

CARE TRANSITIONS TEAM

Analysis of Program Impacts
12/1/2017—12/1/2020



The Mental Health Center
of Greater Manchester

CATT PROGRAM

Analysis of Program Impacts—Executive Summary

Purpose of Report

CATT was designed as an implementation of the Critical Time Intervention Model (CTI) with the goal of improving patient outcomes and reducing recidivism among those with mental illness, specifically those who had been recently released from correctional and inpatient hospital settings. Conducted by the Quality Improvement department at the request of the CATT program coordinator, this report seeks to evaluate program effectiveness in accordance with the Written Plan for Professional Services.

Data & Methods

Data was obtained based on case records and quantitative psychological measures conducted as part of the CATT program. In total, 700 referred and 157 admitted cases spanning 12/1/2017 to 12/1/2020 were analyzed. This report used a longitudinal, retrospective design with pre-post comparisons to analyze bed days (Psychological, Emergency Department, and Incarceration) and IMR scores. Survival analysis was also conducted to measure outpatient retention and patient dropout rates.

Key Findings

Bed Days Entirely Reduced: Among those who completed CATT and reported recent bed days prior to admission, zero new bed days were reported while in the CATT program. This change was statistically significant for both psychological and ED bed days. In aggregate, this may represent as much as 219 days saved across both categories, totaling over 7 months. *Pages 4*

Improved Outpatient Retention After CATT Discharge: Based on survival analysis, those who successfully complete CATT are more likely to remain in outpatient treatment after discharge. At 9 months post-discharge, 65% of completes remained in an outpatient program, compared with 32% among incompletes. This association was apparent at all timescales measured. *Page 5*

Increased CATT Involvement is Associated with Decreased Dropout: Survival analysis of CATT dropout rates revealed that the first and second phases of the program, which have higher levels of CATT interaction, had significantly improved patient retention compared to Phase 3, where over 50% of dropouts occurred. *Page 6*

Improved Patient Health: Patients who completed CATT displayed significant improvement in IMR scores, a measure of mental ill-

7

Months of bed days saved

2×

As likely to remain in outpatient for 9 months

Final Summary

All outcome measures tested (bed days, outpatient retention, and IMR scores) displayed statistically significant improvements in association with the CATT program. CATT admission is associated with reduced bed days during program tenure as well as increased outpatient retention after program completion. Both the nature and duration of these findings is entirely consistent with previously published studies regarding the CTI model. All of these factors point to the effective implementation of CTI within the CATT program. It is an implementation that likely saves significant public costs through reduced bed days and ensures patients are well-positioned to succeed after CATT discharge.



Program Overview

Life of a Program

- ◆ From 12/1/2017 to 12/1/2020 CATT has admitted 157 cases with an average of approximately 37 patients at full capacity.
- ◆ Throughout the program, 72 outright completions have been documented with 19 cases still open. In addition, 8 other patients were referred to ACT.

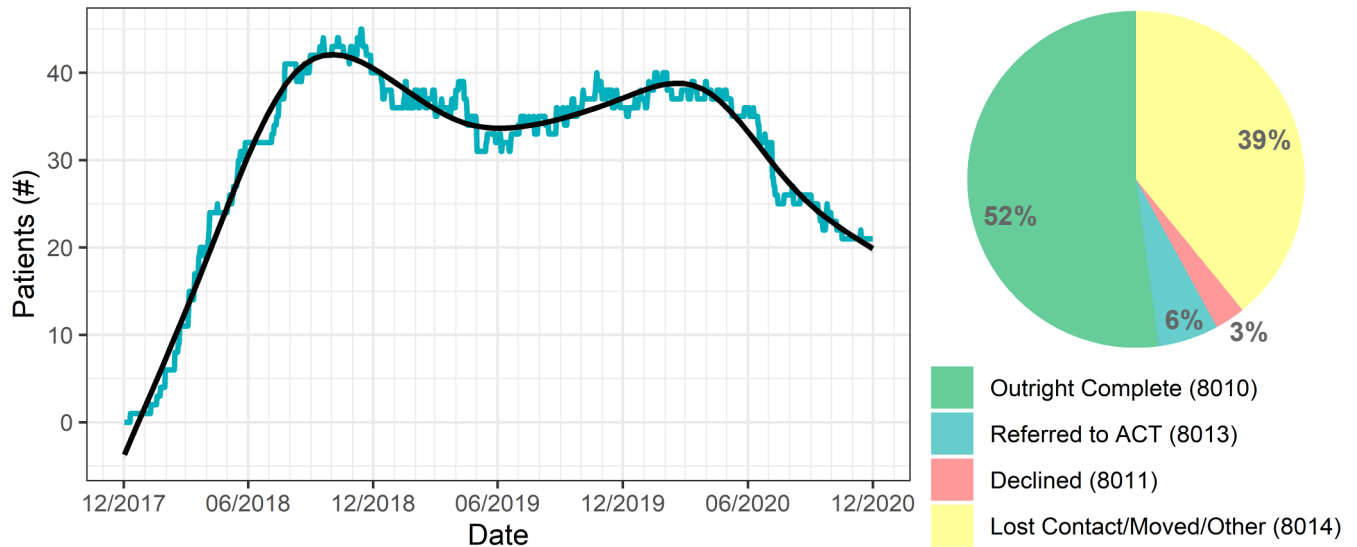


Figure 1. Patient Outcomes. Daily patient count with LOESS regression over time (blue and black lines, respectively; $n = 157$, span = 0.75) as well as a pie chart of discharge codes ($n = 138$).

Who is Referred?

Of 700 known CATT referrals (572 of which included race), 83% originate from hospitals and 14% from prisons.* Using this data, a random sample of referrals was estimated based on demographics for Hillsborough County and NH prisons (Table 1; see page 9 for detailed methods). Based on these estimates, the Asian population appears less likely to be referred to CATT than expected, in contrast with Latinx and African Americans, who are more likely. These differences are statistically significant ($p = 3.1 \text{ e-}07$) and may reflect multiple factors, such as possible reluctance of Asian populations to engage with mental health services, meaning more outreach may be needed.

Table 1. Observed referrals compared to expected estimates based on county and prison population.

| | Expected Referrals | Observed Referrals | Difference |
|------------------|--------------------|--------------------|------------|
| Caucasian | 481 | 480 | -1 |
| African American | 16 | 33 | 17 |
| Asian | 20 | 2 | -18 |
| Hispanic | 39 | 47 | 8 |
| Native American | 1 | 2 | 1 |
| Multiracial | 10 | 8 | -2 |

*The remaining 3% are unspecified or from behavioral health, whose demographics were assumed to approximate the general population.

Program Overview Cont.

Who is Admitted?

Using data from referrals during the program period, a number of demographic factors were tested for association with admittance into CATT (Table 2), revealing:

1. **Those who are separated, but not divorced, may reach admission at higher rates than those who are single ($p = 0.08$).** One could speculate this results from a desire to save the relationship or the impact of its loss as a concrete, detrimental effect of unmanaged MI. Either explanation would be consistent with the lack of association seen with those already divorced ($p = 0.60$). If true, this could serve as an additional tool in convincing individuals to undergo treatment.
2. **Those who are not in the labor force may be more open to treatment than those who are unemployed ($p = 0.03$).** This category includes both students and retired individuals, meaning it could in theory reflect multiple factors from MI severity (i.e. MI has rendered them unable to even consider work at present) to opportunities due to lifestyle (i.e. retirement allows the time requirements of the program to see more reasonable). However, the fact that education may make admittance less likely ($p = 0.03$) could indicate that students are not driving this effect, possibly due to more robust support systems.

Odd Ratios

Odds ratios illustrate how each increment of a variable changes the likelihood of an outcome; 1 means no change, > 1 means the outcome is more likely, < 1 means the outcome is less likely. Odds ratios are more intuitive than log odds in interpretation, meaning that at 2 the outcome is twice as likely and at 0.5 it is half as likely. However, it should be remembered that numeric variables like age are per unit, meaning the odds stack for each unit of the measure.

NOTE: While more categories exist for many of the listed factors, a sample size of 20 within each category was required for it to be included in the analysis. Individual sample sizes available upon request.

Table 2. Logistic regression testing for admission into CATT

| | Intercept (log odds) | Std. Error (log odds) | Odds Ratio [95% CI] | p-value |
|--|-------------------------|--------------------------|------------------------|---------|
| Age (Years) | 0.0055 | 0.0063 | 1.00 [0.99-1.01] | 0.38 |
| Sex (Male) | 0.0048 | 0.18 | 1.04 [0.73-1.51] | 0.79 |
| Race & Ethnicity (Hispanic) | -0.17 | 0.36 | 0.84 [0.40-1.65] | 0.63 |
| Race & Ethnicity (African American) | -0.13 | 0.42 | 0.88 [0.36-1.92] | 0.76 |
| Religion (Christian) | -0.15 | 0.29 | 0.86 [0.49-1.52] | 0.60 |
| Marital Status (Married) | -0.73 | 0.49 | 0.48 [0.16-1.16] | 0.14 |
| Marital Status (Separated) | 0.65 | 0.37 | 1.91 [0.91-3.87] | 0.08 |
| Martial Status (Divorced) | 0.13 | 0.25 | 1.14 [0.68-1.85] | 0.60 |
| Employment (Employed) | 0.18 | 0.36 | 1.20 [0.57-2.37] | 0.62 |
| Employment (Not in labor force) | 0.47 | 0.22 | 1.6 [1.05-2.45] | 0.03 |
| Education (Any college) | -0.67 | 0.31 | 0.51 [0.27-0.91] | 0.03 |



Psychological and ED Bed Days Entirely Reduced

Those Who Completed CATT Needed Zero Bed Days Throughout

- ◆ **There is a significant reduction in bed days.** Among those who completed the program, zero participants with a known history of in-patient ED or psychiatric visits needed bed days (Figure 2). While sample sizes are small, differences are statistically significant based on a paired Wilcoxon test ($p = 0.0035$ and 0.0090 for psychiatric and ED bed days, respectively).
- ◆ **Based on this reduction, hundreds of bed day have been prevented.** Since CATT is a nine-month program, these demonstrated reductions represent a significant saving of resources. Considering only the sample size measured, and only during the duration of the program, it can be estimated that 141.7 psychiatric and 76.8 ED bed days may have been prevented due to CATT enrollment. Added together, this totals over 7 months of reduced bed days in association with CATT admission, without considering post-discharge effects.
- ◆ **NOTE:** Considering that baseline data relies on self-reporting and the majority of CATT referrals are from ED and inpatient facilities, this number is likely a significant *underestimation* of the effectiveness of the program in reducing bed days. This is particularly true when one considers that over 72 individuals have been listed as completing the program to date, a significantly larger number than the sample size for either group with available data.

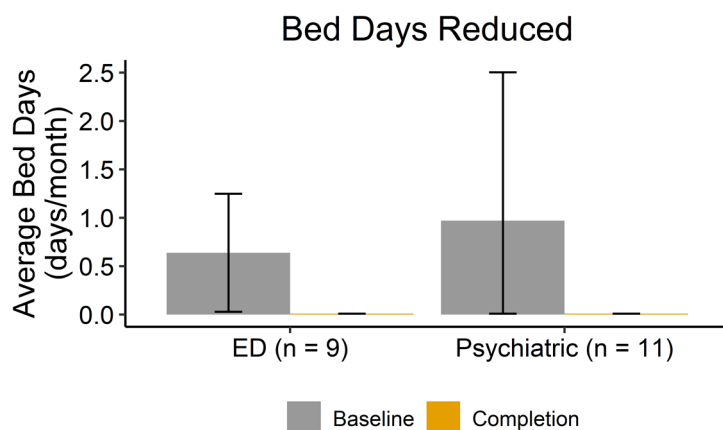


Figure 2. Significant reduction in both ED and psychiatric bed days. Displays average monthly bed days for patients with prior ED and Psychiatric visits based on year prior and during enrollment. Error bars indicate one standard deviation from the mean.

Incarceration Bed Days

While not enough to test. The three individuals who completed CATT and were known to have prior incarceration bed days also saw a complete reduction.

More Than Just Completes

Regardless of completion status, all but one patient accepted into CATT required zero ED, psychiatric, or incarceration bed days while in the program. This finding illustrates that almost all admitted patients involved with CATT in an official capacity may be benefited in some way.

Improved Outpatient Retention

Completes More Likely to Remain in Outpatient 9 Months Later

CTI is noted to have significant benefits for patient well-being that can persist as much as 9 months after discharge (Herman et al., 2011; Susser et al., 1997). To test for these effects in the CATT program, retention in outpatient programs was analyzed using survival analysis:

Completes have significantly improved outpatient retention. Of the 101 CATT patients referred to outpatient programs, 75 remained in outpatient after CATT discharge. Of that 75, those who completed CATT were significantly more likely to be retained in outpatient programs over time after discharge (Figure 3; $p = 0.068$). At nine months, only 32% of patients who didn't complete the program remained in treatment, compared with 65% percent of completes.

NOTE: While it is not entirely possible to rule out selection bias (i. e. those who dropped out of CATT were more likely to drop out of any program), the removal of those who did not remain in outpatient after CATT discharge makes this possibility less likely. These findings are also consistent with randomized trials testing CTI, as noted above. Lastly, the reduction in bed days previously presented further supports the possibility of a positive impact on patient wellbeing.

Probability of Remaining in Outpatient

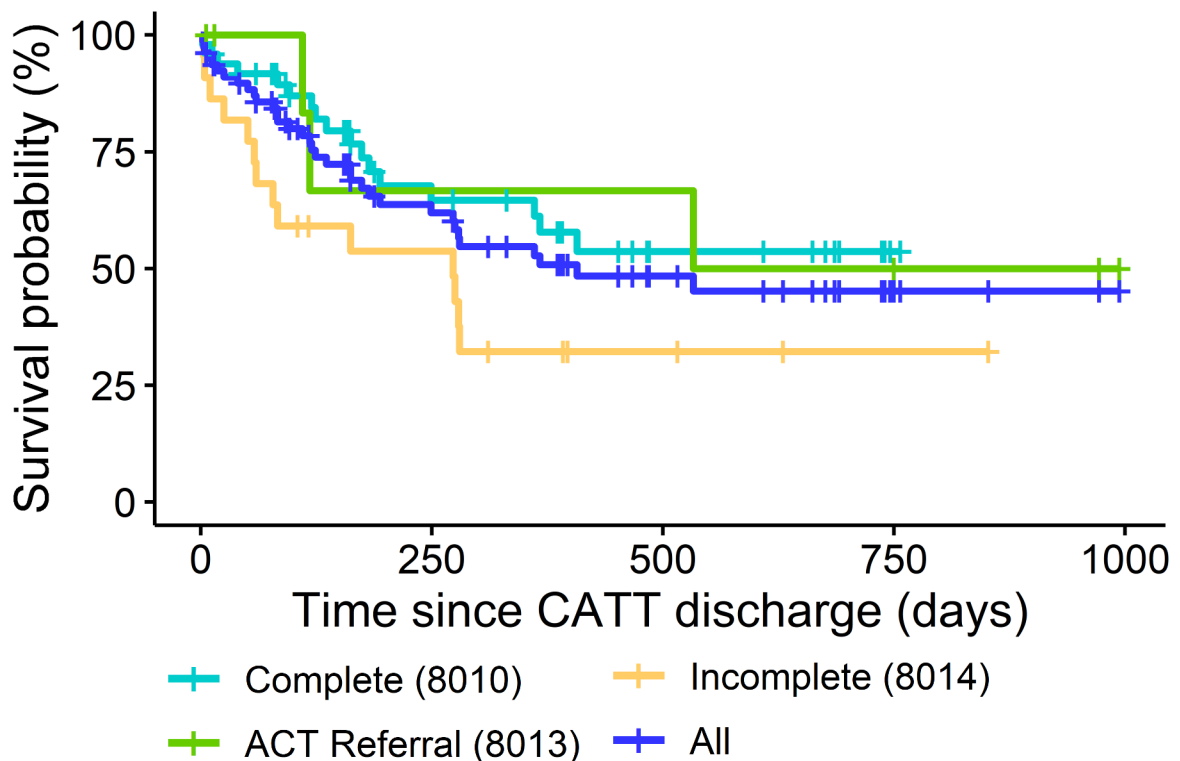


Figure 3. Survival curve measuring probability of retention in outpatient programs. Curve indicating the probability that a patient who has been discharged from CATT will remain in an MHGCM outpatient program that number of days without dropping out (dark blue line, $n = 75$). Crosses on the lines indicate points where a current patient was removed from the analysis. Light blue, yellow, and green lines describe the survival curve for program completes ($n = 46$), incompletes ($n = 22$), and those referred to ACT ($n = 8$), respectively.

Challenge of the Final Handoff

CATT Keeps People Involved

The CTI model that forms the basis for CATT uses 3 distinct phases, each 3 months in length. In order to assess patient dropout rate by phase, a survival analysis was conducted (Figure 4).

- ◆ **Higher levels of CATT involvement equates to fewer incompletes.** Each 3 month phase includes progressively decreasing levels of involvement from CATT, as the patient is handed off to more long-term supports and programs. Based on retention rates, Phase 3 appears to have a disproportionately higher rate of dropout compared to the earlier phases. This effect appears to be non-linear in nature, with over 50% of dropouts occurring in that final phase.
- ◆ **Declines seem to give the program at least one month.** While small in number (n =4), out-right service declines tend to occur in the first phase. However, all patients who eventually declined remained in the program for at least one month (min = 36 days), meaning that first month may be particularly critical if declines are to be further reduced, provided that is even feasible with decline levels already this low.

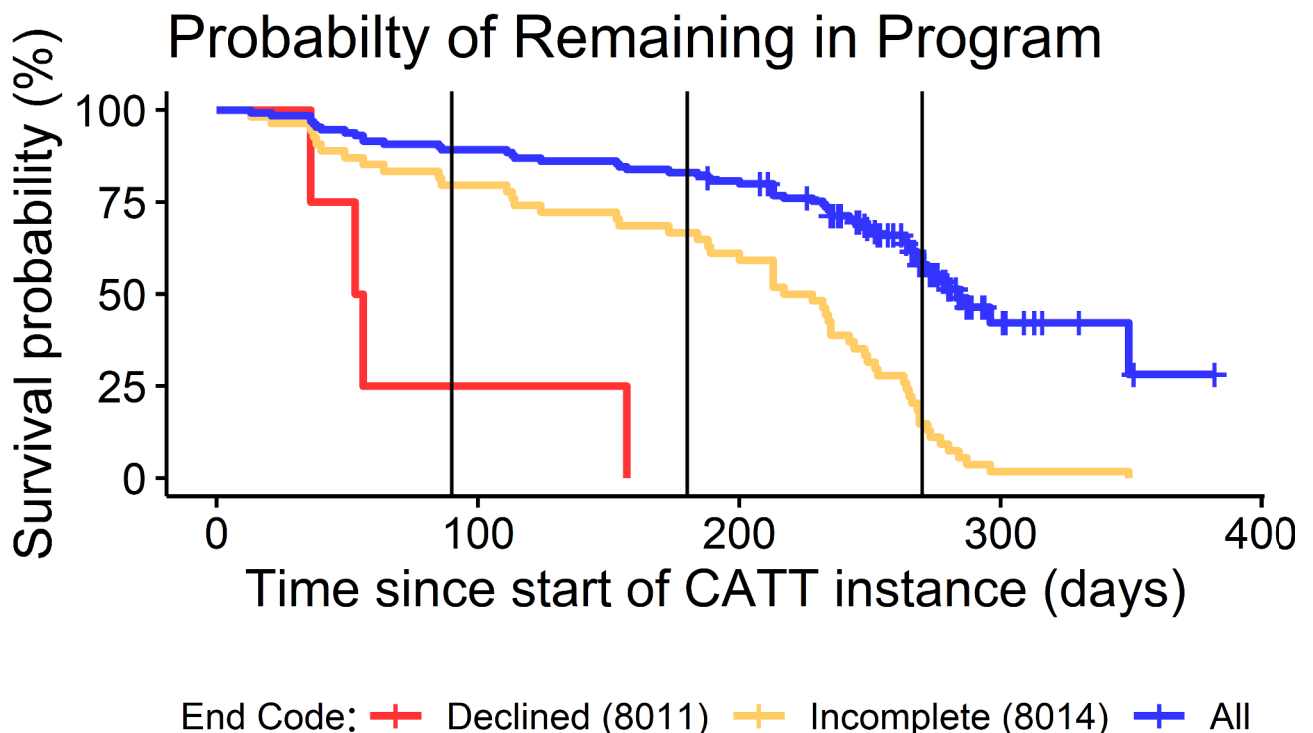


Figure 4. Survival curve measuring probability of retention in CATT program. Curve indicating the probability that a patient admitted will remain in the CATT program that number of days without dropping out (blue line, n =149). Crosses on the lines indicate points where an individual successfully completed the program and was removed from the analysis. Yellow and red lines describe the survival curve for incompletes (n = 54) and those who declined the service (n =4), respectively. Vertical lines from left to right indicate 90, 180, and 270 days, respectively, which are the standard borders between CTI phases.

Program Completion Factors

A Criminal History

Means Vulnerability

Since the target population of CATT has a number of challenges unique to that group, including factors such as increased risk of homelessness and substance abuse, these factors were examined for a possible influence on CATT completion rates, which revealed:

A history of previous convictions is a significant risk factor against program completion (p = 0.006). Interestingly, this finding is specific to any conviction, as violent convictions alone were not significant when measured

against completion (p = 0.44). As would be expected, fewer patients reported a history of violent convictions than convictions in general (19 versus 30), which means the lack of association could be related to sample size. Nonetheless, these findings together are consistent with the idea that any previous conviction is a risk factor. This conclusion is further supported by the fact that, by itself, referral from a correction facility is not associated with decreased rates of completion (p = 0.14), suggesting that this is not simply an effect of recent reintroduction to general society or experiences with the legal system immediately prior to CATT admission.

Table 3. Logistic regression testing population-specific factors for an association with program completion.

| | Intercept (log odds) | Std. Error (log odds) | Odds Ratio [95% CI] | p-value |
|---|----------------------|-----------------------|---------------------|---------|
| Homelessness (Past Year, T/F) n = 62 | -0.47 | 0.52 | 0.62 [0.22-1.73] | 0.37 |
| Substance Use (Views As Problem) n = 119 | -0.56 | 0.37 | 0.57 [0.27-1.18] | 0.13 |
| Previous Convictions (Any, T/F) n = 110 | -1.16 | 0.43 | 0.31 [0.13-0.71] | 0.006 |
| Previous Convictions (Violent, T/F) n = 110 | -0.39 | 0.51 | 0.68 [0.25-1.83] | 0.44 |
| Referral Source (Correctional Facility) n = 125 | -0.71 | 0.48 | 0.49 [0.18-1.25] | 0.14 |

Education May Have Multiple Effects

When testing demographic factors, higher education was associated with increased odds of program completion (Table 4; p = 0.02). This finding is somewhat in contrast with results regarding admissions, where education was associated with lower admission rates. This suggests that, while education may make an individual less likely to move from referral to admit, it may make them more likely to finish once admitted.

Table 4. Logistic regression testing for completion of CATT*

| | Intercept (log odds) | Std. Error (log odds) | Odds Ratio [95% CI] | p-value |
|---|----------------------|-----------------------|---------------------|---------|
| Age (Years) n = 130 | 0.020 | 0.013 | 1.02 [1.00-1.04] | 0.11 |
| Sex (Male) n = 130 | -0.38 | 0.37 | 0.68 [0.33-1.40] | 0.30 |
| Education (Any College, T/F) n = 97 | 2.44 | 1.06 | 11.5 [2.15-214] | 0.02 |

*The smaller sample size of those admitted meant that testing beyond basic demographic factors was not possible.



IMR Scores Increase for Completes

CATT Improves Illness

Management

The Illness Management and Recovery Scale (IMR) is designed to measure well-being and coping in people with mental illness. CATT utilizes a self-administered version of the scale (the patient answers the question rather than the clinician), which is occurs both at admission and graduation from the program. The scoring of the scale ranges from 5 to 75, with higher scores indicating better management and improved recovery. Based on the 52 individuals with both measures. It was determined that:

- ◆ **CATT completion is significantly associated with improved IMR.** When comparing baseline and graduation scores, a mean increase of 8.17 was noted (Figure 5). This difference was statistically significant with $p = 2.4 \times 10^{-8}$ based on a paired t-test. In addition, while no control group was readily available, the coping skills assessed as part of the IMR are unlikely to be obtained by the target population without the help of a clinician as they have, by definition, had past difficulties with coping, as evidenced by factors such as repeated ED visits.

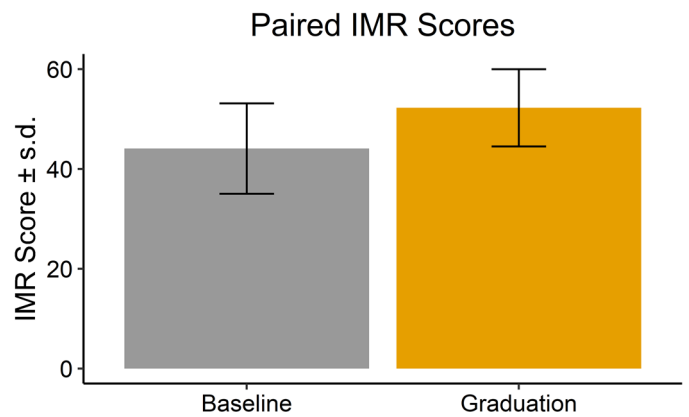


Figure 5. Paired IMR scores between baseline and graduation from CATT. Error bars indicate one standard deviation from the mean.

Methods

Analysis Design. This was a retrospective analysis based on MHCGM case records and assessments available for the CATT program. All data was collected on 12/1/2020 and included all cases that had been referred to the program up to that point. Data was de-identified and partial records were included. All analyses were conducted in R unless otherwise noted (R Core Team, 2020). Significant R packages used include ggplot2 (Wickham 2016), survival (Therneau, 2020), and lubridate (Grolemund & Wickham, 2011).

Pre-Post Analysis. Any assessed measure was first tested for normality via Shapiro-Wilk Test of the pre-post change (significance level: 0.1).

If deviation from normality was found, the comparison was conducted using a paired Wilcoxon Signed Rank Test with continuity correction, otherwise a paired t-test was used.

Modeling of Referrals. Demographics for Hillsborough County were obtained from the American Community Survey (US. Census Bureau, 2019) and demographics for the NH prison population were obtained from the Vera Institute (2017). Patient referral source was based on MHCGM records and used to weight demographics to estimate a random sample.

Survival Analysis. Survival curves were created using the Kaplan-Meier method as implemented in the survival package (Therneau, 2020).

Conclusion

Short and Long-Term Impacts

Based upon each outcome measure studied here, the CATT program is associated with improved patient outcomes. Bed days, outpatient retention, and IMR scores all displayed significant improvements in association with the CATT program. Admission to the program seems to have both immediate benefits, through reduced bed days, and long-term advantages, through increased outpatient retention after program completion. In addition, the nature of these findings is entirely consistent with the proven effectiveness of CTI in published studies, pointing to an effective implementation of the model within CATT. Based upon these factors, CATT can likely be viewed as a successful program working with a challenging population, saving significant public costs through reduced bed days, and ensuring their patients are well-positioned to thrive in outpatient treatment after discharge.

References

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