INTRODUCTION

Various technological innovations have emerged to facilitate real-time data collection, offer remote/distance delivery of dementia care interventions that are traditionally offered in-person, or serve as direct interventions themselves for people living with dementia and their caregivers.1,2 Remote activity monitoring (RAM) is utilized to track and alert users (e.g., professional staff, caregivers) to behaviors and challenging events that may presage more adverse health outcomes such as hospitalizations or nursing home admissions.1,3,4 These systems often feature unobtrusive activity monitoring of people with dementia via the installation of various types of sensors throughout the living setting; algorithms are then applied to the sensor data to alert professionals or family caregivers when certain types of expected or unexpected activities occur. The aim of the present study was to assess whether RAM technology was associated with reductions in negative health transitions and service utilization for persons with Alzheimer’s disease or a related dementia over an 18-month period.

METHODS

The design, procedure, data collection, and sample characteristics of this 18-month, mixed methods randomized controlled trial is described in detail elsewhere.3–6 Briefly, the clinical trial enrolled 88 care recipients and their caregivers in the RAM intervention arm and 91 care recipients and their caregivers in the control arm. To analyze the effects of the RAM system on care recipient health transitions and service utilization, we focused on quantitative data collected on baseline, 6-, 12-, and 18-month caregiver surveys. The treatment group had the RAM system installed in their home. The attention control group did not receive RAM technology, but did receive biannual “check-in” calls from project coordinators to maintain rapport and ensure follow-up survey completion.

Baseline and follow-up surveys assessed whether the care recipient had fallen or wandered in the past 6 months (yes/no). Falling was defined as an unintentional change in position to the floor or ground. Wandering was defined as an aimless or purposeful activity that causes a social problem, such as getting lost, leaving a safe environment or intruding in inappropriate places. Frequency of falling or wandering was captured categorically (1–2, 3–6, 7–9, or 10 or more times).7

Caregivers were also asked whether the care recipient had used any of the following healthcare services in the past 6 months: nursing home stays, assisted living stays (including memory care), other residential care stays (e.g., family care home, adult foster care), hospital stays, or emergency room visits.8

Pearson chi-squared tests were used to conduct a descriptive analysis of outcomes. Multilevel mixed effects models were utilized to estimate odds ratios for binary and categorical outcomes. A random effect was included to account for variability between care recipients. In adjusted models, we included linear time, care recipient age and sex, and baseline level of the dependent variable.
if significant differences were observed at baseline. All analyses were conducted in Stata 15.1.

**RESULTS**

In unadjusted models (Table 1), reported emergency room visits and falls were significantly lower for care recipients in the intervention arm compared with the control arm in the months preceding the 18 month survey interval. In adjusted models (Table 2), emergency department visits were almost 50% lower in the intervention group compared with the control group. In addition, the odds of experiencing a higher frequency of falls (i.e., being in a higher response category) versus a lower frequency of falls was 0.36 (95% CI 0.15–0.85) for those in the intervention group compared with controls. The RAM technology did not have a statistically significant effect on any other outcome.

| Outcomes                        | RAM intervention | Control | p-value |
|---------------------------------|------------------|---------|---------|
| **Falls**                       |                  |         |         |
| Baseline (T1), n (%)            | 47 (53.4%)       | 52 (57.1%) | 0.615   |
| 6 months (T2), n (%)            | 38 (45.8%)       | 45 (52.3%) | 0.217   |
| 12 months (T3), n (%)           | 31 (39.7%)       | 39 (46.4%) | 0.498   |
| 18 months (T4), n (%)           | 36 (46.8%)       | 50 (61.7%) | 0.037   |
| **Wandering**                   |                  |         |         |
| Baseline (T1), n (%)            | 26 (29.6%)       | 15 (16.5%) | 0.037   |
| 6 months (T2), n (%)            | 21 (25.3%)       | 12 (14.0%) | 0.051   |
| 12 months (T3), n (%)           | 20 (25.6%)       | 19 (22.6%) | 0.650   |
| 18 months (T4), n (%)           | 23 (29.9%)       | 15 (18.5%) | 0.086   |
| **Nursing home admission**      |                  |         |         |
| Baseline (T1), n (%)            | 3 (3.4%)         | 2 (2.2%)  | 0.623   |
| 6 months (T2), n (%)            | 4 (4.8%)         | 3 (3.5%)  | 0.664   |
| 12 months (T3), n (%)           | 10 (12.8%)       | 3 (3.6%)  | 0.030   |
| 18 months (T4), n (%)           | 4 (5.2%)         | 6 (7.4%)  | 0.395   |
| **Other residential admission** |                  |         |         |
| Baseline (T1), n (%)            | 3 (3.4%)         | 6 (6.6%)  | 0.330   |
| 6 months (T2), n (%)            | 9 (10.8%)        | 13 (15.1%) | 0.409   |
| 12 months (T3), n (%)           | 8 (10.3%)        | 14 (16.7%) | 0.234   |
| 18 months (T4), n (%)           | 9 (11.7%)        | 8 (9.9%)  | 0.713   |
| **Hospitalization**             |                  |         |         |
| Baseline (T1), n (%)            | 18 (20.5%)       | 12 (13.2%) | 0.193   |
| 6 months (T2), n (%)            | 11 (13.3%)       | 13 (15.1%) | 0.729   |
| 12 months (T3), n (%)           | 7 (9.0%)         | 6 (7.1%)  | 0.668   |
| 18 months (T4), n (%)           | 4 (5.2%)         | 11 (13.6%) | 0.072   |
| **Emergency room visit**        |                  |         |         |
| Baseline (T1), n (%)            | 35 (39.8%)       | 24 (26.4%) | 0.057   |
| 6 months (T2), n (%)            | 20 (24.1%)       | 23 (26.7%) | 0.693   |
| 12 months (T3), n (%)           | 9 (11.5%)        | 19 (22.6%) | 0.062   |
| 18 months (T4), n (%)           | 11 (14.3%)       | 22 (27.2%) | 0.047   |

*Note: Sample sizes for remote activity monitoring (RAM) intervention group: T1 N = 88, T2 N = 83, T3 N = 78, T4 N = 77. Sample sizes for control group: T1 N = 91, T2 N = 86, T3 N = 84, T4 N = 81. Pearson chi-square p-values assess differences in outcomes by treatment group at each time point. Comparisons were deemed statistically significant at p < .05, with differences also reported at the p = .05 level, represented in bold.*
DISCUSSION

Although RAM did not provide direct support for the management of behaviors for persons with AD/ADRD, the findings imply that this technology may prevent some adverse health events for people living with dementia in the community. The ongoing, unobtrusive monitoring and system alerts of RAM may have resulted in caregivers identifying activity or the lack thereof that may have prevented falls and wandering events. In turn, emergency room use among persons with dementia may have been avoided. Although other trials have reported null or nonsignificant findings, the 18-month follow-up period may have allowed us to identify the influence of RAM on health service use or other events that are more likely to occur over time.9,10 There are several important limitations, however. The sample was not representative and researcher blinding was not possible. Although the technology was used in at-home settings, in several instances, dementia caregivers simply stopped using systems when they were perceived as not helpful, thus threatening internal validity.

The clinical and public health needs to develop and implement strategies that effectively support people living with dementia at home and their unpaid caregivers are pressing. Technology solutions that: (a) supplement extensive, unpaid assistance from family members and others; and (b) prevent or delay the onset of negative health events could address dementia care challenges, as suggested by our study.

AUTHOR CONTRIBUTIONS

Joseph E. Gaugler conceptualized the study, drafted and edited the entire manuscript, and prepared the manuscript for final dissemination. Christina Rosebush and Rachel Zmora conducted the empirical analyses and finalized the results in text and tabular format. Elizabeth A. Albers assisted with data analysis and manuscript review.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

SPONSOR’S ROLE

None.

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Oral health is an integral component of age-friendly care

To the Editor,

We congratulate the authors of “Clinician Knowledge and Behaviors Related to the 4Ms Framework of Age Friendly Health Systems” for conducting such an important study of the implementation of the 4Ms framework. While the findings of the study clearly indicate the need for wider implementation, the 4Ms remain a valuable tool for all areas of health care, including oral health. Although dental literature may not have directly informed the 4Ms framework at its inception, it is becoming increasingly evident that oral health is a critical component of geriatric care. We believe healthcare professionals and policymakers should explicitly include oral health as an essential component of the Age-Friendly Health Systems movement.

As healthcare professionals (a dentist, a family physician, and a geriatrician), we recognize that age-friendly care is ideally provided by interprofessional teams. We have noticed that the mouth is often neglected in primary care. Nearly 70% of adults over the age of 65 suffer from periodontal disease. Periodontal disease has been associated with chronic conditions affecting older adults including diabetes, heart disease, and even Alzheimer’s disease.

This makes caring for the mouth an essential aspect of healthy aging. So closely tied are oral and systemic conditions such as periodontal and heart disease that the risk factors for both are nearly indistinguishable. Enlisting oral health providers early in the process of caring for older adults could be an asset in our arsenal to mitigate the impact of chronic illness and also aligns with the 4Ms.

For example, polypharmacy is common in this age group and can lead to xerostomia, which increases the incidence of caries and often leads to tooth loss. Tooth loss creates significant challenges for patients already struggling with social isolation and nutritional deficits. Denture-wearing compliance also becomes an issue as...