatric units are effective, few specialized units exist. The ASD Care Pathway (ASD-CP) was developed as a scalable approach to improving care in general psychiatric units through staff training and a package of autism-specific intervention strategies. An evaluation of the effectiveness of the ASD-CP in a public hospital child psychiatric service compared 18 months ($n = 17$) versus 18 months ($n = 20$) post implementation. Average length of hospital stay decreased 40% (22.4–13.4 days) and use of crisis interventions decreased 77% (holds/restraints; 0.65/day to 0.15/day), though each result only approached statistical significance ($p = 0.07$; 0.057). This study provides preliminary evidence for improved outcomes after implementation of an ASD-CP.

Keywords Autism spectrum disorder · Care pathway · Inpatient hospitalization · Psychiatric

Introduction

Autism spectrum disorder (ASD) is characterized by marked deficits in social communication and social interaction and the presence of restricted, repetitive behaviors and interests (American Psychiatric Association [APA], 2013). Individuals with ASD are also at increased risk for psychiatric comorbidity, with 70% of the ASD population diagnosed with at least one comorbid psychiatric disorder and 41%

with two or more diagnoses (Simonoff et al. 2008). Children and adolescents with ASD are psychiatrically hospitalized at significantly higher rates than children with other developmental or psychiatric disorders, more likely to present to an emergency department (ED) with psychiatric concerns, more likely to be psychiatrically boarded following ED visits, and have longer hospital stays compared to children without ASD (Croen et al. 2006; Kalb et al. 2012; Siegel and Gabriels 2014; Wharff et al. 2011). They are most typically psychiatrically hospitalized for externalizing problem behavior, such as aggression, self-injury and property destruction (Siegel et al. 2012). At particular risk for psychiatric hospitalization are children with ASD who exhibit self-injurious and aggressive behaviors, have depression or obsessive–compulsive disorder, are prescribed psychotropic medications, received an ASD diagnosis late in life, have sleep problems, or come from single parent households (Mandell 2008; Righi et al. 2017).

Although psychiatric hospitalization is relatively common for the population of children and adolescents with ASD, caring for individuals with ASD in an inpatient setting is complex, and research into effective practices is limited. Due to difficulties with social communication and/or associated intellectual deficits, individuals with ASD may have limited insight into the reason for hospitalization and may be unable

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to effectively communicate physical or emotional symptoms. Further, symptoms of medical or emotional problems can present atypically, such as through an increase in externalizing behaviors (e.g., self-injury, aggression). These developmental and communicative factors significantly complicate medical and psychiatric assessment. The verbal, social treatment strategies typically used in psychiatric hospitals, such as process groups, are poorly matched with the needs of individuals with ASD (Gabriels et al. 2012). In addition, hospital personnel often lack the training and clinical experience necessary for the provision of appropriate and effective care to patients with ASD (Gabriels et al. 2012; Heidgerken et al. 2005; Marrus et al. 2014). This limited understanding of autism can translate into increased risk of harm for both patients and staff, increased risk for inaccurate assessment of presenting problems, and inappropriate use of crisis interventions like seclusion, restraint, and PRN (as needed) medication administration (Gabriels et al. 2012).

Recently, research has demonstrated the effectiveness of specialized inpatient child psychiatry units that exclusively serve individuals with ASD and/or intellectual disability (ID; Gabriels et al. 2012; Pedersen et al. 2017; Siegel et al. 2014). Compared to general psychiatric units, these specialized units address the needs of developmentally delayed patients in several key areas: staff training, patient assessment and treatment, and environmental supports. Staff are trained in ASD/ID features and associated symptomology, as well as methods for effective intervention. Patients are assessed with a comprehensive developmental and psychiatric diagnostic as well as targeted assessment of the presenting challenging behaviors. Treatment approaches include a multi-disciplinary team, evidence-based behavior management strategies, often implemented or supervised by a specialist such as a Board Certified Behavior Analyst (BCBA), and intensive caregiver involvement in treatment. Environmental supports commonly include tools designed to enhance communication, equipment to protect staff, and considerations in unit design such as sensory gyms and quiet rooms (Gabriels et al. 2012; Siegel et al. 2014; Siegel and Gabriels 2014). Patients who were admitted to specialized inpatient units had shorter lengths of stay, lower readmission rates, decreased aggression, self-injury, and tantrums, and lower caregiver-reported irritability and hyperactivity scores upon discharge (Gabriels et al. 2012; Siegel et al. 2014). In a multi-site comparative effectiveness study of 350 youth with ASD admitted to six specialized child psychiatric units, there was a significant average decrease in aggression, self injury, and tantrums from admission to discharge, with mild regression at 2 months post-discharge (Pedersen et al. 2017).

Although these results are promising, few specialized psychiatric units for this population exist (estimated at 12–14 in the entire U.S. currently) and the feasibility of creating a separate, specialized unit is low in most hospitals. There

may also be some benefits to treatment in a unit where individuals with higher-functioning ASD are integrated with neurotypical peers, e.g. to practice skills in a setting more similar to the community. Importantly, experts in the field agree that children with ASD and significant emotional or behavioral difficulties can be adequately treated in general psychiatric units with the appropriate accommodations in place (McGuire et al. 2015). Expert consensus recommendations include: thorough assessment methods (i.e., medical, developmental, and psychiatric evaluation; assessment of communication skills and sensory responsivity; functional behavior assessment), environmental manipulations (e.g., visual schedules; quiet rooms), an individualized behavior plan, scheduled therapeutic and educational activities, staff training specific to ASD, and an emphasis on planning for generalization of treatment gains post-discharge (McGuire et al. 2015).

Because specialized units are scarce and appropriate accommodations for serving individuals with ASD in a general psychiatric inpatient setting have been identified, developing and evaluating a clinical care model for children with ASD within a general psychiatric unit is imperative. To address this need, a team of professionals at an urban public hospital, in collaboration with clinicians from a specialized unit, developed the ASD-Care Pathway (ASD-CP). Within the ASD-CP, emphasis is placed on receiving input from caregivers regarding the patient's communication skills, early warning signs of agitation, and activity and item preferences; implementing a structured schedule with extensive use of visual supports; teaching and reinforcing patient coping skills; and training staff in the features of ASD.

In the current study, the effectiveness of the ASD-CP for improving the outcomes of patients with ASD in the hospital's general psychiatric unit was examined. For participants admitted prior to the initiation of the ASD-CP, information was gathered through a retrospective chart review. Following the initiation of the ASD-CP, data were gathered prospectively as youth were admitted, found eligible, and entered the pathway. First, the demographic and clinical characteristics of patients with ASD who were admitted prior to and following the institution of the ASD-CP were examined. Next, clinical outcomes (i.e., the use of holds/restraints or intramuscular [IM] medication administration during admission, and the length of the admission) were compared for patients who did and did not receive the ASD-CP.

Methods

Study Participants

Individuals eligible for this study included all children and adolescents 4–17 years old who presented to the psychiatric

emergency care system (described below in Care Pathway Setting and Components) at a public hospital in the North-eastern United States ($N=5027$) during two time periods: January 2014 to June 2015 (before the implementation of the ASD-CP) and July 2015 to December 2016 (after the implementation of the ASD-CP) with a discharge diagnosis of ASD and who met the inclusion criteria for the ASD-CP. Inclusion criteria were low language level (non-verbal or minimally verbal, e.g. single word utterances or phrases, but not fluent, speech), low adaptive functioning level, and/or high disruptive behavior to the degree that the patient required 1:1 staffing based on the admitting physician's clinical judgment. Patients who did not require 1:1 staffing were not enrolled into the ASD-CP. Patients included in the current study were first-time admissions; children and adolescents who presented to the emergency service for readmission were excluded.

Of the 5027 children and adolescents who presented to the emergency service (the Children's Comprehensive Psychiatric Emergency Program [CCPEP]; Gerson et al. 2017) in the specified time period, 4% ($n=195$) had a diagnosis of ASD. Thirty-nine percent ($n=76$) of those patients with ASD did not require admission following evaluation and were released. Of the remaining 119 patients, 9.2% ($n=11$) were excluded from the study because they were readmissions. For the pre-implementation time period, 74 patients with ASD who were first time admissions were identified. Blind independent raters (SK,BF) used medical record review to determine which children and adolescents might have met criteria for the ASD-CP, had it been implemented, resulting in 23% ($n=17$), who met the criteria for the pathway. The interrater reliability was excellent, $\kappa=0.93$. Of the 34 children/adolescents with ASD who presented to the CCPEP in the 18 months after the implementation of the ASD-CP, 59% ($n=20$) were admitted, met inclusion criteria

and received the ASD-CP. See Fig. 1 for the participant flowchart.

Care Pathway Setting and Components

The ASD-CP was implemented in the pediatric psychiatric acute care system of an urban public hospital, which includes a CCPEP, and three inpatient units with a total of 45 beds. Each patient and family presenting to the CCPEP receives a comprehensive evaluation by a child and adolescent psychiatrist. Patients who present to the CCPEP may be evaluated and released if they do not require further stabilization, admitted for observation in a six-bed brief-stabilization unit, or be directly admitted to the inpatient units. Patients admitted to the brief-stabilization unit can be held for up to 72 h, and released to outpatient care or admitted for further treatment in the inpatient units.

The ASD-CP consisted of a modular staff training, toolkit and prescribed practices to be utilized with the patient. The training was structured as four 45-min modules consisting of lecture, video examples, interactive exercises, and role-play. The first module introduces ASD, including prevalence, diagnosis, and core characteristics. The first module also gives an overview of foundational principles for intervention, including ensuring patients' basic needs (e.g., thirst, hunger, pain) are met, withdrawing attention from problem behavior, and giving choices. The Tip Sheet is introduced and staff practice using the tool.

The next three modules cover components of the ASD-CP using the acronym 'PATHWay' as a shorthand for the principal intervention strategies (i.e., Module 2: Predictability, Activity; Module 3: Total communication, High reward; Module 4: WAY to cope). The Predictability didactic provides an overview of the importance of preparing patients by previewing upcoming events with a Visual Schedule and

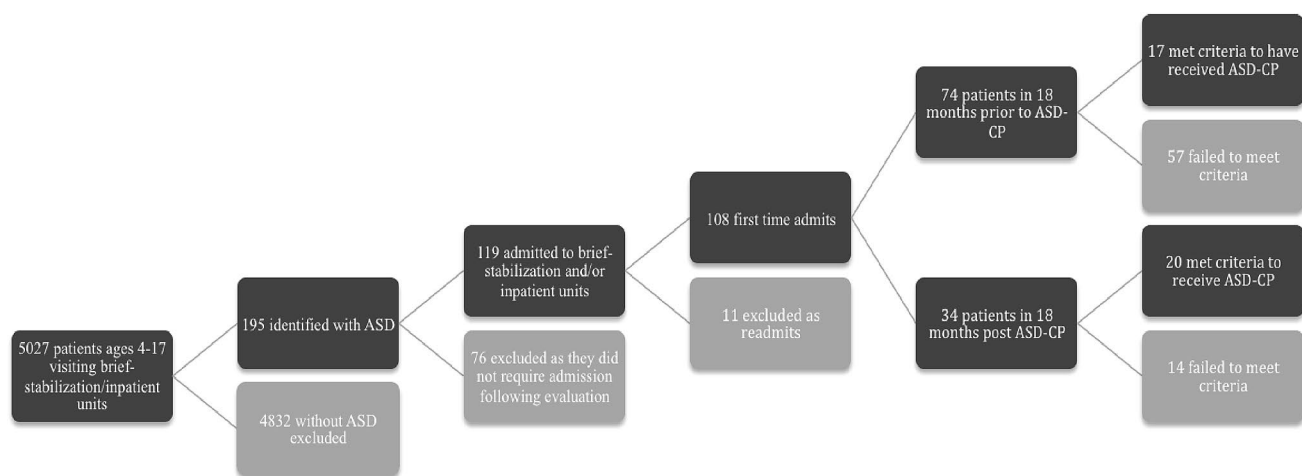


Fig. 1 Participant flowchart

a First-Then Card, giving warnings prior to transitions, and providing specific, concrete information about the future (e.g. “First shower, then lunch”). The Activity didactic discusses engaging patients in developmentally appropriate activities and using motor breaks, which are short intervals where patients are guided through vigorous physical activity. At the end of Module 2, trainees complete an exercise using the Visual Schedule and/or First-Then card to give instructions to a simulated patient.

The Total Communication didactic provides information on receptive and expressive language in ASD, including echolalia. Strategies for communication are introduced including using visual supports, simplifying spoken language, saying what to do instead of what not to do, and increasing communication supports using a hierarchy. The High Reward didactic introduces the idea of reinforcers and how to select reinforcers. Strategies include using labeled praise, rewarding contingently, and selecting reinforcers preferred by the patient. At the end of Module 3, trainees complete an exercise using the Staff Schedule, Visual Schedule, and First-Then Card.

The WAY to Cope module reviews why patients with ASD may become agitated and introduces a typical cycle of agitation. This module provides strategies that can be used throughout the cycle, from prevention through agitation, and afterwards. The Coping Card is introduced as a visual support for providing choices to enhance self-regulation when patients are agitated. This module also focuses on the importance of the team responding consistently to the patient and prioritizing safety-related goals. At the end of Module 4, trainees complete an exercise using the Coping Card with a simulated patient who displays agitation. The training concludes with a review of all materials and implementation guidelines and reminders.

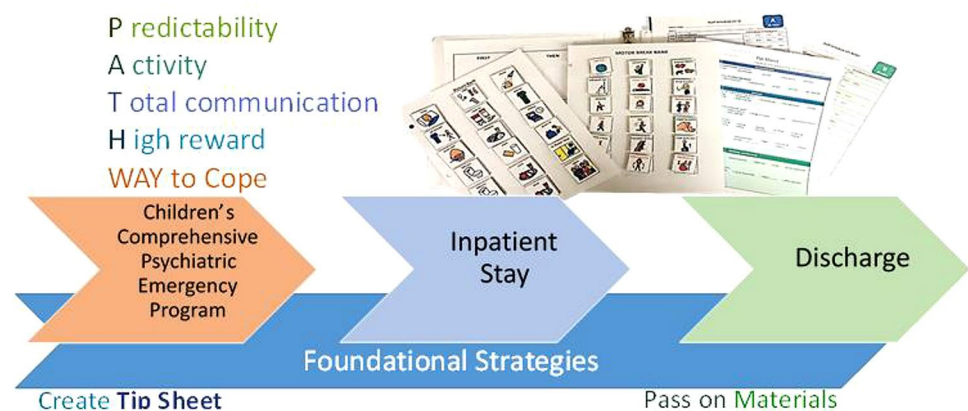
Intervention components within the ASD-CP modules were developed in line with the current evidence base for ASD treatment and include empirically-supported behavioral strategies. The modules can be presented individually in sequence or combined for one-half-day training. In

total, 232 staff were trained. Initial trainings were completed in the five months prior to implementation of the ASD-CP (February–June 2015). After implementation of the ASD-CP, trainings were held approximately once per quarter for staff new to the setting.

The training is supported by a toolkit provided in the form of a 1-inch 3-ring binder, to increase portability for use in the treatment setting. All components of the toolkit are introduced in the training and all role-plays require trainees to interact with the toolkit. The toolkit includes a Tip Sheet, visual supports including a Visual Schedule, First-Then Card and Coping Card, and staff supports including a Staff Schedule, Activity Ideas, and the Irritability subscale of the *Aberrant Behavior Checklist* (Aman and Singh 1986) to be used to further examine outcomes in future studies. The Tip Sheet is a one-page ASD-specific assessment filled out by parents or guardians presenting with the patient, if available. The Tip Sheet gathers information in one accessible place about communication, behavior, and patient preferences, primarily using a checkbox format with some space for free text. Parents are queried about the communication systems and rewards they use, to facilitate continuity during the inpatient stay if possible. The back of the Tip Sheet has room for staff to add information about the patient gathered during the stay.

The Visual Schedule and First-Then Card are used to improve patient compliance and transitions, and are supported by image banks of laminated cards (approx. 1.5” square) with a picture and text description of activities and objects (e.g. wake up, breakfast, meds, talk to doctor) typically present during hospitalization. Images were chosen by the multidisciplinary team and piloted on the units prior to finalizing. The Staff Schedule is a breakdown of the day with activity choices and activities of daily living (e.g., toileting) embedded. The Staff Schedule highlights the Safety Goal chosen by the staff, the Reward identified by the staff and patient, and checkboxes with the schedule of reinforcement (reward) for meeting the Safety Goal. Figure 2 provides an overview of the key components of the ASD-CP.

Fig. 2 ASD-CP overview



Procedures and Measures

Sociodemographic and services use data were abstracted from the medical records by a trained research associate (EO). To insure accuracy, 55% of the records were reabstracted. Variables abstracted included age, sex, amount of time spent in the brief-stabilization unit, brief-stabilization discharge disposition (admitted to inpatient unit or discharged to outpatient care), comorbid diagnoses, inpatient length of stay, number of holds/restraints in brief-stabilization and the inpatient units, and number of IM medication administrations.

Statistical Analyses

Categorical data were summarized using counts and percentages. Continuous data were summarized using means and standard deviations. Differences between the pre ASD-CP and post ASD-CP continuous outcomes of interest were evaluated using unpaired *t*-tests with differences for categorical variables evaluated with Fisher's Exact or Chi-Square tests. Data were analyzed using SPSS version 20.

Results

Table 1 displays the sociodemographic characteristics of the youth who met criteria for the ASD-CP pre and post implementation of the pathway. Examining youth prior to initiation of the ASD-CP, 76.5% were male, 35.3% were 4–12 years of age, 52.9% spent 1 day or less in the CCPEP, 76.5% were admitted and 11.8% had 2 or more comorbid diagnoses. Of youth with ASD who met criteria for the ASD-CP after its implementation, 95% were female, 60% were

4–12 years of age, 55% spent 1 day or less in the CCPEP, 85% were admitted, and 25% had 2 or more comorbid diagnoses. There were no statistically significant differences in sociodemographic or initial clinical features between youth with ASD who met criteria for the pathway pre or post implementation of the pathway (all $p > 0.10$).

Table 2 displays the continuous outcomes of interest for youth treated before and after the implementation of the ASD-CP. Although there were no statistically significant differences in the inpatient length of stay, number of holds/restraints during the inpatient stay, or the number of IM medication administrations delivered, there was a large difference in the absolute number of days spent in the hospital that approached statistical significance (pre ASD-CP = 22.4 days, post ASD-CP = 13.4 days; unpaired *t*-test = 1.88, $p = 0.07$). There was also a large and clinically relevant difference in the number of holds/restraints used in the CCPEP before and after the initiation of the ASD-CP (pre ASD-CP = 0.65,

Table 2 Length of stay, holds/restraints and im medications for youth pre and post initiation of the ASD-CP (N = 37)

	Pre ASD-CP mean	Post ASD-CP mean	Test of significance (unpaired <i>T</i> -test; <i>p</i>)
Inpatient length of stay	20.9	12.5	1.69, 0.10
Total length of stay	22.4	13.4	1.88, 0.07
Brief-stabilization unit holds/restraints	0.65	0.15	1.97; 0.057
Inpatient holds/restraints	2.59	0.50	1.07; 0.291
Total holds/restraints	3.24	0.65	1.34; 0.188
Total intramuscular meds	3.12	0.85	1.17; 0.256

Table 1 Sociodemographic Characteristics of Youth Meeting Criteria for the ASD-CP pre and post Implementation

	Pre ASD-CP N	Pre ASD-CP %	Post ASD-CP N	Post ASD-CP %	Test of significance (Fisher's exact; <i>p</i>)
Male sex	13	76.5	19	95	0.159; 0.123
Female sex	4	23.5	1	5	
Age 4–12	6	35.3	12	60	0.191; 0.121
Age 13–17	11	64.7	8	40	
1 Day in brief-stabilization unit	9	52.9	11	55	1.00; 0.581
2+ Days in brief-stabilization unit	8	47.1	9	45	
Brief-stabilization unit dispo: admit	13	76.5	17	85	0.680; 0.404
Brief-stabilization unit dispo: D/C	4	23.5	3	15	
Comorbidity: 0 Dx	9	52.9	6	30	2.257; 0.323*
Comorbidity: 1 Dx	6	35.3	9	45	
Comorbidity: 2+ Dx	2	11.8	5	25	

*Chi-Square Test

post ASD-CP = 0.15, unpaired t -test = 1.97, $p = 0.057$). When we examined the number of youth who experienced holds/restraints before and after initiation of the care pathway (Table 3), we found a statistically significantly smaller proportion of children experiencing a hold/restraint after the initiation of the ASD-CP (pre ASD-CP = 38.8%, post ASD-CP = 26.3%; Fisher's Exact = 0.050, $p = 0.039$).

Discussion

This first study examining the effectiveness of implementing an ASD care pathway (ASD-CP) within a general child psychiatric setting shows promising preliminary results. Data suggest that the ASD-CP can be implemented and sustained in a public hospital with limited resources. Once the care pathway was established and the staff trained, no additional supports were provided. Continuing trainings were conducted by the psychologist and nurse educator on the unit. Following the initiation of the ASD-CP, there was a significant reduction in holds/restraints for patients with ASD in both the CCPEP and inpatient unit settings, and a marked decrease of 40.2% (9 days) in the total length of hospital stay.

Notably, the patients served prior to and after the institution of the ASD-CP did not significantly differ on measured variables and therefore are comparable for the purposes of this study. It is also notable that the percentage of youth with ASD discharged from brief-stabilization in the CCPEP, rather than admitted, did not significantly change with implementation of the pathway. This may suggest that the pathway is not an effective means of reducing the hospitalization rate for this population once they are in a psychiatric emergency room, though other important clinical variables, such as the number of crisis interventions required and length of brief-stabilization stay, did decrease. Further study of the effectiveness of the ASD-CP by sociodemographic characteristics could facilitate potential modifications based on risk groups.

Most notably, the mean length of total hospital stay (brief-stabilization and inpatient unit) for patients who received the ASD-CP was nine days less (40.2%) than the mean length of stay for patients who were admitted prior to the institution of the ASD-CP. Of note, there was a wide range in the length of

stay in both groups, which is unsurprising given the inherent variability in symptom presentation and severity that leads to psychiatric hospitalization. Given that the great majority of the financial costs of psychiatric hospitalization are directly related to the number of days an individual spends in the hospital, this finding may have major public policy implications. For years, efforts have been made to reduce the length of psychiatric hospitalizations, including utilization review by managed care companies. Achieving a substantial reduction in the length of stay for youth with ASD, while seeing improvement in other clinical indicators, such as decreased use of crisis interventions, suggests that use of the ASD-CP reduces challenging behaviors and leads to patients being stabilized for discharge more rapidly than treatment as usual. While there is a training and materials cost associated with implementing the pathway, all participants were youth who had been assigned a 1:1 staff regardless of their participation in the pathway, so the cost for direct care staff was no different globally for the two groups. It is also important to note that for the entire patient populations in the brief-stabilization and inpatient units under study, there were no overall differences in average length of stay for the two time periods (pre ASD-CP = 16.0 days, $n = 910$; post ASD-CP = 16.2 days, $n = 1079$). This suggests that the finding of a markedly reduced length of stay for the ASD group in the post ASD-CP period was not simply reflecting a change due to factors not associated with the ASD-CP.

In regards to possible mechanisms of change explaining decreased length of stay following the initiation of the ASD-CP, it is important to note that discharge is primarily a decision regarding a patient's safety level. The pathway appeared to increase safety, as suggested by the decrease in the need to use crisis interventions. Within an inpatient stay, if a child becomes agitated by the environment, lack of reinforcement, inability to communicate, or other factors and then engages in behaviors deemed unsafe (e.g., aggression, self-injury), the inpatient stay can become a self-perpetuating cycle. It may be the case that the ASD-CP was successful in preventing or minimizing this cycle by providing strategies to proactively address typical antecedents to dangerous behavior within general psychiatric units. Provided future research supports these findings, a decreased length of stay would provide clinical, financial, and public health benefits; patients who received the ASD-CP would be integrated into less restrictive environments sooner, costs for hospitalization would be reduced, and the unit would have increased availability for other children in need of inpatient services.

Given that more intrusive treatment interventions are rated lower in acceptability (Carter 2007), the ASD-CP may improve treatment ratings by families, although this would need to be formally tested. After the initiation of the ASD-CP, there was a significant decrease in the proportion of children experiencing holds/restraints and a large

Table 3 Number of youth with holds/restraints in CCPEP and inpatient units pre and post ASD-CP ($N = 37$)

Any hold/restraint	Pre ASD-CP		Post ASD-CP		Test of significance (Fisher's Exact; p)
	N	%	N	%	
No	7	41.20%	15	75.00%	0.050; 0.039
Yes	10	58.80%	5	25.00%	

and clinically relevant reduction in the number of holds/restraints used in the CCPEP. This is an important finding given that reduction in use of restraint is a priority of regulators, advocates, and providers, as these interventions carry substantial safety risks for patients and staff (Masters 2017). There was also a large decrease in the mean number of IM medications administered after the initiation of the ASD-CP (pre ASD-CP = 3.12; post ASD-CP = 0.85). Although this difference did not reach statistical significance, the reduction is clinically important given the risks associated with the use of IM medications. Beyond medication side effects, reliance on IM medications for behavior management denies patients the ability to learn and practice replacement behaviors that could then be generalized to outside settings where IM medications are unavailable in crises.

Continued study into which aspects of the ASD-CP were most helpful in reducing crisis interventions events is necessary. It is likely that staff confidence and comfort level with the population following staff training, teaching coping techniques and the availability of the coping strategies card, increased communication tools, and the use of positive reinforcement in establishing replacement behaviors all contributed to these positive outcomes but the individual effects of each of these elements needs to be tested. Notably, administrative leadership reported anecdotally that staff self-efficacy with this patient population improved, and this should be the subject of further study. Future research could also assess the added value of additional intervention components. For example, it is likely that formally training parents in the Toolkit would improve outcomes post-discharge. Similarly, consulting with the school at intake, to add information to the Tip Sheet, and at discharge to pass on the Toolkit, may reduce likelihood of re-hospitalization.

The major limitations of this study are the sample size and lack of a randomized control group. Due to the relatively low number of patients who met the criteria for inclusion in the ASD-CP, the sample is inadequately powered. Given that the study sample was limited to first time admissions, nearly 10% of admitted patients with ASD were excluded from the study. This highlights the need for more effective ASD-specific care within inpatient psychiatric hospitalization to reduce the rate of readmission, and should be a focus of future study. A previous study in a specialized inpatient program found that ASD-specific care could reduce the rate of readmission (Gabriels et al. 2012). As such, future research should assess if and how the ASD-CP changes the utilization trajectories of children and adolescents with ASD post discharge. However, it is important to acknowledge that many readmissions are due to lack of appropriate supports post discharge. Therefore, not only are improvements in inpatient care necessary for reducing readmissions but continued efforts to improve links from psychiatric hospitalization to effective outpatient services are essential. Approximately

40% of patients who presented to the CCPEP were also evaluated and released without being admitted, which also contributed to the small sample size.

The results are also limited because participants were not randomized to the ASD-CP or usual care. Randomization was not possible because implementation of the ASD-CP required extensive training for all staff in order to ensure that the pathway was available regardless of time of day, day of week, or treatment setting (CCPEP, inpatient units) as well as environmental manipulations to make the units more ASD-focused. Since staff training, visual supports, and environmental supports are part of the ASD-CP, the best option for capturing the impact of the pathway on a general inpatient psychiatric unit was a pre-post design. Additionally, while data were collected on whether pathway instruments were utilized by direct care staff, observation was not systematically conducted to capture fidelity to all aspects of the ASD-CP, and thus was not evaluated. Future research should measure the level of fidelity to the ASD-CP, and the impact of fidelity on outcomes. As the ideal intervention utilizes the least resources and is the easiest to implement, it will be important in future studies to identify those elements of the care pathway that are most strongly related to clinical improvements, and then test the effectiveness of just those elements in a larger, adequately powered sample.

Regardless of these limitations, this study has demonstrated that an ASD-CP can be implemented within a public, general inpatient child and adolescent service and sustained with minimal expertise. With little cost beyond the training time and materials, this pathway was associated with a markedly reduced length of stay and reduced use of crisis interventions. Follow up research studies are being conducted to address staff perception and frequency of implementation of the ASD-CP strategies, as well as behavioral outcomes at the patient level (i.e., symptom improvement) associated with the initiation of the ASD-CP. Given the low likelihood of specialized units being developed in most hospitals, these data provide support for the feasibility of providing improved services for children and adolescents with ASD within general inpatient psychiatry units and suggest that improved services may not only include care that is more effective, but also less costly.

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Author Contributions SK designed the intervention, participated in the study design and coordination, and helped to draft the manuscript. BF coordinated the intervention implementation and participated in the study design and coordination. MM co-designed the intervention, designed the study and study database, and coordinated the study. EO coordinated data collection, performed the statistical analyses, and helped to draft the manuscript. PC helped to draft the manuscript. MS

consulted to the design of the intervention and the design of the study and helped to draft the manuscript. SH participated in the design of the study and interpretation of the data and helped to draft the manuscript. JH oversaw the implementation and participated in its design and coordination. All authors read and approved the final manuscript.

Compliance with Ethical Standards

Conflict of interest All the authors declares that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent A waiver for authorization was granted for this study by the Institutional Review Boards of both institutions.

References

- Aman, M. G., & Singh, N. N. (1986). *Aberrant behavior checklist (abc)*. East Aurora: Slosson Educational Publications, Inc.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th edn.). Washington, DC: American Psychiatric Association.
- Carter, S. L. (2007). Review of recent treatment acceptability research. *Education and Training in Developmental Disabilities, 2007*, 301–316.
- Croen, L. A., Najjar, D. V., Ray, G. T., Lotspeich, L., & Bernal, P. (2006). A comparison of health care utilization and costs of children with and without autism spectrum disorders in a large group-model health plan. *Pediatrics, 118*(4), e1203–e1211. <https://doi.org/10.1542/peds.2006-0127>.
- Gabriels, R. L., Agnew, J. A., Beresford, C., Morrow, M. A., Mesibov, G., & Wamboldt, M. (2012). Improving psychiatric hospital care for pediatric patients with autism spectrum disorders and intellectual disabilities. *Autism Research and Treatment, 2012*, 1–7. <https://doi.org/10.1155/2012/685053>.
- Gerson, R., Havens, J., Marr, M., Storfer-Isser, A., Lee, M., Marcos, C. R., ... Horwitz, S. M. (2017). Utilization patterns at a specialized children's comprehensive psychiatric emergency program. *Psychiatric Services, 68*(11), 1104–1111.
- Heidgerken, A. D., Geffken, G., Modi, A., & Frakey, L. (2005). A survey of autism knowledge in a health care setting. *Journal of Autism and Developmental Disorders, 35*(3), 323–330. <https://doi.org/10.1007/s10803-005-3298-x>.
- Kalb, L. G., Stuart, E. A., Freedman, B., Zablotsky, B., & Vasa, R. (2012). Psychiatric-related emergency department visits among children with an autism spectrum disorder. *Pediatric Emergency Care, 28*(12), 1269–1276. <https://doi.org/10.1097/PEC.0b013e3182767d96>.
- Mandell, D. S. (2008). Psychiatric hospitalization among children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 38*(6), 1059–1065. <https://doi.org/10.1007/s10803-007-0481-2>.
- Mandell, D. S., Xie, M., Morales, K. H., Lawer, L., McCarthy, M., & Marcus, S. C. (2012). The interplay of outpatient services and psychiatric hospitalization among Medicaid-enrolled children with autism spectrum disorders. *Archives of Pediatrics & Adolescent Medicine, 166*(1), 68–73.
- Marrus, N., Veenstra-VanderWeele, J., Hellings, J. A., Stigler, K. A., Szymanski, L., King, B. H., ... Pruett, J. R. Jr. (2014). Training of child and adolescent psychiatry fellows in autism and intellectual disability. *Autism, 18*(4), 471–475.
- Masters, K. J. (2017). Physical restraint: A historical review and current practice. *Psychiatric Annals, 47*(1), 52–55. <https://doi.org/10.3928/00485713-20161129-01>.
- McGuire, K., Erickson, C., Gabriels, R. L., Kaplan, D., Mazefsky, C., McGonigle, J., ... Siegel, M. (2015). Psychiatric hospitalization of children with autism or intellectual disability: Consensus statements on best practices. *Journal of the American Academy of Child & Adolescent Psychiatry, 54*(12), 969–971. <https://doi.org/10.1016/j.jaac.2015.08.017>.
- Pedersen, K. A., Santangelo, S. L., Gabriels, R. L., Righi, G., & Siegel, M. (2017). Specialized inpatient psychiatry units for youth with autism and serious problem behaviors: Treatment model and behavioral outcomes. *Journal of the American Academy of Child & Adolescent Psychiatry, 56*(10 Supplement), S31. <https://doi.org/10.1016/j.jaac.2017.07.123>.
- Righi, G., Benevides, J., Mazefsky, C., Siegel, M., Sheinkopf, S. J., & Morrow, E. M. (2017). Predictors of inpatient psychiatric hospitalization for children and adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders. https://doi.org/10.1007/s10803-017-3154-9*.
- Siegel, M., Doyle, K., Chemelski, B., Payne, D., Ellsworth, B., Harmon, J., ... Lubetsky, M. (2012). Specialized inpatient psychiatry Units for children with autism and developmental disorders: A united states survey. *Journal of Autism and Developmental Disorders, 42*(9), 1863–1869. <https://doi.org/10.1007/s10803-011-1426-3>.
- Siegel, M., & Gabriels, R. L. (2014). Psychiatric Hospital treatment of children with autism and serious behavioral disturbance. *Child and Adolescent Psychiatric Clinics of North America, 23*(1), 125–142. <https://doi.org/10.1016/j.chc.2013.07.004>.
- Siegel, M., Milligan, B., Chemelski, B., Payne, D., Ellsworth, B., Harmon, J., ... Smith, K. A. (2014). Specialized inpatient psychiatry for serious behavioral disturbance in autism and intellectual disability. *Journal of Autism and Developmental Disorders, 44*(12), 3026–3032. <https://doi.org/10.1007/s10803-014-2157-z>.
- Simonoff, E., Pickles, A., Charman, T., Chandler, S., Loucas, T., & Baird, G. (2008). Psychiatric disorders in children with autism spectrum disorders: Prevalence, comorbidity, and associated factors in a population-derived sample. *Journal of the American Academy of Child & Adolescent Psychiatry, 47*(8), 921–929. <https://doi.org/10.1097/CHI.0b013e318179964f>.
- Wharff, E. A., Ginnis, K. B., Ross, A. M., & Blood, E. A. (2011). Predictors of psychiatric boarding in the pediatric emergency department: Implications for emergency care. *Pediatric Emergency Care, 27*(6), 483–489.