

INTENSIVE TRANSITION TEAM

Analysis of Program Impacts
7/1/2018—11/23/2020



The Mental Health Center
of Greater Manchester

ITT PROGRAM

Analysis of Program Impacts—Executive Summary

Purpose of Report

The ITT program was instituted to reduce the burden of hospital emergency departments, improve mental health outcomes for patients in crisis, and serve as transitional case management for mental health services. Conducted by the Quality Improvement department of MHCGM at the request of the ITT program coordinator, this report seeks to evaluate the effectiveness of the program in accordance with goals and values outlined in the Written Plan for Professional Services.

Data & Methods

Data was obtained based on CMT records, case records, and quantitative psychological measures conducted as part of the ITT program. In total, 845 referred and 357 admitted cases spanning 7/26/2018 to 11/23/2020 were analyzed. This report used a longitudinal, retrospective design with pre-post comparisons to analyze Emergency Department (ED) visits, survival analysis to review time to first ED visit after admission, and pre-post analysis to evaluate psychological measures.

Key Findings

ITT Patients Have Significant Health Needs: Of those with CMT data, 57.2% had presented at the ED multiple times before enrollment and 54.6% of referrals were diagnosed with a substance abuse disorder. *Pages 2-4.*

ED Visits are Reduced and Time Between is Increased: Those who completed ITT demonstrated significantly lower rates of ED visits than those who did not, saving an estimated 64 ED visits per year. This effect is consistent across multiple timescales and endures after discharge. In addition, those who completed the program were roughly half as likely to represent in the ED within 3 months, compared with incompletes. *Page 3-4*

Improved Outpatient Retention: Those who successfully complete ITT are more likely to remain in outpatient treatment after discharge, with over 50% of completes remaining at one year, compared with 17% of incompletes. *Page 5*

Patient Mental Health Rapidly Improves: Within 30 days of ITT admission, the average PHQ-9 score for patients drops one category from moderately-severe to moderate depression. Patients also reported improved scores on the Herth Hope Index, with both changes enduring over the entirety of the program. *Pages 6-*

144

*Unnecessary ED
visits prevented*

50%

*Reduced ED
presentation at 3
months*

Final Summary

It is clear that ITT serves a population with significant mental health needs as well as complex medical requirements in general. In light of this complexity, the immediate and enduring impact of the program on ED recidivism is consistent with the program's effectiveness. The findings presented here are consistent with the team's ability to rapidly connect patients to needed services, benefiting both the community and the patients themselves through improved mental health, greater outpatient retention, and reductions in emergency medical costs. As a whole, this report demonstrates the success of the ITT program in both fulfilling its stated goals and having an enduring impact on patients' mental health well beyond their discharge date.



Program Overview

A Consistent Presence

- ◆ From 7/26/2018 to 11/23/2020 ITT admitted 362 cases with an average of approximately 50 patients in the program on a given day, with a recent uptick since September (Figure 1).
- ◆ 153 outright completions have been documented with 59 cases still open. In addition 50 patients were also referred to other programs (38 within cen-

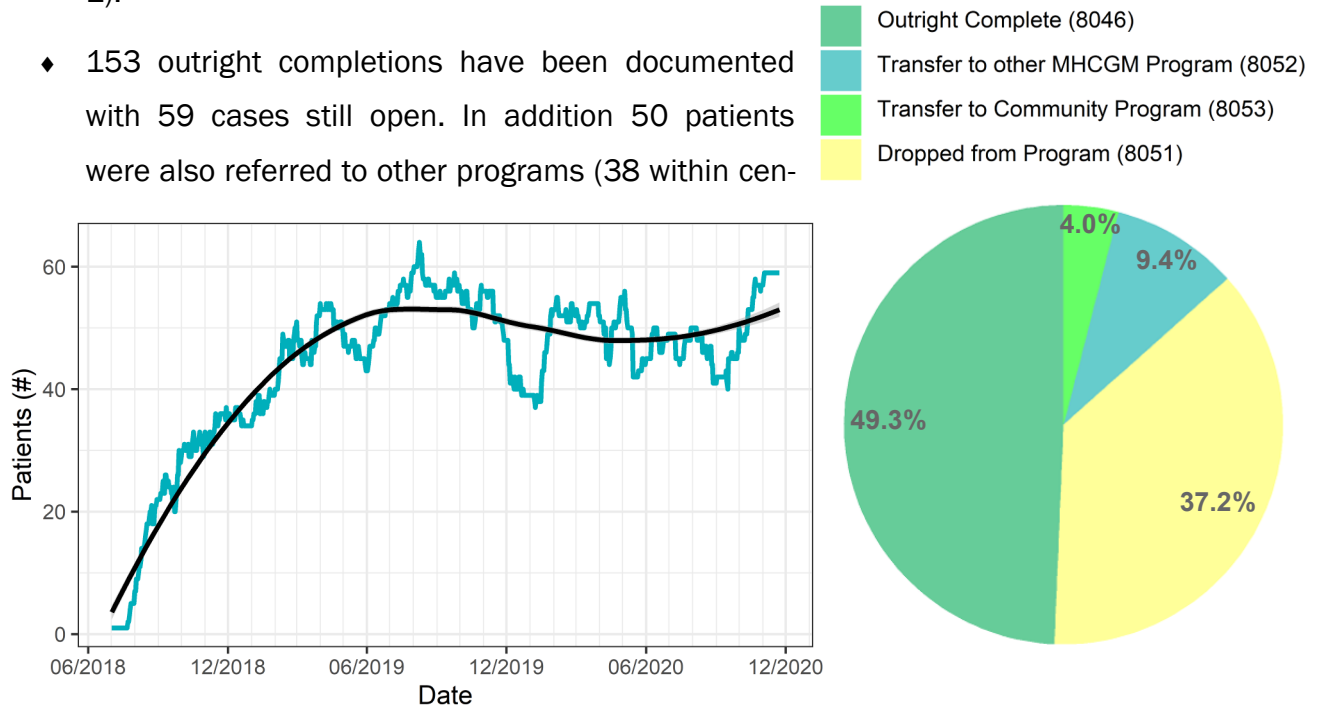


Figure 1. Patients enrolled in ITT and program outcomes. Daily patient count with smoothed average (blue and black lines, respectively) with pie chart describing program outcomes.

Patient Snapshot

Referral to ITT occurs at equal rates between males and females. However, while 39.1% of referrals are admitted, males are 8.1% less likely to be than females (Table 1; n = 841). This finding is consistent with other ITT programs that have found males to have a more difficult time engaging with mental health service in general and ITT programs specifically (Wright et al., 2015). The target population of ITT also has multiple health and mental health needs, with 55.4% of ITT referrals were diagnosed with some form of substance abuse disorder.

Table 1. Logistic regression of ITT admission

	Intercept (log odds)	Std. Error (log odds)	Odds Ratio [95% CI]	P-value
Sex (Male) n = 841	-0.34	0.14	0.71 [0.54-0.94]	0.015
Age (years) n = 841	0.0057	0.0042	1.00 [1.00-1.25]	0.16

What's a Log Odd?

Log odds are transformed probabilities, not percentages; 0.25 doesn't mean a 25% higher chance. However, a positive value does mean the outcome is more likely compared to baseline and negative does mean it is less likely.



Program Overview Cont.

Who is Admitted?

- ◆ Admission associated with divorce and employment. Beyond patient sex, divorce and employment were also associated with admission. Patients who had experienced either may be more likely to move from referral to admit ($p = 0.05$ and 0.07 , respectively; see table A1 in appendix).

Table 2. Observed referrals compared to expected estimates based on county and prison population.

	Expected Referrals	Observed Referrals	Difference
Caucasian	524	527	3
African American	14	22	8
Asian	25	6	-19
Hispanic	42	49	7
Native American	1	6	5
Multiracial	13	11	-2

- ◆ Possible missing population. When comparing referral rates to the demographic make-up of Hillsborough County, significant differences were observed than would be expected from a random sample (Table 2; $p = 1.85 \times 10^{-15}$). In particular, some minority groups appear to be overrepresented and Asian populations appear to be underrepresented. This could be due to multiple factors, such as socioeconomic status or cultural differences.

Who Completes?

After admission, older patients are more likely to complete. Based upon completion records a 50-year-old is roughly 15% more likely than a 20-year-old to successfully complete the program once admitted (Table 3). This finding could be viewed as consistent with previously published studies, which show that mental health generally improves with age (Lorem et al., 2017).

Table 3. Logistic regression of ITT completion.*

Odd Ratios

Just a reminder that odds ratios are per unit for numeric measures. For example, the odds of completing the program go up by 1.02 for every year of age the individual has reached.

	Intercept (log odds)	Std. Error (log odds)	Odds Ratio [95% CI]	P-value
Age (Years) n = 258	0.026	0.0086	1.02 [1.01-1.04]	0.003
Sex (Male) n = 258	-0.36	0.26	0.70 [0.42-1.15]	0.16
Education (Any College, T/F) n = 158	0.62	0.42	1.85 [0.84-4.36]	0.14

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

ITT Reduces the Average Number of ED Visits

Over 140 ED Visits Prevented

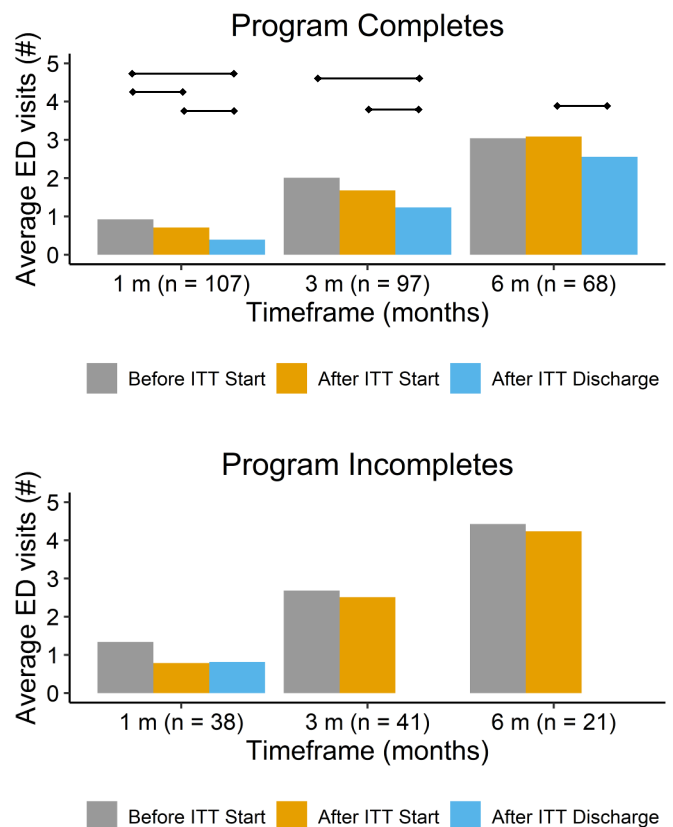
- ◆ **Completion of ITT was associated with reduced ED visits.** Comparisons of the average number of monthly ED visits per patient were made at 1, 3, and 6 month intervals. The association was significant across all timescales, with the 3-month interval averaging 0.77 fewer visits per patient compared to the 3 months before admission (Figure 2; $p = 0.004$). In contrast, no significant difference were seen among those who dropped from the program. Both groups were statistically similar at all timescale before admission ($p > 0.2$ in all cases).
- ◆ **Multiple ED visits prevented per week.** With 187 individuals having completed ITT and 0.77 ED visits reduced per patient, roughly 144 unnecessary ED visits may have been prevented to date, averaging 64 visits per year.
- ◆ **NOTE:** Since CMT data only exists when an ED visit occurs after MHCGM admission and is limited to one year in scope, the effect seen here is likely an underestimation of the impact of ITT, since cases where ED visits are reduced to 0 are excluded due to lack of CMT records.

Helping Everyone

Regardless of completion status, the number of total ED visits for ITT patients was reduced by:

- ◆ 30.6% within 30 days pre/post ITT admission
- ◆ 20.9% within 90 days pre/post ITT admission
- ◆ 9.8% within 6 months pre/post ITT admission

Figure 2. Average number of ED visits based on completion status. Horizontal lines indicate a statistically significant difference between two columns at a p-value threshold of 0.1, based on a Wilcoxon test. No significant differences were seen among program incompletes. Sample sizes below a period apply to all bars in that period. Data for incompletes at 3 and 6 months post-discharge was both low in number and biased toward those already in MHCGM programs, leading to their exclusion.



ITT Increases Time to Next Emergency Department Visit

50% Reduction in ED Representation at 3 Months

- ◆ ED visits are common among ITT patients prior to admission. Based on CMT data for those admitted to the program, 124 were known to have had at least one ED visit within the past 6 months (excluding visits on the day of ITT admission). Of these, 39 individuals eventually dropped out of the program and 85 completed in some capacity.
- ◆ ITT completion is associated with increased time to ED representation. Two out of five patients who do not complete ITT represent to the ED within 3 months. However, if an individual completes the program in any capacity, the likelihood of that is reduced to one in five (Figure 3).
- ◆ This effect can persist for over 1 year at varying strengths. The enduring nature of the effect

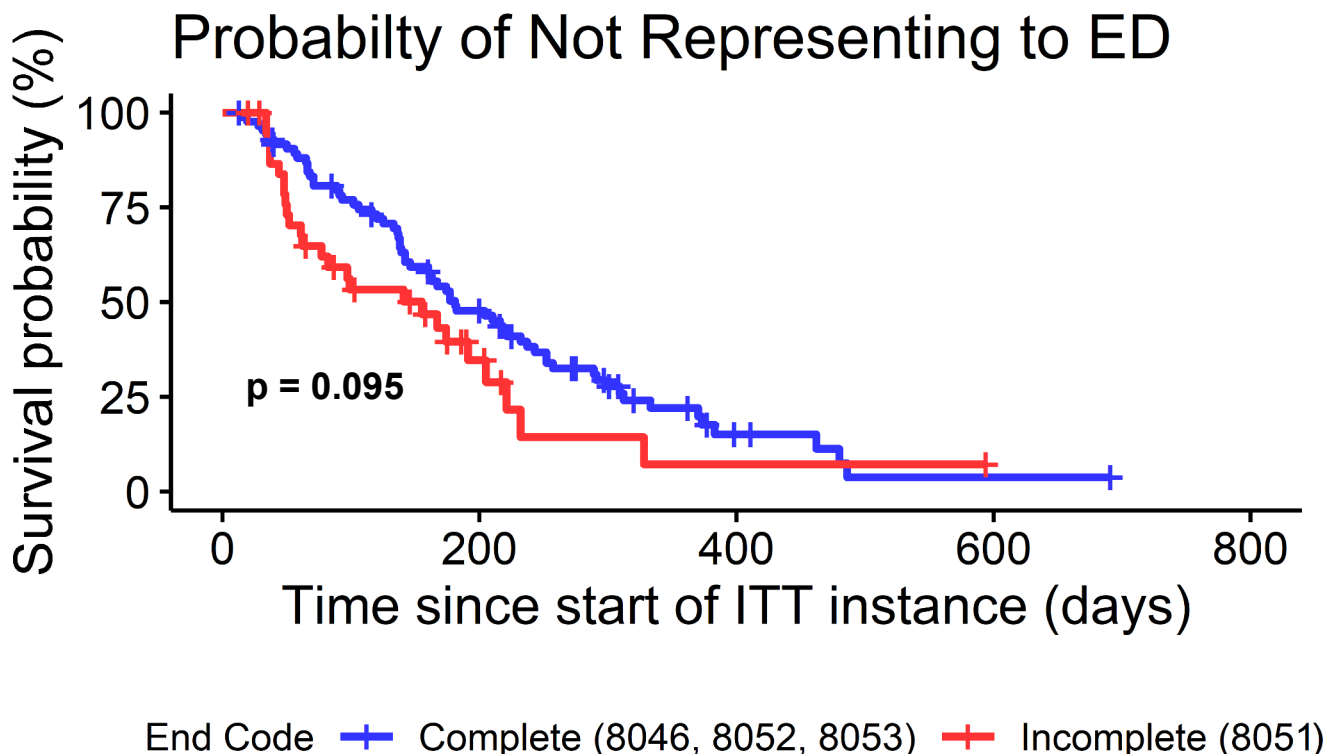


Figure 3. Survival curve measuring time to ED visit. Curve indicating the probability that a person who completes the ITT program (blue) or doesn't (red) will reach that number of days without an ED visit. Crosses on the lines indicate points where an individual dropped from the analysis without an ED visit due to ceasing interaction with MHCGM. Note that a patient was required to have remained in the program at least one week to be included.

ITT Improves Outpatient Retention After Discharge

Majority of Completes Remain in Outpatient 1 Year Post-Discharge

One goal of ITT is to improve outpatient retention. Analysis of admission and discharge dates among those who remained in other outpatient programs after ITT discharge revealed:

- ◆ **ITT completion significantly improves outpatient retention.** The majority of patients (52%) who completed ITT remained in outpatient services 1 year after discharge, compared to only 17% of incompletes. This difference is evident across all timescale and applies to both MHCGM referrals as well as completes (Figure 4; $p = 3.98 \times 10^{-9}$).

NOTE: While it is not entirely possible to rule out selection bias (i. e. those who dropped out of ITT were more likely to drop out of any program), the removal of those who did not remain in outpatient after ITT discharge makes this possibility less likely. In addition, the reduction in ED visits previously presented is also consistent with a direct effect on patient wellbeing.

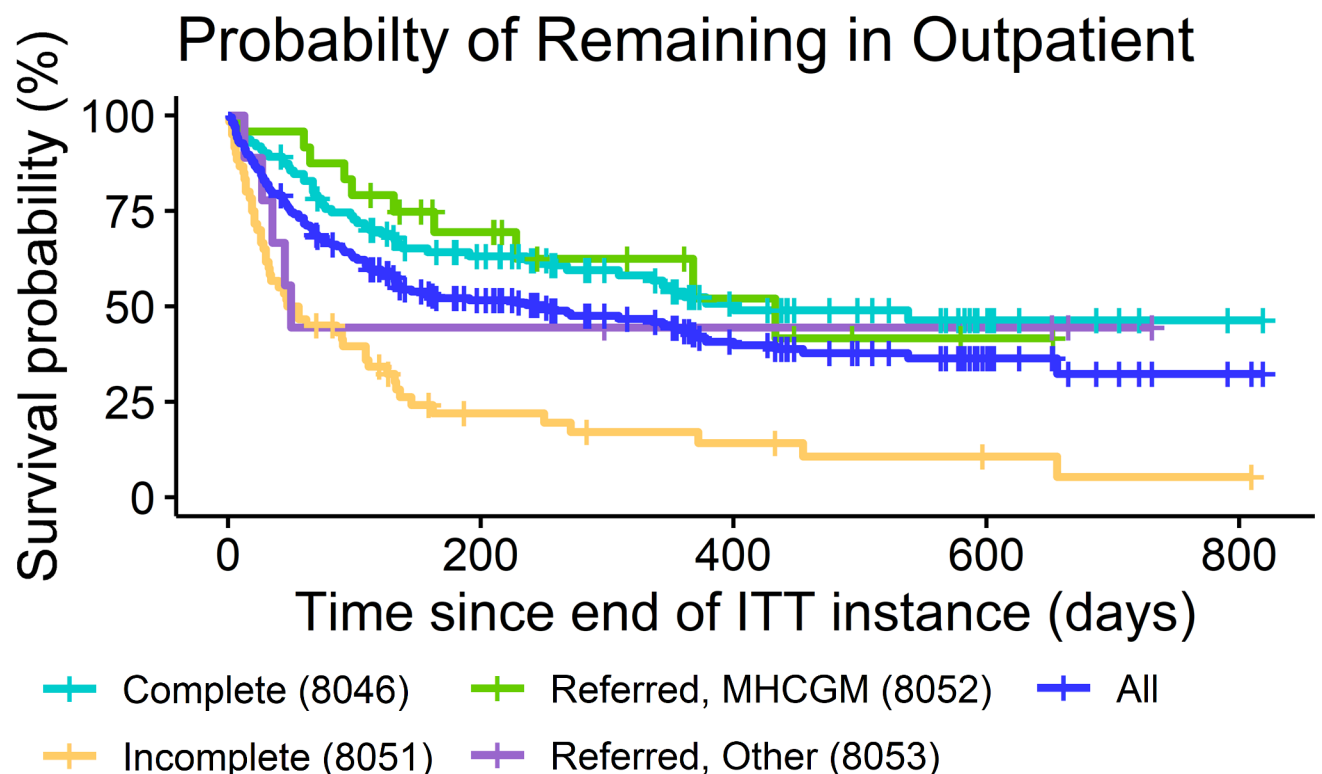


Figure 4. Survival curve measuring probability of retention in outpatient programs. Curve indicating the probability that a patient discharged from ITT will remain in an MHCGM outpatient program that number of days without dropping out (dark blue line, $n = 204$). Crosses indicate points where a patient was removed from the analysis, but did not drop out. Light blue, yellow, green, and purple lines depict the survival curve for completes ($n = 111$), incompletes ($n = 60$), direct MHCGM program referrals ($n = 24$), and referrals to other community programs ($n = 9$), respec-

Increase in Herth Hope Index Over 6 months

Rapid Increase Over 30 Days While in Program

- ◆ **Rapid improvement in Herth Hope Scale.** Within an episode, Herth Hope Index scores appear to increase over the first 6 months compared to baseline for those who eventually complete the program (Figure 5). However, for the few completes in ITT over 6 months (n=6) there is a significant drop off, with scores at or below baseline. This apparent decrease could be due to selection bias (i.e. they stayed in the program because they had more needs). In any case, a 9 month reevaluation might be considered for long term patients.
- ◆ **Increased scores are significant.** When comparing baseline to last follow-up during or shortly after ITT (< 30 days), we see a statistically significant increase (mean: 2.1, $p = 0.005$), which strengthens among those in ITT less than 6 months (mean: 2.3 , $p = 0.002$). Over the full course of an admit-to-discharge episode; 35 individuals displayed improved scores, 4 were unchanged, and 17 decreased. Individuals could be counted twice if separate instances of ITT had baseline and follow-up data. This did not occur in practice.

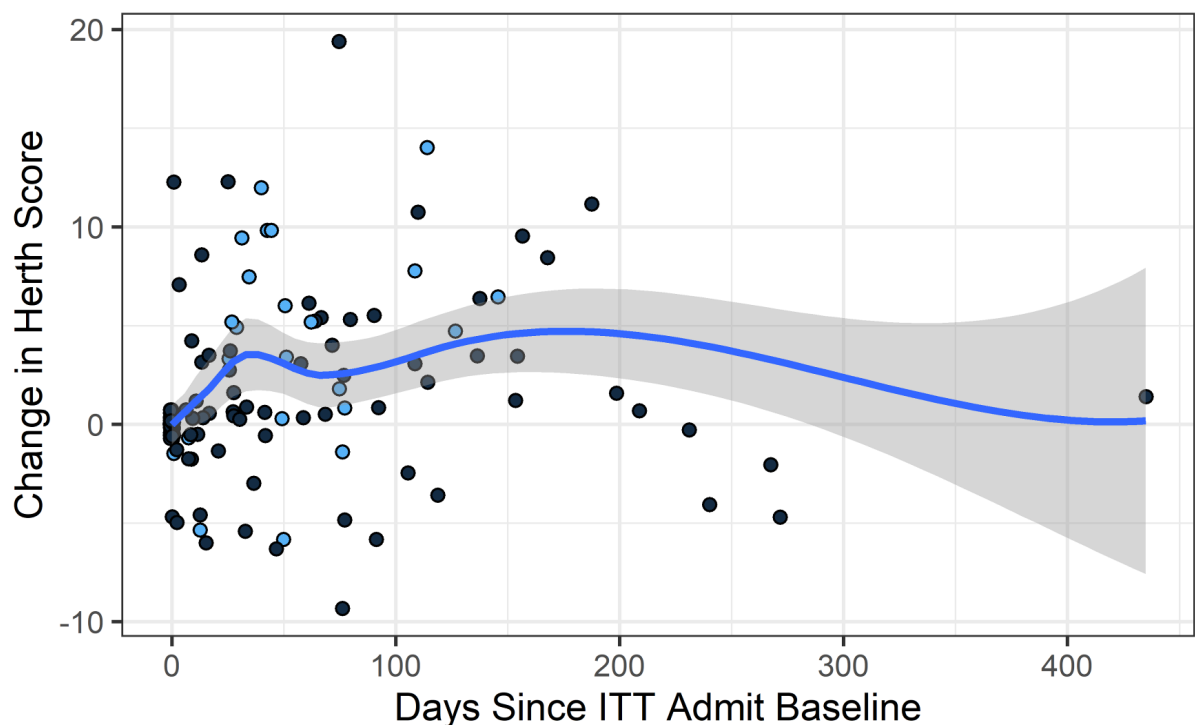


Figure 5 Curve measuring change in Herth Hope Index from baseline. Blue curve represents average of all measures with a grey 95% confidence interval. Light blue dots indicate the measure was between one week before and 30 days after program complete.

Consistent Improvement in PHQ-9 Scores

Rapid Improvement Followed by Steady Increase

The PHQ-9 has been shown to be a robust predictor of depression and risk for suicide behaviors among all age groups (Rossom et al., 2017). It and related measures have come to be adopted throughout MHCGM programs as part of the Zero Suicide initiative. Baseline scores among the sample averaged 16.7, which is consistent with moderately severe levels of depression, making improved scores a priority for patient's mental health and wellness.

- ◆ Patients who eventually complete ITT see a rapid and statistically significant decrease in PHQ-9 scores after admission. When comparing baseline to most recent follow-up during or shortly after ITT (< 30 days), we see a statistically significant decrease in scores (mean: -3.3, $p = 1.2 \times 10^{-5}$, $n = 95$), lowering the average score to 13.4, resulting in a category decrease from moderately severe to moderate. Among those who completed, 65 individuals displayed decreased scores, 9 were unchanged, and 21 increased. Individuals could be counted twice if a separate episode included both baseline and follow-up. This did not occur in practice.

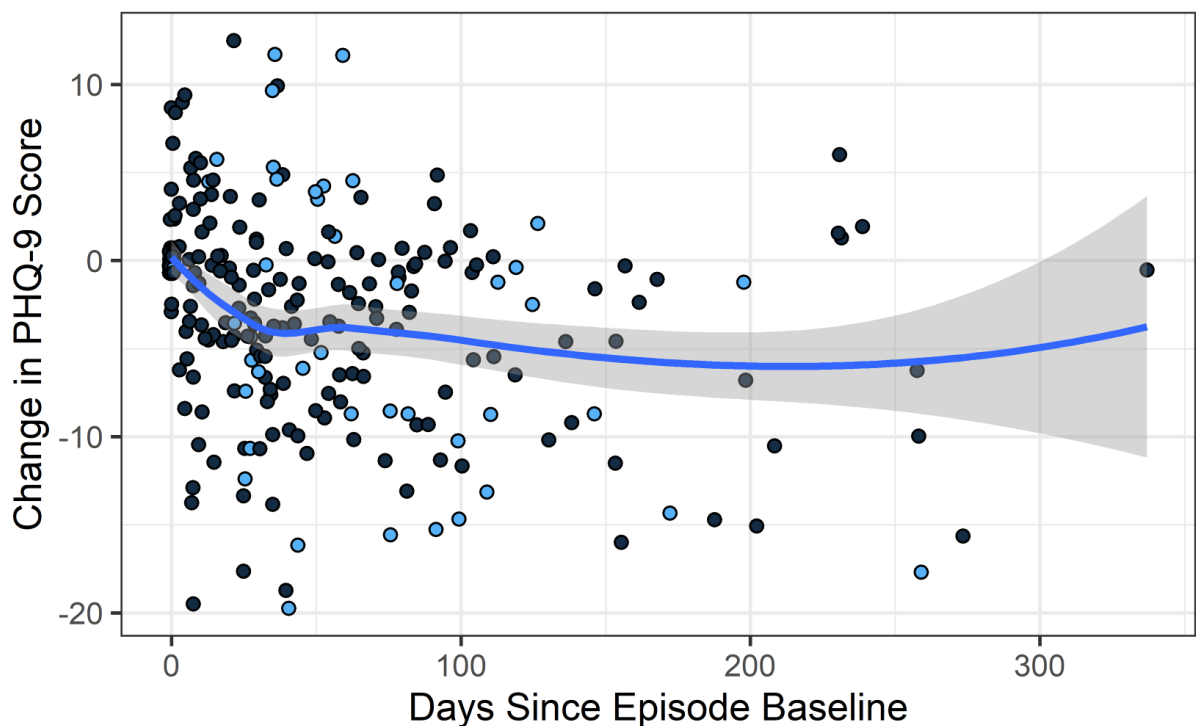


Figure 6. Curve measuring change in PHQ-9 scores from baseline. Blue curve represents average of all measures with a grey 95% confidence interval. Light blue dots indicate the measure was between one week before and 30 days after program complete.

Methods

Analysis Design. This was a retrospective analysis based on MHCGM case records and assessments available for the ITT program. All data was collected on 11/23/2020 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.

When comparing average ED visits before, dur-

ing, and after ITT, only cases with information in all categories were included, with the exception of incompletes, where only those with data before and after ITT admission were included. Since CMT records only report ED visits up to one year prior to the record creation date, this meant individuals without a CMT record within 6 months of admission were excluded from the 6 month category, without one within 9 months from the 3 month category, and those without one within one year were excluded entirely.

Modeling of Referrals. Demographics for Hillsborough County were obtained from the American Community Survey (US. Census Bureau, 2019).

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

Conclusion

Aiding Both Individuals and the Community

It is clear that ITT serves a population with significant mental health needs as well as complex medical requirements in general. In light of this complexity, the immediate and enduring impact of the program on ED recidivism is consistent with the program's effectiveness. The findings presented here are consistent with the team's ability to rapidly connect patients to needed services, benefiting both the community and the patients themselves through improved mental health and reductions in emergency medical costs. This is supported through associations between ITT and reduced ED visits as well as longer times between each visit. This association is particularly significant for the target population, which often frequents the ED. The ability of ITT to connect patients with resources in an enduring manner is also supported based on outpatient retention and is associated with improved Herth Hope and PHQ-9 measures, which more directly measure patient well-being. As a whole, this report demonstrates the success of the ITT program in both fulfilling its stated goals and having an enduring impact on patients' mental health well beyond their discharge date.

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Appendix

Table 1A. Logistic regression testing for admission into CATT.*

	Intercept (log odds)	Std. Error (log odds)	Odds Ratio [95% CI]	p-value
Age (Years) n = 841	0.0057	0.0042	1.00 [1.00-1.25]	0.16
Sex (Male) n = 841	-0.34	0.14	0.71 [0.54-0.94]	0.015
Race & Ethnicity (Hispanic) n = 576	0.30	0.37	1.35 [0.61-2.72]	0.42
Race & Ethnicity (African American) n = 549	-1.38	1.03	0.25 [0.01-1.22]	0.18
Marital Status (Married) n = 539	0.33	0.31	1.39 [0.74-2.49]	0.29
Marital Status (Separated) n = 486	-0.11	0.55	0.89 [0.25-2.38]	0.84
Marital Status (Divorced) n = 558	0.52	0.27	1.69 [0.98-2.85]	0.05
Marital Status (Widowed) n = 487	0.11	0.51	1.12 [0.37-2.78]	0.82
Employment (Employed) n = 463	0.49	0.27	1.64 [0.96-2.75]	0.07
Employment (Not in labor force) n = 495	0.41	0.26	1.51 [0.91-2.50]	0.11
Education (Any College, TF) n = 453	0.37	0.28	1.44 [0.83-2.45]	0.19

*A minimum sample size of 20 in each category was required for inclusion.