Pharmacy Automation and Technology

Advancements in Adherence Monitoring

Brent I. Fox, PharmD, PhD,* and Bill G. Felkey, MS†

Some things really never change. For example, medication adherence remains a critical factor that influences the effectiveness of our modern health care system. Is there a magic bullet to solve the problem of nonadherence? We don't think there is. We do believe, however, that tools to monitor adherence continue to improve in their utility.

We've been thinking about medication adherence lately, probably because the topic comes up almost everywhere we turn. A Google Scholar search for "medication adherence" articles returns 87,200 hits (in 0.05 seconds!), while a PubMed search for the same term returns 12,540 hits. We are not here to argue the merits of each search method, instead we use these as an example of how longstanding and significant the topic is; the first PubMed citation is from 1979.

Depending on the source, estimates indicate that up to 30% of new prescriptions are never filled (known as primary medication nonadherence) and 50% of those that are filled are not continued as prescribed. At the same time, the prevalence of chronic conditions in the United States continues to grow. Medications are often a cornerstone of treatment for chronic conditions such as hypertension and hypercholesterolemia. Obviously, high nonadherence in conditions that require routine medication use creates a serious problem. So, what are the costs?

We often use a commonly applied model to characterize costs, better thought of as outcomes. The model, known as ECHO, classifies outcomes as economic, clinical, and humanistic. Economic and clinical outcomes are likely the ones you most often think of when you consider the costs of nonadherence. Economic outcomes are the financial costs incurred by the patient and the health care system. Estimates indicate that this country is spending hundreds of billions of dollars on the treatment of patients who are nonadherent to their medication regimens. Clinical outcomes are the outcomes of the disease being

treated, for example, death. It's logical that patients who are adherent to medications for chronic diseases have better clinical markers and better outcomes. This is supported by data across conditions and is the underlying reason that we use medications so extensively. Humanistic outcomes are those that the patient experiences, such as patient satisfaction, quality of life, and daily functioning. These outcomes are often more difficult to measure and historically have not received as much attention as the others. However, in today's changing health care landscape where patients are increasingly engaged in their own care, there is increasing focus on the patient experience.

So, if medication adherence is such a vital piece of the outcomes puzzle, why is it so difficult to fix? There are entire books on that topic, and there are numerous schools of thought on the best approach to adherence. Some say it is a knowledge issue in which patients don't understand the importance of their medications. Others argue that medication regimens aren't tailored to patients' lifestyles, so we set them up to fail. Still others believe we should change the way in which we communicate with patients. Can we implement technology to help patients understand the importance of taking their medications and to help them with remembering to comply and/or with difficult regimens? The short answer is "yes," there are numerous technologies to help with these and other problems (some patients don't remember if they took their medication and then take another, unnecessary dose). The reality is, however, that the medication adherence problem is extremely complex and is not likely to be solved with a single approach (eg, education, technology, etc).

*Associate Professor, Department of Health Outcomes Research and Policy, Harrison School of Pharmacy, Auburn University, Auburn, Alabama; †Professor Emeritus, Auburn University, Auburn, Alabama

What technology is increasingly allowing us to do better is to measure adherence. There are a variety of tools that measure adherence with oral solid dosage forms by recording when the cap is removed from a medication bottle. The assumption – and challenge – of this type of measurement is that it equates cap removal with taking a dose. Variations of this method include those that incorporate lights and audible beeps in the cap to remind patients to take their medications. You have undoubtedly seen other technology-based adherence measurement tools.

Thinking of another oral dosage form, adherence monitoring in asthma has also been on our minds lately. Similar to the monitoring caps, enterprising companies have created sensors that attach to multi-dose inhalers for asthma and chronic obstructive pulmonary disease (COPD). These sensors record actuations of the inhaler and use Bluetooth to send the data to the patient's phone. The data are then used to present trends and tips to the patient regarding his or her inhaler use. The data are also made available to caregivers who are following the patient.

As informative and advanced as these asthma sensors are, the most reliable way to measure adherence is to know when the medication is swallowed by the patient. Obviously, it's not practical to watch patients take their medications on a routine basis, but we have followed a company for several years that takes a different approach. They attach an ingestible sensor to each dose during manufacturing. Recently, another company has announced a similar tool. Their sensors are included with each dose during manufacturing.

When the sensor comes in contact with the stomach, it sends a signal to a patch on the patient's skin, which then wirelessly communicates with the patient's phone, recording each dose. The sensor can also record the patient's physiologic response. The data can be shared with the patient's provider, if the patient wants this option. This is certainly advanced technology and is currently being explored for mental health conditions in which adherence is extremely critical.

This technology is in the early stages of use with mental health patients. In fact, it's undergoing US Food and Drug Administration (FDA) approval. This technology has been available for routine use in clinical trials for quite some time, but think about the potential of its widespread use. What if we could truly monitor a patient's adherence based on an ingested sensor? Does that seem a bit 1984-ish to you? Looking at it from another perspective, does your inpatient service have "frequent flyers" whose primary reason for continued visits to the hospital is related to adherence? Maybe your outpatient clinics and pharmacies have patients who could benefit from close adherence monitoring. Could widespread use of this type of adherence monitoring tool greatly inform your patient education efforts? Could it positively impact your efforts to decrease readmissions? We also see the potential of this tool to support insurance companies' efforts to control costs by informing interventions that target adherence. We would enjoy hearing your perspectives. Contact us at foxbren@auburn.edu (Brent) and felkebg@auburn.edu (Bill). ■