User Experience with a New Smartphone Application for Blood Glucose Monitoring (BGM) in an Information-Motivation-Behavioral Skills (IMB) Model Study

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INTRODUCTION

- The CONTOUR[®]NEXT ONE smart meter and app system (Ascensia Diabetes Care, Parsippany, NJ, USA) includes a wireless-enabled blood glucose meter that links to the CONTOUR[®]DIABETES app installed on a mobile device via Bluetooth[®] technology (**Figure 1**)

- The CONTOUR[®]DIABETES app (Version 2 Prototype) detects and reports patterns of blood glucose readings and provides guidance for self-management
- The app employs self-management feedback based on the Information-Motivation-Behavioral Skills (IMB) model of health behavior change^{1,2}
 - The IMB model is a well-researched and well-validated approach to health behavior change, which emphasizes the need for actionable information, motivation to act, and behavioral skills for acting effectively to strengthen self-management of diabetes^{3,4}
- The CONTOUR[®]NEXT ONE smart meter and app system is engineered to provide the user with actionable information, motivate the user to act, and guide the individual with diabetes in applying skills in self-management action
- Features of the CONTOUR[®]NEXT ONE smart meter and app system include My Readings view (sequential day view of blood glucose readings), Expanded Graph view (detailed graph of blood glucose readings), blood glucose pattern detection with user-controlled notifications, and Smart Reminders (preset reminders to help users remember to test their blood glucose in different situations [referred to as Test Reminder Plans in the current version of the app]; **Figure 2**)
 - The blood glucose pattern notifications (e.g., Critical High, Running High, Critical Low, Day of Week High) are user controlled; they provide messages that are informational (not prescriptive) and help the user consider the possible causes for blood glucose patterns of concern and potential means for improving these outcomes
 - The CONTOUR[®]NEXT ONE smart meter and app system also provides a user-controlled opportunity for automatically checking back to see whether implemented changes have improved blood glucose outcomes
 - CONTOUR[®]NEXT ONE smart meter and app system messages are based on algorithmic recognition of patterns in the users' blood glucose results and can guide the user through a series of educational screens to identify the readings that triggered the pattern and explore options for addressing the situation
 - By decision of the user, recommendations are triggered to help eliminate conditions related to the diagnosed pattern
- The CONTOUR[®]NEXT ONE smart meter and app system may be used with iOS or Android operating systems and uses CONTOUR[®]NEXT test strips
- The current 6-week study with 46 insulin-using individuals with diabetes assessed the CONTOUR[®]NEXT ONE smart meter and app system to explore user feedback and optimize the functionality and self-management strength of the system

OBJECTIVE

- To collect user experience observations concerning the CONTOUR[®]NEXT ONE smart meter and app system with a sample of individuals with diabetes treated with insulin

METHODS

Study Design

- This study was designed to explore participants' user experience with the CONTOUR[®]NEXT ONE smart meter and app system
- Insulin-using individuals aged 18 to 75 years with type 1 or type 2 diabetes who perform self-monitoring of blood glucose ≥ 2 times daily utilized the CONTOUR[®]NEXT ONE smart meter and app system over a 6-week period and reported their experiences on closed- and open-ended items.
- Each subject made two visits to the study site
 - At **Visit 1**, subjects were given a brief overview of the CONTOUR[®]NEXT ONE smart meter and app system
 - Subjects downloaded the CONTOUR[®]DIABETES app (Version 2 Prototype) onto their mobile devices and were instructed to use the system at home for 6 weeks as part of their routine diabetes self-management
 - At **Visit 2**, after 6 weeks of testing at home, subjects returned to the site, provided feedback via an interview with study staff, and completed questionnaires about their experience
- Descriptive statistics were employed to characterize user experience with the CONTOUR[®]NEXT ONE smart meter and app system

Primary Endpoint: Closed-ended Questionnaire Responses

- Closed-ended questionnaire items included 59 statements with responses based on a 5-point Likert scale
 - Responses ranged from either 1 = Strongly Agree to 5 = Strongly Disagree, or 1 = Very Simple to 5 = Very Difficult
 - A 'No Opinion' option was also offered
- The primary objective required that $\geq 85\%$ of potential users should be able to perform the task (utilization of the app feature) successfully (defined as responses of 1, 2, or 3) for the following four key statements/tasks:
 - Obtain a synced blood glucose reading from meter to app
 - Successfully access blood glucose displays, such as Expanded Graph and My Readings views in the app
 - Successfully interpret blood glucose displays, such as Expanded Graph and My Readings views in the app
 - Successfully access and use Smart Reminders in the app
- Additional questions assessed IMB model-specified information, motivation, and skill of self-management impacts of utilization of the CONTOUR[®]NEXT ONE smart meter and app system
 - These questions are of special interest and are featured in the following subsections by category: empowerment to self-manage, engagement and adherence, and the provision of actionable information

RESULTS

Subjects

- 47 subjects with diabetes on insulin therapy enrolled in the study; 45 subjects completed the study
 - One subject was withdrawn due to a technical issue, and one withdrew 1 week early for personal reasons
 - Data from 46 subjects were analyzed, including data from the subject who withdrew early
 - Of these 46 subjects, 57% were female, 43% were male, 76% had type 1 diabetes, 24% had type 2 diabetes, 39% used an insulin pump, and 61% used multiple daily injections

Primary Objective

- The primary objective was met. Nearly all subjects reported successful syncing of the blood glucose value on the meter with the app, accessing and successfully interpreting blood glucose displays, and accessing and using the Smart Reminders feature in the app (**Table 1**)

Table 1. Questionnaire Results for the Primary Endpoint (N = 46)	
Statement	Subjects responding Agree, Strongly Agree, or Neutral
Overall, I was able to successfully sync my blood glucose value on the meter with the app	89.1%
Overall, I was able to successfully access blood glucose displays, such as Expanded Graph view and My Readings view in the app	100%
Overall, I was able to successfully interpret blood glucose displays, such as Expanded Graph view and My Readings view in the app	97.8%
I was able to successfully access and use the Smart Reminders feature in the app	100%

IMB Foundations-Related Results

- Participant appraisal of the CONTOUR[®]NEXT ONE smart meter and app system was positive on multiple IMB model dimensions, including empowerment to self-manage, engagement and adherence, and the provision of action-oriented information
 - In particular, participants reported positive assessments of the My Patterns feature, which detects and reports information about patterns of out-of-range (high or low) blood glucose readings to the user

Empowerment to Self-manage

- 73% of subjects Strongly Agreed/Agreed that pattern notification was helpful in managing their diabetes (**Figure 3**)
- 74% of subjects Strongly Agreed/Agreed that information learned through pattern-related messaging (e.g., possible causes of the observed patterns) was useful/helpful in managing their diabetes
- Most subjects Strongly Agreed/Agreed that the blood glucose displays (e.g., My Readings, Expanded Graph) were helpful to them in managing their diabetes

Figure 3. 'Empowerment to Self-manage' questionnaire results for insulin-using subjects with diabetes (N=46).

Engagement/Adherence

- 91% of subjects Strongly Agreed/Agreed that the CONTOUR[®]NEXT ONE smart meter and app system helped them feel more engaged with their diabetes management program (**Figure 4**)
- 76% of subjects Strongly Agreed/Agreed that, while using the CONTOUR[®]NEXT ONE smart meter and app system, they felt more motivated to adhere to their healthcare provider's therapy and testing recommendations

BGM, blood glucose meter.

Figure 4. 'Engagement/Adherence' questionnaire results for insulin-using subjects with diabetes (N=46).

Actionable Information

- 98% of subjects Strongly Agreed/Agreed that the CONTOUR[®]NEXT ONE smart meter and app system will provide them with a better understanding of their disease (**Figure 5**)
- 95% of subjects Strongly Agreed/Agreed that information learned through pattern messages was understandable, and they were able to interpret it
- 82% of subjects Strongly Agreed/Agreed that they would be likely to use My Patterns in the future

BGM, blood glucose meter.

Figure 5. 'Actionable Information' questionnaire results for insulin-using subjects with diabetes (N=46).

DISCUSSION

- The CONTOUR[®]NEXT ONE smart meter and app system is based upon the IMB model approach to diabetes self-management, which employs technology to provide individuals with actionable information, motivation to act on it, and skills for acting effectively in self-management of blood glucose
- IMB-based monitoring can have a beneficial impact on patient adherence to treatment and improved control of blood glucose levels⁵
- The CONTOUR[®]NEXT ONE smart meter and app system features include pattern recognition, notifications, and guided user reflection on causes and change in blood glucose outcomes
 - These features mobilize the IMB model's information, motivation, and skills essential to help guide and support user self-management
- The clinical utility of the CONTOUR[®]NEXT ONE smart meter and app system was supported by positive feedback from users related to usability, functionality, empowerment to self-manage diabetes, engagement and adherence to treatment and testing recommendations, and ease of understanding of the app and the information it provides

CONCLUSION

- This initial study of user experience indicates overall positive appraisals of the CONTOUR[®]NEXT ONE smart meter and app system and shows specific benefits in terms of user-reported increases in understanding their disease, engagement in self-management, and motivation to adhere to their healthcare provider's therapy and testing recommendations

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