

# Ways Health Care Providers Can Promote Better Medication Adherence

Jennifer K. Bussell,<sup>1</sup> EunSeok Cha,<sup>2,3</sup> Yvonne E. Grant,<sup>4</sup> David D. Schwartz,<sup>5</sup> and Lara A. Young<sup>6</sup>

Optimal diabetes management requires patient engagement in a variety of self-care activities, including adherence to medication regimens, adjustment to lifestyle modifications, and monitoring of blood glucose levels. Perhaps one of the most challenging self-care issues facing patients living with diabetes is that of medication adherence. Patients take their medication as prescribed only 50% of the time (1) and are reluctant to share the details of their less-than-optimal medication-taking behavior with their health care providers (HCPs) (2).

In 2003, the World Health Organization stated that increasing medication adherence might have a far greater impact on the health of the population than any improvement in specific medical treatments (3). During the past 14 years, a better understanding of the barriers related to nonadherence has become more apparent. The following barriers have been consistently implicated in medication nonadherence for patients with diabetes: patients' emotions, patients' intention to not take medications, emotional distance from HCPs (e.g., because of HCPs' poor understanding of the situation), social and cultural beliefs about health and antidiabetes medications, low health literacy, insufficient information about ancillary resources, medication complexity and lack of support or powerlessness to handle medication complexity, and poverty (4). Researchers have also documented the consequences

of nonadherence, which include increased morbidity, mortality, and health care costs (5). Although the body of knowledge informing the issues of medication nonadherence has grown, the practical problem of medication adherence is one that patients and providers continue to struggle with on a daily basis.

The National Diabetes Education Program developed a web resource titled "Promoting Medication Adherence in Diabetes," available at [www.niddk.nih.gov](http://www.niddk.nih.gov), to give HCPs evidence and tools to help them promote optimal medication-taking behavior among patients. To help busy HCPs, we have distilled the current knowledge base related to medication nonadherence in patients with diabetes into this practical collection of tips and tricks. Our intention is to help HCPs feel better equipped to tackle the crucial issue of medication nonadherence in clinical practice. Below, we present practical ways to identify patients at greatest risk for nonadherence, suggest when a more in-depth assessment of patient medication adherence should be done, share the best tools to use to identify medication nonadherence, and demonstrate strategies to help improve medication adherence.

## Who Is at Risk for Diabetes Medication Nonadherence?

### Sociodemographic Factors

Adult patients who are younger, members of racial and ethnic minority groups, unmarried, or immigrants

<sup>1</sup>Northwestern Memorial Hospital, Chicago, IL

<sup>2</sup>Chungnam National University, Daejeon, South Korea

<sup>3</sup>Emory University, Atlanta, GA

<sup>4</sup>Kaiser Permanente, Panorama City, CA

<sup>5</sup>Baylor College of Medicine, Houston, TX

<sup>6</sup>University of North Carolina at Chapel Hill, Chapel Hill, NC

Corresponding author: Jennifer K. Bussell, [jbussell@nm.org](mailto:jbussell@nm.org), [gbsussell@gmail.com](mailto:gbsussell@gmail.com)

<https://doi.org/10.2337/cd016-0029>

©2017 by the American Diabetes Association. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. See <http://creativecommons.org/licenses/by-nc-nd/3.0> for details.

are more likely to be nonadherent to prescribed medications for controlling chronic diseases, including diabetes (6). Poverty is another crucial risk factor for nonadherence. In addition to difficulties with affording prescribed medications, other con-

straints, such as low-quality housing, shift work, and food insecurity, are common among low-income patients and contribute to medication nonadherence. These patients also tend to have more chaotic lifestyles, lower health literacy levels, and higher levels

of psychological stress, which are also linked to higher rates of medication nonadherence (4).

**Psychosocial Factors**

Patients who are struggling with negative emotions, including fear, self-

**TABLE 1. Suggested Checklist for Identifying Patients at High Risk for Medication Nonadherence**

	Evidence-Identified Factors	Measures	
Socio-demographic factors	Ethnicity	<input type="checkbox"/> Hispanic <input type="checkbox"/> Non-Hispanic	
	Race	<input type="checkbox"/> White <input type="checkbox"/> African American <input type="checkbox"/> Asian <input type="checkbox"/> Multiracial <input type="checkbox"/> Other (Specify: _____)	
	Age	<input type="checkbox"/> Young (<39 years) <input type="checkbox"/> Middle-aged (40–64 years) <input type="checkbox"/> Old (65–74 years) <input type="checkbox"/> Elderly (≥75 years)	
	Education	<input type="checkbox"/> < High school <input type="checkbox"/> High school graduate <input type="checkbox"/> ≥High school	
	Low income	Below 200% of federal poverty level? <input type="checkbox"/> No <input type="checkbox"/> Yes	
	Acculturation	Language barrier?	<input type="checkbox"/> No <input type="checkbox"/> Yes
		Immigration?	<input type="checkbox"/> No <input type="checkbox"/> Yes (When? _____)
		Acculturation (e.g., follows U.S. practices)?	<input type="checkbox"/> No <input type="checkbox"/> Yes
	Health insurance	Has health insurance?	<input type="checkbox"/> No <input type="checkbox"/> Yes
		Has prescribed drug coverage?	<input type="checkbox"/> No <input type="checkbox"/> Yes
Living conditions	Working ≥2 jobs:	<input type="checkbox"/> No <input type="checkbox"/> Yes	
		<input type="checkbox"/> Married (or living with someone)	
		<input type="checkbox"/> Unmarried (or living alone)	
Patient factors	Understanding of diabetes	<input type="checkbox"/> No <input type="checkbox"/> Yes	
	Experiencing diabetes symptoms	<input type="checkbox"/> No <input type="checkbox"/> Yes (Specify: _____)	
	Comorbidities	1.                      2.                      3.	
	Poor eyesight/hearing	Glasses?	<input type="checkbox"/> No <input type="checkbox"/> Yes; Vision corrected? <input type="checkbox"/> No <input type="checkbox"/> Yes
		Hearing aids?	<input type="checkbox"/> No <input type="checkbox"/> Yes; Hearing corrected: <input type="checkbox"/> No <input type="checkbox"/> Yes
	Cognitive function	How frequently does patient experience forgetfulness? <input type="checkbox"/> Never <input type="checkbox"/> Hardly ever <input type="checkbox"/> Sometimes <input type="checkbox"/> Often <input type="checkbox"/> Always	
	Emotional states (all that apply)	<input type="checkbox"/> Depression <input type="checkbox"/> Anxiety <input type="checkbox"/> Denial <input type="checkbox"/> Fear	
		<input type="checkbox"/> Other (Specify: _____)	
	Coping skills	<input type="checkbox"/> Inadequate <input type="checkbox"/> Adequate	
	Trust in HCP	<input type="checkbox"/> No <input type="checkbox"/> Yes	
	Social support (all that apply)	<input type="checkbox"/> Spouse/partner <input type="checkbox"/> Family <input type="checkbox"/> Friend(s)	
	In need of ancillary resources (e.g., dental care, pharmacy, or nutrition counseling)	Expressing need of ancillary resources? <input type="checkbox"/> No <input type="checkbox"/> Yes (Specify: _____)	
	Awareness/usage of ancillary resources	<input type="checkbox"/> Nutrition counseling	
<input type="checkbox"/> Peer support			
<input type="checkbox"/> Community outreach program (Specify: _____)			
<input type="checkbox"/> Other (Specify: _____)			

Downloaded from <http://jada.silverchair.com/clinical/article-pdf/39/3/171/500497/171.pdf> by guest on 18 April 2024

**TABLE 2. Signs That a Patient May Be Struggling With Medication Adherence**

Patient-related signs that can predict nonadherence	Clinic visit	<ul style="list-style-type: none"> <li>• Missed last clinic appointment</li> <li>• Lack of appropriate follow-up</li> </ul>
	Prescription	<ul style="list-style-type: none"> <li>• Did not refill last prescription</li> </ul>
	Clinical outcomes	<ul style="list-style-type: none"> <li>• Suboptimal clinical outcomes: A1C, fasting glucose, blood pressure, lipids, BMI</li> <li>• Number of hypo- or hyperglycemic episodes</li> <li>• Number of hospitalizations and readmissions for diabetes in the past 6 months</li> </ul>
Medication-related signs that can predict nonadherence	Medication cost	<ul style="list-style-type: none"> <li>• Difficulty affording the medication</li> <li>• Prescribed medication is not on prescription plan formulary or is not covered by health insurance</li> </ul>
	Polypharmacy (≥4 medications)	<ul style="list-style-type: none"> <li>• Patient is taking ≥4 medications</li> <li>• Patient does not have clear understanding of the reason for taking the medication</li> </ul>
	Complex medication regimen	<ul style="list-style-type: none"> <li>• Patient is taking the medication &gt;1 time per day (e.g., twice daily or three times daily)</li> <li>• Patient does not take the same doses consistently</li> <li>• Patient takes the medication at different times during the day</li> <li>• How is the medication taken? Oral or injection?</li> </ul>
	Side effects	<ul style="list-style-type: none"> <li>• Patient experiences side effects from medication</li> <li>• Patient has made trial-and-error attempts in the past</li> </ul>

blame, guilt, helplessness, and frustration, are at greater risk for medication nonadherence (7). Depression, which is more common in diabetes patients, is a significant risk factor for suboptimal medication adherence (8). Poor cognitive function and insufficient social support from family or friends are other factors that hamper medication adherence (4).

Sometimes, patients deliberately do not take their diabetes medications if they deny having the disease (e.g., new patients), are afraid of side effects, or perceive a lack of immediate benefit of medications (e.g., asymptomatic patients) (3). Patients' cultural beliefs about health, diabetes, and medication-taking are also contributing factors causing intentional medication nonadherence (4). Patients are often reluctant to share their intentions to not take medications and their concerns with their HCPs. Other patients apply a trial-and-error approach to self-adjusting their medication (4). Therefore, HCPs often fail to

capture hidden reasons for suboptimal medication adherence (9). The financial and emotional burdens of taking medications and a lack of understanding of long-term diabetes outcomes are other factors that diminish medication adherence (6). A quick reference tool to help primary HCPs identify patients at heightened risk for problematic adherence is presented in Table 1.

#### **When Should Patients With Diabetes Be Evaluated for Medication Nonadherence?**

##### ***Patient-Related Signs That Can Predict Nonadherence***

Low health literacy impedes medication adherence in patients with diabetes. A strong relationship has been identified between low health literacy and demographic factors (i.e., advanced age, low education level, poverty, low acculturation, and health insurance status) (4). A lack of ancillary resources such as a peer support group and nutrition counseling decreases patients' empowerment

and problem-solving skills. Thus, HCPs need to assess patients' health literacy, problem-solving skills, and knowledge about ancillary resources when patients miss clinic visits, fail to refill medication prescriptions, show poor clinical outcomes, report frequent hypo- or hyperglycemic episodes, or have been recently admitted to a hospital.

##### ***Medication-Related Signs That Can Predict Nonadherence***

A complex treatment regimen, multiple medication schedules, expensive medications, and polypharmacy are factors that decrease medication adherence (1). Patients' concerns regarding the potential side effects of their medication or actual side effects experienced by patients or their family members also may influence medication-taking behavior (1). Thus, HCPs must provide accurate information about common side effects, with an emphasis on the benefits of taking the medication. A list of signs that a patient may be struggling

**TABLE 3. Questions HCPs Can Ask in a Blame-Free Environment to Assess Patients' Medication Adherence (10)**

- These are difficult to take every day. How often do you skip one?
- There are quite a few medications; how many of these do you take?
- Most people don't take all their meds every day. How about you?
- Have you stopped taking any of your medications when you feel well?
- Are you worried about any side effects from your medications?
- When was the last time you took drug A? Drug B?

gling with medication adherence is presented in Table 2.

### How Can Medication Nonadherence Be Discovered?

Medication nonadherence is often hidden. In one study, 83% of patients did not tell their HCPs that they were not going to fill a new prescription (10). Qualitative studies suggest that the manner in which an HCP asks about medication-taking behavior is crucial in facilitating discovery of patients' true medication nonadherence (4). Directly asking patients, "Are you taking your medication(s)?" is not adequate to discover nonadherence. HCPs need to discuss adherence with their patients in a nonjudgmental way to uncover the true medication-taking behavior. For example, HCPs can ask patients if they are taking their medications regularly as prescribed, how often they miss taking their medications, if they stop taking their medications at times, and what side effects they are worried about (Table 3). Providers must create an encouraging, blame-free environment to allow patients to describe their medication-taking behavior.

Providers often do not recognize patients' medication adherence barriers until a catastrophic event occurs (11). Some of the clues to identify nonadherence include nonaligned pill counts, missed refills, missed appointments, escalating therapies without improvement in clinical measures, presence of depression, low health literacy, or use of alternative medicines (12,13). If any of these concerns are identified, patients can complete the Morisky 4-Item or 8-Item Self-Report Measure of Medication-Taking

Behavior questionnaire (14) or the Adherence Estimator 3 questionnaire (15). Both of these self-administered questionnaire tests show validity across a variety of disease states and can assist HCPs in identifying medication nonadherence (16,17).

Once medication nonadherence is identified, it is important to begin a dialogue to determine the cause of nonadherence. The barriers of nonadherence can be divided into unintentional and intentional causes. Unintentional causes include lack of access, prohibitive cost, lack of understanding about the medication regimen, forgetfulness, low health literacy, and complicated drug regimens. However, some patients are intentionally nonadherent because of fear of side effects, perceived lack of benefit, fear of dependency, lack of understanding of their diagnosis and complication risks, personal beliefs, and mistrust of the health care and pharmaceutical industries (4). When medication nonadherence is discovered, it is imperative to review patients' barriers and concerns to improve their adherence. Examples of patients' disclosures of medication nonadherence and their challenges can be found in interviews of real patients at [www.drmariebrown.com](http://www.drmariebrown.com).

### What Can Be Done to Improve Medication Adherence?

#### **Strengthen the Relationship/ Partnership With Patients**

Patients consider their HCPs the major and most reliable source of information about their health condition and treatment (4), and they are more likely to follow treatment plans

when they trust their HCP. Trust is developed through time with the same HCP in a relationship in which patients perceive that their HCP has a high level of competence and truly cares about their health (18). Mistrust develops when patients receive unrealistic, inconsiderate, or insensitive advice from their HCPs and feel emotional distance from them (4).

Patients who are engaged in meaningful partnerships are more receptive to messages delivered by their health care team. As a result, these patients tend to have more realistic perceptions of disease severity and of the benefit of treatment—both factors that affect medication adherence. Furthermore, patients who are engaged in a partnership are more likely to disclose clues that will help HCPs employ a personalized approach to supporting medication adherence efforts. Gaining a keen understanding of patients' needs through effective patient-provider communication is vital when employing the practical approaches to improving medication adherence suggested in this article.

#### **Help Patients Understand How and Why to Take Each Prescribed Medication**

An estimated 35% of American adults have basic or below-basic health literacy, resulting in their inability to read a medicine bottle label (13). It is helpful to adopt universal precautions against medication nonadherence and low health literacy, which encourage HCPs to assume that patients are not taking their medications as prescribed or may not understand the written directions until proven otherwise (18). Clear written and verbal instructions describing precisely how each medication should be taken should be provided to each patient. Using simple language and employing teach-back methods have been shown to improve adherence (19). Patients or their support people should be asked to explain in their own words what they need to know or do. The Agency for Healthcare Research and

Quality offers a training tool on the teach-back method that provides additional information on this approach for interested HCPs (20).

Concerns about side effects can be barriers to medication regimen adherence, especially when the benefits of taking the medication are not well understood. To reduce potential concerns related to side effects, HCPs can provide information about common side effects when they prescribe medication. For example, when prescribing metformin, informing patients that diarrhea is to be expected and that loose bowel movements will resolve within about a week if metformin is continued can improve patients' adherence. If only a brief explanation can be delivered because of time limitations, involving other members of the health care team (e.g., medical assistants, nurses, pharmacists, and diabetes educators) in providing additional education may be helpful. Additionally, printed handouts, websites, and teaching modules with more in-depth information should be readily available to share with patients. Helping patients build a foundation of knowledge is crucial to ensuring both initial and sustained adherence to medication regimens.

### **Simplify the Medication Regimen**

For patients who take multiple medications, simplifying the medication regimen can greatly improve adherence. Increases in the frequency of doses are inversely related to adherence, and with each additional daily dose, adherence decreases by 10% (1). Therefore, HCPs should give once-daily dosing when possible, simplify the timing of prescribed medications (i.e., have patients take all medications at the same time of day), and minimize the number of pills taken per day by using combination pills when available. If once-daily dosing cannot be achieved, matching medication-taking times to patients' activities of daily living may improve adherence.

Encourage patients who take multiple medications to place all doses for each day in a convenient pill box. Minimize the use of different pharmacies and prescribers and varied refill dates, and encourage patients to consolidate medication refill visits to their pharmacy. Using mail-order pharmacies for chronic medications can also greatly increase adherence (21).

### **Understand the Importance of Cost**

Providers often feel rushed during their visits and sometimes are inadequately equipped to deal with patient-reported financial constraints. Patients often worry that raising issues of cost could possibly affect the quality of their future care. Simple tactics to address these issues include:

- Check online resources to assess the cost of the drugs in question (e.g., goodrx.com, onerx.com, rxpricequotes.com, lowestmed.com, and CRBestBuyDrugs.org)
- Begin conversations that focus on cost issues with patients using words such as, "Affording medications is challenging for many of my patients with diabetes. Is this something you struggle with?"
- Use lower-priced generic alternatives
- Become familiar with local pharmacy/supermarket discount drug programs (e.g., Walmart \$4 program, Sam's Club Free Rx program, Target \$4 program, and Meijer's Free Antibiotics list)
- Investigate pharmaceutical assistance programs and savings programs (e.g., rxassist.org, pparx.org, benefitscheckuprx.org, and needymeds.org)
- Familiarize yourself with local and regional assistance programs that help patients struggling to afford medications and medical care (e.g., HelpRx.info and Scbn.org)

### **Use Tools to Build Patients' Self-Efficacy and Support Adherence**

Positive family and social support are important aspects of adherence

to diabetes management. If appropriate, engaging family members can improve diabetes self-care activities, including eating healthy food, being physically active, monitoring blood glucose, problem-solving, and adhering to medications (22).

There are >55,000 community pharmacies in the United States, and >70% of patients receive their medications from one (23). Therefore, patients may interact with pharmacists more than with any other member of their health care team. Pharmacists educated in motivational interviewing may help to improve medication adherence. Pharmacists' involvement in screening patients for adherence to diabetes medications and providing brief motivational interviewing at the time of face-to-face interaction can significantly improve medication adherence (24). Likewise, involving clinical pharmacists at the time of hospital admissions and discharges improves the accuracy of admission and discharge medication reconciliations and reduces hospital readmission rates (25,26).

An innovative approach to involving patients in the medication reconciliation process via a web portal to verify their regimens and clarify any inaccuracies after hospital discharge has been shown to improve adherence and decrease potential adverse drug events (27). There may be a greater role for engaging patients with their electronic medical records (EMRs) so they can easily verify and help to maintain the accuracy of their medication list to reflect their actual medication-taking.

There are tremendous opportunities to use smartphones to potentially improve medication adherence. Nearly two-thirds of adults in the United States are smartphone users and use their phones to get health information (28). Mobile health technologies can be used to deliver health education, enhance self-management of chronic disease, and assist patients in improving adherence. Increasing

numbers of smartphone applications (“apps”) provide simple reminders to take medications and pick up refills (e.g., Med Agenda, Dosecast, MedSimple, Med Helper, and Medisafe). Other apps (e.g., RxmindMe and MyMeds) can also track doses taken or missed and export that data to HCPs for review to assess medication adherence. Patients with complex medication regimens may benefit from a device such as MyMedSchedule, which allows HCPs to input patients’ prescribed regimens and then push the information directly to patients’ personal devices with reminders, as well as to retrieve and modify instructions (29). Using these devices to send a short text message to remind patients with diabetes to take their medications has led to improved adherence (30).

**Continual Reassessment**

Starting a new medication is generally only half the battle. Persistence with the therapy often is also a challenge for patients. Persistence in medication-taking can decline as early as 3 months after a medication is initiated and continues to decline thereafter (31). Therefore, HCPs need to remember to assess medication adherence at every visit. If the expected clinical outcome is not being achieved, it is important to review what role medication nonadherence may be playing. Some EMRs may have an alert feature to inform HCPs of delays or gaps in patients’ requests for the medication refills. Although more time-intensive, calling a patient’s pharmacy to assess refill patterns can also be helpful.

**Conclusion**

Medication adherence is challenging for patients with chronic illnesses such as diabetes. Optimal adherence to prescribed medications can decrease complications, improve clinical outcomes, and save health care costs. This article has reviewed which patients are at risk for nonadherence, when to look deeper for nonadherence, and how to evaluate patients effectively and efficiently in a clinical setting and has provided

practical solutions to help improve medication adherence. Medication adherence is perhaps the largest challenge facing HCPs and their patients. It is a crucial issue that deserves greater attention. Inspiring and supporting patients to take their medications as prescribed can be challenging, but it also has the potential to have the greatest impact on their long-term health and on the economic well-being of the nation’s health care system.

**Duality of Interest**

L.A.Y.’s institution has received research funding from Bayer, Boehringer Ingelheim, Bristol-Myers Squibb, Eli Lilly, GI Dynamics, Johnson & Johnson, Lexicon, Novo Nordisk, Orexigen, Scion NeuroStim, and Theracos. No other potential conflicts of interest relevant to this article were reported.

**References**

1. Osterberg L, Blaschke T. Adherence to medication. *N Engl J Med* 2005;353:487–497
2. Wabe NT, Angamo MT, Hussein S. Medication adherence in diabetes mellitus and self-management practices among type 2 diabetics in Ethiopia. *N Am J Med Sci* 2011;3:418–423
3. Sabaté E. *Adherence to Long-term Therapies: Evidence for Action*. Geneva, Switzerland, World Health Organization, 2003
4. Brundisini F, Vanstone M, Hulan D, DeJean D, Giacomini M. Type 2 diabetes patients’ and providers’ differing perspectives on medication nonadherence: a qualitative meta-synthesis. *BMC Health Serv Res* 2015;15:516
5. Blackburn DF, Swidrovich J, Lemstra M. Non-adherence in type 2 diabetes: practical considerations for interpreting the literature. *Patient Prefer Adherence* 2013;7:183–189
6. Steiner J, Ho P, Beaty B, et al. Sociodemographic and clinical characteristics are not clinically useful predictors of refill adherence in patients with hypertension. *Circ Cardiovasc Qual Outcomes* 2009;2:451–457
7. Phillips A. Experiences of patients with type 2 diabetes starting insulin therapy. *Nurs Stand* 2007;21:35–41
8. Gonzalez JS, Payrot M, McCarl LA, et al. Depression and diabetes treatment non-adherence: a meta-analysis. *Diabetes Care* 2008;31:2398–2403
9. Lutfey K. On practices of ‘good doctoring’: reconsidering the relationship between provider roles and patient adherence. *Social Health Illn* 2005;27:421–447

10. Lapane K, Dubé C, Schneider K, Quilliam B. Misperceptions of patients vs providers regarding medication-related communication issues. *Am J Manag Care* 2007;13:613–618
11. Brown M, Bussell J. Medication adherence: WHO cares. *Mayo Clin Proc* 2011;86:304–314
12. Açıköz SK, Açıköz E, Topal S, et al. Effect of herbal medicine use on medication adherence of cardiology patients. *Complement Ther Med* 2014;22:648–654
13. Kutner M, Greenberg E, Jin Y, Paulsen C, White S. *The Health Literacy of America’s Adults: Results From the 2003 National Assessment of Adult Literacy*. (NCES 2006–483). Available from <https://nces.ed.gov/pubs2006/2006483.pdf>. Accessed 2 May 2017
14. Morisky DE, Ang A, Krousel-Wood H, Ward HJ. Predictive validity of medication adherence measure in an outpatient setting. *J Clin Hypertens (Greenwich)* 2008;10:348–354
15. McHorney CA. The adherence estimator: a brief, proximal screener for patient propensity to adhere to prescription medications for chronic disease. *Curr Med Res Opin* 2009;25:215–238
16. Morisky DE, DiMatteo MR. Improving the measurement of self-reported medication nonadherence: response to authors. *J Clin Epidemiol* 2011;64:255–263
17. McHorney CA. Validity of the adherence estimator in the prediction of 9-month persistence with medications prescribed for chronic diseases: a prospective analysis of data from pharmacy claims. *Clin Ther* 2009;31:2584–2607
18. Brown M, Bussell J, Dutta S. Medication adherence: truth and consequences. *Am J Med Sci* 2016;351:387–399
19. Dinh HT. The effectiveness of the teach-back method on adherence and self-management in health education for people with chronic disease: a systematic review. *JBI Database System Rev Implement Rep* 2016;14:210–247
20. Agency for Healthcare Research and Quality. *Health Literacy Universal Precautions Toolkit*. 2nd ed. [Internet]. Available from <http://www.ahrq.gov/professionals/quality-patient-safety/quality-resources/tools/literacy-toolkit/healthlittoolkit2-tool5.html>. Accessed 16 May 2016
21. Curkendall SM, Thomas N, Bell KF. Predictors of medication adherence in patients with type 2 diabetes mellitus. *Curr Med Res Opin* 2013;29:1275–1286
22. Mayberry LS, Osborn CY. Family support, medication adherence, and glycemic control among adults with type 2 diabetes. *Diabetes Care* 2012;25:1239–1245
23. National Community Pharmacists Association. *Medication Adherence in America: A National Report Card*. Available

from [http://www.ncpa.co/adherence/AdherenceReportCard\\_Full.pdf](http://www.ncpa.co/adherence/AdherenceReportCard_Full.pdf). Accessed 28 March 2017

24. Pringle JL. The Pennsylvania Project: pharmacist intervention improved medication adherence and reduced health care costs. *Health Aff (Millwood)* 2014;33:1444–1452

25. Mueller SK. Hospital-based medication reconciliation practices: a systematic review. *Arch Intern Med* 2012;172:1057–1069

26. Haynes KT. Pharmacists' recommendations to improve care transitions. *Ann*

*Pharmacother* 2012;46:1152–1159

27. Heyworth L, Paquin AM, Clark J, et al. Engaging patients in medication reconciliation via a patient portal following hospital discharge. *J Am Med Inform Assoc* 2014;21:e157–e162

28. Pew Research Center. U.S. smartphone use in 2015 [Internet]. Available from <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015>. Accessed 27 March 2017

29. Dayer L. Smartphone medication adherence apps: potential benefits to

patients and providers. *J Am Pharm Assoc* 2003;53:172–181

30. Vervloet M. Short- and long-term effects of real-time medication monitoring with short message service (SMS) reminders for missed doses on the refill adherence of people with type 2 diabetes: evidence from a randomized controlled trial. *Diabet Med* 2014;31:821–828

31. Benner JS. Long-term persistence in use of statin therapy in elderly patients. *JAMA* 2002;288:455–461

# DiabetesPro SmartBrief



A daily e-mail newsletter designed to help you break through the information clutter with quick, easy-to-read summaries of articles relevant to you and the broader diabetes research and clinical community

Sign up free at  
[www.smartbrief.com/diabetespro](http://www.smartbrief.com/diabetespro)

 American Diabetes Association®