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High Intensity Telemedicine Reduces Emergency Department Use by Older Adults with Dementia in Senior Living Communities

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Abstract

Objectives—Individuals with dementia have high rates of emergency department (ED) use for acute illnesses. We evaluated the effect of a high-intensity telemedicine program that delivers care for acute illnesses on ED use rates for individuals with dementia who reside in senior living communities (SLC, independent and assisted living).

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Design—We performed a secondary analysis of data for patients with dementia from a prospective cohort study over 3.5 years that evaluated the effectiveness of high-intensity telemedicine for acute illnesses among SLC residents.

Setting and Participants—We studied patients cared for by a primary care geriatrics practice at 22 SLCs in a northeastern city. Six SLCs were selected as intervention facilities and had access to patient-to-provider high-intensity telemedicine services to diagnose and treat illnesses. Patients at the remaining 15 SLCs served as controls. Subjects were considered to have dementia if they had a diagnosis of dementia on their medical record problem list, were receiving medications for the indication of dementia or had cognitive testing consistent with dementia.

Measures—We compared the rate of ED use among subjects with dementia and access to high-intensity telemedicine services to control subjects with dementia but without access to services.

Results—Intervention group subjects had 201 telemedicine visits. In subjects with dementia, it is estimated that one year of access to telemedicine services is associated with a 24% decrease in ED visits (Rate Ratio 0.76, 95% confidence interval [CI]: 0.61 – 0.96).

Conclusions and Implications—Telemedicine in SLCs can effectively decrease ED use by individuals with dementia, but further research is needed to confirm this secondary analysis and to understand how to best implement and optimize telemedicine for patients with dementia suffering from acute illnesses.

Brief Summary

Access to telemedicine services for older adults with dementia residing in senior living communities can effectively decrease Emergency Department utilization.

Keywords

Telemedicine; Telehealth; Dementia; Acute illness; Assisted Living

INTRODUCTION

Currently, 5.7 million Americans live with dementia; that number is projected to increase to 14 million by 2050.¹ Persons with dementia commonly present to the emergency department (ED) for acute illness care, and a significant proportion of these visits are potentially avoidable.^{2,3,4,5} In the ED, persons with dementia are exposed to a difficult, unfamiliar environment (e.g., excessive noise, inadequate lighting).⁶ ED providers are faced with challenges when caring for these patients, including a lack of medical information, absent knowledge of patient goals of care, and poor continuity of care.⁷ Subsequently, those with dementia more frequently develop delirium, incur greater testing, and experience greater rates of hospital admission and mortality than those without dementia.^{2,6,8,9}

Some have suggested that ED visits for those with dementia can be avoided through acute illness care in community-based settings.^{10,11} Unfortunately substantial challenges to this solution exist, which is reflected in recent trends showing a shift in acute care for older adults away from primary care offices.¹² Individuals with dementia often have functional impairments that limit their ability to urgently access traditional primary care settings. Other

barriers include caregiver fatigue, limited availability of appointments, and difficulty coordinating transportation.^{13,14} Even in senior living communities (SLC), which include both independent and assisted living facilities, limited availability of nursing supports and unscheduled transportation can limit acute illness care options to the ED.

We have previously demonstrated that integrating our Health-e-Access high-intensity telemedicine program into a geriatrics practice that serves SLC residents decreases ED use.^{15,16,17} However, the effectiveness of this program specifically on ED use by individuals with dementia has not been examined. Because these individuals are fundamentally different than those without dementia, including but not limited to cognitive barriers that can affect the clinical history obtained, caregivers that are also involved in decisions, and goals of care that may affect decisions, the effect of our high-intensity telemedicine program on ED use rates may be notably altered by those with dementia. Understanding the effectiveness of telemedicine for acute illness care for patients with dementia is critical to developing high-value acute illness care programs for this expanding patient population. Thus, this study evaluated the effect of our Health-e-Access high-intensity telemedicine program for SLC residents on the rate of ED use among individuals with dementia. We hypothesized that access to telemedicine services for acutely ill SLC residents with dementia would decrease the rate of ED use, as compared to a control cohort with dementia but without access to telemedicine services.

METHODS

This is a secondary analysis of a broader study examining the effectiveness of a patient-to-provider, real-time or store-and-forward, high-intensity telemedicine for acute illness care for older adults residing in SLCs. Full details of the program have been published previously.^{15,16,17} Briefly, patients were enrolled from a geriatrics practice that provided in-person primary care services at 22 SLCs. Seven SLCs were invited to participate in the telemedicine intervention, chosen to ensure variation in site characteristics within the intervention and control groups, as well as similar resident characteristics between the two groups. One site that initially agreed to participate subsequently declined and was excluded from analyses, leaving six SLCs in the intervention (telemedicine) group and 15 in the control (no telemedicine) group. No nursing homes were included in this study.

When an intervention subject needed care and requested assistance from the geriatrics practice, the provider managed the issue via phone, an outpatient or ED visit, or a telemedicine visit. Control group subjects could not receive telemedicine services. To deliver the telemedicine visit, a telemedicine facilitator, trained at the nursing assistant level, traveled to the patient in their residence and gathered historical (e.g., symptoms) and clinical information (e.g., video, audio of lung and heart sounds) based on chief complaint-based protocols. They also performed medication reconciliation. This information was uploaded into the cloud-based electronic medical record which was accessed via a broadband “hotspot” card for review by the telemedicine provider, who was usually part of the geriatrics practice. The provider reviewed the information and, as necessary, communicated with the subject and/or caregivers via telephone or videoconference, ordered testing (e.g., labs, imaging), ordered interventions (e.g., prescribed antibiotics), and directed follow-up

care. To differentiate this level of care from many available telemedicine services, including the facilitator assistance in the patient's home and the capture of greater clinical detail than simple videoconferencing, we added the descriptor "high-intensity".

Services provided through this program were not differentiated based on patient characteristics and were available to all members of the intervention group on weekdays between 8a.m. and 6p.m. A weekend pilot was attempted but found very low utilization rates and was discontinued.

Informed consent for participation was obtained from the patient or their health proxy. The control group included all practice patients at control sites and those at intervention facilities for whom we did not obtain consent. Subjects continued in the study until they left the geriatrics practice, died, or the study ended.

Subjects were considered to have dementia if they had a diagnosis of dementia on their medical record problem list, were receiving medications for the indication of dementia or had cognitive testing consistent with dementia. The University Research Subjects Review Board approved this study with written informed consent.

Analyses

Using billing data and medical records, we generated descriptive statistics on the frequency of telemedicine visits and any ED use for people with and without dementia during the study period. We compared the demographic and healthcare use characteristics of the subjects with and without dementia who resided in the intervention SLC sites and with those living in control SLC sites. We identified and measured potential confounders that may predict ED use and are associated with intervention status. We included six patient-level characteristics: age, independent vs. assisted living setting, gender, race, advanced directives, and Charlson comorbidity score. We also included two facility-level characteristics: profit status and specialization in dual-diagnosis (medical and psychiatric) patients.

All analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC). Baseline patient and facility characteristics were summarized with descriptive statistics and compared between study groups using two-sample t-tests or Chi-square/Fisher's exact tests. We used person-month as the unit of analysis, defined as the observation of a single subject during a given 28-day period. With each subject contributing multiple person-months, our analysis accounted for the clustered data structure within subjects. Generalized estimating equations were used to estimate the effect of telemedicine on rates of ED use by fitting marginal Poisson models. Telemedicine availability (intervention vs. control), time from study enrollment (months), and the interaction of the two were included in the model as independent variables. The interaction assessed whether rates of ED use changed differently with respect to time by intervention status.

Confounding variables at both patient-level and facility-level were controlled as covariates in the regression model. Person-months with missing data for covariates were excluded from the multivariable analyses. Sandwich estimators were calculated to provide robust estimation of standard errors. Estimated monthly rate ratios and 95% confidence intervals were further

converted to reflect reductions in use per year (each year including thirteen 28-day person-months) for ease of interpretation.

RESULTS

731 subjects with dementia were enrolled with the practice during the study (220 intervention subjects and 511 control subjects). Overall, the demographic characteristics of the subjects residing in the intervention and control facilities for those with and without dementia had slight differences (Table 1). During the study, 201 telemedicine visits were completed with subjects who had dementia and 316 with subjects without dementia. Subjects in control facilities had no telemedicine visits.

Table 2 demonstrates our primary outcome, health care utilization. Bivariate comparison that did not adjust for covariates showed no statistically significant difference in ED use for subjects with dementia who had access to telemedicine as compared to control subjects with dementia without access, but showed a significant decrease among subjects without dementia. There was no observed difference in unadjusted primary care provider use between the groups.

Table 3 shows the change in rate of ED use over time, by presence of dementia and intervention status, after adjusting for potential confounders. Subjects with dementia with access to the telemedicine intervention had a greater decrease of all ED visits over time than subjects without telemedicine, with annualized decrease in ED visits of 24% compared to a 4.5% increase in ED use among control group subjects ($p=0.006$ for the between-group difference). There was a non-significant decrease in ED use of 10.7% among subjects without dementia. No significant decrease was noted in ED visits that resulted in care and discharge to home among either subjects with or without dementia.

However, subjects with dementia who resided in SLC units with access to the intervention had a significantly greater decrease of ED visits that resulted in hospitalization than subjects with dementia at control units, with an annualized decrease of 25% compared to subjects in control units, who experienced an increase in use by 11.3% ($p=0.005$ for between group difference).

DISCUSSION

This study confirms the feasibility of high-intensity telemedicine for acute illness care for individuals with dementia residing in SLCs. Furthermore, it demonstrates the effectiveness of telemedicine in decreasing ED use among individuals with dementia at a greater rate to those without dementia. Our findings are significant as we aim to improve the convenience and quality of care and decrease avoidable costs for patients with dementia who reside in SLCs.

Recent studies have demonstrated that community-dwelling individuals with dementia are significantly more likely to have an ED visit each year, and that a substantial proportion of these events are avoidable.^{2,5} Furthermore, studies indicate that more than three-quarters of people with dementia will have at least one ED visit in their last year of life. These visits,

precipitated by acute illness, often occur outside of usual clinic hours.¹⁸ Access to telemedicine affords a mechanism to deliver high quality care to this frail population while avoiding the burdensome transportation and the unfamiliar and challenging ED environment. Furthermore, it allows us to follow previously expressed goals of care. Four percent of the older adults in this study had previously expressed advance directives that included a desire to avoid hospitalization. Access to care through telemedicine enabled them to be treated in place and maintain continuity of care for older adults with their primary medical team. This continuity optimizes communication for the patient and their health care providers and is especially important to the care of those with dementia.¹⁹

In late life, health care costs are higher for dementia than any other medical condition.²⁰ While we did not evaluate cost savings generated by access to telemedicine for those with dementia residing in an SLC, it is reasonable to anticipate substantial savings associated with a 25% decrease in ED use and hospitalization and without an increase in other health care use (e.g., primary care visits).^{2,21} Study of the financial impact of models like ours will be valuable to payers such as accountable care organizations, as they consider return on investment for telemedicine programs

Limitations

As this study describes the impact of telemedicine through a single geriatric practice in a single metropolitan area, the findings may not be generalizable elsewhere. Also, the multivariate analysis is critical to our conclusions and is only able to adjust for measured factors. As this is a secondary analysis of data from a study not established to answer this question, other yet unmeasured patient characteristics such as functional ability and other facility features may also influence program outcomes. This necessitates future studies to confirm our findings, as well as to examine changes in the cost of healthcare delivered, as technician-facilitated home-based care also has expense.

CONCLUSIONS/RELEVANCE

Telemedicine in SLCs can decrease ED use by individuals with dementia. Additional research is needed to confirm our findings and understand how to effectively engage patients with dementia and the facilities that care for them in telemedicine.

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CONFLICTS OF INTEREST

Authors S.M.G, E.B.W, H.W., A.D. and D.N. have no reported conflicts of interest. Two of the authors, K.M.M. and N.E.W., were eligible to receive royalties from Trifecta Technologies while this research was active. Trifecta developed and maintained the software used in the study. They were no longer eligible to receive royalties as of December 31, 2013. M.N.S. was a consultant to Fortress Investment Group and one of their companies,

Lifeline2Care, which was, but no longer is, developing a senior living community telemedicine model. M.N.S. currently has funding from Roche Molecular Systems and Omron, Inc., neither of which are involved in telemedicine.

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Table 1.

Characteristics of Subjects Residing in Senior Living Community Sites.

	With Dementia N, %		p-value	Without Dementia N, %		p-value
	Intervention (n=214)	Control (n=517)		Intervention (n=265)	Control (n=541)	
Age at enrollment, median (IQR)	86 (83,90)	86 (80,90)	0.15	84 (77, 89)	84 (75, 89)	0.46
Female	170 (79.4)	383 (74.1)	0.30	179 (67.5)	359 (66.4)	0.74
Race			0.02			0.02
• Non-white	11 (5.2)	12 (2.3)		15 (5.7)	21 (3.9)	0.36
• White	201 (94.8)	504 (97.7)		250 (94.3)	518 (96.1)	
Residence Type			<0.001			<0.001
• Assisted	165 (77.1)	459 (88.8)		113 (42.6)	434 (80.2)	
• Independent	49 (22.9)	58 (11.2)		152 (57.4)	107 (19.8)	
Health Insurance, primary			0.10			0.28
• Medicaid	1 (0.5)	2 (0.4)		7 (2.7)	10 (1.9)	
• Medicare	114 (53.3)	222 (42.9)		137 (51.9)	288 (53.3)	
• Medicare Advantage	96 (44.9)	284 (54.9)		118 (44.7)	228 (42.2)	
• Private	3 (1.4)	9 (1.7)		2 (0.76)	14 (2.6)	
Advanced Directives						
• Limited care *	145 (67.8)	379 (73.3)	0.08	140 (52.8)	298 (55.1)	0.54
• Do not resuscitate	148 (69.2)	391 (75.6)	0.04	187 (70.6)	322 (59.5)	<0.001
• Do not intubate	131 (61.2)	341 (66.0)	0.18	157 (59.2)	272 (50.3)	0.02
• Do not hospitalize	8 (3.73)	23 (4.4)	0.89	10 (3.8)	14 (2.6)	0.35
Charlson Score >0	73 (34.1)	186 (36.0)	0.62	80 (30.2)	158 (29.2)	0.77
Independent Comorbidities						
• Arthritis	80 (37.4)	158 (30.6)	0.15	94 (35.5)	125 (23.1)	<0.001
• Asthma	26 (12.1)	76 (14.7)	0.39	46 (17.4)	73 (13.5)	0.15
• Cancer	45 (21.0)	112 (21.7)	0.96	54 (20.4)	99 (18.3)	0.48
• Diabetes	31 (14.5)	89 (17.2)	0.27	45 (17.0)	95 (17.6)	0.27
• Digestive problems	66 (30.8)	145 (28.0)	0.53	85 (32.1)	150 (27.7)	0.20
• Heart trouble	73 (34.1)	161 (31.1)	0.34	98 (37.0)	164 (30.3)	0.06
• Kidney disease	37 (17.3)	90 (17.4)	0.79	39 (14.7)	79 (14.6)	0.97
• Stroke	30 (14.0)	67 (13.0)	0.50	29 (10.9)	64 (11.8)	0.71

IQR=Interquartile Range

* Limited care is defined as a documented advance directive stating that the patient has chosen to receive limited interventions or comfort care, or to not be hospitalized.

Table 2. Health Care Utilization per Patient-Month of Older Adults residing in Senior Living Community Sites with Telemedicine, Unadjusted.

Visit Type	With Dementia			Without Dementia		
	Intervention (n=3,219 patient-months)	Control (n=10,976 patient-months)	Rate Ratio, 95% CI	Intervention (n=4,975 patient-months)	Control (n=10,337 patient-months)	Rate Ratio, 95% CI
All ED visits*	Number	287	n/a	438	1169	n/a
	Rate	0.0892	0.918 (0.758–1.11)	0.0880	0.113	0.770 (0.627–0.947)
ED, resulted in treatment and release	Number	122	n/a	193	541	n/a
	Rate	0.0379	0.807 (0.615–1.06)	0.0388	0.0521	0.734 (0.550–0.978)
ED, resulted in hospital admission	Number	154	n/a	232	591	n/a
	Rate	0.0478	1.0 (0.808–1.24)	0.0466	0.0572	0.807 (0.615–1.06)
Primary care provider	Number	2278	n/a	3213	6976	n/a
	Rate	0.7077	1.03 (0.96–1.11)	0.646	0.675	0.947 (0.890–1.01)

* ED=Emergency Department.

Table 3. Annualized Rate of Change in Health Care Utilization by of Older Adults with Dementia residing in a Senior Living Community Sites with Telemedicine.*

Visit Type	With Dementia			Without Dementia		
	Intervention (% per year, 95% CI)	Control (% per year, 95% CI)	p-value for group - time interaction	Intervention (% per year, 95% CI)	Control (% per year, 95% CI)	p-value for group - time interaction
All ED visits [†]	-23.7 (-39.2, -4.11)	+4.5 (-2.84, +12.6%)	0.006	-10.7 (-25.3, +6.7)	-3.3 (-11.5, +73.7)	0.219
ED, resulted in treatment and release	-20.1 (-41.8, +9.68)	-2.25 (-10.5, +6.82)	0.225	-18.6 (-37.4, +6.18)	-8.6 (-87, +25.6)	0.386
ED, resulted in hospital admission	-25.2 (-43.7, -5.98)	+11.3 (+1.45, +21.9)	0.005	-3.77 (-21.8, 18.4)	1.21 (-8.39, +11.8)	0.264

* Estimations were based on Generalized Estimating Equation (GEE) to account for the clustering data structure. Adjusting for: subject age, gender, Charlson score, residence type, care status, facility profit status (not-for-profit / for profit), and specialization in dual diagnosis (medical and psychiatric) patients.

[†] ED=Emergency Department.