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MST for Adolescents with Poorly Controlled Type I Diabetes: Reduced DKA Admissions and Related Costs over 24 Months

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Objective: The study aim was to determine if Multisystemic Therapy (MST), an intensive home-based psychotherapy, could reduce admissions for diabetic ketoacidosis (DKA) in youth with poorly controlled type 1 diabetes over 24 months. Potential cost savings from reductions in admissions were also evaluated.

Research Design and Methods: 127 youth were randomly assigned to MST or control plus standard medical care.

Results: MST youth had significantly fewer admissions than controls [X^2 (4, N=127) =11.77, P=.019]. MST youth had significantly fewer admissions versus their baseline rate at 6 month (P=.004), 12 month (P=.021), 18 month (P =.046), and 24 month follow-up (P = .034). Cost to provide MST was $6,934 per youth. However, substantial cost offsets occurred from reductions in DKA admissions.

Conclusions: The study demonstrates the value of intensive behavioral interventions for high risk youth with diabetes for reducing one of the most serious consequences of medication non-compliance.

We previously reported on Multisystemic Therapy (MST), an intensive, home-based family therapy, for youth with chronically poor metabolic control (CPMC). MST produced improvements in metabolic control and indicators of serious non-adherence (DKA admissions) at treatment termination (1, 2). Reductions in admissions were maintained six months later (2). The present study investigated MST's effects on DKA admissions at the conclusion of the trial, and related cost-savings.

RESEARCH DESIGN AND METHODS

127 adolescents with CPMC and their families were recruited from endocrinology clinics at Children's Hospital of Michigan between 1999-2004. Eligible youth were diagnosed with type 1 diabetes for at least one year, had an average glycated hemoglobin (A1C) of 8% or higher during the year prior to study entry, and were aged 10 -17. Mean A1C at study entry was 11.3% (*SD* =2.3%). 92% used injected insulin. 8% used insulin pumps. Mean age was 13.2 (*SD*=2.0). 63% were African-American.

Sixty-four participants were randomly assigned to MST and 63 to control. All families received quarterly visits with a multidisciplinary diabetes team. MST families also received six months of therapy (mean = 5.7 months). Families were followed for 24 months total. MST targeted adherence-related problems within the family and broader community systems (school, health care) (1, 3). These included family (e.g. poor parental supervision and oversight of youths' diabetes care completion), school (e.g. inadequate communication between parents and school personnel regarding the youth's health needs), and health care system factors (e.g. barriers to keeping clinic appointments due to problems with transportation or family disorganization).

Number of DKA admissions was obtained from the treating hospital's information system for the six-month window prior to study entry [baseline (T1)] and for the follow-up periods [baseline-six months (T2), 6-12 months (T3), 12-18 months (T4), and 18-24 months (T5)]. Criteria used to diagnose DKA were hyperglycemia (blood glucose>16.65 mmol/L), serum acetone positive at greater than 1:2 dilution of serum, acidosis (pH<7.30 and bicarbonate<15 mmol/L), ketonuria, and glucosuria.

As decreases in HbA1c at treatment termination for MST youth were not maintained at 6-months (2), cost-effectiveness evaluation was not appropriate. Cost-savings were evaluated by reductions in admissions. Forty-five youth (21 MST, 24 controls) had at least one admission during the study. Costs were estimated by obtaining direct hospital costs and revenues from the hospital financial database and calculating an average cost for DKA admissions during the study. Revenues reflected third-party payor reimbursements.

Costs of MST for youth with CPMC were estimated from MST costs in the "real world", rather than costs in the trial, which might underestimate true implementation costs. Because MST as originally developed for delinquent youth is widely disseminated, real-world estimates could be calculated. Costs included: salary, benefits, and overhead for therapists, supervisor, and program staff; therapist mileage; travel for training; MST licensing fees; and quality assurance costs. Costs per youth were estimated at $6,934.

RESULTS

Figure 1 shows cumulative DKA admissions for MST and control youth. Change in admission frequency over the 24-month trial was evaluated using repeated-measures Poisson regression. Analyses were

performed with generalized estimating equations (GEE) by specifying the Poisson distribution for the response variable (4;5); this accounted for correlated error. Time effects were partitioned into time-ordered contrasts comparing T1 with each follow-up period (T2-T5). MST's effects were evaluated by the Group X Time interaction, followed by simple effect tests of MST within-group changes from baseline. Single parent status was used as a covariate due to its relatedness to outcome in prior studies. The Group X Time interaction was significant [X^2 (4, *N*=127) =11.77, *P*=.019], indicating MST youth had significantly fewer admissions than controls. Simple effect contrasts showed MST youth had significantly fewer DKA admissions relative to baseline frequency at T2 (*P*=.004), T3 (*P*=.021), T4 (*P* =.046), and T5 (*P* = .034). Drops in admissions per youth were obtained over constant six month intervals and hence are measures of effect size when expressed as rates. The rates and 95% CI were .31 (.09-.54), .27 (.03-.50) .23 (.01-.47) and .23 (.01-.47) for T2-T5. Controls had fewer admissions only at T5 (*P*=.026); rate =.24(.02-.45).

Hospital direct costs were $4,237 and revenues were $5,446 per admission. The 24 control youth with any admission in 24 months had 85 DKA admissions. The 21 MST youth had 45 admissions. Hence, DKA admissions resulted in $360,145 and $190,665 in hospital costs and $462,910 and $245,070 in third-party payor costs for control and MST youth, respectively. Costs to provide MST for 21 youth were estimated at $145,614 (21 X $6,943). Therefore, MST was estimated to potentially save a total of $23,886 (institutional perspective) or $72,226 (third-party payor perspective).

CONCLUSIONS

MST produced lasting reductions in post-diagnostic DKA admissions, which occur most commonly due to insulin non-compliance (6, 7). Reduced admissions rates in the MST group at follow-up were consistent with those reported in recent general population studies of youth with diabetes (8). The only other intervention to have effects on DKA in youth with CPMC is residential psychiatric treatment (9), a costly intervention with unknown long-term impact. Costs to provide MST to youth with CPMC were relatively high. However, preliminary evaluation suggests control youth with DKA admissions accumulated sufficient costs over 24 months that expenditures on MST may be justified by potential for savings. MST could produce cost-savings for the subset of youth with CPMC and a recent history of DKA admissions, although not if such admissions are not present. The study demonstrates the potential for intensive behavioral interventions to reduce serious consequences of medication non-compliance in high-risk youth.

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Figure Legend

Figure 1. Cumulative number of DKA admissions during five six-month intervals for MST (♦) and control (◊) participants. The baseline interval (T1) started six months prior to trial entry; the subsequent intervals were from T1 to treatment termination (T2), from (T2) to 12-month follow-up (T3), 12-month to 18-month follow-up (T4) and 18-month to 24-month follow-up (T5). Error bars are +/- one standard error of the mean.