



**An Economic Analysis of
Technology Enabled Care in
Assisted and Independent
Living Communities from
an Owner or Operator Perspective**

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Executive Summary

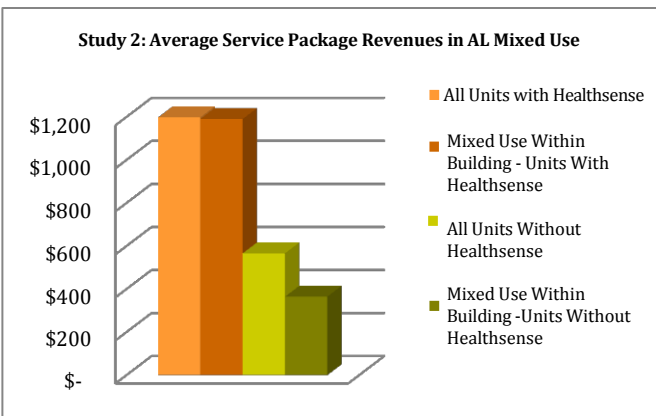
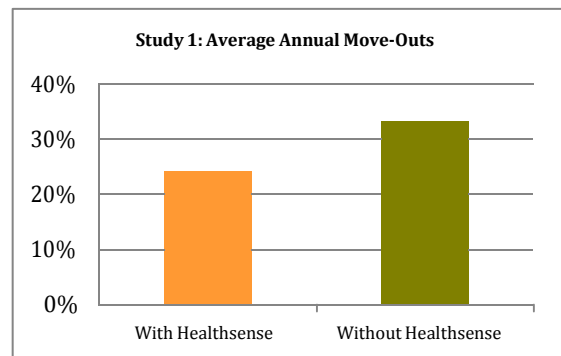
This study's purpose is to determine if there is a return on investment (ROI) for implementing Healthsense's remote monitoring platform, a system that monitors daily activities and behaviors, in assisted living (AL) communities and in independent living (IL) senior housing. The subjects of the study are seven facilities owned and operated in Minnesota. The perspective of the study is that of the communities' owners/operators.

Remote monitoring is in a relatively early stage of development and diffusion. Without an economic linkage to a medical care purchaser or managed care organization, the implementation of remote monitoring and related enhanced care in AL or IL for the elderly must be supported by incremental revenue, improved occupancy, and/or improved staff productivity for the owner/operator. This study hopes to begin to build the evidence base for the technology through an observational retrospective look at the experience of three organizations that have implemented remote monitoring in their AL and IL facilities.

We evaluated the impact of Healthsense's remote monitoring system on three areas: 1) occupancy levels through decreasing the number of discharges, 2) revenues for the service packages provided to residents, and 3) staff productivity.

The study found evidence of ROI for owner/operators of AL communities in all three of the analyses performed (comparison data was not available for IL communities):

Study 1: A statistically significant decrease in the discharge rate for facilities with Healthsense vs. facilities without Healthsense.



Study 2: A threefold increase in the service package price for AL facilities with Healthsense vs. facilities without Healthsense.

Study 3: An estimated savings of 1 FTE per day for a facility with 42 residents when Healthsense was used in their units.

Introduction

This study's purpose is to determine if there is a return on investment (ROI) for implementing Healthsense's remote monitoring system in assisted living (AL) communities and in independent living (IL) senior housing.

The Healthsense system uses sensors to track Activities of Daily Living (ADLs). The sensors provide input to Healthsense's software to establish individualized, typical levels of daily activity, or a "routine" for each person being monitored in their own unit or individual home. This "routine" becomes the benchmark for establishing when the person may need assistance from caregivers in the building or from others who may receive the alerts (such as family members).

The economic perspective for this retrospective study is the facility's owners or operators; however, we expand the consideration of costs and benefits to health and quality of life impacts in the discussion section that follows the report of the key empirical findings of the study.

The sponsors of the study are the members of the Healthsense Care Alliance (HCA) and Healthsense, Inc. with primary funding support from Healthsense, Inc., and in-kind support from the members of the HCA.

The subjects of the study are the facilities owned and operated by members of the HCA. These include Ebenezer, Northfield Retirement Community, and The Lutheran Home Association - all of which are operated in Minnesota.

Neither HCA nor Healthsense, Inc. have influenced the outcome of this study.

Background

Healthsense, Inc. is a growing provider of aging services technology, which provides technology-enabled care solutions for the entire senior care continuum. It offers a full range of health and safety monitoring solutions to help senior care providers reduce costs, increase seniors' independence, and enhance caregiver and senior experiences.

Healthsense is based in Minnesota and provides services to organizations across the U.S.

The HCA is an organization of innovators and leaders in the senior care field. Its members share a vision of providing best-in-class aging services to seniors and their families. HCA is founded on the belief that “unobtrusive sensors ... offer caregivers objective real-time information that they could previously obtain only through personal observation and self-reporting by clients. It is important to note that technology does not replace personal touch. Rather it directs personal touch to where it provides the greatest benefit. Seniors enjoy a better quality of life while care providers deliver better care at a lower cost.” (Healthsense Care Alliance, 2011)

The HCA members assert that (HCA, 2011):

- Remote monitoring can be added to existing residences or incorporated into new construction. The systems are simple to install and can be easily relocated, if necessary, which allows campus-based communities or home care services to incorporate technology-enabled care services for a small capital investment.
- Care providers are able to develop integrated care service offerings or *a la carte* services supported by remote monitoring technology. These service offerings may be extensions of services they already provide, or may be provided through alliances with other service providers (meal delivery, home maintenance, etc.).
- Properties with remote monitoring develop a reputation for progressive amenities. Residents appreciate the aging-in-place (AIP) model and will seek out properties where this is offered. This will lead to lower turnover and lower vacancy rates.
- Remote monitoring offers greater flexibility in placing residents with varying needs. It is often difficult to maintain a desired occupancy balance between areas of a property designated for independent vs. assisted living. Residents who might have traditionally required relocation to AL may do quite well for some time in an IL setting with the addition of remote monitoring services.

Remote monitoring technology ranges from physiological monitoring using body-worn sensors to activity monitoring through both worn sensors and passive installations. A system that monitors activities of daily living (ADLs) and provides alerts to caregivers is the focus of this study. While there are a limited number of formal studies on the cost-benefit of remote monitoring technologies, there is much optimism that the economic value of such technologies will be

supported when implementation is more developed and additional studies are conducted.

The Center for Technology and Aging (CTA) reports that monitoring ADLs “can have a profound positive impact on the lives of older adults (April, 2013¹).” These in-home technologies include fall detection, biometric monitoring, and ADLs tracking. CTA’s Impact Report - which summarizes CTA’s programs, particularly the Diffusion Grants Program - documents a positive ROI for grantees. These grantees are primarily in aging services, managed care, and accountable care organizations whose ROI is mainly achieved by reducing hospital use through decreasing admissions or emergency room use (February, 2013²).

Telemonitoring allows home monitoring of patients using specialized devices that connect through telephone lines, cable networks, or broad band technology. Through the connection, it can provide diagnostic information regarding weight, blood pressure, pulse, etc. Where telemonitoring has been most applied is in the arena of disease management, especially for heart failure patients. In a review of studies of this application, Amala, *et al*, found that observational studies suggest that telemonitoring (used either alone or as part of a multidisciplinary care program) reduced the number of hospital bed days. Patient acceptance of, and compliance with, telemonitoring was high. Two randomized controlled trials also suggest that telemonitoring of vital signs and symptoms facilitated early detection of deterioration, reduced readmission rates and length of hospital stays in patients with heart failure. They conclude that “telemonitoring might have an important role as part of a strategy for the delivery of effective health care for patients with heart failure... analysis of existing studies, and new large multicenter, randomized controlled trials are necessary to evaluate the potential benefits and cost-effectiveness of this intervention.” (Louis, *et al*, 2003³)

Wagner, *et al*, reviewed the literature related to monitoring technology for older adults (January, 2012⁴). They reviewed 45 of 162 articles identified through online databases and search engines, for the purpose of describing the use of these technologies. Wagner categorized the results in four categories: personal alarm devices, fall detection devices, activity monitoring devices, and wearable technology. Regarding activity monitoring devices, the paper describes the wide array of activities monitored and a fairly large array of well-known examples of implanting such technologies in buildings often labeled “smart homes.” However, a recent Cochrane Review found there were no studies testing the effectiveness of “smart home” technology (Wagner, *et al*, January, 2012).

Demiris and Hensel (2008⁵), in their review of the literature, reported that none of the studies they reviewed presented any evidence of use on health outcomes and suggest that randomized controlled studies be conducted once the use of monitoring technology is more widespread. Another developmental objective is to assure the reliability and validity of the systems to minimize both false alarms and missed problems. Finally, there will be critical privacy and data security requirements to address. Like their colleagues in the research community, Demiris and Hensel indicated that cost effectiveness and cost benefit needs to be determined.

Ranz *et al* (2013⁶), studied the use of sensor technology to support AIP. They report on the findings from a Centers for Medicare and Medicaid Services (CMS) evaluation of a program that received a CMS grant to develop and test the AIP concept. The study focused on the value of nurse care coordination and technology and findings suggested a significant savings to the Medicare program due to nurse-directed community-based care coordination compared with usual care. Based on these promising results, the University of Missouri Sinclair School of Nursing partnered with Americare to develop a housing environment that would build on the goal of AIP. Their four-year evaluation determined that sensing technology would be a key component of their program and showed that this program had “significantly lowered costs and improved outcomes compared with national benchmarks. Much of the effort for this program was working out the alert logic.”

There is a paucity of economic cost benefit studies related to remote monitoring in all of its forms. Where they exist, the studies primarily take the perspective of a health care purchaser, managed care organization, integrated delivery system, or Accountable Care Organization (ACO). However, in summary, the above observers report a rapidly growing, and arguably very promising, technology to support the goal of AIP. With some of the to-be-expected implementation bugs ironed out, research can be conducted to begin to examine both effectiveness and economic benefit of remote sensing systems.

We hope to begin to build the evidence base for technology-enhanced care with this observational, retrospective study of the experience of three organizations that have implemented remote monitoring in AL and IL senior communities. In time, when housing facilities not only install the technology, but establish their internal capacity to fully integrate it into their work flows and staffing structures, additional prospective studies should be conducted.

Early indicators suggest that there is a business case for housing owners and operators to leverage the outcomes of remote sensing and enhanced care in their buildings. The purpose of this study is to examine that question.

Cost and Benefits from the Perspective of an Owner or Operator of an Assisted Living Community or Independent Living Senior Housing

Unlike the extensive history of use of emergency response “panic buttons,” remote monitoring is in a relatively early stage of development and diffusion. Without an economic linkage to a medical care purchaser or managed care organization, the implementation of remote monitoring and related enhanced care in AL or IL for the elderly must be supported by incremental revenue, improved occupancy, and/or improved staff productivity for the owner/operator. The presence of remote monitoring and enhanced care processes may then support an increased asset value for the facility and the perceived value the facility has to payers and others focused on the total cost of care for a resident. The senior housing industry seems to recognize that this new technology will have a significant impact on their business in the near future.

In its survey of 1,077 thought leaders, the American Senior Housing Association (Volume II, 2012⁷) found that most senior managers rated technology advances at the top of their list of factors. They forecasted the greatest competition for senior living communities in the future to be from technology assisted, in-home care (61% overall, 72% CEOs). They also forecasted that the availability of technology used in care will rival location as more important for next generation’s purchasing decisions (63% care technologies vs. 62% location). Among the thought leaders, technology as a resource available for new residents moving to senior housing settings was most frequently selected as the item that will be more important to the next generation (81%) than it is currently.

Finally, when asked about remote monitoring per se, the thought leaders reported that the top three remote technologies that retirees would accept were: medication management, vital signs checking, and movement sensing. When asked where the technology impact would be most felt, the top two areas were on resident/family interaction and on resident personal care (33% and 30% respectively).

By studying the experience of three early adopters of the Healthsense system, we may begin to support the economic business case for implementing remote monitoring and enhanced care even without taking into account the economic link to the medical managed care funding stream.

Study Approach

This retrospective study was conducted for the purpose of evaluating return on investment of implementing Healthsense remote monitoring in AL and IL settings. The economic perspective of this study is that of the owner/operator; thus medical cost offsets that may accrue to the residents and family as well as those to a health care purchaser or risk bearing organization such as a health plan or an ACO are not captured in this study. Additionally, although the cost, health, and quality of life for the residents is of paramount importance, it is only incorporated into this analysis if it is reflected in the economic terms of the housing owner/operator (for example, lower turnover due to more satisfied residents would be one such impact).

The subjects of the study are residents in AL communities and IL buildings operated by one of the sponsor members. A planning meeting was held with leadership from each organization and Healthsense to determine the research questions and identify data sources. We also communicated individually and in group meetings with the data contact staff members from each organization throughout the process of data collection. We collected data from seven buildings (6 AL and one IL). We analyzed results separately for each facility to account for variations across buildings for the year of 2012 with secondary analysis using data from prior years, where available. To address the question of whether the use of Healthsense is associated with increased occupancy, we also attempted to compare length of stays for residents in AL. Where data were not available or where the nature of the data differed across sites, we determined how to produce comparable data for the analysis.

We selected three areas of study:

- 1) Occupancy through decreasing the number of discharges;
- 2) Revenues for the service package including the price of the remote technology, and
- 3) Staff productivity of activities that are most directly substituted by remote monitoring technology.

To address the first question - whether Healthsense is associated with improved facility occupancy - we compared the number of discharges for buildings with and without the remote monitoring system fully installed in all units and where single buildings have units with and without Healthsense.

The second question - whether Healthsense services are associated with increased service revenues over and above the cost of unit rental costs - we collected monthly service package revenues for residents with and without Healthsense services. The service package revenues for the analysis included revenues for Healthsense and all other care-related services purchased by the resident from the facility.

The third question - whether Healthsense services improve staff productivity for the facility - was addressed by conducting retrospective analysis using estimates from staffing experts within each member organization. The analysis was limited to the productivity gains of direct substitution impact of Healthsense on the need for in-person room checks by staff benchmarked by standards of care for the frequency of such room checks.

ROI Analysis

Study 1: Move-Out (Discharge) Rates

We obtained historical data from the accounting records from six AL communities. Three have Healthsense in all units and three have no Healthsense services. Our analysis was focused on CY 2012 in order to have comparable data across all six communities. The available data included move-outs and number of residents in each facility at some point during 2012. We assumed that the impact of Healthsense is primarily on allowing residents to remain in their existing facility longer than would be the case without the technology. We are aware that the availability of the technology itself may influence the likelihood of admissions as well, but our focus on discharges as the primary of length of stay seems reasonable.

We assumed that the residents of each AL facility are similar with regard to level of care needs. We also obtained data from two buildings, one AL and another IL, in which some residents had Healthsense and others did not. The AL facility had a sufficiently large sample of both residents with and without Healthsense to conduct a comparison. The IL facility had too few residents with Healthsense to support a comparison, therefore study of the impact on discharge rates for IL was not possible.

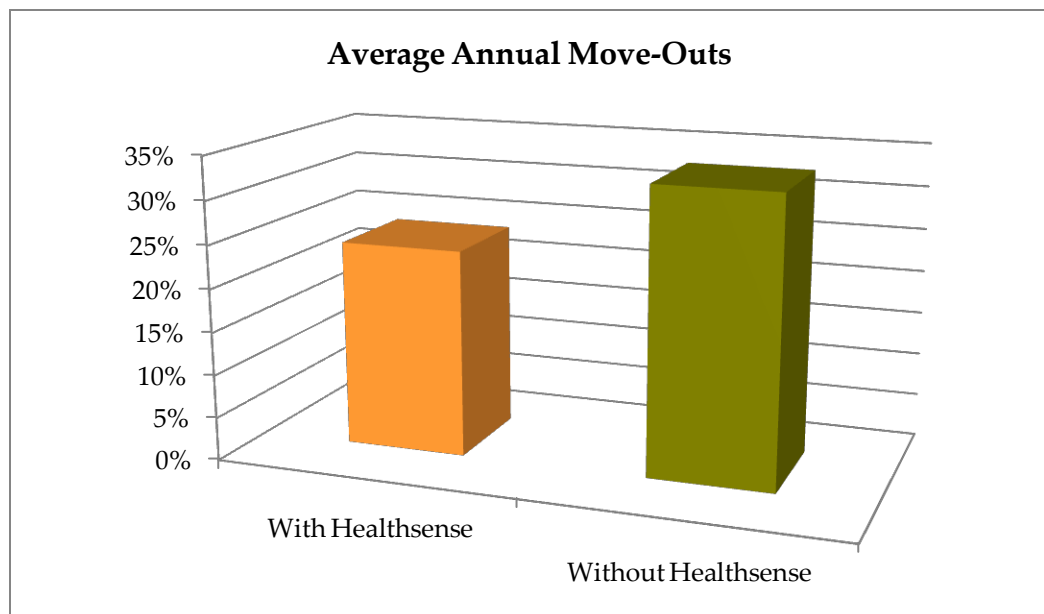
Table 1 shows the percentage of discharges per number of residents in each AL facility at any time during 2012. This percentage ranged from 13-29% for

buildings with Healthsense equipped units and 29-43% for buildings without Healthsense-equipped units. The average percentage of discharges was 24% for buildings with Healthsense and 33% for buildings without the system; or 27% fewer move-outs in units with Healthsense. This difference is statically significant ($p < .04$). Therefore, on this measure, using Healthsense is statistically shown to decrease the number of discharges from the assisted living units.

Table 1: Number of Move-Outs for AL Buildings With and Without Healthsense equipped units (2012 data)

All Healthsense Equipped Units	Number of Residents in 2012	Number of Move-Outs	Percent of Move-Outs	Admissions	Net Change
Facility 1	170	51	30%	NA	NA
Facility 2	160	32	20%	50	18
Facility 3	31	4	13%	7	3
Total	361	87	24%	--	--
No Healthsense Equipped Units					
Facility 4	86	29	34%	NA	NA
Facility 5	97	28	29%	NA	NA
Facility 6	40	17	43%	22	5
Total	223	74	33%	--	--

Chart 1: Number of Move-Outs for AL Buildings with and without Healthsense Equipped Units (2012 data)

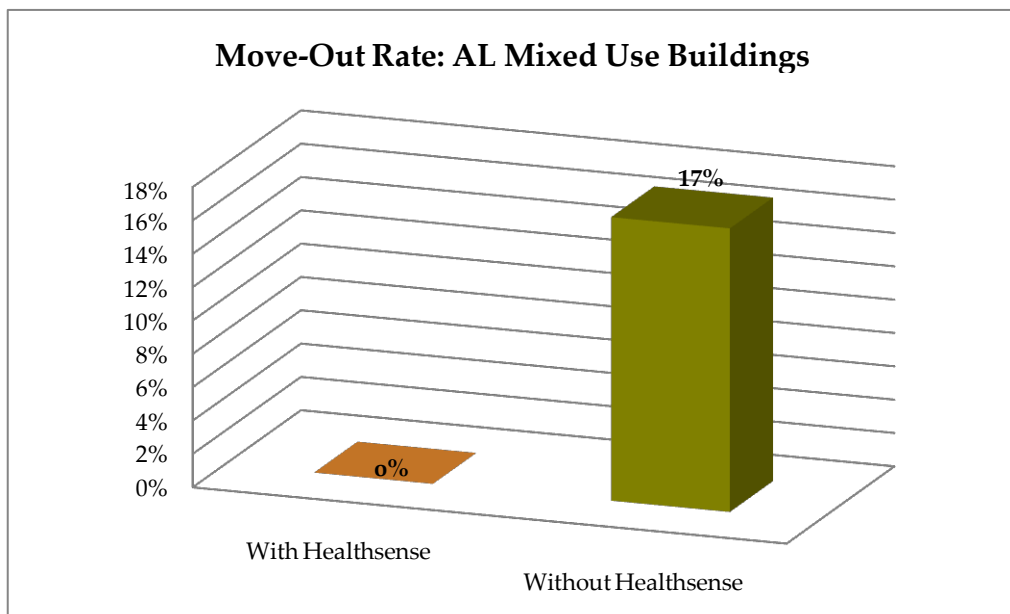


A similar analysis of discharges for facilities that have some units with the technology and some without showed the number of discharges ranging from from 0 at a facility with 23 residents and 10 discharges for the 60 residents without Healthsense at some time during the year. On this measure, using Healthsense is shown to decrease the number of discharges from the AL units, which is also statistically significant. Table 2 shows these results, below:

Table 2: Move-Out Rates for AL Buildings with Mixed Healthsense/No Healthsense Units (2012 data)

	With Healthsense			Without Healthsense		
	Number of Residents in 2012	Number of Move - Outs	Percent of Move-Outs	Number of Residents in 2012	Number of Move - Outs	Percent of Move-Outs
Facility 1	23	0	0			
Facility 2				60	10	17%

Chart 2: Move-Out Rates for AL Buildings with Mixed Healthsense/No Healthsense Units (2012 data)



Study 2: Service Revenues

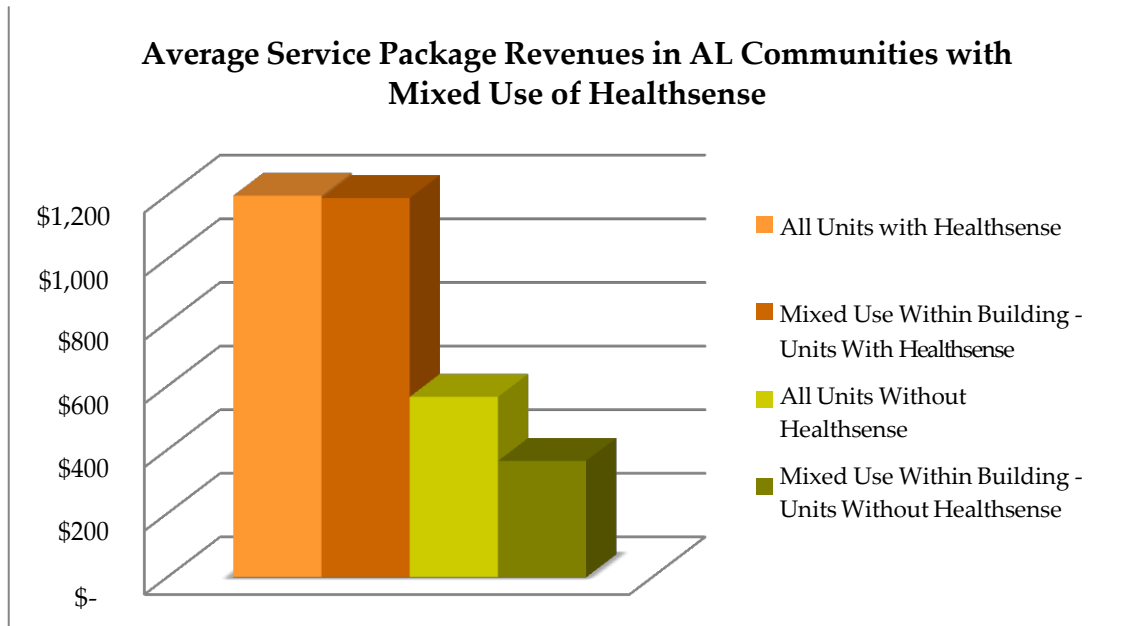
We compared monthly average 2012 service revenues for residents of ALs with and without Healthsense units. The service package revenues were substantially higher for residents with Healthsense. In facilities in which all residents have Healthsense installed, the average monthly non-rent service package revenue ranged from \$1,162 to \$1,268/month. The monthly revenues for facilities without Healthsense were substantially lower, ranging from \$540 to \$593/month. These differences were consistent even within facilities operated by the same owner.

In one facility with some resident units with and others without Healthsense, the average monthly difference was \$1,191 with Healthsense and \$325 without. This is over a threefold increase (3.66). Table 3 and Chart 3 show these results.

Table 3: Average Service Package Revenues in Buildings with Mixed Use of Healthsense (2012 data)

All Units with Healthsense	Monthly Service Package Revenue
Facility 1	\$1,258
Facility 2	\$1,176
Facility 3	\$1,162
Average	\$1,198
All Units without Healthsense	
Facility 4	\$540
Facility 5	\$593
Facility 6	NA
Average	\$567
Mixed Use within Building	
With Healthsense	\$1,191
Without Healthsense	\$365

Chart 3: Average Service Package Revenues in Buildings with Mixed Use of Healthsense (2012 data)



Study 3: Staff Productivity

We convened staffing experts from the participating organizations to discuss the staffing productivity measure. They reached the consensus that basing this analysis of staff productivity on the substitution of Healthsense for staff time needed for room checks would provide a quite conservative, transparent, and credible means to demonstrate impact on staff productivity. We believe that a comprehensive prospective study would likely produce larger gains than we report here. The HCA members and their staffing experts agreed that this is but one small aspect of staff productivity that is likely to be impacted by Healthsense and could be examined going forward.

The staffing experts also reached consensus on the appropriate time and task requirements for a credible staff time savings based on number of residents per facility. The experts established that a desired standard is for each resident in AL to be checked on every two hours around the clock. Healthsense fulfills much of this needed oversight without staff physically conducting the checks. The staffing experts estimated that each room check required conservatively five minutes and that each resident would then be checked 12 times per day or require 60 minutes of staffing time per eligible resident per day.

If we assume a facility has 42 eligible residents, at one hour per day per resident, the facility would need to commit 42 hours per day for room checks. If we assume that Healthsense does not substitute for all room checks, and use a more conservative estimate of the substitution effect of for example, 85% substitution (as suggested by our staffing experts), we can make the case that for a facility with 42 eligible residents, that approximately one full time equivalent (FTE) staff person per day of a health aide or a nurse was being offset by Healthsense services.

Study Conclusions and Discussion

We found evidence of a ROI for owner/operators of AL communities in all three of the studies performed:

Study 1: A statistically significant decrease in the discharge rate for facilities with Healthsense vs. facilities without Healthsense.

Study 2: A threefold increase in the service package price for AL facilities with Healthsense vs. facilities without Healthsense.

Study 3: An estimated savings of 1 FTE per day for a facility with 42 residents when Healthsense was used in their units.

One caveat of the study is that it is retrospective; however, we attempted to use accounting data to address questions 1 and 2. Staff productivity studies are more difficult to conduct retrospectively but we attempted to use a conservative approach to address the question. A prospective staff productivity study should be conducted to more fully explore the impacts of Healthsense on staff productivity.

Limitations of our work include the use of data from different organizations that was often formatted differently or with values expressed in varying terms. We also were limited by missing data that narrowed our analysis. However, we are confident that the somewhat simple approach we have taken is supported by the data and has face validity and credibly lends supports to an argument for a significant ROI for owners and operators of AL and IL. However, a more comprehensive analysis may further refine these findings and offer a more comprehensive test of ROI.

Finally, while this retrospective analysis is a credible start, the next step in further advancing this research is to conduct prospective studies either randomized

controlled studies or prospective observational studies that begin with common metrics to be collected in real time across living settings.

Perspectives and Considerations Beyond This Study

This study assessed a limited set of economic impacts from the perspective of an AL community owner or operator. While we identified positive economic impacts from the more limited perspective of facility owners and operators, even larger impacts would likely be observed if the finance perspective included that of payers and the individuals and families.

Research on economic impacts from the payer perspective have shown that such impacts are nontrivial. In a case-control study of the use of remote sensing on an AL community over a three month period, Alwan and colleagues (Alwan⁸, 2006). demonstrated a reduction in billable interventions for the monitored versus control from 73 to 47 interventions, a reduction in hospital days from 33 to 7 as well as a reduced cost of care from \$67,754 to \$21,187. Each of these reductions was statically significant. Additionally, like this study, they found reduced workloads for monitored site caregivers (ibid.).

The impact on reduced inpatient and emergency department use also has a very large economic impact for providers under risk arrangements with payers, such as with ACOs. Additionally, many primary care providers under patient-centered medical home (PCMH) contracts with payers also often participate in shared savings from a reduction in total per capita cost of care for the payer. It will be just a matter of time before the payer community with CMS (Medicare and Medicaid) products discover this potential. ACOs and PCMH providers will likewise seek to take advantage of this opportunity when they are presented with its benefits for their patients and for themselves.

This reduction in emergency department and hospital use is also a signal of better quality of care for the individual and reduced stress and cost for the family and other informal caregivers. While the patient and family cost sharing for medical care is not a small cost for many individuals and families, it is this reduction in pain and suffering as well as improved safety and quality of life that becomes a very compelling impact of remote monitoring for individuals and families. Although the research on quality of life with monitoring is limited, in another pilot study conducted by Alwin and colleagues⁹, pre- and post-installation scores on a standardized quality of life scale found and significant increase in life satisfaction with remote monitoring.

Appendix: Data Analysis

This preliminary analysis relied on a core set of data elements that were commonly reported by all participating facilities. Some reported data from 2011 through 2013 YTD and others reported only for 2012. Thus, we decided to limit our analysis to 2012. In addition, there were missing data on some residents that limited the scope of the analysis and the questions that could be addressed. Where we needed to make some assumptions about missing data, we attempted structured the analysis so as to be able to compare across sites while avoiding bias.

Since all but two facilities studied had either all Healthsense equipped units or all without Healthsense equipped units, and since we had variable information about the histories of specific residents in which to analyze the level of care by resident, we chose the facilities as the unit of analysis for these preliminary analyses.

For the Move-Out (or discharge) rate analysis, the denominator was all residents in a unit at any time during 2012. While this method was required due to missing admission data, we are aware that the length of stay would have been a preferred measure. Obtaining additional data will allow for such an analysis. We conducted a one-tailed t-test to determine whether the move-out rate differences between the residences with and without Healthsense was significant and found the difference significant at the $p = .037$ level.

For the single community with sufficient Healthsense residents to compare discharge rates between residents with Healthsense and non-Healthsense units, we calculated a one-tailed Pearson's Chi Square analysis and found the difference to be significant at the $p = .049$ level.

For the service package revenue comparison, where the comparability of the revenue sources for specific residents was unclear, we approached exclusion of residents or revenues in such a way as to minimize the bias toward finding a difference. Thus, our monthly revenue estimates of the differences between units with and without Healthsense likely underestimates the true difference.

While the variability within the communities of service revenues varied widely across residents, the monthly revenue per residence was quite stable over a year.

Table 1: Range of Monthly Revenues per Facility

All Healthsense Units	Monthly Service Package Revenue per Month	Monthly Revenue Range Over 12 Months
Facility 1	\$1,258	\$1,089 - \$1,506
Facility 2	\$1,176	\$1,164 - \$1,347
Facility 3	\$1,162	\$809 - \$1,230
No Healthsense Units		
Facility 4	\$540	\$332-\$561
Facility 5	\$593	\$495-\$693
Facility 6	NA	

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