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Structural model of patient-centered communication and diabetes management in early emerging adults at the transfer to adult care

Ashley C. Baker[1] · Deborah J. Wiebe[1] · Caitlin S. Kelly[2] · Ascher Munion[2] ·
Jonathan E. Butner[2] · Michael T. Swinyard[3] · Mary Murray[4] · Cynthia A. Berg[2]

Abstract Early emerging adulthood (ages 18–25) is a time of risk for type 1 diabetes (T1D) when relationships with parents and providers are changing. We examined whether individuals' high-quality relationships with mothers are associated with greater perceptions of patient-centered communication (PCC) with their doctor and whether PCC is associated with better adherence and glycemic control through diabetes-related self-efficacy. Additionally, we tested whether associations of PCC with self-efficacy and diabetes outcomes are stronger among those who had transferred to adult care. One-year post-high school, 217 individuals with T1D (60% women, 53% in adult care) reported perceptions of maternal relationship quality, PCC, self-efficacy, and adherence. Glycemic control was measured via HbA1c assay kits. Structural equation modeling indicated good model fit and revealed indirect paths linking higher maternal relationship quality to better adherence through higher PCC, and higher PCC to better HbA1c through adherence. Transfer status moderated the link between PCC and self-efficacy, suggesting PCC may be especially important when emerging adults transfer to adult care.

✉ Ashley C. Baker
abaker26@ucmerced.edu

[1] Psychological Sciences and Health Sciences Research Institute, University of California, Merced, 5200 N. Lake Rd SSM, Merced, CA 95343, USA

[2] Department of Psychology, University of Utah, Salt Lake City, USA

[3] Mountain Vista Medicine, University of Utah School of Medicine, Salt Lake City, USA

[4] Department of Pediatrics, University of Utah School of Medicine, Salt Lake City, USA

Introduction

Type 1 diabetes (T1D) management is critical to maintaining good health, and is most effective when it occurs in the context of supportive and collaborative relationships with healthcare providers and parents (Wiebe et al., 2016). T1D management requires the coordination of complex behaviors (e.g., maintain proper diet, exercise, blood glucose checks, and insulin adjustment) in order to regulate blood glucose levels close to the normal range (American Diabetes Association, 2017). Early emerging adulthood (ages 18–25 years; Arnett, 2000) is considered a time of high risk for managing T1D (Weissberg-Benchell & Shapiro, 2017). Glycemic control deteriorates longitudinally across adolescence, with many individuals displaying their poorest glycemic control during the late adolescent and early emerging adulthood years (Helgeson et al., 2018b; Schwandt et al., 2017). Late adolescents and early emerging adults also display poorer diabetes management behaviors compared to younger and older cohorts (Miller et al., 2015), show declines in clinic attendance (Bowen et al., 2010; Lyons et al., 2014), and early signs of long-term complications of diabetes (Bryden et al., 2003). This also is a time when young people are managing diabetes more independently from parents (Hanna et al., 2013), and experience changing relationships with providers as they transfer from long-standing relationships with pediatric providers to new relationships with adult care providers (Monaghan et al., 2015). Such relationships with healthcare providers and parents may be associated with and partially

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explain poor T1D management during this high risk but understudied time of development.

Position statements on the needs of early emerging adults with T1D recommend that young people at this stage of life may better manage T1D if they have high quality patient-centered interactions with their pediatric or adult care provider (Peters & Laffel, 2011). PCC is an autonomy supportive communication style between patients and providers with the goal to promote openness, trust and health information exchange (Erickson et al., 2005). Patient-centered communication (PCC) allows for a trans-actional relationship between patient and provider that focuses on patients' goals and their participation in healthcare (Michie et al., 2003). PCC has been acknowledged as a central component for improving modern healthcare (Institute of Medicine, 2001), and is a common part of training requirements and certification of healthcare providers (US Medical Licensing Examination, 2012). Qualitative and quantitative research demonstrates that patients desire their providers to engage in PCC and display better diabetes outcomes (i.e., adherence and glycemic control) with higher PCC (Wiebe et al., in press).

Higher PCC may develop out of high quality relationships with parents. In early emerging adulthood, individuals are in a transitional period in their relationships with parents, with parents continuing to play an important, but potentially less direct role for diabetes management (Helgeson et al., 2018a). A large developmental literature demonstrates that warm, loving, and accepting relationships with parents set the foundation for establishing positive relationships with others, with some research suggesting this extends to healthcare providers (see, Berg et al., 2017, for review). For example, adults with type 2 diabetes who had secure attachment styles (indicating better early relationship quality) experienced better diabetes management through positive patient-provider encounters (Ciechanowski et al., 2004). Because mothers are most frequently involved in diabetes care (as compared to fathers; Berg et al., 2016), higher quality relationships with mothers may be especially important in understanding PCC. Thus, we posit that early emerging adults who feel valued and accepted by their mothers may be able to develop more PCC with their healthcare providers.

PCC is theorized to facilitate diabetes management by promoting self-efficacy, which may be especially important during early emerging adulthood when young people are managing diabetes more independently. Self-determination theory (SDT) purports that autonomy is a universal human need that, when promoted, encourages feelings of competence and more autonomous forms of behavioral regulation (see, Ng et al., 2012, Ryan & Deci, 2000, for a review). From this perspective, PCC may be associated with an individual's autonomous motivation and feelings of self-efficacy and competence, which are vital motivational factors that promote diabetes self-management (Ng et al., 2012; Ryan & Deci, 2000). A sizeable literature examining adults with diabetes has demonstrated that PCC is associated with better diabetes management, but most studies have not examined the theorized explanatory processes (cf. Wiebe et al., in press, for a review). A small literature suggests perceptions of PCC are indirectly associated with better diabetes outcomes through self-efficacy beliefs in adults with type 2 diabetes (Williams et al., 1998, 2004, 2009) and in adolescents with T1D (Croom et al., 2010). However, the role of PCC has not been studied during early emerging adulthood, when young people are likely to be interacting more independently with their healthcare providers and experiencing new relationships with adult providers (Croom et al., 2010; Weissberg-Benchell et al., 2007).

The role of PCC in diabetes-related self-efficacy and outcomes may differ for early emerging adults who have transferred to adult care versus remained in pediatric care. Early emerging adults may display poor diabetes outcomes because they are managing diabetes more independently while experiencing numerous pivotal transitions (e.g., moving out of the parents' home, attending college or entering the work force), including transferring from pediatric to adult care (Monaghan et al., 2015). The transfer to adult care, in particular, may challenge T1D management during early emerging adulthood because of potential differences between the two healthcare settings. Pediatric care has been characterized as being more family-focused and using management approaches that match the family's involvement and lifestyle, while adult care has been argued to involve brief visits focused on the individual patient assuming full responsibility for the medical management of their illness (Peters & Laffel, 2011; Weissberg-Benchell et al., 2007). Pediatric care often also involves a long-standing triadic relationship between parents, adolescents, and their pediatric care providers, with parents' more active role allowing them to compensate when adolescents do not have the competence or motivation to manage their illness independently (Wiebe et al., 2014). Therefore, PCC and diabetes-related self-efficacy beliefs may matter more for diabetes management among early emerging adults who are in adult care versus in pediatric care settings. We are unaware of research examining whether PCC functions differently across pediatric and adult care settings. Understanding how PCC may be more important for early emerging adults may inform interventions to promote diabetes management as young people transfer to adult care.

Current study

The primary aim of this study was to test a structural model examining whether early emerging adults' perceptions of high quality relationships with mothers set the context for better PCC with doctors, whether better PCC is associated directly with higher diabetes-related self-efficacy beliefs and better adherence and glycemic control, as well as whether PCC is associated indirectly with better adherence through higher self-efficacy, and with better glycemic control through both self-efficacy and adherence behaviors. The second aim was to examine whether associations of PCC with self-efficacy and diabetes outcomes are stronger when early emerging adults are establishing new relationships with an adult care provider (i.e., versus remaining in pediatric care). The study utilized data from a larger study examining T1D management in late adolescence and early emerging adulthood, drawing on cross-sectional assessments obtained one year after high school when approximately half of the sample had transferred to a new adult care provider. We expected that higher maternal relationship quality would be associated with higher perceptions of PCC with doctors, and that PCC would be linked to higher diabetes-related self-efficacy, that higher self-efficacy would be linked to higher perceptions of adherence, and that higher adherence would be linked to better (i.e., lower) glycemic control. We also hypothesized that higher perceptions of PCC with doctors would have direct links to both higher adherence and better glycemic control (see Fig. 1). Given the unique challenges of early emerging

adulthood and transferring to adult care, we also investigated if transfer status moderated the associations of PCC with diabetes-related self-efficacy beliefs and diabetes outcomes. Although we expected PCC to be a salient predictor in both clinical groups, we also expected that PCC would be even more important when early emerging adults transfer to a new adult care provider.

Method

Participants

As part of a larger longitudinal multisite study, 247 high school seniors were recruited in clinic or by mail and phone through outpatient pediatric endocrinology clinics in two southwestern cities. Eligibility for the larger study included being diagnosed with T1D for at least one year (M length of illness = 7.35 years, SD = 3.88), speaking English as the primary language, being in the final year of high school, living with a parent (68.4% lived at home with both biological parents, 27.1% with one biological parent), being able to have regular contact with parents over the subsequent two years (consistent with objectives of the broader longitudinal study), and having no condition that would prohibit study completion (e.g., severe intellectual disability, blindness, etc.). Of the qualifying 507 individuals approached, 301 (59%) agreed to participate. Of those who initially agreed, 247 (82%) were enrolled in the study. Reasons for not participating included lack of interest
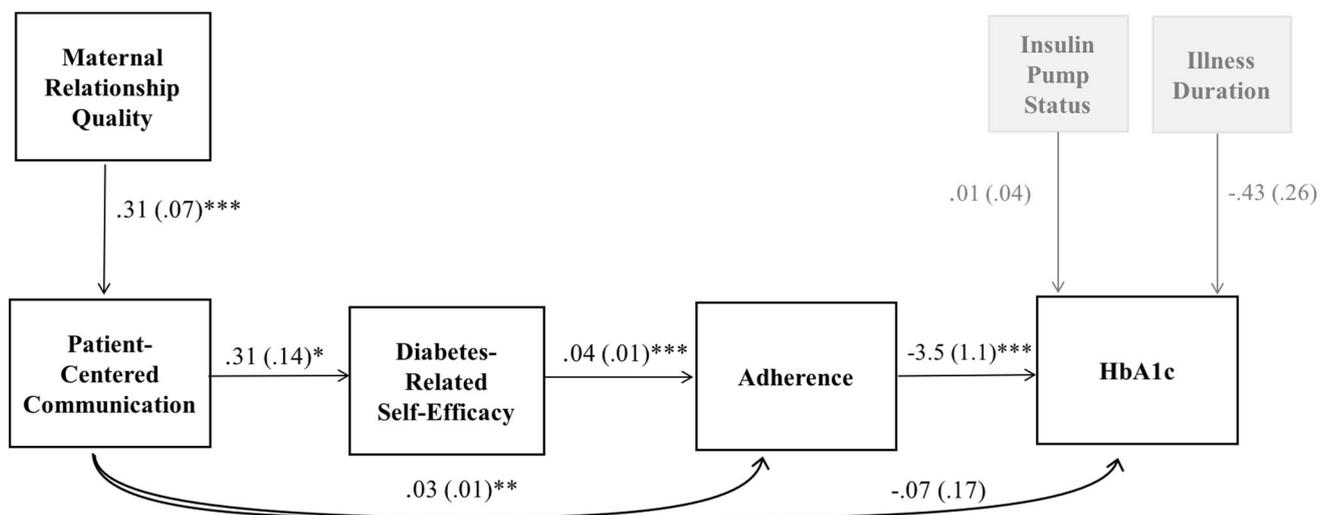
Fig. 1 Study structural model demonstrating the direct associations between maternal relationship quality, patient-centered communication, diabetes-related self-efficacy, and diabetes outcomes. Unstandardized path coefficients (standard errors) are presented. Indirect effects are presented in Table 2. Insulin pump status usage and years since diagnosis of illness were controlled for on HbA1c (greyed out). Higher HbA1c levels correspond with poorer glycemic control. *p < .05, **p < .01, ***p < .001

(33%) or being too busy in their senior year to participate (34%); 20% declined to give a reason. At one site, IRB permitted data to be collected comparing those who did versus did not participate. Participants and nonparticipants did not differ on HbA1c, time since diagnosis, gender, or pump status ($ps > .05$). However, participants were slightly younger, M (SD) = 17.77 (.43) versus 17.91 (.48) years, $t(203) = 2.274$, $p = .024$, and more likely to be Latina/o (21% vs. 11%), X^2 ($df = 1$) = 3.88, $p = .049$, than nonparticipants. This study utilized cross-sectional data from the 217 early emerging adults who completed the Year 2 assessment of the larger longitudinal study (88% of the initial sample). Year 2 completers did not differ on sociodemographic or study variables, with the exception that they had lower HbA1c levels at baseline compared to non-completers ($M = 8.19\%$ vs. 9.25%, 66 mmol versus 78 mmol; $t(238) = 3.08$, $p < .01$).

Procedures

The Institutional Review Boards at each study site approved the study. All participants provided informed consent prior to completing the study measures. Early emerging adults completed on-line survey items regarding relationships with parents and providers, as well as self-efficacy and adherence. Participants were emailed a link to a confidential online survey and were asked to complete the survey individually. Upon completion, participants were mailed an HbA1c assay kit to measure glycemic control. Participants were compensated $50 for completing the survey and HbA1c assay.

Measures

Maternal relationship quality

The five-item acceptance subscale of the Mother-Father-Peer Scale (Epstein, 1983) was used to assess relationship quality between the early emerging adult and his or her mother. Items assessed perceptions of warmth and acceptance from mothers (e.g., My mother gives me the feeling that she likes me as I am.") using a 1 (strongly disagree) to 5 (strongly agree) scale. An average score across items was created. Maternal acceptance is a widely used construct to capture the general quality of mother–child relationships, and is predictive of positive ways in which adolescents stay connected with their mothers over time (Hare et al., 2011). In the context of T1D, scores on this subscale predicted longitudinal deterioration in T1D adherence from early to late adolescence (King et al., 2014), and formed an independent dimension of parental support for T1D during adolescence (Palmer et al., 2010). For our sample, internal consistency of the five-item scale was $\alpha = .82$.

Patient-centered communication

PCC was measured by the Modified Health Climate Questionnaire (Williams et al., 1998). This survey uses a Likert-based scale (1 = strongly disagree to 5 = strongly agree) to characterize perceptions of patient-centered communication (e.g., My doctor listens to what I think before setting treatment goals; My doctor encourages me to ask questions about managing my diabetes). Scores were averaged across items with higher scores indicating higher perceptions of PCC. This scale has acceptable reliability among adults (Williams et al., 1998) and adolescents with T1D (Croom et al., 2010). For the present sample, internal consistency was $\alpha = .92$.

Diabetes-related self-efficacy

Participants completed the Self-Efficacy for Diabetes Management scale (Iannotti et al., 2006), a 10-item scale that assesses confidence in one's abilities to manage diabetes across 10 problematic situations (e.g., How sure are you that you can manage insulin intake when you have eaten more or less than usual?"). Participants rated each item on a 1 (not sure at all) to 10 (completely sure) scale. This scale has shown strong reliability in prior studies with adolescents with diabetes, and longitudinally predicts adherence across adolescence (King et al., 2014). In the present sample, internal consistency was $\alpha = .88$.

Adherence to diabetes regimen

For the primary index of adherence, participants completed the revised Diabetes Behavior Rating Scale (DBRS) (Iannotti et al., 2006). This 37-item scale assesses adherence to the multiple behaviors currently recommended for adequate diabetes management. The scale is indexed by a proportion from 0 to 1, with scores closer to 1 indicating better adherence. The DBRS correlates well with more time-intensive interview measures and with HbA1c (Iannotti et al., 2006). In our sample, internal consistency was $\alpha = .83$.

Glycemic control

Glycemic control was indexed using dried blood spot HbA1c mail-in assay kits obtained from and processed by CoreMedica Laboratories (https://www.coremedicalabs.com), which is accredited by the College of American Pathologists. This approach has major advantages compared to the more typical approach of obtaining HbA1c values from medical records. It ensured that procedures were consistent between those who had versus had not

transferred to adult care, that HbA1c could be attained even if participants displayed poor clinic attendance (as is common at this stage of development; Sheehan et al., 2015), and that the HbA1c measure could be consistently timed to survey completion. In our sample, HbA1c values from assay kits were strongly correlated with HbA1c obtained from point-of-care assays in medical records at baseline ($r = .74$, $p < .001$). Higher scores indicate poorer glycemic control over the preceding 3–4 months.

Pediatric versus adult care

To measure whether participants had remained in pediatric care or transferred to adult care, participants were asked if they had transferred out of pediatric care and into adult care in the past year. Responses were binary (0 = no; 1 = yes).

Statistical analysis

First, using independent t-tests and Chi square analyses, we examined descriptive information on the sample to determine whether those who remained in pediatric care versus transferred to adult care differed on sociodemographic, illness characteristics, and study variables. Next, we examined bivariate correlations among study variables in the full sample and then separately in the two transfer status subgroups. Structural equation modeling via Mplus v.7 (Muthén & Muthén, 2012) was then used to estimate the hypothesized path model, and bootstrapping methods with bias-corrected confidence intervals were used to test indirect effects. Missing data was less than nine percent on all variables. Full Information Maximum Likelihood (FIML) was used in addition to the default Maximum Likelihood (ML) as the estimator. We initially estimated the model in the full sample, regardless of whether participants had remained in pediatric care or transferred to adult care, to understand associations at this high risk time of development. To investigate whether transfer status moderated the associations of PCC with self-efficacy, adherence, and glycemic control, multi-group analyses using Wald Tests were conducted to test the equality of parameters. We controlled for pump status and illness duration on HbA1c given that these variables are commonly associated in the literature (Clements et al., 2014; Wong et al., 2014); these covariates were not correlated with other variables in the model in the present sample.

Four goodness-of-fit indices were utilized to determine how well the model reproduced the characteristics of the observed data (e.g., covariance or correlation matrices): the χ^2 index, which should be as close to zero as possible and non-significant; the root mean square error of approxima-

tion (RMSEA), which should be less than .08 (Browne & Cudeck, 1993); the comparative fit index (CFI) and Tucker Lewis Index (TLI) which should exceed .90 (Hu & Bentler, 1998). Each of these model fit indices are sensitive to different model qualities (e.g., small sample size). Thus, we did not reject good model fit based on an individual fit index, but rather considered indices together to interpret the results.

Results

Preliminary analyses

The average age of the present participants was 18.81 ($SD = .40$) years, 60% were female, and 43.7% of mothers reported having a bachelor's degree or higher. Of the participants who reported both race and ethnicity (n = 204), 76.5% identified as non-Latina/o White/Caucasian, 10% as Latina/o White/Caucasian, 3.2% as Latina/o non-white, 5.4% as non-Latina/o Black/African American, and 7.4% as either non-Latina/o Asian, Native Hawaiian/Pacific Islander, Native American, or more than one race. While all participants were living at home and in pediatric care during enrollment, 48% were living out of the parental home and 53% reported they had transferred to adult care by the time of the present assessment one year later (Year 2). On average, early emerging adults in our sample did not meet the American Diabetes Association recommended levels of HbA1c levels below 7.5% ($M = 8.9$, $SD = 1.9$), and 46% used an insulin pump. Comparisons between the pediatric care group and the adult care group revealed no significant differences on any of these variables. Descriptive information on study variables is reported in Table 1.

Correlations in the full sample are shown in the top panel of Table 1. Consistent with the study model, maternal relationship quality was associated with higher perceived PCC, and higher PCC was associated with higher diabetes-related self-efficacy and adherence. Higher diabetes-related self-efficacy was associated with better adherence and glycemic control. Such findings are consistent with our hypotheses that high quality relationships with mothers may set an important context for the types of relationships that early emerging adults have with their providers, and that perceptions of patient-centered relationships with providers would be associated with diabetes-related self-efficacy beliefs, adherence, and glycemic control. Bivariate correlations for each sample individually are shown in the bottom panel of Table 1. Correlations for the separate transfer groups are consistent with those found for the full sample, with the exception that PCC was not associated with diabetes-related self-efficacy or diabetes outcomes for those who remained in pediatric care.

Table 1 Correlation matrix of study variables for full sample model (top matrix) and transfer status subgroups (bottom matrix)

Model measures (N = 217)	1	2	3	4	5	6	7	8
1. Maternal relationship quality	1	–	–	–	–	–	–	–
2. Patient-centered communication	.31***	1	–	–	–	–	–	–
3. Diabetes-related self-efficacy	.10	.14*	1	–	–	–	–	–
4. Adherence to diabetes regimen	.14*	.26***	.54***	1	–	–	–	–
5. HbA1c	− .07	− .09	− .29**	− .25**	1	–	–	–
6. Transfer status	− .02	.007	.02	.02	.01	1	–	–
7. Insulin pump usage	− .02	− .13	.002	.06	− .12	.07	1	–
8. Illness duration	.01	.07	.05	.05	.02	.19*	− .08	1
M	4.32	4.00	6.99	.59	8.90	53%	46%	7.50
SD	.85	.86	1.6	.13	1.9	–	–	3.9

Adult care group (below diagonal; n = 115)	1	2	3	4	5	6	7	–
Pediatric care group (above diagonal, n = 102)								
1. Maternal relationship quality	–	.38***	− .03	− .02	.15	.02	.13	–
2. Patient-centered communication	.27***	–	.05	.12	− .09	− .12	.16	–
3. Diabetes-related self-efficacy	.19	.30**	–	.54**	− .27*	− .03	.08	–
4. Adherence to diabetes regimen	.25*	.39***	.59***	–	− .16	.09	.12	–
5. HbA1c	− .24*	− .09	− .33**	− .40***	–	− .02	− .04	–
6. Insulin pump usage	− .06	− .11	.04	.02	− .15	–	.22*	–
7. Illness duration	− .08	.08	.06	− .02	.01	.16	–	–
M pediatric care	4.34	4.00	7.00	.59	8.9	42%	7.8	–
SD	.85	.84	1.7	.12	1.9	–	4.1	–
M adult care	4.30	4.02	7.03	.59	8.9	50%	7.1	–
SD	.95	.84	1.6	.12	1.8	–	3.6	–

Pump status = 0 = multiple daily injections; 1 = insulin pump regimen. Transfer status = whether or not the early emerging adult has transferred out of pediatric care into adult care (0 = pediatric care; 1 = adult care); Higher levels of HbA1c corresponds to poorer glycemic control

*p < .05,; **p < .01,; ***p < .001

Path model of maternal relationship quality, patient-centered communication, diabetes-related self-efficacy, and diabetes outcomes

Path coefficients for the model are shown in Fig. 1, and fit indices and tests of indirect effects are reported in Table 2. The hypothesized model had good fit to the data across all fit indices. Results reported in Fig. 1 supported several hypotheses indicating that: (1) perceptions of higher maternal relationship quality were associated with higher perceptions of PCC; (2) higher perceived PCC was associated with higher diabetes-related self-efficacy; (3) higher diabetes-related self-efficacy was associated with better adherence, and (4) better adherence was associated with better (i.e., lower) HbA1c. Perceptions of PCC also had direct associations with adherence, but not with glycemic control. In addition to these direct paths, results reported in Table 2 supported two indirect paths, along with several additional indirect paths that approached significance. The indirect path from maternal relationship quality to adherence through PCC was significant, supporting the hypoth-

esis that PCC occurs in a context of high relationship quality with mothers and may be important for adherence at this time of development. Furthermore, the indirect path from PCC to glycemic control through adherence was significant.

It is notable that several of the hypothesized indirect paths that did not reach statistical significance involved the link between PCC and self-efficacy beliefs, which we had hypothesized a priori would differ between transfer status groups. Separate Wald Tests were conducted to test for the equivalency of regression coefficients across transfer status. All direct paths were freely estimated, except for the direct paths from PCC to diabetes-related self-efficacy, and from PCC to diabetes outcomes which were constrained to be equal across transfer status. Transfer status moderated the association of PCC with diabetes-related self-efficacy $(X^2 = 4.4, p = .03)$, indicating stronger associations among those who had transferred to adult care. Transfer status did not moderate the associations of PCC with adherence $(X^2 = .98, p = .32)$ or HbA1c $(X^2 = 1.4, p = .23)$.

Table 2 Indirect Path Coefficients and Fit Indices for Study Structural Model

	Unstandardized coefficient (SE)	p value	CI range 95%
N = 217			
Maternal relationship quality to adherence through patient-centered communication, and diabetes-related self-efficacy	.004 (.002)	.06	[.001, .009]
Patient-centered communication to adherence through diabetes-related self-efficacy	.01 (.007)	.06	[.002, .26]
Maternal relationship quality to adherence through patient-centered communication	.008 (.004)	.03	[.002, .018]
Maternal relationship quality to HbA1c through patient-centered communication	− .02 (.06)	.69	[− .14, .08]
Maternal relationship quality to HbA1c through patient-centered communication and adherence	− .03 (.02)	.07	[− .08, − .008]
Maternal relationship quality to HbA1c through patient-centered communication, diabetes-related self-efficacy, and adherence	− .01 (.01)	.14	[− .04, − .001]
Patient-centered communication to HbA1c through adherence	− .09 (.05)	.05	[− .22, − .02]
Patient-centered communication to HbA1c through diabetes-related self-efficacy and adherence	− .04 (.03)	.14	[− .14, − .002]
χ^2, df	14.4, 10	–	–
p value	> .15	–	–
CFI	.96	–	–
TLI	.93	–	–
RMSEA	.04	–	–
CI of RMSEA	.00 to. 09	–	–

CFI comparative fit index, *TLI* Tucker–Lewis Index, *RMSEA* root mean square error of approximation, *CI* confidence interval, Higher levels of HbA1c correspond to poorer glycemic control

Findings reported thus far are consistent with the hypothesis that PCC is a predictor of better diabetes outcomes. However, because it is conceivable that PCC is a response to, rather than predictor of, better diabetes outcomes (Aikens et al., 2005), we tested an alternative model. In this alternative scenario, maternal relationship quality may be associated with better adherence and HbA1c through diabetes-related self-efficacy (King et al., 2014), with PCC being a response to displays of better HbA1c, a measure that is routinely obtained at the beginning of clinic visits. That is, providers may feel free to engage in more collaborative patient-centered care during medical encounters when their patients display better glycemic control (i.e., lower HbA1c). We thus tested an alternative model examining PCC as the final outcome (i.e., PCC was regressed on to HbA1c). In this partial reverse causal model, the X^2 was significant (43.10, p < .05), and the fit indices were not optimal (RMSEA = .11; CFI = .73; TLI = .59). Additionally, the path from HbA1c to PCC was not significant, b = − .04 (.03), p = .25.

Discussion

The current study is consistent with the idea that high maternal relationship quality sets the stage for greater perceived PCC, and that PCC is a link between maternal relationship quality and adherence. Perceptions of PCC were associated with higher diabetes-related self-efficacy and better diabetes outcomes during early emerging adulthood, a time when young people are typically considering or actively transferring to adult care. Perceptions of PCC with doctors were associated with better glycemic control (i.e., lower HbA1c) indirectly through better adherence. In addition, these findings are unique in demonstrating that PCC may be especially crucial as early emerging adults are managing their illness more independently and establishing new relationships with adult care providers. The present findings suggest that understanding the healthcare provider context may be a fruitful avenue for promoting good diabetes management during early emerging adulthood, a high risk time of development.

We anticipated that perceptions of PCC would be important for all participants, but would have stronger associations with self-efficacy and diabetes outcomes among those who had recently transferred to adult care. Findings revealed that PCC was associated with diabetes outcomes in both healthcare contexts, supporting its importance at a high risk time of development. However, transfer status moderated associations with diabetes self-efficacy beliefs, suggesting such perceptions are particularly relevant when emerging adults are developing new relationships with adult care providers. It is notable that perceptions of PCC were fairly high and did not differ

across transfer groups, despite some research suggesting that adult care settings may be less conducive to developing high levels of PCC (Van Staa et al., 2011). In the present observational study, the transfer to adult care was a naturally-occurring variable. Although the pediatric versus adult care group did not differ on any sociodemographic, illness, or study variable examined, it is conceivable that unmeasured factors (e.g., insurance status) contributed to participants' decision to transfer and also affected the findings.

Consistent with our hypotheses, perceptions of PCC occurred in the context of high maternal relationship quality, and formed an indirect path through which maternal relationship quality was linked to better adherence. We speculate that high relationship quality with mothers serves as a foundation for developing a more collaborative and supportive relationship with their providers (Berg et al., 2017; Ciechanowski et al., 2004; Wiebe et al., 2016). If so, the present findings suggest a transactional view where the early emerging adults shape the social context in which they are managing their diabetes. The present findings also complement recent reports that relationships with parents remain a key resource for T1D management during early emerging adulthood (Goethals et al., 2017; Helgeson et al., 2018a), and suggest there may be multiple pathways through which such associations occur.

We had anticipated that diabetes-related self-efficacy would be a mediator of PCC associations based on prior SDT literature (Ng et al., 2012; Ryan & Deci, 2000). For example, adolescents' perceptions of PCC promoted better diabetes outcomes (i.e., adherence and glycemic control) through stronger diabetes-related self-efficacy beliefs (Croom et al., 2010). Likewise, adults with type 2 diabetes who perceived their providers as more supportive led to an increase of felt competence, which led to better glycemic control over 12 months (Williams et al., 1998). Although our data indicated significant direct paths between PCC and diabetes-related self-efficacy, and between self-efficacy and adherence, the indirect paths involving self-efficacy only approached significance in several cases. This may partially reflect the fact that the path between PCC and self-efficacy differed as a function of transfer status. PCC was primarily associated with self-efficacy among those in the adult care group. Replicating these indirect paths involving diabetes-related self-efficacy among early emerging adults who have transferred to adult care is a high priority for future research.

To clarify interpretations of the findings, we tested an alternative model examining PCC as an outcome rather than a predictor of diabetes outcomes (i.e., adherence and HbA1c). It is possible, for example, that providers interact with their patients in a less autonomy supportive manner when they perceive patients have poor glycemic control (Aikens et al., 2005). This alternative model was not consistent with the data, providing some confidence in interpreting PCC as facilitating better adherence and glycemic control among early emerging adults. Because tests of mediation are limited, even with experimental designs, and need to be cumulative across multiple studies and methods (Bullock et al., 2010), the present finding should be considered a starting point for future research to examine these associations further.

There are limitations that need to be considered when interpreting the findings. First, the data are correlational and causal associations cannot be inferred. Second, with the exception of HbA1c, variables were measured through self-reported surveys, creating potential for self-report biases. In particular, we measured early emerging adults' perceptions of PCC with doctors rather than objectively analyzing PCC during medical encounters. More objective measures (Cox et al., 2007) with a variety of healthcare clinicians (e.g., nurse practitioner) may be beneficial to determine whether perceptions of PCC reflect aspects of the specific patient-provider interactions, or if they materialize out of the early emerging adults' relationship history or trust in the provider. Third, participants in the present analyses had somewhat better glycemic control than those enrolled in the larger longitudinal study, potentially providing a conservative test of the hypotheses. Fourth, we focused only on mothers' relationship quality with early emerging adults, but past research has shown that fathers' relationship quality with adolescents is also important for good adherence and may yield different findings (King et al., 2014). Fifth, participants were assessed 1 year after high school, a time in early emerging adulthood that is marked by multiple transitions that may pose challenges for managing T1D (Monaghan et al., 2015). Results may not generalize to the full emerging adult time of development (typically ages 18–29; Arnett, 2004). Lastly, although T1D is more common among those of European descent, and the ethnic distribution of our sample is consistent with national samples of youth with T1D (Dabelea et al., 2014), our participants were mostly white, and from families with educated mothers. Results may not generalize to more diverse samples.

Results support the recommendations of the American Diabetes Association (Peters & Laffel, 2011) regarding facilitating successful transfer from pediatric to adult care by encouraging adult care providers to provide coordinated, compassionate, and patient-centered care. However, we know of no interventions that have attempted to foster PCC in this age group. Interventions teaching providers to develop a more collaborative patient-centered relationship with their patients have been reported to improve diabetes management among adults with type 2 diabetes, and may

generalize to early emerging adults with T1D (Williams & Zeldman, 2002). Other intervention approaches to promote PCC have targeted patients' active participation in their medical encounters and health care decisions, rather than attempting to change the physician's behavior (Van Dam et al., 2003; Williams et al., 2005). This may be an important component of preparing late adolescents to transfer to adult care, when they will be more independently responsible for their interactions with providers. A literature review identified that repeated discussions between pediatric providers and patients regarding transition-related issues fostered early emerging adults' perceived readiness for adult care and decreased treatment gaps in diabetes care (Monaghan et al., 2013). Additionally, early emerging adults' advocacy skills have been associated with better adherence, especially in combination with PCC (Kelly et al., 2018), suggesting that enriching the quality of PCC in late adolescent and early emerging adult medical encounters could be a crucial target point for promoting better diabetes outcomes in these populations. Lastly, our results suggest that relationship quality with mothers may remain important even as early emerging adults are becoming more independent. It may be beneficial for healthcare providers to encourage continued family involvement in their health care at this important time of development.

Compliance with ethical standards

Conflict of interest Ashley C. Baker, Deborah J. Wiebe, Caitlin S. Kelly, Ascher Munion, Jonathan E. Butner, Michael T. Swinyard, Mary Murray and Cynthia A. Berg declare they have no conflict of interest.

Human and animal rights and Informed consent All reported studies with human subjects performed by the authors have been previously published and complied with all applicable ethical standards (including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines). Informed consent was obtained from all individual participants included in these studies.

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