New Technology for Medication Adherence

Electronically Managed Medication Dispensing System

Increasing medication compliance can improve quality of life for older adults.

Kathleen Coen Buckwalter, PhD, RN, FAAN, Bonnie J. Wakefield, PhD, RN, Barbara Hanna, RN, PHN, BSN, CCM, and Julie Lehmann, RN, PHN, BSN

Lack of compliance with prescribed medication regimens is a well-known and well-documented problem among elderly individuals, especially those who live alone or who have some degree of cognitive or functional impairment.

Non-compliance results in decreased quality of life, increased health-care costs related to acute and long-term care admissions, and the need to enhance home care support. Hayes, McDonald, Garg, & Montague (2004) note only 50% of older adults adhere to medication treatment, with a variety of reasons attributed to non-adherence including poor instructions, disagreement with the treatment prescribed, inability to pay, and adverse effects.

Pillboxes and blister packaging have been set forth as a means to help organize medications with some success in increasing rates of compliance (Ware, Holford, Davison, & Harris, 1991; Wong & Norman, 1987). However, these

ABOUT THE AUTHORS

Dr. Buckwalter is Associate Professor for Health Sciences, College of Nursing, University of Iowa, Iowa City, Iowa. Dr. Wakefield is Research Scientist, Iowa City VA Medical Center, and Clinical Associate Professor, University of Iowa, College of Nursing, Iowa City, Iowa. Ms. Hanna is President and CEO, and Ms. Lehmann is Program Director, Home Health Care Management, Inc., Chico, California.

Address correspondence to Kathleen Coen Buckwalter, PhD, RN, FAAN, Professor, College of Nursing, University of Iowa, 2252 Cae Drive, Iowa City, IA 52246.

approaches require a level of manual dexterity that may be lacking in older adults. There is also growing evidence that community-dwelling older adults can increase their compliance with prescribed medications as a result of targeted interventions (e.g., phone calls, electronic devices) encouraging them to take their medication as prescribed (Fulmer et al., 1999). However, insufficient

week; and the standard message, if any, to announce to the user. This information can be entered via the Internet or by faxing or calling the IMD Support Center where it is entered into a database.

At the time of installation, the caregiver or medical professional has the MD.2 unit call the support center and the information is downloaded. Based on this information,

hang up and call the next caregiver. If none of the caregivers respond by entering a "1," the unit will call the IMD Support Center and the Center's staff will continue trying to alert caregivers.

All dispensing history and alarm notices are up-loaded at the end of the day to the Web-enabled support center so that caregivers or other medical professionals can review the dispensing data to monitor patients' status. All user history is stored, and the previous 35 days are available for viewing via secure Internet connection by caregivers and medical professionals. User confidentiality is maintained via the unit serial number and the user's telephone number, which serve as identification numbers for security purposes.

If patients do not dispense the medication after 90 minutes, the MD.2 will lock away the cup so they cannot overdose or double dose.

numbers of rigorous studies examining these compliance aids have been conducted to date.

THE MD.2 AUTOMATED MEDICATION DISPENSING SYSTEM

An innovative new technology, called the MD.2 Automated Medication Dispensing System (Interactive Medical Developments [IMD], Webster City, IA), recently has been developed to address some of the issues for medication non-compliance. The MD.2 was developed by Dr. Anil Sahai after he observed many of his patients who were able to handle most activities of daily living were prematurely admitted to acute or long-term care facilities because they were unable to properly manage their medications.

The MD.2 medication-dispensing technology allows caregivers to organize medications into easily opened plastic cups. Each cup holds one or more medications and represents one dispensing period (e.g., morning medications).

Caregivers use a simple and straightforward process to help with installation. User data are collected and include patient's name, address, and phone number; unit serial number; caregiver names and the order in which to call them; medication dispensing times by day of the

the unit verbally prompts the caregiver through the loading of the cups. After loading, the unit is kept locked so patients do not have access to the medications. Depending on the frequency of doses, the system can dispense medications for a 10- to 30-day period (the unit holds 60 cups).

Using a series of verbal and auditory reminders (e.g., a flashing light, voice reminders, and a loud beeping noise for a 60- to 90-minute period), the MD.2 will alert patients that it is time for their medication, allowing them to press an easy-to-use button to dispense the pre-filled medication cup. The MD.2 also will remind patients to take the medication with food, check their blood sugar, or announce other pre-programmed messages.

If patients do not dispense the medication after 90 minutes, the MD.2 will lock away the cup so they cannot overdose or double dose. The MD.2 will then begin calling caregivers. Based on the input notification order, the unit will call up to four caregivers or medical professionals to alert them of the non-dispense. It will verbally announce it is the MD.2 and give the user's name, phone number, and the fact that the medication was not dispensed. The caregiver must respond by entering a "1" on their phone or the MD.2 will

The technology is especially useful with older patients, individuals with brain injuries, or other outpatients who have difficulty managing their medications. Current medication management tools consist of devices such as: weekly pillboxes, which only organize medications; reminder devices such as beeping medication caps or wristwatches, which remind but don't organize; and electronic dispensers, which organize, remind, and safeguard. However, none of these methods have the full functionality of the MD.2 to organize, remind, dispense, monitor, safeguard, and report on medication management. The MD.2 is designed to bridge the gap when simpler reminders do not work and proper medication adherence is critical to avoid a more costly level of care.

The price of the MD.2 varies by distributor. However, average monthly rental costs approximately $90 per month.

EVALUATION OF THE MD.2

Two preliminary studies have been conducted with the MD.2, the first under the auspices of the Johnson County (Iowa) Visiting Nurses Association (VNA) and

the second by the California Health Professionals Plus/Home Health Care Management company (CHP Plus).

Visiting Nurses Association Pilot Study

Study Description. In August 2000, the Johnson County VNA installed MD.2 machines in the homes of 12 patients with known or suspected problems with medication non-compliance. Patients were referred to the project either by a nurse or physician. Six patients had a primary medical diagnosis, five of whom also had a secondary psychiatric diagnosis; the remaining six patients had a primary psychiatric diagnosis. Nine patients were women, and three were men. Patient age ranged from 33 to 86.

Medication dosing frequency was twice daily for six patients and three times daily for six patients. The number of medications per patient ranged from 4 to 16, with an average of 8 medications per patient per day.

Outcomes evaluated included the frequency of home health aide visits, dispensing rate statistics, and the number of requests for technical support assistance from the IMD Support Center. Data for the latter two outcomes were collected from reports generated by the IMD Support Center.

To assess the frequency and content of nursing care and home health aide visits, patient records were reviewed for 3 months prior to and 12 months after installation of the MD.2 or discharge from home care, whichever came first. The number, route, and frequency of prescribed medications also were obtained from records.

The visiting nurses were given a 2-hour training session by IMD employees. The nurses then installed, maintained, and loaded the units. Patient training was minimal because they only need to push the large red button, when prompted, and then take the medication.

	MD.2	Medi-Set
Hospitalizations per patient	.09	.42
Emergency department visits per patient	.18	.42
Prescriptions per patient	7.62	8.65

TABLE 1

COMPARISON OF MD.2 AND MEDI-SET FOR HOME HEALTH CARE MANAGEMENT PATIENTS*

*After 6 months of program data

TABLE 2

COMPARISON OF MISSED MEDICATION DOSES FOR HOME HEALTH CARE MANAGEMENT PATIENTS USING MD.2 AND MEDI-SET

	MD.2	Medi-Set
Missed doses per patient per 2-month evaluation period	.62	3.39
Total missed doses per patient during 6-month period	2.9	7.31

During the course of the pilot study, MD.2 units remained in the home an average of 5.1 months (range, 2 months to longer than 7 months).

Study Findings. It took an average of 2 to 4 weeks for patients to become comfortable with the MD.2 routine, voice/instructions, and presence in the home. As with any new technology, some of the VNA nurses were more open to using it than others.

For the first outcome, the frequency of home health aide visits, the number of patient home visits did not decrease because other medical problems required attention. However, the nurses' notes reflected home visit time was spent on other issues in the nursing care plan rather than medication compliance.

For the second outcome, dispensing rate statistics, the frequency of missed doses was higher immediately after the MD.2 was placed and then decreased steadily the longer patients used the MD.2. An overall dispensing rate of 98.26% was determined: of 3,737 doses monitored, there were 65 "missed doses" where patients did not access their medications within the 60- to 90-minute window allotted by the MD.2.

The third outcome was the number of requests for technical support assistance from the IMD Support Center. For the 3,737 doses, there were 10 requests for technical support. Seven requests related to maintenance and schedule issues, and three requests were for assistance in removing a "double cup" loaded improperly (i.e., two medication cups nested together with one cap).

Home Health Care Management Study

Study Description. Through a grant from the State of California, Department of Aging Long Term Care Innovative Grant Program, Home Health Care Management

tested the MD.2 by comparing it to the use of medi-sets (plastic medication boxes). The first 6 months of the program compared 89 community-dwelling older or disabled adults who used the MD.2 with 45 older or disabled adults who used the medi-sets. Patients were assigned to either the MD.2 or the medi-set group based on criteria that assessed cognitive and physical functioning.

Study Findings. After 6 months of program data, the outcomes favored the MD.2 in terms of reduced hospitalization rates and emergency room visits and fewer number of medications being taken (Table 1). Home Health Care Management staff believed some of the greatest successes of the MD.2 were with patients on warfarin therapy, patients with mental health issues, and patients with early to mid-stage Alzheimer's disease. The MD.2 was also very effective for patients in independent living facilities.

In addition, the MD.2 group reduced the total number of prescriptions being taken to 7.62 compared with 8.65 in the group using the medi-sets. One possible reason for this difference could be the regular and accurate implementation of the prescribed medication regimen that resulted in stabilization of patients' condition. This stabilization could have then resulted in a decreased demand for compensatory medications. Regular and accurate medication implementation was demonstrated by the fact that patients using the MD.2 missed fewer medications than patients using the medi-sets (Table 2).

Anecdotal Data and Future Research

Anecdotal data also have been gathered from participants nationally who have used the MD.2. Success has been reported among adults with a variety of chronic diseases, including those with mid-stage Alzheimer's disease who live inde-

pendently, brain-damaged individuals, individuals with bipolar disease and other psychiatric disorders, and patients with insulin-dependent diabetes, congestive heart failure, and acquired immunodeficiency syndrome. In some cases, individuals who were previously confined to a group home setting were able to live independently.

Future research is planned to establish the effectiveness of the MD.2 on outcomes with potential cost benefit to Medicaid and all other payor sources. Planned research for the future will address the following issues:

- Developing a profile of individuals most likely to benefit from use of the MD.2.
- Determining costs associated with the device including training and installation.
- Estimating the cost effectiveness of the MD.2 compared to other forms of care (i.e., visiting nurses, assisted living).
- Determining the impact of the MD.2 on the number of hospitalizations and emergency room visits.

Other studies will compare the length of time in home care and measure changes in caregivers' stressors, endurance potential, burden, and well-being between those using the MD.2 and those using their normal medication routine. Cognitive and functional characteristics, and how they influence compliance rates among frail older adults also will be examined.

ENHANCEMENTS TO THE MD.2

The original MD.2 has been enhanced. The MD.2+ offers the original functionality of the MD.2 with a built-in Personal Response System. The Personal Response System allows patients to wear a small, lightweight, waterproof pendant or bracelet that can be pressed in the event of a fall or other medical emergency. The MD.2+ will then dial out to a 24-hour emer-

gency call center and, through a two-way speaker, the nature of the emergency can be determined and appropriate help dispatched. The most recent development is an MD.2 that announces all of its messages in Spanish.

CONCLUSION

Medication management requires psychomotor and cognitive activities to take medications as prescribed. Non-compliance with medications increases health-care spending and the need for home care support, and can lead to avoidable hospitalizations and placement in long-term care facilities. Many community-dwelling older adults have both cognitive and functional deficits that make it difficult for them to properly manage their medications. The MD.2 shows great promise in alleviating many of these problems and enhancing compliance through an innovative system of reminders and caregiver support.

More information can be obtained by accessing IMD's Website at www.imd2.com, by sending an e-mail to haroldp@imd2.com, or by calling 1-877-563-2632.

REFERENCES

Fulmer, T.T., Feldman, P.H., Kim, T.S., Carty, B., Beers, M., Molina, M., & Putnam, M. (1999). An intervention study to enhance medication compliance in community-dwelling elderly individuals. *Journal of Gerontological Nursing, 25*(8), 6-14.

Haynes, R.B., McDonald, H., Garg, A.X., & Montague, P. (2004). Interventions for helping patients follow prescriptions for medications (Cochrane Review). In *The Cochrane Library, 2001, Issue 2.* Chichester, UK: John Wiley & Sons.

Ware, G.J., Holford, N.H., Davison, J.G., & Harris, R.G. (1991). Unit dose calendar packaging and elderly patient compliance. *New Zealand Medical Journal, 104*(924), 495-497.

Wong, B.S.M., & Norman, D.C. (1987). Evaluation of a novel medication aid, the calendar blister-pack, and its effect on drug compliance in a geriatric outpatient clinic. *Journal of the American Geriatrics Society, 35*, 21-26.