

# Secure messaging and diabetes management: experiences and perspectives of patient portal users

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## ABSTRACT

**Background** Patient portal use has been associated with favorable outcomes, but we know less about how patients use and benefit from specific patient portal features.

**Objective** Using mixed-methods, we explored how adults with type 2 diabetes (T2DM) use and benefit from secure messaging (SM) within a patient portal.

**Methods** Adults with T2DM who had used a patient portal participated in a focus group and completed a survey (n=39) or completed a survey only (n=15). We performed thematic analysis of focus group transcripts to identify the benefits of and barriers to using SM within a portal. We also examined the association between use of various patient portal features and patients' glycemic control.

**Results** Participants were on average 57.1 years old; 65% were female; 76% were Caucasian/White, and 20% were African American/Black. Self-reported benefits of SM within a portal included *enhanced patient satisfaction, enhanced efficiency and quality of face-to-face visits, and access to clinical care outside traditional face-to-face visits*. Self-reported barriers to using SM within a portal included *preconceived beliefs or rules about SM and prior negative experiences with SM*. Participants' *assumptions about providers' opinions about SM and providers' instructions about SM* also influenced use. Greater self-reported use of SM to manage a medical appointment was significantly associated with patients' glycemic control ( $p=-0.29$ ,  $p=0.04$ ).

**Conclusion** SM within a portal may facilitate access to care, enhance the quality of office visits, and be associated with patient satisfaction and clinical outcomes for patients with diabetes, but provider communication about SM is essential.

## BACKGROUND AND SIGNIFICANCE

In the past two decades, an increasing number of healthcare organizations have instituted patient portals—secure, electronic systems that allow patients to view portions of their electronic health record (EHR), and (in many) send messages to their providers and manage medical appointments and bills.<sup>1–4</sup> Among general patient populations, patient portal use has been associated with satisfaction with care,<sup>4–6</sup> and there has been discussion that these systems may engage patients<sup>7–8</sup> and reduce medical errors.<sup>9</sup> However, not all patients with access to a portal use it. Several factors impede portal use, including limited access to computers and the Internet,<sup>10</sup> difficulty using computers,<sup>11–12</sup> difficulty logging in,<sup>13</sup> concerns about privacy,<sup>11–14</sup> health literacy limitations,<sup>15–16</sup> and/or visual or motor impairments.<sup>12</sup> While there has

been an accumulation of evidence about the benefits and barriers to using patient portal systems as a whole, we know less about the isolated benefits and barriers to using different features within them.

Secure messaging (SM) is a common feature within patient portals.<sup>11–17–20</sup> This feature allows patients to communicate securely with providers outside regular office hours for clinical concerns and administrative tasks (eg, reauthorizing prescriptions, scheduling appointments, and requesting referrals).<sup>5–21</sup> SM saves patients' time and resources, can keep providers informed about a patient's clinical status, and is a preferred method for communicating sensitive information (eg, depression/anxiety symptoms, sexual dysfunction).<sup>5–22–23</sup> SM also benefits healthcare organizations by reducing patient phone call volume and unnecessary office visits, and thus the concomitant resources and costs.<sup>20–21</sup> Furthermore, SM will play an increasingly active role in healthcare since the inclusion of an SM feature, tethered to the EHR, and benchmarks for patient use of SM are among the next stage of meaningful use requirements for healthcare organizations to receive federal incentives.<sup>24</sup>

Certain patient portal features, such as SM, may be particularly advantageous for individuals with a chronic health condition, such as diabetes,<sup>25–26</sup> who require frequent interactions with the healthcare system.<sup>27</sup> Patients with chronic health conditions are also more likely to access and use portals than patients without these conditions.<sup>5–17–20–28</sup> Moreover, our review of studies examining the impact of patient portals on diabetes outcomes found that the use of a portal or a system with patient-portal-like characteristics was associated with favorable patient-provider communication, satisfaction with care, the performance of self-management behaviors, and clinical outcomes (eg, glycemic control and a reduction in emergency room visits and hospital admissions).<sup>29</sup>

Despite the benefits of using entire patient portal systems, many users elect not to use SM. One study found that most portal users do not use SM at all.<sup>17</sup> Another found that only 19% of 15 000 portal users with diabetes used SM.<sup>30</sup> Still others have reported that portal users are more likely to view personal health information than use SM.<sup>1–5–31</sup> While we have begun to understand what patient portal features patients use the most, we do not yet know what motivates portal users to use SM, why some patients use SM less often than other features, or whether using SM within a portal is individually associated with favorable health outcomes.

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## OBJECTIVE

Our study objectives were threefold: (a) to understand why patient portal users with type 2 diabetes (T2DM) use SM and (b) why they do not use SM, and (c) to explore the relationship between self-reported SM use within a portal and glycemic control.

## METHODS

### The MyHealthAtVanderbilt patient portal

The MyHealthAtVanderbilt (MHAV) patient portal allows Vanderbilt University Medical Center (VUMC) patients to view EHR data, use SM to communicate with providers, manage medical appointments and bills, and perform other tasks.<sup>1</sup> All office visits scheduled through the portal are managed via SM, and patients can send a message to their providers for any other purpose. SM is a closed-loop process—patient-initiated messages are dealt with by clinic groups and thus may be answered by a clinic staff member, nurse, or patients' physician depending on the message content.<sup>1</sup> All messages are retained in patients' EHR for clinical reference and patients can view current and previous message threads in their patient portal account.

### Recruitment and data collection

We recruited adults with T2DM who were prescribed antihyperglycemic medications from VUMC primary care clinic waiting rooms.<sup>32</sup> As part of a larger study, participants attended a focus group and completed a survey or completed a survey only by phone/email. Use of MHAV and its individual features was self-reported. Since database counts may be confounded by illness severity, we deliberately used self-reported frequency of use in an attempt to disentangle use from participants' need to contact the healthcare system (ie, how often someone uses MHAV or the features within it *when needed*, regardless of their illness severity or level of healthcare need). We used self-reported frequency of MHAV use to stratify participants into one of 11 focus group sessions (two non-user groups, four low-user groups, five high-user groups).<sup>32</sup> Our survey collected demographic information, diabetes characteristics, and responses to 10 items asking participants to rate how often they used different MHAV features on a scale ranging from 1='never' to 6='very often' (see items in Table 4). Glycemic control was assessed by obtaining the most recent hemoglobin A1c value (A1c) from participants' EHR. The Vanderbilt University institutional review board approved these procedures before participant enrollment.

### Analysis

We performed mixed-methods analyses to understand why and how participants with T2DM use SM within MHAV, and to see if there was a relationship between using SM and using other patient portal features, and a relationship between using SM and glycemic control. We therefore excluded participants who had never used MHAV, retaining nine focus group transcripts (excluding two non-user groups) and 54 participants' survey data for analysis.

### Qualitative analysis

First, authors AW-V and LSM read the transcripts to identify general themes and generate a list of terms for a word search. Next, author AW-V used NVivo 9 to conduct a word search using terms such as 'MHAV', 'portal', 'email', 'send', 'message' and 'provider/doctor/physician'. During the initial reading of transcripts, we identified colloquial phrases, such as 'I MyHealthed my doctor', which were included in this search.

Next, author AW-V read all 1490 references identified by the word search and identified participant quotes relevant to SM.

We conducted thematic analysis in iterative stages<sup>33</sup>—meeting at each stage of analysis to establish and refine word search and coding criteria, and to determine if identified quotes were consistent with established and emergent themes. This process resulted in 62 participant quotes describing decisions about, perceptions of, or experiences with SM. We categorized these quotes into two a priori themes: (1) benefits of SM and (2) barriers to using SM. Within these themes, we conducted comparative analyses to identify subthemes<sup>34 35</sup> at which point a third theme emerged, (3) perceptions of provider endorsement of SM.

### Quantitative analysis

First, we used Fisher's exact tests and Mann-Whitney U tests to examine differences between focus group and survey-only participants on demographic and diabetes characteristics, including A1c values. Next, we used Spearman's correlation coefficients to explore the relationships between participants' reported use of each MHAV feature with their use of every other feature, and then between their use of each feature with their A1c values. Finally, we used Mann-Whitney U tests and Spearman's correlation coefficients to test for demographic differences in the use of MHAV features that were significantly associated with participants' A1c values.

## RESULTS

Participants were 54 adult MHAV users with T2DM. Participants were on average 57.1 (SD=8.4) years old, 65% were female, 76% were Caucasian/White, and 20% were African-American/Black. All participants had at least a high school education, and 77% had household incomes  $\geq$ \$40 000. Table 1 presents the sample characteristics stratified by type of participation (focus group and survey vs survey only). There were no significant differences between the two groups.

Qualitative analysis resulted in three major themes: 'benefits of SM' (34 references), 'barriers to using SM' (23 references), and 'perceptions of provider endorsement of SM' (39 references). Benefits of SM included three emergent subthemes: (a) enhanced patient satisfaction, (b) enhanced efficiency and quality of face-to-face visits, and (c) access to clinical care outside traditional face-to-face visits. Barriers to using SM included two emergent subthemes: (a) preconceived beliefs or rules about SM and (b) prior negative experiences with SM. Perceptions of provider endorsement of SM included two subthemes: (a) participants' assumptions about providers' opinions about SM and (b) providers' instructions about SM.

### Benefits of SM

Table 2 presents subthemes and participant quotations. In-text descriptions and corresponding quotations are indicated by superscript letters.

#### Enhanced patient satisfaction

Participants frequently described satisfaction with SM for clinically relevant, administrative purposes such as scheduling medical appointments or requesting prescription reauthorizations. Participants described how SM saves everyone time, including their providers.<sup>a</sup> In addition, participants were satisfied with having multiple communication options because they could select their preferred method of communication (eg, phone, office visit, SM), which often varied depending on the circumstance. Most participants felt patient-initiated SM elicited a faster response from providers than a phone call.<sup>b</sup> Some

**Table 1** Participant characteristics

Characteristics	MHAV users		
	Focus group (n=39)	Survey only (n=15)	All (n=54)
Age, years	57.9±8.6	55.1±7.8	57.1±8.4
Gender			
Male	15 (38.5)	4 (26.7)	19 (35.2)
Female	24 (61.5)	11 (73.3)	35 (64.8)
Race			
Caucasian/White	30 (78.9)	11 (78.6)	41 (75.9)
African-American/Black	8 (21.1)	3 (21.4)	11 (20.4)
Education, years	15.3±2.3	14.9±2.4	15.2±2.3
Income (US\$)			
≤39999	9 (23.7)	3 (23.1)	12 (23.5)
40000–59999	13 (34.2)	2 (15.4)	15 (29.4)
≥60000	16 (42.1)	8 (61.5)	24 (47.1)
Diabetes duration, years	7.1±5.0	10.2±7.7	8.0±6.0
Duration of MHAV use			
<3 months	2 (5.1)	1 (6.7)	3 (5.6)
3 months–1 year	2 (5.1)	3 (20.0)	5 (9.2)
1–3 years	11 (28.2)	2 (13.3)	13 (24.1)
>3 years	24 (61.5)	9 (60.0)	33 (61.1)
Diabetes medication			
Oral agents only	26 (68.4)	10 (71.4)	36 (69.2)
Insulin only	5 (13.2)	2 (14.3)	7 (13.5)
Both	7 (18.4)	2 (14.3)	9 (17.3)
BMI	33.9±8.3	35.9±14.4	34.4±10.2
A1c value, %	6.8±1.0	7.4±2.2	7.0±1.4

Results are shown as mean±SD or number (%).

Tests included Fisher's exact tests for categorical variables and Mann–Whitney U tests for continuous variables. There were no significant differences between focus group participants and survey-only participants for any variables.

A1c, hemoglobin A1c; BMI, body mass index; MHAV, MyHealthAtVanderbilt.

participants wanted providers to use SM exclusively when communicating with them (eg, asking for a message response to a patient-initiated phone call<sup>c</sup>), so they could read the providers' response and retain the message for future reference.

#### Enhanced efficiency and quality of face-to-face visits

Participants frequently mentioned that SM facilitated more efficient patient–provider interactions. For example, participants emphasized the utility of SM to keep providers informed between medical appointments, thus promoting better continuity and quality of care.<sup>d</sup> One participant used SM to ask her provider if she should have any laboratory tests performed before her medical appointment and explained that SM helps her prepare for medical appointments, and makes her visits more efficient and productive. Another participant sent her blood glucose values to her provider in-between medical appointments, so her provider could detect patterns or changes that might warrant action.<sup>e</sup> Several participants also described using SM to avoid unnecessary medical appointments.<sup>f</sup>

#### Access to clinical care outside traditional face-to-face visits

Several participants shared the view that SM expanded access to their provider and healthcare team because using SM is not bound by normal clinic hours or time constraints associated with traditional face-to-face visits.<sup>g</sup> Others described how SM often extended face-to-face visits because they could use SM to ask questions after medical appointments.<sup>h</sup>

SM also replaced face-to-face visits for some needs. For example, participants used SM to inform a provider about a clinical problem, which initiated patient–provider collaboration and shared decision-making outside a face-to-face visit. For example, participants used SM to report a medication side effect or that a medication was not relieving symptoms, and then discussed a course of action with their provider (eg, reducing the dose amount or switching to a new medication) without a face-to-face medical appointment.<sup>i</sup>

One participant recounted how SM helped her avoid an adverse drug event. In an effort to save medical costs, one of her providers wanted to prescribe her a less expensive medication, but, after reading message exchanges stored in her EHR, the provider learned she had an allergic reaction when she had taken that medication in the past, and therefore elected not to change her prescription. She was enthusiastic about how messages were retained in her medical record, stating:

And so that was really cool because I had totally wiped it from my mind. Having that record there was really, really great. (58-year-old, Caucasian/White, female)

#### Barriers to using SM

##### Preconceived beliefs or rules about SM

Several participants reported that their preconceived beliefs about technology and rules about message content were barriers to using SM. Participants also expressed doubts about the reliability of the patient portal to facilitate a timely and productive message exchange with their providers. For example, this participant described concerns about reliance on technology and potential workflow disruptions in a provider's office due to technical problems:

And I think what you might run into after a certain point in time, if the computers are down, you are going to end up with some overloads and some downtime [when] you could be helping somebody that is right here in the office...[they'd] have to go back to the old way anyway. (59-year-old, African-American/Black, female)

In addition, participants reported personal rules about the appropriateness of SM as a modality for certain types of communication. However, participants' rules differed. For instance, one participant indicated he preferred to call his provider's office for more pressing medical questions or concerns because he thought he would get an immediate response, but he preferred to use SM to schedule appointments or ask less time-sensitive questions. Another participant indicated the opposite rule. He thought SM elicited a quicker response than a phone call for urgent needs.

Other participants used different communication modalities for different needs based on beliefs about who would respond (eg, a receptionist, a nurse, or a physician). For medical questions, they preferred the modality they thought would get them in touch with their physician the fastest. For scheduling appointments or renewing prescriptions, they preferred to communicate with nurses or staff and not 'bother' the physician. However, participants had different beliefs about which method of communication (eg, a phone call or a secure message) would elicit a physician's response versus which would elicit a response from a nurse or an administrative staff member.

##### Prior negative experiences with SM

Participants were less inclined to use SM after a negative experience. The most frequently reported negative experience was not receiving a response to a patient-initiated message. For example,

**Table 2** Participant comments about benefits of SM

Demographics	Enhanced patient satisfaction
Administrative tasks quickly completed via SM	
a 67/M W	<i>'You can set up appointments with specific reasons. And it saves their time and everyone's time.'</i>
a 58/F W	<i>'You can log in and send messages directly to your doctors and they will respond to you and it's very helpful because then we can go in and ask for a refill on prescriptions.'</i>
Patients choose most convenient communication method	
b 42/F W	<i>'[Messaging] is usually the way that we go. If you call you have to talk to the nurse and you have to wait for them to call you back. So then its phone tag and then [the providers are] out for the day and with the medications we're on you really can't play, you've got to know what you're supposed to take.'</i>
b 40/F AA	<i>'I get a quicker response [with messaging] than actually calling the physician. I usually hear from them at the end of that day.'</i>
c 59/F AA	<i>'I usually call in because that way I can get to talk to them and let them know what's going on with my body...So then I ask them to [send the] reply to my [message box]. It's just better for me to read, than it is for me to write. I am not too computer literate. [But], I don't mind getting on to read. We just work like that.'</i>
Demographics	Enhanced efficiency and quality of traditional face-to-face visit
SM to prepare for face-to-face visits	
d 58/F W	<i>'The other thing I like about MyHealth is that my doctor can't remember when I'm coming to see him, so about a week before [my appointment] I'll send him a MyHealth message and say "Do you want me to have any labs done?"'</i>
e 56/F W	<i>'I use MyHealthAtVanderbilt all the time—I message my doctor and put my glucose logs in there from the time I was there last until the time I am going to see her, and so she has that before I even go in.'</i>
SM to assess need for face-to-face visit	
f 71/M W	<i>'It saves time and, if I have a question, well, should I come in or shouldn't I? That's one of the benefits of using [SM].'</i>
f 53/F W	<i>'I look up my test results. I send messages. I had a huge bruise come up on the bottom of my toes...and he had me come in so he [could] look at it.'</i>
f 66/F AA	<i>'On Sunday, [my hypoglycemia] got real bad. I will probably send [my doctor] a message and see what she says—if she wants me to come in, I'll come in. Or if she wants to adjust my medication. That's what I love about MyHealthAtVanderbilt.'</i>
Demographics	Access to clinical care outside traditional face-to-face visits
SM replaces face-to-face visit	
g 53/F W	<i>'[SM] is such an efficient way of being able to communicate to your doctor...if it saves me from having to go in and chat with him—and he knows me. My doctor knows me like a book.'</i>
g 46/M W	<i>'So I will say [in a message], for instance, 'I think I'm getting sick, might have a sinus infection, can you zip me a Z-Pak?' And I won't even have to come in. I just tell them my symptoms, and pop over here to the pharmacy...because I'm a nurse. I can't go down. I have to be on my feet.'</i>
SM extends face-to-face visit	
h 67/F W	<i>'MyHealthAtVanderbilt is a real valuable tool for people that want to interact with their medical [team] without bugging them. Because you only get 7 or 8 min in the doctor's office.'</i>
SM to inform provider of clinical issues and make clinical decisions	
i 58/F W	<i>'I have a really good relationship with my primary care doctor and my endocrinologist, when I start...having problems with my blood sugar dropping, I would MyHealth [my doctor]—and that's a verb by the way—'Okay this is what my blood sugar has been running, and what my blood pressure medicine is running. I'm going to start cutting my blood pressure medicine in half and my metformin in half'...he would respond back 'Okay sounds like a plan.' That way he could update it in the problem list...so that if I had to go to the emergency room they would have that information updated.'</i>

Note: a–i quotations correspond to in-text descriptions.

AA, African-American/Black; F, female; M, male; MHAV, MyHealthAtVanderbilt; SM, secure messaging; W, Caucasian/White.

one participant decided to call her provider's office after waiting 2 weeks for a response. This participant was unsatisfied with SM:

I got less interested in messaging them when I knew [the messages] would be able to just get lost in the system somewhere. (58-year-old, Caucasian/White, female)

Another participant expressed dissatisfaction after he sent a message to his provider about a medication side effect, and did not get a response within a reasonable time frame. The consequences of this were threefold: (1) the participant adjusted his medication without provider input; (2) the participant now relies on more traditional forms of communication (eg, a phone call or an office visit); and (3) the participant has been unsatisfied with his care. The first two consequences (ie, adjusting a medication without provider input and relying on phone calls) appear in the following quote:

My wife says, 'I can't take this coughing...I am just hacking you know....She said just stop [the medication] and see if it stops. So I stopped taking it [and the coughing] stopped. We messaged the doctor, and it was like a day, then another day, then another day...So I called the nurse—asked to speak to the nurse. (46-year-old, African-American/Black, male)

The third consequence (ie, being unsatisfied with care) is illustrated in this quote:

I don't get a quick response. That's good if you get a quick response...as a matter of fact, my wife has been on me to switch doctors. (46-year-old, African-American/Black, male)

### Perceptions of provider endorsement of SM

Table 3 presents subthemes and participant quotations. In-text descriptions and corresponding quotations are indicated by superscript letters. Participants' perceptions of provider endorsement of SM were (a) based on participants' assumptions about

**Table 3** Participant comments about perceptions of provider endorsement of SM

Demographics	Participants' assumptions about providers' opinions about SM
Provider resistance to technology	
a 45/M W	'Older physicians are not [willing], they didn't grow up with computers...they don't want to use them, they want to go back to the pen and paper method.'
Providers are interrupted by SM	
b 71/M W	'I feel guilty when I take a question to one of my physicians because I know that they have to take time [to answer the message].'
Providers are not reimbursed for SM	
c 52/F W	'When you send messages [to your provider], they are not getting paid to respond to you.'
Demographics	Providers' instructions about SM
Participants use SM when providers tell them to	
d 45/M W	'Every doctor recommends [messaging], that's what [my doctor] tells you: 'If you need me [message] me.'
e 58/F W	'And then [in] another department I just have my doctor's direct email [address]. He said don't go [through MyHealth].'
Participants want providers to talk to them about SM	
f 54/F W	'I think it's a wonderful tool for people that are technology savvy and have access and I think it would take some teaching. I think you would have to get the providers on board to do the education piece about 'This is how I want you to do this. I can check on you with [SM]. You know, I can see how you are doing, because I can see what you are putting in [to the MHAV] system.'
g 68/M W	'They have the knowledge. It's just, I think, a little bit of laziness. You know—all you have to do is, you know, get a little bit more communication with the people. [To another participant] Have they ever asked you about MyHealth? No, they have never mentioned it have they?'

Note: a–g quotations correspond to in-text descriptions.  
F, female; M, male; SM, secure messaging; W, Caucasian/White.

providers' opinions about SM or (b) dictated by providers' instructions about SM. Participants' assumptions about providers' willingness to use SM,<sup>a</sup> providers being interrupted by SM,<sup>b</sup> and providers not being reimbursed for SM<sup>c</sup> were barriers to use. In addition, some participants recalled instances when their providers gave them explicit instructions to use SM, which was a primary facilitator of use.<sup>d</sup> Participants also recounted instances when providers instructed them not to use SM, which was a strong barrier to use.<sup>e</sup> Finally, participants thought provider communication about SM would clarify how SM should be used,<sup>f</sup> and wanted more communication about SM during their office visits.<sup>g</sup>

**Quantitative results**

On average, participants had been using MHAV for 3.1 years (SD=1.8); 85% had been using MHAV for >1 year. Table 4

presents the percentage of participants who reported frequent use (≥4 on a 6-point scale) of MHAV features; 63% of participants reported frequently using SM to send a message to a provider for any reason (M=4.2, SD=1.6) and 36% reported frequently using SM to schedule a medical appointment (M=2.8, SD=1.7). While most participants reported frequently using MHAV to review laboratory results or view their personal health information, only using SM was associated with glycemic control. Specifically, greater SM use to send a message to a provider for any reason was marginally associated with lower A1c values (ρ=-0.26, p=0.07), and greater SM use to schedule an appointment was significantly associated with lower A1c values (ρ=-0.29, p=0.04). Participant age, gender, race, income, or education level were not associated with using SM to send a message to a provider for any reason or using SM to schedule an appointment.

**Table 4** Relationships between self-reported frequency of patient portal feature use and glycemic control among patient portal users (N=54)

Feature number	How often do you use MHAV to...	Percentage reporting frequent use† (%)	Spearman's ρ										A1c value	
			Feature number											
			1	2	3	4	5	6	7	8	9	10		
1	Review laboratory results?	76	1.00											NS
2	View your medical record?	61	0.69**	1.00										NS
3	Send a message to your doctor? (SM)	63	0.60**	0.63**	1.00									-0.26#
4	Request an appointment? (SM)	36	NS	0.36**	0.36**	1.00								-0.29*
5	Access billing information?	19	NS	0.31*	NS	0.31*	1.00							NS
6	Access telephone directory?	19	NS	NS	NS	NS	NS	1.00						NS
7	Find a doctor?	11	NS	NS	NS	NS	0.37**	0.31*	1.00					NS
8	Pay medical bills?	11	NS	NS	NS	NS	0.66**	0.36**	0.38**	1.00				NS
9	Access clinic maps/directions?	6	NS	NS	NS	NS	0.36**	0.52**	0.59**	0.37**	1.00			NS
10	Access insurance information?	2	NS	NS	NS	0.37**	0.56**	NS	NS	0.44**	0.33*	1.00		NS

#p<0.08; \*p<0.05; \*\*p<0.01.  
†Self-reported use of MHAV features; ≥4 indicate frequent use (on a scale from 1='never' to 6='very often').  
A1c, hemoglobin A1c; MHAV, MyHealthAtVanderbilt; NS, not significant; SM, secure messaging.

## DISCUSSION

We examined perceived benefits of and barriers to using SM among users of a multi-feature patient portal. Participants reported that SM enhanced satisfaction with care, expanded access to care, and improved the efficiency and quality of office visits, and greater SM use was associated with glycemic control. In a large cohort of adults with diabetes, Harris *et al*<sup>30</sup> found that greater SM use within a patient portal, defined by number of message threads in a 15-month period, was associated with glycemic control. We found the same relationship in a smaller sample of patient portal users and with SM use defined by self-report. In addition, our mixed-method approach allowed us to explore the ways in which patients leverage SM to manage their diabetes, which included using SM to communicate with their providers about changes in blood glucose results and the efficacy of medications.

Participants reported purposefully using SM immediately before/after medical appointments to enhance the quality of their face-to-face visit; they used SM to contact providers before appointments to prepare for face-to-face visits (eg, complete laboratory results) and afterwards to ask questions and to provide status updates (eg, how they're responding to a new medication). Harris *et al*<sup>30</sup> also found that more frequent messaging was associated with more office visits among adults with diabetes, whereas more frequent SM use has been associated with fewer office visits in the general population.<sup>20–36</sup> Since patients with diabetes have more office visits than the general population,<sup>27</sup> our finding that patients with diabetes use SM before and after office visits may explain why more frequent SM use has been associated with more office visits in diabetes populations (ie, the association may reflect the greater use of SM before and after regularly scheduled visits rather than its use being associated with additional visits).

Consistent with findings from general patient populations, we found that patients with T2DM were satisfied with SM,<sup>5, 20</sup> and that using SM was associated with greater satisfaction with care.<sup>22</sup> Other studies have also reported that patients use SM for status updates and to give their provider clinical data,<sup>17, 22</sup> and that SM in a patient portal can be used for collaborative decision-making (eg, deciding if an office visit is necessary, discussing a medication change).<sup>13</sup> However, this is the first study, to our knowledge, to report on the utility of retaining message exchanges in the EHR for preventing future adverse drug events.

To our knowledge, this is also the first study to explore barriers to using SM among existing patient portal users. Participants thought messages could be 'lost in the system'. Although MHAV has instituted audits and other processes to ensure messages receive timely responses,<sup>1</sup> early problems with this technology might have dissuaded patients from continued SM use. Thus, dealing with barriers to using SM early in implementation will increase the likelihood that patients who use portals adopt and sustain use of the SM feature within them. Participants were also concerned that their messages would interrupt or burden their providers and reported rules about how and when SM was useful. Some participants' perceptions about how messages were answered did not align with the way the feature actually works,<sup>1</sup> and participants' rules about when to use SM reflected assumptions that might or might not align with their providers' opinions about how SM could enhance their care. These discrepancies indicate a lack of communication between patients and providers about SM. Participants whose provider(s) endorsed and used SM said they were more likely to use SM, and reported satisfaction with SM, and satisfaction with their care and their provider(s). Participants reported that

providers knew them better because of SM, and described how a provider's response increased their satisfaction, whereas a slow or no response created dissatisfaction.

Zickmund *et al*<sup>37</sup> examined opinions about a newly implemented patient portal with SM among adults with diabetes and found that participants were concerned that SM would make their relationship with their provider less personal. These fears were based on confusion about who would receive and respond to messages and concerns about the reliability of SM. While MHAV attempts to deal with these concerns by providing the name and credentials of the person responding to patient-initiated messages,<sup>1</sup> participants were uncertain about the processes through which messages were received, or, often, who would answer their message. To remove these barriers, our participants indicated a desire to have more education about SM from providers. Based on our findings, and those of Zickmund *et al*,<sup>37</sup> we recommend that providers explicitly discuss the utility of SM and the processes whereby messages are read and answered, despite the short period of time afforded to patient-provider interactions during office visits.

Although this paper provides insight into SM use among users of a single patient portal at an academic medical center, the generalizability of these findings is limited. There were no differences in SM use by age, gender, race, income or educational level, which might be due to the limited variability in our sample. SM may also present different benefits and challenges to patients with varying levels of education and English proficiency, which we were unable to capture since we only included English-speaking participants, and most of our participants reported at least some college education. Additionally, we used participant self-reported frequency of MHAV use, so associations might not reflect associations with actual frequency of use. Moreover, owing to our mixed-method approach, our sample size was not large enough to examine potential confounders of the relationship between SM use and glycemic control (eg, diabetes duration, comorbidities, number of prescribed medications). Finally, patients managing other chronic illnesses probably have illness-specific uses (just as our participants used SM to send blood glucose results). Thus, research on other patient populations and portals is necessary to enrich our understanding of SM use to manage a chronic illness and to optimize usability for the broadest range of patients with high communication and care needs.

Nonetheless, our findings have important implications for the successful implementation of meaningful use goals.<sup>24</sup> First, if providers communicate with patients about the benefits of SM and remove potential barriers to use, SM can facilitate the achievement of other meaningful use benchmarks (eg, maintaining up-to-date medication and problem lists in the EHR, avoiding unnecessary office visits). Second, SM engages patients in their care (a primary goal of meaningful use) by facilitating patient-initiated communication of health information and questions about personal health information. Third, providers must have protected time to adequately leverage SM and ensure patients continue to use SM to manage their health. Given our finding that patients distrust SM technology after negative experiences, it is critical that providers have protected time to devote to patients' messages.

## CONCLUSION

This mixed-methods study provides new insight into the benefits of and barriers to using SM by adults with diabetes who are already patient portal users. Our participants frequently used

SM to send clinical information to their provider, thereby initiating collaborative decision-making about diabetes management. Participants' comments emphasized the critical role of providers in their decision to use SM, and participants desired more communication during office visits about the utility of SM. Furthermore, greater SM use was associated with glycemic control. In summary, SM facilitates access to care and the delivery of care, enhances patient satisfaction, and is associated with certain clinical outcomes. The relationship between SM use and a wide range of clinical outcomes and the potential for SM to improve the quality of patient care should be studied further in larger and more diverse populations.

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