

Medication adherence and technology

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Importance of medication adherence

Medication adherence is a costly issue in the United States, with an estimated \$100 billion to \$300 billion spent annually on the effects of nonadherence.¹ Although much research has been devoted to medication nonadherence in the past few decades, approximately half of patients with chronic conditions still don't take their medication as prescribed.¹⁻² About 20 percent to 30 percent of patients never even fill their prescriptions.¹ And the effects on patient health are extensive.¹ As former U.S. Surgeon General Dr. C. Everett Koop put it simply, "Drugs don't work in patients who don't take them."³

Beyond simply taking medication, adherence is generally understood as taking medication at the right time, at the right dosage, at the frequency prescribed, for the right length of time, from the start to the end of therapy. A common way to measure adherence uses the medication possession ratio, which is based on the total days supplied with prescription medication over a specific period of time.⁴ A common medication adherence threshold is 80 percent, based on the Haynes definition of adherence to antihypertensive medication.⁵

Barriers to adherence

Providers do not see what happens when patients leave the office. Clinicians might not be aware of potential barriers to adherence, such as health literacy, financial limitations and cultural factors.⁶ And many patients might be afraid to tell their providers they are not taking their medications. Research suggests several reasons for nonadherence.

Common reasons for nonadherence

The American Medical Association identifies fear, cost, misunderstanding, too many medications, lack of symptoms, worry, depression, and mistrust among the common reasons for nonadherence.⁷ Walgreens research finds that forgetfulness, cost issues, untoward side effects, doubts about needing medication and difficulty with complex regimens are other common reasons.⁸ Other patient-related barriers to adherence include disengagement with treatment decisions, impaired cognition, substance abuse, depression and other mental health conditions.⁹

Unintentional and intentional nonadherence

As described by the Centers for Disease Control and Prevention, unintentional nonadherence can be attributed to forgetting to take medication, not refilling medications or not understanding dosing or schedules.⁹ For many patients, nonadherence is intentional. Intentional factors might include patients' active decisions to modify or discontinue medication based on inability to pay, attitudes about their disease or side effects.⁹

Technology to improve adherence

Several technological innovations can remind unintentionally nonadherent patients to take medications and refill prescriptions¹⁰:

- **Electronic pill monitors.** Pill monitors provide effective behavioral prompts, especially for older patients who need reminders to take medications. If a patient misses a scheduled dose, pill monitors can also alert caregivers and providers.¹¹
- **Medication adherence apps.** Various apps include pill reminders or alarms, scheduled pill intake, pharmacy synchronization, data logs, patient diaries, side effect records and refill reminders.
- **Multidose delivery.** E-prescribing and online pharmacy automation allow pharmacies to package and deliver multidose delivery services to patients nationally, especially if they are on stable doses of medications. Some clinical trials are using medication bottles, blister packages or vials that automatically record both date and time when opened to measure exact adherence. Multidose delivery data is then available for review on a smartphone or tablet.¹¹
- **Smart pill bottles.** Cap or weight sensors detect medication being removed from a smart pill bottle. The bottle then uses wireless technology and a connected app to send adherence data to caregivers or providers who have signed up for such alerts.
- **Voice recognition.** Tech companies are developing ways for smart speakers to assist with personal healthcare, such as reminding patients to take their medication or book medical

appointments. When used for emergency calls, a smart speaker might also help patients relay information to emergency personnel about their condition, symptoms and medications.¹²

Other technologies can help minimize intentional nonadherence¹⁰

- **Gamification.** Online gaming incentives or financial rewards are designed to help motivate patients toward medication adherence.
- **Ingestible pill sensors.** An ingestible pill sensor, paired with an external abdominal sensor and an app, can record and report when medication is taken and, potentially, the type of medication taken. A patient can choose to have adherence data sent to healthcare providers, family or caregivers. The sensors offer more timely information, promote earlier interventions and allow for more informed treatment decisions.¹³ This technology might be especially helpful for nonadherent patients with mental illness.¹³
- **Medical device sensors.** Sensors attached to medical devices measure medication intake and send refill alerts. A connected app tracks and reports dose amounts and times taken. This type of technology helps account for doses of medication taken intermittently or as needed, to assess control of certain conditions such as asthma.
- **Pill safes.** Lockable, tamper-resistant pill boxes for dispensing medications have an additional safety feature with identification capabilities and locking mechanisms designed to prevent abuse of prescription pain medication, narcotics or psychiatric medication. The devices also help keep medications locked and out of reach of children or teens.

Effectiveness of adherence technologies

Recent research examines the effectiveness of adherence technologies and identifies possible improvements.

Electronic prescriptions

Research comparing electronic prescribing with paper prescribing suggests e-prescribing has several advantages over traditional prescriptions. E-prescribing software can monitor when prescriptions are dispensed or unfilled and send patients reminders and alerts for prescription pickup. This kind of information can

help identify the cause of medication nonadherence and help clinicians find cost-effective approaches to manage nonadherence and improve long-term health in diverse patient populations.¹⁴

Medication adherence apps

A 2018 study of medication adherence apps found the technology might still have a way to go.¹⁴ Researchers identified 5,881 medication adherence apps, then assessed 420 free apps for the use of three adherence strategies: reminders, behavioral strategies and education. Of the 420 free apps, 250 used a single strategy, 149 used two strategies and 22 used all three strategies. A total of 57 free apps involved a healthcare professional during development, and just four free apps followed evidence-based methodology. The paid apps fared worse. Researchers concluded that future app development should focus on making medication adherence apps more clinically sound.¹⁵

Ingestible pill sensors

An eight-week study of a digital adherence system suggests ingestible technology might have some promise.¹⁴ Researchers followed 49 patients using an ingestible pill sensor and external patch system along with an integrated call center. Results suggest patient interaction with the call center might have supported adherence, as ingestion adherence was higher than average, at 88.6 percent.¹⁴ The study concluded that an integrated call center, digital medicine system and clinical practice program for patients on stable oral medication could measure adherence objectively and improve adherence rates.^{15,16}

Conclusion

The clinical and financial costs of medication nonadherence are a constant concern for patients and clinicians. But new technologies have the potential to improve adherence and, therefore, patient outcomes. As healthcare providers employ medication adherence technology more widely and more outcome data becomes available, research should continue to assess the effectiveness of technologically assisted adherence.

About the author

Jean Cherry, BSN, MBA, is a clinical manager for the Walgreens Clinical Programs and Quality Department. Cherry started her career in nursing, specializing in telemetry, cardiovascular surgery, and heart transplantation. She became a research coordinator for the International Diabetes Center and later a disease management product director for Optum, where she had the opportunity to present poster abstracts on quality measures at two conferences, the United Network for Organ Sharing and the Children's Hospital of Philadelphia. Cherry previously served on the board of directors for Avinity Senior Living Centers. She holds a Bachelor of Science in nursing and a Master of Business Administration.

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