Improving Depression Screening for Adolescents With Type 1 Diabetes

OBJECTIVE: Depression is common among adolescents, but rates increase significantly in the presence of chronic health conditions. Outpatient screening for depression is recommended but rarely formally conducted due to barriers of implementation.

METHODS: To provide a model for depression screening of youth with chronic health conditions, a standard process using a self-administered electronic version of the Children’s Depression Inventory (CDI) was developed. Quality improvement methodology and traditional analytic approaches were used to test the feasibility and outcomes of routine screening in patients 13 to 17 years of age with type 1 diabetes.

RESULTS: Of the 528 eligible adolescents, 509 (96%) received at least 1 depression screen during the first year. The process was tested and refined in over 1200 patient encounters, which resulted in an increase in depression screening rates from <5% to a median of 85% over the initial 12 months. Both patients and staff reported acceptance of screening on qualitative surveys. Elevated CDI scores (≥16) were found in 8% of the sample; moderate scores (10–15) in 12% of the sample. Low risk scores were found in 80% of the sample. Higher CDI scores correlated with lower blood glucose monitoring frequency and higher hemoglobin A1c, confirming the link between more depression symptoms and poorer diabetes management and control. Suicidal ideation was endorsed in 7% of the population.

CONCLUSIONS: Systematic depression screening in adolescents with type 1 diabetes can be reliably implemented with clinically significant results. A systematic approach, such as described in this study, can serve as a model for other chronic health conditions. Pediatrics 2013;132:e1395–e1402

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KEY WORDS adolescent depression, chronic conditions, type 1 diabetes, quality improvement

ABBREVIATIONS
BGM—blood glucose monitoring
CDI—Children’s Depression Inventory
EMR—electronic medical record
HbA1c—hemoglobin A1c
QI—quality improvement
PDSA—plan, do, study, act

Dr Corathers conceptualized and designed the study, coordinated and supervised data collection and analysis, and drafted the initial manuscript, reviewed and revised the manuscript; Dr Kichler contributed to the design of the study and reviewed and revised the manuscript; Dr Jones conceptualized and designed the study, designed the data collection instrument, and reviewed and revised the manuscript; Ms Houchen, Ms Morwessel, and Dr Crawford conceptualized and designed the study and reviewed and revised the manuscript; Ms Jolly coordinated and supervised data collection and reviewed and revised the manuscript; Dr Dolan participated in the design of the study and critically reviewed the manuscript; Dr Hood conceptualized and designed the study, carried out the data analysis, and drafted the initial manuscript, and all authors approved the final manuscript as submitted.

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One out of 5 adolescents in the United States has a chronic condition that requires ongoing treatment and management.¹ Advancements in technology, pharmacology, and delivery of multidisciplinary specialty care have improved health outcomes, but medical treatment regimens place significant demands upon children and families. Type 1 diabetes is an example of a common chronic condition in children with a complex regimen.² Management of type 1 diabetes involves checking blood glucose levels frequently and coordinating those levels with the amount and timing of insulin administration, dietary intake, and physical activity. Effective management of these tasks often results in achieving treatment targets for glycemic control as measured by the hemoglobin A1c (HbA1c) value.³ The landmark Diabetes Control and Complication Trial demonstrated that achieving optimal glycemic control prevents or delays the onset of complications to the kidneys, blood vessels, eyes, and cardiovascular system over time.⁴ However, even with substantial improvements in therapeutics and technologies, HbA1c values of adolescents in the Diabetes Control and Complication Trial remained an average of 1% higher than adult counterparts and globally, glycemic control remains suboptimal for most adolescents with type 1 diabetes.⁵⁻⁷

Depression is a contributing factor to suboptimal health outcomes and is common among adolescents. Up to 9.5% of the general population of adolescents are depressed,⁶⁻¹⁰ and the rate is 2 to 3 times higher for adolescents with type 1 diabetes and other chronic health conditions.¹¹⁻¹⁶ When present, depression in adolescents with type 1 diabetes is associated with less frequent blood glucose monitoring (BGM),¹⁷ higher HbA1c values,¹⁸⁻²¹ and increased rates of diabetes-related hospitalizations.²²⁻²³ All of these negative health outcomes are associated with higher risk of long-term complications from diabetes and consequent increase in medical care costs. Furthermore, depression does not typically resolve without treatment. Thus, depression during adolescence increases the likelihood for depression as an adult.²⁴⁻²⁵

Given the impact of depression on adolescent outcomes (including health), the US Preventative Task Force recommended screening adolescents for depression when adequate systems are in place to ensure accurate diagnosis and treatment.²⁶ Early detection of depressed symptoms makes referral for formal evaluation possible and has shown to be effective in pediatric primary care settings.²⁷⁻³⁰ In a high-risk patient population such as adolescents with type 1 diabetes, we hypothesized that depression screening would identify risk for depression and serve as an indicator of potential problems with diabetes management. In the present feasibility and outcomes study, standard depression screening was operationalized to detect and address common barriers that prevent implementation of routine screening. The specific aims were to (1) evaluate the prevalence of depressive symptoms and endorsement of suicidal thoughts in a cohort of adolescents with type 1 diabetes, (2) quantify the number of social work and psychology referrals generated from routine depression screening, (3) evaluate patient and staff acceptance of depression screening performed at diabetes clinic visits, and (4) confirm the documented link between depressive symptoms and glycemic control.

**METHODS**

**Setting**

Cincinnati Children’s Hospital Medical Center is an urban tertiary care center with an on-site Diabetes Center that serves 1829 patients with type 1 diabetes. The diabetes team is composed of physician and nurse practitioner providers, nurses, dieticians, social workers, education specialists, and a clinical psychologist.

**Multidisciplinary Screening Committee and Quality Improvement Methodology**

In April 2010, a multidisciplinary committee composed of endocrinology providers, pediatric psychologists, and social workers was established. Utilizing a quality improvement (QI) framework, the group identified an overall goal to establish feasibility and clinical significance of routine depression screening in a tertiary care diabetes center. A measurable and time bound specific aim was developed, which was to increase depression screening and appropriate mental health referral rates from a baseline of 5% to 90% within 1 year. Four integral components, or key drivers, were identified that were critical for success of the project. For each key driver, a series of interventions were identified (Fig 1). Representatives from each step in the proposed process (e.g., registration, point of care testing, nurse intake, provider encounter) were included in the design development, which included anticipation of possible problems at each step with correlated interventions to address the potential obstacle. Institute of Healthcare Improvement methodology was followed to iteratively test interventions targeted to each of the 4 key drivers with a series of plan, do, study, act (PDSA) cycles to define a reliable process for depression screening and referral.

**Step 1: Identification of a Screening Measure**

The committee considered published valid measures of depression (Table 1) and selected the Children’s Depression Inventory (CDI) as the screening tool. The CDI is a 27-item, widely used measure of depressive symptoms in children ages 7 to 17 (inclusive) in clinical and research settings. The CDI is written at a third grade reading level, can be self-administered in 15 minutes or less and includes an item about suicidal ideation.³¹ Adolescents select 1 of 3 statements that describe how
they have been feeling in the past 2 weeks for each of the items; higher scores reflect more depressive symptoms (range 0–54). The CDI manual reports a high level of internal consistency among the CDI items; in the current sample, the coefficient α was excellent at 0.89.

**Step 2: Patient Selection for Depression Screening**

Adolescents with type 1 diabetes ages 13 to 17 presenting for routine diabetes visits were selected as the initial target population given their increased risk for elevated depressive symptoms. Self-administration of the survey required patients to be developmentally appropriate and literate in English. Participation was voluntary but encouraged for all patients in the target group. The institutional review board at Cincinnati Children’s Hospital reviewed and approved a waiver of consent for this aspect of clinical care.

**Step 3: Pilot Testing**

Initial testing of the proposed process was undertaken in select half-day diabetes clinics with limited providers. A paper version of the survey tool was used, which allowed for rapid feedback from patients, families, and clinic staff with a limited investment of resources. Learning from several weeks of small trials informed the team that a successful process would need to be flexible to compensate for a variable...
Step 4: Revision to the Screening Process and Implementation

The multidisciplinary committee met biweekly for the first year. Interval interactions with key stakeholders were conducted periodically to gain input and provide updates. Training sessions between providers and psychologists resulted in production of talking points for outcomes of depression screening. The committee developed a revised screening process through a series of PDSA ramps and consideration of the pilot testing results. Additional support from the information technology department and a data programmer were required to automate the screening process. Paper forms were replaced with electronic tablets to improve reliability, ensure accuracy of depression screening scores, and to reduce staff burden. The screening process is described below and included in Fig 2.

1. Each day, an automated query of eligible patients is generated from the electronic medical record (EMR). Identified patients are given a letter describing the purpose of depression screening with an electronic version of the CDI. The survey is answered in the examination room simultaneous to nursing intake, thus increasing rates of completion without adding to the overall time in clinic.

2. Responses are calculated electronically and sent wirelessly to a secure printer that provides a confidential score report for the provider. A clinically informed and evidence-based algorithm (Fig 3) is printed with the patient score to guide interpretation, talking points, and recommended next steps.

3. The survey includes an item about suicidal ideation. If this item is positive, an alert is generated guiding referral to a social worker for an immediate evaluation. A standard suicide assessment interview is conducted to determine risk and need for urgent intervention, such as transfer to the emergency department. If this item is negative, a second level decision algorithm proceeds based upon the total depression score. A CDI score above 10 prompts a recommendation for a same-day referral to a social worker for psychosocial assessment. A score above 16 triggers an additional recommendation for referral to outpatient psychology services for further evaluation and treatment.

4. The CDI score, suicidal ideation, and referral action are recorded by the provider in a flow sheet, a tool within the EMR used to track data over time. The clinic progress note template includes a field to record the outcome of depression screening, which is automatically populated once the flow sheet is completed. A best practice alert is generated by the EMR if suicidal ideation or elevated CDI score is entered into the flow sheet to remind providers to refer to mental health as indicated.

Step 5: Evaluation of Depression Screening

The feasibility and acceptance of this depression screening process was evaluated via quantitative and qualitative methods. Process outcome was defined as percentage of eligible patients with completion of depression screening and appropriate social work or mental health referrals each week. Performance for the Diabetes Center was tracked graphically over time (Fig 4). In addition, provider specific feedback was given at regular intervals. Participating physicians who demonstrated >80% documented screening rates were eligible to receive performance in practice credit toward maintenance of certification from the American Board of Pediatrics. Qualitative feedback was obtained with survey tools.

In addition, medical chart reviews were performed for patients who completed routine depression screening by using the electronic CDI survey tool. Chart reviews and analyses were conducted under an institutional review board-approved protocol. Specific patient data on demographics, duration of type 1 diabetes, mode of insulin delivery
(pump or injections), and frequency of BGM were extracted. Of note, during patient data retrieval, any patients identified as having missed a depression screening opportunity or appropriate mental health referral were highlighted to be offered the CDI again at the next upcoming visit. Study data that identified participants were entered into a password-protected computerized data file and stored for analysis. Data were then deidentified before analysis for protection of privacy and confidentiality of patients. In addition to conducting sample means and frequencies for all variables, simple (Pearson) correlations were conducted to confirm the association between depressive symptoms (CDI score) and glycemic control (HbA1c). Data were analyzed with SAS version 9.2 (SAS Institute, Cary, NC).

RESULTS

Demographic Features of Sample

Of the 528 eligible adolescents, 509 (96%) received at least 1 depression screen during the first year (January 2011–January 2012). This sample is 48% female and is largely non-Hispanic white (86% non-Hispanic white, 8% African American, 6% either Hispanic or unknown). The mean age of the sample is 15.5 ± 1.4 years, with a type 1 diabetes duration of 5.9 ± 4.0 years, mean daily frequency of BGM of 3.8 ± 2.1 checks, and an average HbA1c value of 8.9 ± 1.8%. Fifty-five percent (55%) were on insulin pump therapy.

Depression Score Outcomes

The mean CDI score for the sample was 5.4 (range, 0–29; SD, 6). CDI total scores fell in to 3 categories: <10 = low risk (80% of the sample), 10 to 15 = moderate risk (12%), and ≥16 = high risk (8%). Suicidal ideation was endorsed in 7% of the sample (n = 37). A small number of patients in the low risk category endorsed suicidal ideation (5/37), whereas most (32/37) were in either the moderate or high risk categories.

Social Work and Psychology Referrals

Referrals to social work for psychosocial evaluation of elevated scores ≥10 and/or endorsement of suicidal ideation generated an average of 2.7 social work (range 0–6) and 1.5 outpatient psychology services (range 0–3) referrals weekly. Of the 37 patients who endorsed suicidal ideation and received a same-day suicide assessment by a social worker, 1 patient required urgent referral to emergency department services.

Acceptance of Depression Screening

Patient Responses

Responses to qualitative questions after the CDI survey were recorded in 86% (438/509) of patients. In response to the question, “How important is it for your diabetes provider to know about symptoms of depression in type 1 diabetes?” a majority of responders (58%) rated importance of depression screening ≥7 (highly important), 33.5% rated importance between 4 and 6 (moderately important), and 8.5% rated importance ≤3 (not important) on a Likert-type scale ranging from 0 to 10. Responses to the question, “How often do you think screening for depression with a CDI survey should be given to teens with type 1 diabetes?” were distributed as follows: no screening at all (12%), every 3 months (16%), every 6 months (38%), and annually (34.5%).

Diabetes Center Staff Responses

Staff responses to the above questions were compiled from nurses, providers, and social workers via an online survey tool with a survey response rate of 81% (26/32). All staff who responded rated the importance for the diabetes provider to know about symptoms of depression screening as ≥7 (highly
Response to the screening frequency question was mixed: no screening at all (0%), every 3 months (33%), every 6 months (54%), and annually (12.5%). Qualitative comments from staff support the survey findings such as, “I have seen the CDI survey pick up depression and suicidality when it was not suspected by the family or providers. I think it has been very valuable.”

**Depression Score and Diabetes Management and Control**

There were modest but statistically significant associations between higher levels of depressive symptoms as measured by the CDI and lower BGM frequency \( (r = -0.14, P = .002) \) and higher HbA1c values \( (r = 0.15, P = .0005) \). These correlations are in line with published reports from other samples.\(^ {17-25} \) Of note, the correlation between BGM frequency and HbA1c was large \( (r = -0.37, P < .0001) \), indicating the expected strong relationship between management and control in this study sample.

**DISCUSSION**

Systematic outpatient depression screening was implemented successfully in a large tertiary diabetes center with multiple providers, with a high rate of adolescent and staff acceptance. QI methodology guided the standardization of the screening process with adoption of a defined instrument, automated scoring, objective mental health referral criteria, consistent documentation in the EMR, efficient integration into the existing clinic workflow, and tracking of performance over time. Weekly chart review of eligible patients who did not have screening documented was performed to uncover the reasons for the “failure.” These reviews revealed specific areas for intervention (eg, inadequate number of tablets during high patient volume, inconsistent documentation). Throughout the process design, attention was paid to the reliability of each step that resulted in significant change and sustainable improvement. Although implemented in a large, tertiary care medical center, we believe this approach could be applied to a variety of clinical settings.

Our sample appears representative of the broader pediatric diabetes patient population as nearly 20% of those screened endorsed moderate or high levels of depressive symptoms; 7% of
the sample endorsed suicidal ideation. Consistent with the literature, there were positive correlations between higher depressive symptom scores and worse diabetes management and control, supporting our hypothesis that depression screening provides an indication of youth at-risk for suboptimal diabetes-specific health outcomes. Furthermore, qualitative provider feedback indicated that an objective survey score facilitated conversation with families about psychosocial conditions affecting diabetes care. Routine screening enabled providers to identify patients at risk for more significant depression and refer for mental health evaluation and treatment. Earlier identification and treatment of depression is predicted to remove barriers to adherence and improve coping skills with chronic illness thus leading to more effective self-management behaviors and improved outcomes.

The “lessons learned” from this process highlight a critical point; the integration of depression screening into a busy clinical setting is challenging but feasible. In terms of cost, an investment of $4800 to cover the initial expense of computer tablets, data programming time, and proprietary materials was required, which translates to approximately $4.00 per encounter for the first year. The maintenance cost for the proprietary change of the screening instrument is approximately $2.00 per encounter. The clinic is located within a hospital setting, which supports the staffing and referral resources, including clinical social workers and pediatric psychologists in a collaborating division (Behavioral Medicine and Clinical Psychology) to ensure accurate diagnosis and treatment of depression and/or suicidal ideation when identified. The role of social workers in the Diabetes Center is well established. Interpretation and discussion of elevated CDI scores falls within their current job description. Equivalent resources may not be available in all clinics, although research and clinical data indicate the overwhelming need for these psychosocial services.

The generalizability of the previously described depression screening process to other clinical locations may be limited by differences in institutional support and regional mental health referral resources. However, the model presented here can be modified to fit local resources. The critical step to achieving improved rates of routine depression screening and mental health referrals for adolescents was to identify a standard process and set of expectations. A variety of screening tools are available (Table 1) at no cost both with and without an item assessing suicidal ideation. Translation into additional languages may be available with permission of the publisher. A recent systematic review provides a comprehensive listing of instruments used for screening of depression in type 1 and type 2 diabetes. The decision of which tool is most appropriate for a clinic should be guided by local resources. In our study, clear recommendations including talking points and indication for referral for further evaluation based upon the output of the assessment tool gave providers a platform to discuss mental health topics in a medical setting. Consistent documentation via a common template ensured standard assessment and facilitated tracking of scores over time.

CONCLUSIONS AND FUTURE DIRECTIONS

The described QI initiative to implement routine depression screening for adolescents with type 1 diabetes addresses a significant gap between national recommendations and widespread clinical practice. Implications of this research are wide reaching as this process may serve as a model for integration of depression screening across a variety of clinical settings for youth with chronic health conditions.

Further research is needed to determine longitudinal diabetes and psychology outcomes. Future studies will include evaluation of the uptake and outcome of psychology referrals in reducing depressive symptoms and improving health outcomes. In addition, cost-effectiveness analysis of depression screening and intervention in this population should be explored. Based upon our current research, it is recommended that screening occur at least annually and be examined within the context of how depression scores relate to diabetes management to inform health-promoting clinical interventions.

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