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ORIGINAL RESEARCH

A Retrospective Chart Review Suggests That Coordinated, Multidisciplinary Treatment for Patients with Anorexia Nervosa Improves Odds of Weight Restoration

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Purpose: The objective of this study was to conduct a secondary data analysis of clinical information documented in the electronic medical record to assess the clinical outcomes of patients who received three different treatment approaches on clinical outcomes for treatment of patients with anorexia nervosa (AN).

Patients and methods: Historical electronic medical record (EMR) data on patients aged 6 to 80 years diagnosed with AN seen in a healthcare system between 2007 and 2017 were stratified, according to services received, into three groups: Group A (n = 48) received hospital-based services; Group B (n = 290) saw one or two provider types; Group C (n = 26) received outpatient coordinated multidisciplinary care from three provider types. Clinical outcomes [body mass index for adults (BMI), body mass index percentile (BMI%ile) for pediatric patients] defined AN severity and weight restoration. EMR data were analyzed using a generalized mixed-effects model and a Markov Transition model to examine the odds of weight restoration and the change in odds of weight restoration across the number of provider visits, respectively.

Results: Patients receiving coordinated multidisciplinary care had significantly higher odds of weight restoration compared with patients receiving hospital-based services only (OR = 3.76, 95% CI [1.04, 13.54], $p = 0.042$). In addition, patients receiving care from 1 to 2 providers (OR = 1.006, 95% CI [1.003, 1.010], $p = 0.001$) or receiving coordinated multidisciplinary care (OR = 1.005, 95% CI [1.001, 1.011], $p = 0.021$) had significantly higher odds of weight restoration per provider visit day compared with patients receiving hospital-based services only.

Conclusion: This retrospective chart review supports the coordinated, multidisciplinary care model for the weight restoration in patients with AN in an outpatient setting.

Plain Language Summary: Treatment recommendations for the care of individuals with anorexia nervosa recommend a coordinated, multidisciplinary approach that, at a minimum, includes the following healthcare professional groups: a medical provider, mental health professional, and registered dietitian. Until there is enough evidence for this treatment approach in outpatient settings, it will remain underutilized, compromising the treatment of patients with anorexia nervosa. Since it would be unethical to conduct a randomized trial comparing coordinated, multidisciplinary care with uncoordinated care (it has already been identified as "best practice" by the American Psychiatric Association), the current study conducted a pragmatic, retrospective analysis of this care model on restoring weight in patients with anorexia nervosa. Patients were grouped according to the services they received: hospital-based services only (Group A), treatment from one or two different healthcare professional types (Group B), or treatment provided by all three healthcare professional types representing coordinated care (Group C). The results suggest that patients in Group C were more likely to restore weight, a necessary criterion for eating disorder recovery, compared with the other two groups.

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We hope these results provide the necessary support for increased use of an important treatment approach for treating individuals with anorexia nervosa.

Keywords: eating disorders, recovery, treatment team

Introduction

Anorexia nervosa (AN) is a clinical eating disorder characterized by restrictive dietary intake, maintenance of an inappropriately low body weight, and a disturbed body image.[1] Using the Diagnostic and Statistical Manual (DSM) 5 criteria, the lifetime prevalence of AN for males and females likely ranges between 0.8% and 1.9%.[2–4]

Anorexia nervosa results in considerable morbidity, accompanied by one of the highest mortality rates of any psychiatric condition.[5,6] Patients with a diagnosis of AN may exhibit substantial chronicity, including high rates of relapse and an overall protracted course.[7] Individuals with AN may deny their disease and often do not seek treatment. Estimates of full recovery range from 50% to 63%.[8,9] Anorexia nervosa is often considered one of the most difficult psychiatric conditions to treat.[7]

Individuals with medically stable AN may benefit from outpatient care as it maintains their sense of autonomy and increases patient acceptability of treatment.[10] Outpatient care allows individuals to apply the skills, tools, and healthy behaviors learned in treatment to their daily lives.[10,11] Outpatient treatment is significantly less costly for the patient. Cost estimates of outpatient care widely vary based on insured status and insurance coverage of service; a patient with AN could expect to pay up to $400 to $500 per week out-of-pocket based on estimated market rates. Given that a 2017 study estimated the weekly cost of inpatient and residential care to be approximately $16,065 and $8435, respectively,[12] that is in addition to the weekly cost of outpatient care these patients receive upon discharge, the outpatient cost savings are noteworthy.

Outpatient care may improve treatment engagement. One large, multicenter control trial randomized 167 adolescents with AN to treatment in a specialist inpatient center, specialist outpatient treatment, or general/non-specialist treatment outpatient. Treatment engagement was higher in the specialist outpatient group (77%) compared with engagement among those in the inpatient group (50%). Study authors determined that specialized outpatient treatment was no less effective than first-line inpatient treatment and was the most cost-effective approach.[11] A systematic review by Madden et al identified five randomized, controlled trials comparing outcomes of patients with AN in different treatment settings (inpatient, partial hospitalization, and outpatient) and lengths of stay. The authors concluded that no difference in treatment outcomes existed between the different treatment settings and lengths; the authors also noted the significant cost savings of outpatient and day-patient treatment.[13]

Treatment guidelines for individuals with AN advocate for a coordinated, multidisciplinary approach whereby the healthcare professionals address the multidimensional nature of this disorder.[14] The multidisciplinary team includes, at a minimum, a medical provider (physician, advanced practice provider, psychiatrist, etc.), a mental health professional (psychologist, licensed clinical social worker), and a registered dietitian [except for pediatric patients receiving Family-Based Therapy/FBT, a predominant therapeutic modality for this population, without registered dietitian involvement].[15] The medical provider addresses medical complications, manages medications, and advises on appropriate physical activity levels. The mental health professional focuses on the cognitive distortions, psychological underpinnings, and dysfunctional interpersonal relationships that contribute to the disorder, depending on the therapeutic modality utilized (eg, Cognitive Behavioral Therapy/CBT, psychodynamic therapy, and FBT for children and adolescents), and identifies effective alternative coping strategies. A registered dietitian facilitates nutrition rehabilitation in the patient through nutrition education and meal planning. Other treatment team members may be included depending on the patient's needs.

In a coordinated care context, providers discuss treatment plan details for shared patients, collaborate in the delivery of consistent patient messaging, and update fellow providers on the patient's physical, emotional, and psychological health. These provider communications also prevent confusion, triangulation, and undue burden on patients from managing the team.[16–18]

Challengingly, limited evidence supports the recommendation for multidisciplinary care that is coordinated. While the American Psychiatric Association,[19] the American Academy of Family Physicians,[20] and the American Academy of Pediatrics[21] recommend the multidisciplinary model, research substantiating these guidelines lacks support for care

coordination. Given the difficulties patients may face when receiving uncoordinated care (conflicting messages from providers that may stagnate progress and impede the establishment of patient-provider trust, splitting of providers which takes the focus off of the patient's recovery, etc.), greater empirical evidence is needed as support for greater implementation of coordinated, multidisciplinary care.

In this study, we used secondary data analysis of clinical information documented in the electronic medical record (EMR) to assess clinical outcomes using a coordinated, multidisciplinary treatment approach for patients with AN. Specifically, we aimed to identify the odds of achieving a normal BMI in adults and returning to baseline BMI percentile for pediatric patients with AN that were and were not receiving coordinated, multidisciplinary care.

Methods

Patients

We collected patient information from the EMR for any encounter or claims data from an individual diagnosed with AN by a medical provider or mental health specialist, seen in the Intermountain Healthcare system in the intermountain west geographical region, and billed for services with Select Health Insurance any time between January 1, 2007, and December 31, 2017. Patients were included in the dataset based on their first encounter in the healthcare system documenting a diagnosis of AN over the 10-year data collection period. Claims data were only available for Select Health Insurance, though outcome measures in the EMR represent clients of various insurance providers. The inclusion criteria comprised any patient aged 6 to 80 years diagnosed with AN. Exclusion criteria were any documented encounters for an individual not diagnosed with AN.

Measures

Eating Disorder Diagnosis and Severity

We classified eating disorder severity according to the DSM 5 criteria. We applied AN severity to the weight measurements gathered from the EMR and categorized for adults (mild: BMI > 17 kg/m^2, moderate: BMI 16–16.99 kg/m^2, severe: BMI 15–15.99 kg/m^2, extreme: BMI < 15 kg/m^2) and percent of body mass index (BMI) percentile decline for the pediatric population since severity specifiers do not exist for the pediatric population (Table 1). We collected all BMI

Table 1 Descriptive Statistics for the Total Sample and Within Experimental Groups (Counts (%) or Means (SDs))

Variable	Level	Group A (n = 48)	Group B (n = 290)	Group C (n = 26)	Group Difference *p*-value
Sex	Female	32 (10.2%)	257 (82.1%)	24 (7.7%)	**< 0.001**
	Male	16 (31.3%)	33 (64.7%)	2 (3.9%)	
Race	White	40 (12.7%)	249 (79.6%)	24 (7.7%)	0.563
	Non-White	8 (15.7%)	41 (80.4%)	2 (3.9%)	
Severity	Low (Mild-Moderate)	45 (14.0%)	256 (79.8%)	20 (6.2%)	0.101
	High (Severe-Extreme)	3 (7.0%)	34 (79.0%)	6 (14.0%)	
Age at First ED Diagnosis (years)		14.9 (8.7)	15.8 (5.4)	15.3 (3.7)	0.575
Age at Most Recent Visit (years)		17.5 (10.2)	20.1 (7.5)	21.0 (5.2)	0.098
Documented Time in Treatment (years)		2.9 (3.4)	4.9 (4.0)	6.7 (3.5)	**< 0.001**
BMI (kg/m^2) First Diagnosis		16.9 (2.8)	17.9 (4.3)	16.8 (2.2)	0.514

Notes: Group A is hospital care only; Group B is uncoordinated care from 1–2 providers; Group C is coordinated care from 3 providers; Prevalence is % of variable level. bold denotes statistical significance.
Abbreviations: SD, stands for standard deviation; ED, stands for eating disorder; BMI, stands for body mass index.

values from the EMR; both computer software analysis and study investigator data checks ensured the proper application of severity criteria.

Weight Restoration

We categorized weight restoration according to the DSM 5 criteria for recovery from AN of achieving a normal BMI (>18.5 kg/m^2) for adults; we considered pediatric patients recovered if they returned to their pre-morbid BMI percentile based on available growth charts (BMI%ile).

Defining Three Study Groups

Patient data were collected by mining the EMR data for all patients with a diagnosis of AN who received care in this healthcare system from 2007 to 2017. Study authors did not pre-assign patients to their respective groups; rather, we examined the EMR data collected on the standard care pathways patients experienced during the defined time period. We sorted patients into the following three groups based on their encounters (defined as an entry in the EMR): (A) those who only had service(s) delivered by a hospitalist in an inpatient setting according to claims data (for example, a patient with AN who was admitted to the emergency department and had AN listed in the encounter); (B) those with at least one encounter from one or two provider types (medical provider, mental health professional, and/or registered dietitian) over the 10-year study interval; or (C) those with encounters from all three provider types (medical provider, mental health professional, and registered dietitian) within a six-month period which served as a proxy for coordinated, multidisciplinary care. Patients were only assigned to one group; if a patient met the criteria for group B, for example, the patient did not crossover to group A at other time points.

In the healthcare system that produced the data, one primary medical provider specializes in the treatment of individuals with AN and works within a coordinated, multidisciplinary team that includes one medical provider (board certified in Family Medicine and Sports Medicine with over 25 years of clinical experience), eight registered dietitians, and eight therapists. All therapists are licensed clinical social workers (LCSW) who employ a variety of therapeutic treatment modalities (eg, FBT, CBT, Dialectical Behavioral Therapy/DBT, and psychotherapeutic approaches based on training). This team meets weekly for 90 minutes to collaborate on the care of shared patients. Thus, the patients who received care from all three provider types (Group C) likely received care from this treatment team, though we could not ascertain the coordination of care of this patient group.

Due to insufficient sample size, we could not separately examine the outcomes of pediatric and adult patients.

Patient Measures

Our analysis of the EMR included the following data: date of birth, each patient encounter date, number of patient encounters, weight, height, BMI (adults)/BMI%ile (pediatric patients), and gender.

Statistical Analysis

Descriptive Statistics

Descriptive analyses were performed before the primary analyses. Descriptive statistics were presented as counts and % for categorical data and as means and standard deviations for continuous data. We examined the differences among treatment groups for categorical demographic and descriptive variables (ie, sex, race/ethnicity, AN severity) using Pearson chi-squared statistics.

Differences Among Treatment Groups on Continuous Outcomes

This analytic approach allowed for examining differences among treatment groups on the dependent variables that were on the continuous measurement scale while controlling for other covariates within one regression model. Robust linear regression models were employed to examine differences among treatment groups on age at first diagnosis, age at most recent visit, documented time-in-treatment (defined as the duration from patient diagnosis of AN to the end of data collection based on the patient encounter information), and BMI. Baseline treatment group differences were not analyzed for adolescent BMI%ile at first diagnosis because of low treatment group counts. We entered predictors into the model using forced entry (all variables entered the model at once) and adjusted all models for AN severity and age group. The

Huber-White sandwich estimate (robust estimate) of variance was used for all models to ensure precision of the parameter estimates and to protect against potential violations of homoscedasticity, which is an assumption of multiple linear regression. After initial models were run to examine main effects, we employed post hoc analyses to test joint associations (interactions) between the treatment group and AN severity on each outcome. Group A was the referent for all comparisons. Results reporting consisted of communicating the regression coefficients with corresponding 95% Confidence Intervals.

Differences Among Treatment Groups on Weight Restoration

This analysis allowed for examining differences among treatment groups on the weight restoration variable that was binary (no/yes). Because the dependent variable was binary, a non-linear modeling approach, generalized linear mixed-effect model was used with a logit (log odds) link function while also controlling for covariates. A generalized linear mixed-effects model was employed to address the main research question of the likelihood of weight restoration based on treatment group, controlling for documented time-in-treatment, AN severity, and age group. Due to the clustering of visit days within patients, we employed random intercepts at the patient level. Adjusting for this clustering yielded more reliable variance estimates (confidence intervals). The coefficients from this modeling approach were transformed to odds ratios for interpretation. We then derived post-estimation marginal predicted probability plots to provide graphical differences in terms of probability of weight restoration. Group A was the referent for all comparisons.

Association Between Visit Days and Weight Restoration

This secondary analysis allowed for examining how a higher number of visit days associated with a change in odds (a proxy for probability) for weight restoration over time and if these observed differences across days changed according to treatment group. The change in odds of weight restoration across provider visit days was examined using a Markov Transition Model. Specifically, we ran the Markov Model using a generalized estimating equation (GEE), testing the association of two lag variables on the odds of weight restoration. The lag variables represented the first two immediately prior time points (ie, provider visits) respective to any one respective provider visit across the patients' documented time-in-treatment. We carried out the GEE using a binomial link function and an independent correlational structure. We population-averaged the models and adjusted for documented time-in-treatment and the respective lag variables. Our parameter estimates of interest were the joint associations between the treatment group and number of provider visits. Our reporting of the results for both the primary and secondary analyses on weight restoration consisted of communication of the transformed parameter estimates (odds ratios) with the corresponding 95% Confidence Intervals. We set the alpha level for all analyses at $p < 0.05$ and used Stata v15.0 statistical software package (StataCorp, College Station, Texas, USA). We only included patient data with a baseline BMI%ile measure (for pediatric patients) and had at least one BMI/BMI%ile value after the date of AN onset (in this case, the first date at which the diagnosis of AN was noted in the EMR) in analyses; we excluded any patient whose data did not meet these criteria and had missing data. Of note, all relationships in this study were interpreted as associations (correlations) and no causal inferences could be made based on the research design.

Results

Patient Characteristics

We present descriptive statistics for the total sample in Table 1. The treatment group distribution was heterogenous with 48 (13.2%) patients receiving only hospital services (Group A), 290 (80.0%) patients receiving uncoordinated provider care from 1 to 2 providers (Group B), and 26 (7.1%) patients receiving multidisciplinary, coordinated care from at least three providers (Group C). The majority of the individuals with AN sample was female (86.0%), was White/Non-Hispanic/Latino (86.2%), was characterized as having a mild-to-moderate AN severity (88.2%), had an average age of AN diagnosis of 15.6 years old and spent an average of 5.0 years in documented time-in-treatment. The average number of hospital visits was 9.8 for patients within Group A, 31.5 outpatient visits for patients within Group B, and 46.7 outpatient visits for patients within Group C. The time in treatment data for each group are also presented in Table 1. By dividing documented time-in-treatment by the number of visits, there were, on average, 108.7 days between visits for

patients within Group A, 57.8 days between visits for patients within Group B, and 52.4 days between visits for patients within Group C. The average BMI at first AN diagnosis was 17.9 kg/m^2 for adults, and an average BMI%ile at first AN diagnosis was 42.3% for pediatric patients. There was no standardized number of weight assessments for patients within the sample because of the variation in the number of visit days and length of time-in-treatment. BMI was recorded for all patients at each provider visit; therefore, there was no missing BMI data.

For the categorical descriptive data, there was no statistically significant association between race and treatment group or between AN severity and treatment group. However, there was a statistically significant association between patient sex and treatment group; there was a significantly higher percentage of male patients in Group A than female patients (χ^2 = 16.1, p < 0.001). For the continuous descriptive data, no significant differences were evident among treatment groups in age at first diagnosis, age at most recent visit, and BMI at first diagnosis. However, patients with severe-extreme AN had significantly lower BMI at first diagnosis than adult patients with mild-to-moderate severity AN (b = −5.3 kg/m^2, 95% CI: [−6.8 kg/m^2, −3.7 kg/m^2], p < 0.001) and significantly lower BMI%ile compared to pediatric patients with mild-to-moderate AN (b = −42.4%, 95% CI: [−52.8%, −32.1%], p < 0.001).

Documented Patient Time-in-Treatment

Table 2 presents the results of the documented time-in-treatment analysis. Patients in Group C spent significantly longer documented time-in-treatment compared to patients in Group A (b-coefficient = 3.9 years, 95% CI: [0.8 years, 7.0 years], p = 0.013) after adjusting for AN severity and age group (see Figure 1). Additionally, patients with severe-to-extreme AN spent significantly less documented time-in-treatment compared to patients with mild-to-moderate AN (b = −2.8 years, 95% CI: [−5.4 years, −0.2 years], p = 0.034) within the adjusted model. Adults, on average, spent significantly less documented time-in-treatment than pediatric patients (b = −1.4 years, 95% CI: [−2.7 to 0.0], p = 0.049). Finally, results reflected a significant treatment group by severity joint effect. Patients in Group B who also had severe-to-extreme AN spent significantly longer documented time-in-treatment (b = 5.9 years, 95% CI: [2.5 years, 9.3 years], p = 0.001) compared to patients in Group A (see Figure 2).

Weight Restoration

Table 3 reports the results of the generalized linear mixed-effects model. Patients in Group C had significantly higher odds of weight restoration compared with Group A (OR = 3.76, 95% CI [1.04, 13.54], p = 0.042), with no statistically significant effect on AN weight restoration for Group B (OR = 1.73, 95% CI [0.86, 3.52], p = 0.125). No significant

Table 2 Parameter Estimates Predicting Documented Time-in-Treatment (in Years) Using Robust Linear Regression

Predictor	Level	b-Coefficient	95% Confidence Interval	*p*-value
Treatment Group	Group A	Referent	Referent	Referent
	Group B	1.3	−0.9 to 3.7	0.235
	Group C	**3.9**†	0.8 to 7.0	0.013
Severity	Mild/Moderate	Referent	Referent	Referent
	Severe/Extreme	**−2.8**†	−5.5 to −0.2	0.034
Group x Severity	Group A x Mild/Moderate	Referent	Referent	Referent
	Group B x Severe/Extreme	**5.9**†	2.5 to 9.3	0.001
	Group C x Severe/Extreme	3.2	−0.4 to 6.7	0.077
Age Group	Adolescents	Referent	Referent	Referent
	Adults	**−1.4**†	−2.7 to 0.0	0.049

Notes: Group A is hospital care only; Group B is uncoordinated care from 1–2 providers; Group C is coordinated care from 3 providers; bold and †denotes statistical differences compared to Group A, p < 0.05.

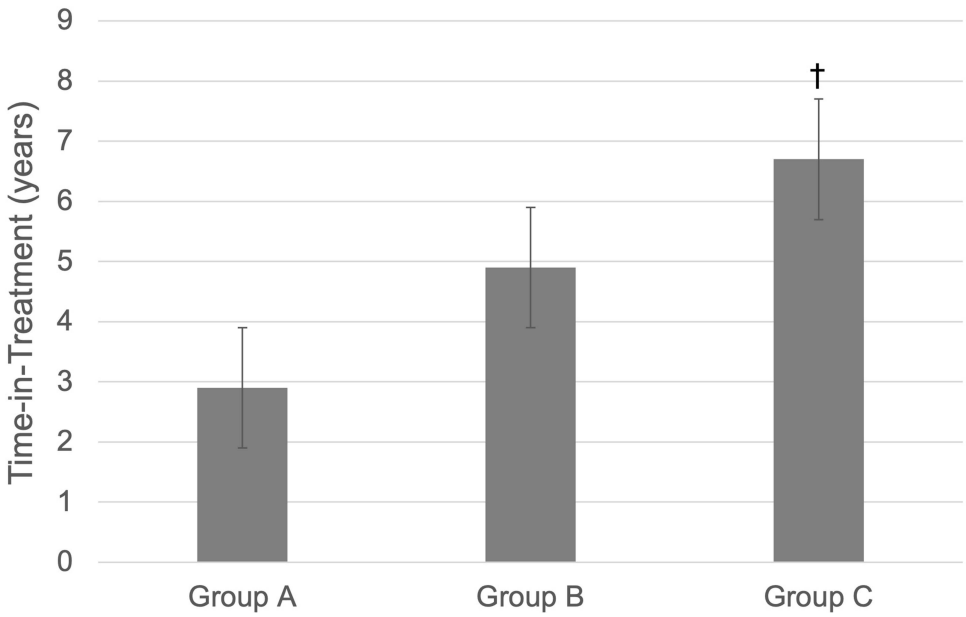

Figure 1 Mean documented time-in-treatment across treatment groups.
Notes: Group A is hospital care only; Group B is uncoordinated care from 1 to 2 providers; Group C is coordinated care from 3 providers; † denotes statistical differences compared to Group A, $p < 0.05$.

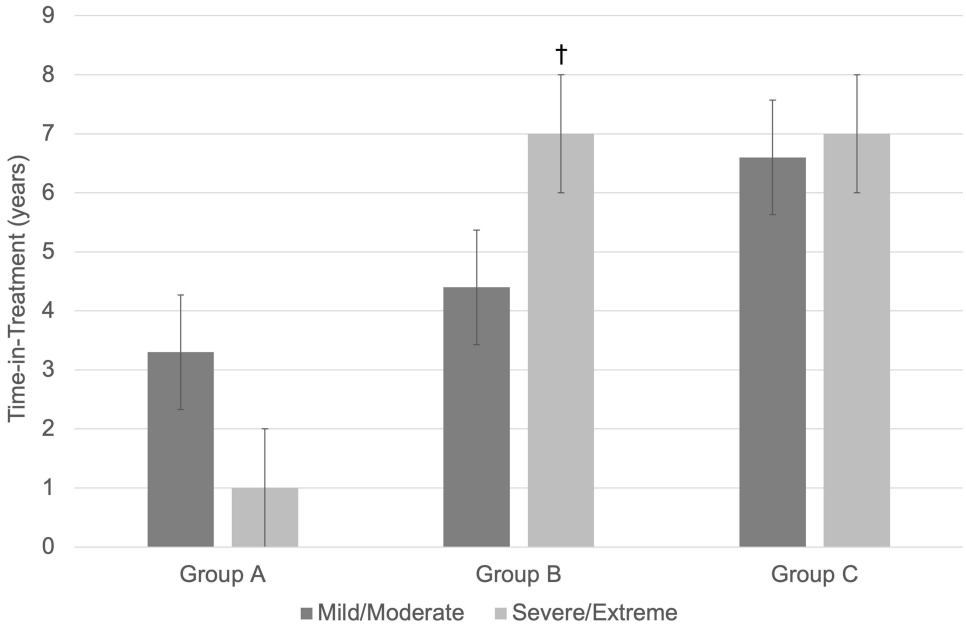

Figure 2 Mean documented time-in-treatment across treatment groups, stratified by disease severity.
Notes: Group A is hospital care only; Group B is uncoordinated care from 1 to 2 providers; Group C is coordinated care from 3 providers; † denotes statistical differences compared to Group A, $p < 0.05$.

differences were observed between Groups B and C ($p > 0.05$), indicating that Groups B and C did not differ on the odds of AN weight restoration after controlling for time-in-treatment, severity, and age group. For every 1 additional documented year in time-in-treatment, there were significantly higher odds of AN weight restoration (OR = 1.08, 95% CI [1.02, 1.16], $p = 0.015$). On average, patients with severe/extreme AN severity had 86% lower odds of AN weight restoration compared to patients with mild/moderate AN severity ($p < 0.001$). Additionally, adult patients, on average, had higher odds of AN weight restoration compared to pediatric patients (OR = 1.95, 95% CI [1.18, 3.24], $p = 0.009$).

Table 3 Parameter Estimates (Odds Ratios) Predicting Weight Restoration Using a Generalized Linear Mixed-Effects Model

Predictor	Level	Odds Ratio	95% Confidence Interval	*p*-value
Group	A	Referent	Referent	Referent
	B	1.73	0.86 to 3.52	0.125
	C	**3.76**†	1.04 to 13.54	0.042
Documented Time-in-Treatment		**1.08**†	1.02 to 1.16	0.015
Severity	Mild/Moderate	Referent	Referent	Referent
	Severe/Extreme	**0.14**†	0.07 to 0.30	< 0.001
Age Group	Adolescents	Referent	Referent	Referent
	Adults	**1.95**†	1.18 to 3.24	0.009

Notes: Group A is hospital care only; Group B is uncoordinated care from 1–2 providers; Group C is coordinated care from 3 providers; bold and †denotes statistical significance, $p < 0.05$.

Figure 3 displays the probability of weight restoration based on the treatment group, stratified by AN severity. Both categories of severity in Group C saw a greater probability of weight restoration.

Table 4 reports the results of the Markov Transition Model. Patients in Group B (OR = 1.006, 95% CI [1.003, 1.010], $p = 0.001$) and Group C (OR = 1.005, 95% CI [1.001, 1.011], $p = 0.021$) had significantly higher odds of AN weight restoration per provider visit day across the documented time-in-treatment, with no significant visit day trends for patients in Group A (OR = 0.957, 95% CI [0.878, 1.053], $p = 0.160$). There were no observed differences in and interactions with time between Groups B or C ($p > 0.05$), indicating that there were no differences between patients within Group B and C on how the number of visits associated with AN weight restoration, controlling for time-in-treatment. Within the Markov Model, one additional documented year in time-in-treatment was associated with significantly higher odds of AN weight

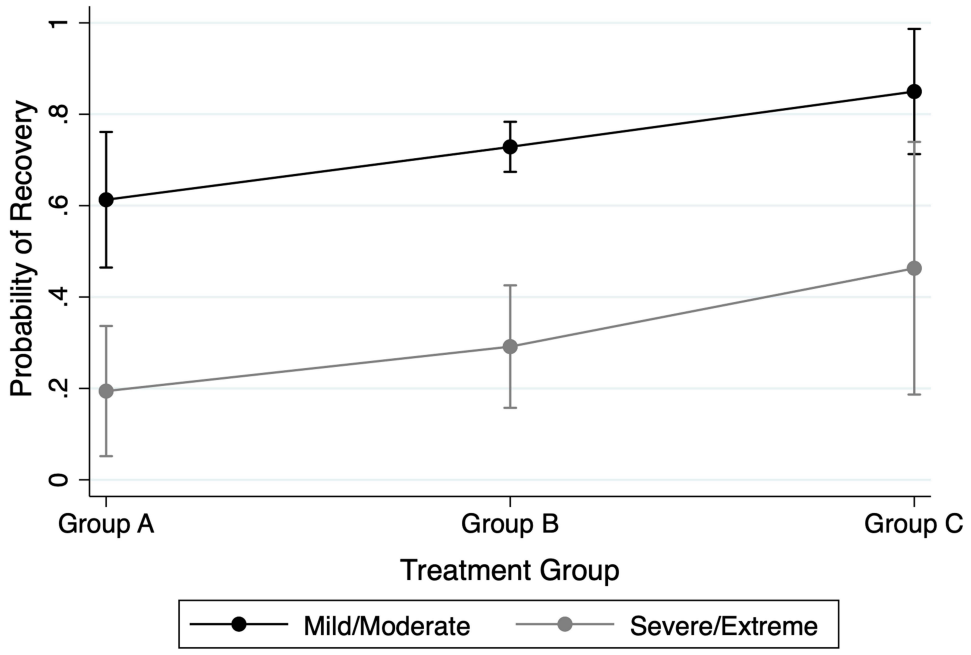

Figure 3 Probability of weight restoration in anorexia nervosa recovery among treatment groups stratified by disease severity.
Notes: Group A is hospital care only; Group B is uncoordinated care from 1 to 2 providers; Group C is coordinated care from 3 providers.

Table 4 Parameter Estimates (Odds Ratios) Predicting Anorexia Nervosa Recovery Using Markov Transition Model

Predictor	Level	Odds Ratio	95% Confidence Interval	*p*-value
Treatment Group x Visit Number	Group A x Visit Number	0.957	0.878 to 1.053	0.160
	Group B x Visit Number	**1.006**†	1.003 to 1.010	0.001
	Group C x Visit Number	**1.005**†	1.001 to 1.011	0.021
Documented Time-in-Treatment (year)		**1.101**†	1.041 to 1.180	0.011
Lag Variable 1		**29.161**†	21.542 to 36.322	< 0.001
Lag Variable 2		**4.009**†	3.111 to 5.008	< 0.001

Notes: Group A is hospital care only; Group B is uncoordinated care from 1–2 providers; Group C is coordinated care from 3 providers; bold and †denotes statistical significance, $p < 0.05$.

Abbreviations: AN, anorexia nervosa; EMR, electronic medical record; BMI, body mass index; BMI%ile, BMIpercentile; DSM, diagnostic and statistical manual; FBT, family-based treatment; CBT, cognitive behavioral therapy; DBT, dialectic and behavioral therapy; LCSW, licensed clinical social worker; GEE, generalized estimate equation; OR, odds ratio.

restoration (OR = 1.101, 95% CI [1.041, 1.180], $p = 0.011$). Finally, patients who achieved AN weight restoration had significantly higher odds of remaining weight restored at their next immediate provider visit (Lag 1: OR = 29.161, 95% CI [21.542, 36.322], $p < 0.001$) and at their subsequent second visit (Lag 2: OR = 4.009, 95% CI [3.111, 5.008], $p < 0.001$).

Discussion

Our main objective of this study was to identify the difference in clinical outcomes between patients with AN who did and did not receive coordinated, multidisciplinary care by assessing the odds of achieving a normal BMI in adults and returning to baseline BMI percentile for pediatric patients. Patients receiving coordinated, multidisciplinary care had significantly higher odds of achieving weight restoration than those receiving hospital and uncoordinated care. To our knowledge, this is the first study of its kind to demonstrate the effectiveness of coordinated, multidisciplinary care compared to other forms of outpatient care. These results provide important support for the multidisciplinary care model.

That adults with AN, on average, had 87% lower odds of weight restoration compared with pediatric patients is consistent with previous research. Generally, adolescents exhibit higher recovery rates than adults.[22] This finding also supports the recommendation for earlier identification and intervention for eating disorder behaviors and diagnoses.[23,24] Our results indicated that patients with severe/extreme AN had 56% lower odds of weight restoration than those with mild-to-moderate AN. This finding is expected, given that eating disorder severity is a known predictor of poorer outcomes.[25]

We are optimistic about the finding that if a patient achieved weight restoration at the time of one provider visit, the individual had higher odds of staying weight restored at the subsequent visit (ie, first follow-up visit from meeting recovery criteria). However, it is concerning that the odds of remaining weight restored at their subsequent provider visit decreased. Anorexia nervosa is a condition known to have a high rate of recidivism. Berends and colleagues found that approximately 31% of patients with AN relapsed, with the relapse rate highest in the first two years of recovery.[26] Of note, we did not analyze patient relapses as these are behaviors, which may or may not be accompanied by change in weight. Behaviors are not documented in the EMR as discrete data. Our current findings support that achieving a BMI of 18.5 kg/m^2 does not ensure that individuals remain weight restored.

Time-in-treatment is a critical consideration in the management of patients with AN. In a 22-year longitudinal study of patients with AN, the achievement of recovery was unlikely in the first decade of treatment; however, recovery rates improved over the following decade.[8] In the current study, those receiving coordinated, multidisciplinary care engaged in treatment almost four years longer than those receiving only hospital-based care, which likely contributes to the significantly higher odds of weight restoration in the coordinated, multidisciplinary group (Figure 1). Many aspects of coordinated care might facilitate greater treatment engagement, such as an increased sense of support and accountability. A qualitative study conducted by the current authors that examined the patient experience of receiving coordinated, multidisciplinary care corroborates this sense of support felt by the patient.[27]

Our current finding that patients with severe-to-extreme AN spent significantly less time engaged in treatment than patients with mild-to-moderate AN is a likely contributor to the poorer outcomes seen in those with worse severity. Patients with severe AN often experience multiple treatment failures and may be reluctant to continue engaging in treatment;[28] other contributors include the same risk factors for a worse AN prognosis, including depression, self-isolation, and ego-syntonicity. The considerable psychological and physiological comorbidities among individuals with more severe AN reinforces the importance of multidisciplinary care to address the complex nature of the disease.[25] As indicated, a multidisciplinary approach may support patients engaging in treatment longer and receiving sufficient care necessary for weight restoration.

We are encouraged that patients who worked with at least one provider had improved odds of weight restoration *per visit day* while in treatment. The change in odds of weight restoration per provider day was not greater for Group B or Group C and highlights the importance of having at least one additional provider other than hospitalization care. Frequent touchpoints with patients matter, as evidenced by the greater number of visit days in Group B or C, resulting in higher odds of weight restoration. The clinical relevance for providers working with this population is to meet regularly with patients. For the provider working with a patient with AN and cannot work within a multidisciplinary team context, these results indicate that recurrent patient visits may support improved patient outcomes.

This study is unique in documenting the efficacy of *coordinated*, multidisciplinary care for the outpatient treatment of individuals with AN over a 10-year period. Eating disorder treatment guidelines endorse a multidisciplinary care model focused on patient-centered, collaborative care, yet up until now, this recommendation has not been empirically supported. The literature suggests that the majority of individuals with eating disorders do not receive evidence-based care, owing in part to the fact that the field has yet to identify sufficient, effective interventions.[19,29] These findings corroborate coordinated, multidisciplinary care as an evidence-based approach and promote its broad implementation among eating disorder treatment providers.

We acknowledge the limitations of the current study. This study was an observational, retrospective chart review that relied predominantly on claims data within an integrated healthcare delivery system. BMI and BMI%ile were the sole measures of AN severity and weight restoration due to our reliance upon the EMR data. The DSM 5 promotes using BMI and BMI%ile as measures of recovery. Some researchers propose that achieving a normal BMI is an essential treatment goal and is necessary, if not sufficient, for remission.[12] However, other research indicates that BMI *level* may not accurately capture AN severity.[30] BMI and BMI%ile alone do not encapsulate cognitive distortions, body image disturbances, and eating behavior pathology. Eating disorder assessment tools and clinical judgment may adjust the severity ranking of the disorder and to define recovery. Khalsa and colleagues propose administering the Eating Disorder Examination to determine the recovery and remission criteria.[31]

Due to the study's retrospective nature, we could not prospectively assign participants to treatment groups to create more balanced groups. As it was, the dataset includes heterogeneity regarding sex, age, weight, severity, and disease duration, all limiting the generalizability of the treatment effects. That 80% of the patients with AN received uncoordinated care from one or two providers, and only 7% received coordinated, multidisciplinary care, which speaks to the enormous disconnect between treatment guidelines for coordinated, multidisciplinary care and actual practice. Limited payer reimbursement for coordinated care, insufficient payer coverage for AN treatment for nutrition services, and a shortage of treatment providers with expertise in eating disorders are likely contributing factors.

We recognize the notable challenges of working with data derived from the EMR. Data accuracy and representativeness rely on the ability of providers to chart all relevant patient information. Individuals with eating disorders are likely to go undiagnosed, or their diagnosis may not be included in the medical record, which introduces the risk of substantial missing data. Further, patients may have been given an incorrect diagnosis.

The current dataset came from one large healthcare system, with claims data available from the affiliated healthcare payer. Group A or B patients may have received care from provider types not accounted for in the EMR. While it is possible that patients went outside their insurance to seek care, it is unlikely that patients in groups A and B received extensive, longitudinal, or coordinated care without the benefit of their insurance coverage. Nonetheless, our inability to account for external patient care limits the prediction of time-in-treatment. Moreover, Group B represented patients who received treatment for AN but did not receive coordinated care; due to the wide variety of potential services received by these patients, future studies with an adequate sample size might consider further stratifying this group based on the types

of services received. Finally, our study insufficiently captures the continuum of care often experienced by these patients. Patients were assigned to the highest level of care received (group A, B, or C); however, patients may have met the criteria for more than one group over the 10-year study interval. Failing to account for group crossover could bias our interpretation of the results.

Potential errors in data mining and extraction may affect the interpretation of the results. Time-in-treatment was based on the duration of EMR-derived encounters that had a diagnosis of AN and is estimated via provider documentation; some patients may have been followed longer – suggesting a longer treatment period – when in fact, active treatment was not occurring during that time frame. If a patient sought additional treatment elsewhere, it is unknown when their treatment ended and their final weight status. Therefore, the results of the documented time-in-treatment analyses should be interpreted with caution. Additionally, there was a sample size discrepancy among the study treatment groups, with fewer patients in Groups A and C than in Group B. Although this discordance in patient distribution is reflective of real-world "effectiveness" behavior change trials as opposed to highly controlled "efficacy" behavior change trials,[32] the results still need to be interpreted with caution.

AN has one of the highest costs of treatment of any psychiatric condition[33] due in large part to the inpatient and residential treatment costs of nutritional rehabilitation.[12] The current findings that coordinated multidisciplinary outpatient care results in improved odds of weight restoration have financial implications for both healthcare systems and healthcare payers. This team-based approach has advantages if it decreases the total cost of care due to improved weight restoration while maintaining patients' care in an outpatient setting. Future studies might directly examine the cost-effectiveness of the coordinated approach compared to other outpatient and inpatient treatment settings.

Conclusion

In summary, the current findings provide preliminary support for the recommendation that patients seen in an outpatient context for the treatment of AN receive care from a multidisciplinary team coordinating care. Patients in this multidisciplinary team coordinating care model had greater odds of weight restoration and spent a longer time in treatment than patients not receiving coordinated care. These findings provide preliminary support for healthcare systems to implement the coordinated, multidisciplinary approach more consistently. Despite these positive findings, the results observed were merely associations; therefore, no causal inferences could be made. Ultimately, given the complex nature of eating disorders and the well-known treatment challenges, this study suggests that the coordinated, multidisciplinary care approach shows promise, with additional research needed to further address these complexities and challenges.

Ethics Approval and Consent to Participate

The Intermountain Healthcare Institutional Review Board (IRB) approved the study. Given that the study qualified for exempt status due to the retrospective chart review format, participant consent was not required.

Data Protection and Privacy

The data referenced in this study complied with relevant data protection and privacy regulations.

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