

White paper

Insights from studies on the use and impact of assistive AI technology on caregiver burden and wellbeing

Based on recent research studies conducted by U.C. Berkeley and FutureCare, this white paper examines the impact of aging population, the caregiver gap and the potential of technology interventions (such as ambient sensors, predictive AI and mobile communications). The findings have implications for senior focused solutions and service providers.



Authors: Gene Wang, Vishal Dubey, Sally Rouses

Prof. Bob Levenson, PhD, UC Berkeley, Prof. Dolores Gallagher-Thompson, Ph, Stanford University

Oct 10, 2022

www.futurecare.ai

Copyright FutureCare 2022

WHO IS THIS FOR

- Assisted living senior housing providers
- Aging-in-place solution developers
- Healthcare and Insurance providers
- Families and Caregivers

Key findings

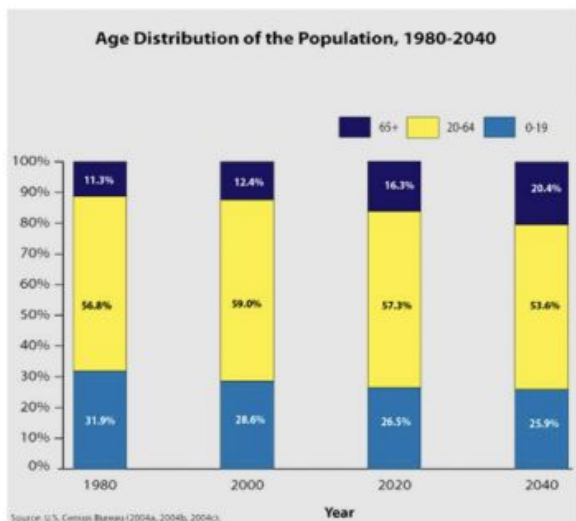
In-home assistive technology with timely alerts to caregivers on falls, wandering and other potentially dangerous situations was shown to reduce caregiver anxiety and prevent decline in their sleep quality.

Table of contents

The aging population	4
Dementia and its impact in the United States	5
Impact on Caregiver’s health and wellbeing.....	6
Can Technology help?	6
Recent studies scientifically measured the impact of technology on caregiver wellbeing	7
The Technology	7
STUDY 1: Impact of monitoring technology on caregiver Anxiety.....	9
STUDY 2: Impact of monitoring technology on caregiver Sleep Quality	11
What did the UC Berkeley professor have to say about the studies?	13
What did the study participants have to say about their experience?.....	14
The key takeaways	15
Applying the findings to your work.....	16
Senior housing providers	16
Age-Tech Solutions developers.....	16
Health systems and Insurance companies.....	17
Conclusion.....	18
Continuing the conversation.....	Error! Bookmark not defined.
References	20

The aging population

By 2040, about **one in five** Americans will be age 65 or older, up from about one in eight in 2000. In fact, 2030 is going to be an interesting year in the United States, when every Baby Boomer will be age 65 or older. (1)



87% of adults age 65 and older want to stay in their current home or community as they age and preferably with as much independence as possible. Aside from remaining in a comfortable and well-known environment, it's also a massive cost savings for everyone involved. (2)

THE CARE GAP

CDC considers Caregiving for family and friends, a public health issue.

There are 7 potential family caregivers per older adult. By 2030, the **available family caregivers will shrink to only 4 family caregivers per older adult** (13)

As the population gets older, there will be an increased demand on health care workers to the point where there are not going to be enough health care workers to meet the needs of our aging population.

Dementia and its impact in the United States

The aging of the U.S. population and the concurrent rise in the number of adults living with dementia underscore the urgent need for human and technological care interventions for people with dementia and their formal and informal caregivers.

Dementia (loss of memory) affects about 6.5 million U.S. adults 65 years and older, and that number may grow to almost 14 million by 2060. Furthermore, 200,000 individuals under age 65 have some form of early-onset dementia. (4)

Dementia can lower an individual's quality of life, burden caregivers (even those who find caregiving very rewarding), increase institutionalization, and increase costs to families and society. Dementia has no known cure, but both drug and nondrug interventions are available to treat symptoms, support function, and improve quality of life. Nondrug interventions have been recommended as first-line treatments for behavioral and psychological symptoms of dementia, but pharmacological treatment options such as antipsychotics are also available.



More than **6 million** Americans are living with Alzheimer's. By 2050, this number is projected to rise to nearly 13 million.



In 2021, these caregivers provided more than **16 billion** hours of care valued at nearly \$272 billion.



More than **11 million** Americans provide unpaid care for people with Alzheimer's or other dementias.

Impact on Caregiver's health and wellbeing

83% of older adults with dementia, rely on help from family members.

2 in 3 of those informal caregivers are women.

Evidence suggests that these caregivers have lower self-ratings of physical health, elevated levels of stress hormones, higher rates of chronic disease, and impaired health behaviors. Familial caregivers (caregivers) for people with dementia experience higher levels of psychological distress and greater burden than their age-matched counterparts without caregiving duties. (5)

Anxiety is exceptionally prevalent among caregivers; because of its known association with suicidal ideation, it is an important target for interventions. (6,7)

Can Technology help?

Sensor-based in-home technologies represent a novel intervention for caregivers (e.g., monitoring care recipient falls to reduce caregiver worry), but few technology-based products have been systematically evaluated (8).

There are many solutions in the market today such as:

- **Virtual Voice Assistants** like the Amazon Echo/Alexa and Google Home that help senior citizens remember their daily schedules (when to eat, take their medication, or go to their doctor's appointments).
- **Smart pillboxes** that help with dosage amounts and timing.
- **In-home sensors, smart mattresses and smart clothing** that can help doctors or family members monitor their patients' movements and check for irregular walking, or to alert the patient's team if the person falls.

Recent studies scientifically measured the impact of technology on caregiver wellbeing

In 2018 FutureCare was awarded an NIH grant and it started working with U.C. Berkeley to systematically deploy and measure the impact of assistive technology solutions on caregiver burden and mental health. The studies were led by Prof. Robert Levenson, Director of the Berkeley Psychophysiology Lab and measured caregiver's mental health and sleep in two independent, randomized controlled trials. They utilized FutureCare's caregiving solution and measured the efficacy of its technology solution on caregiver wellbeing. The Chief Scientist and Principal Investigator of FutureCare collaborated closely with the Director of the Berkeley Psychophysiology Lab and his dedicated team for this study.

The studies were six to nine months long and designed to determine whether a sensor-based in-home support system for caregivers caring for a family member with dementia, reduced caregiver anxiety and depression, and increased well-being.

The main difference between the two studies was the number of participants in each and the length of the study. Both studies showed promising results on caregiver's mental health and sleep.

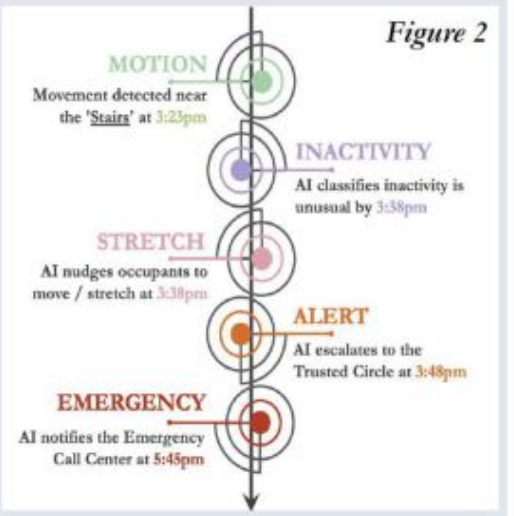
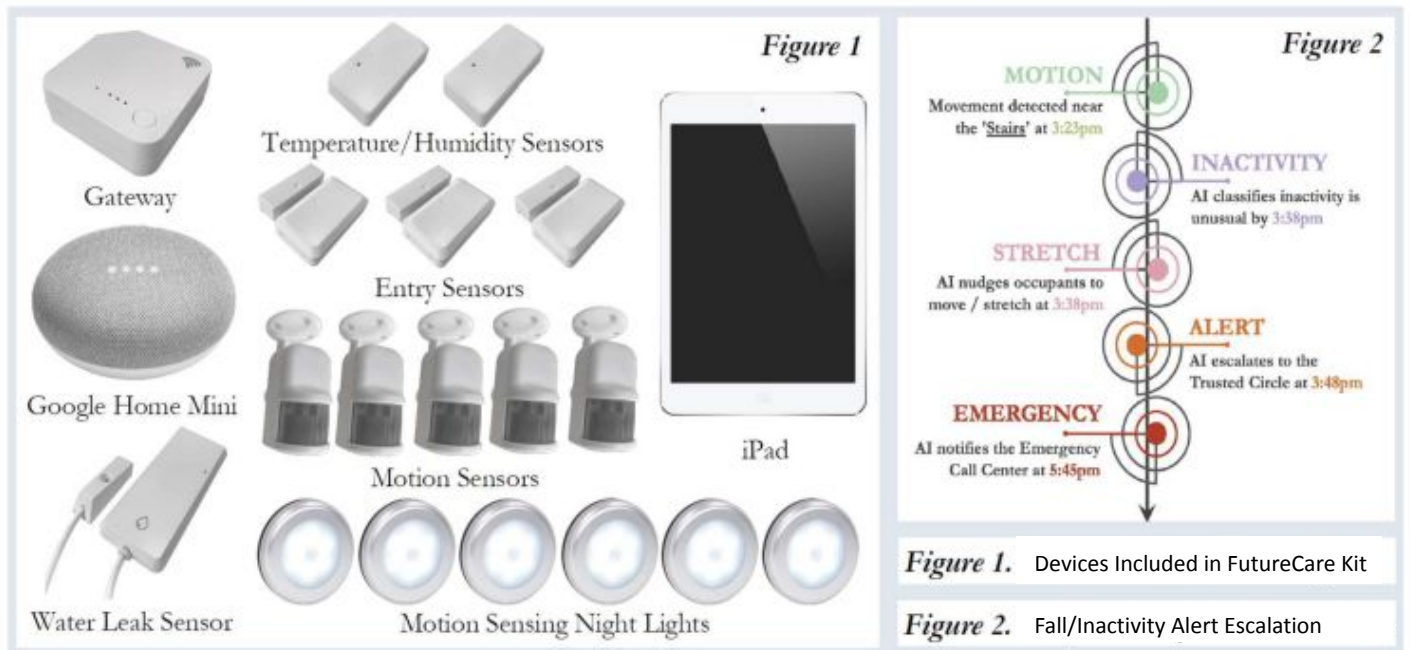
The Technology

An AI powered Virtual Care Platform for Caregivers (FutureCare) developed and deployed by FutureCare was used for these studies. FutureCare's AI bots for personalized senior care utilized and the solution included the following components (see Figure 1 below):

- a) in-home sensors (e.g., door, water, heat, motion)
- b) cloud based machine-learning software,
- c) a smartphone-based app.

The system was designed to achieve the following objectives:

- a) learn normal patterns of activity in the home
- b) detect potentially worrisome deviations from those patterns, and
- c) provide appropriate warnings (e.g., wandering, falling) to caregivers (via text messages and through an app)
- d) train the ML models based on progressive feedback obtained from the caregiver after receiving the alerts to continuously improve the warning accuracy (see Figure 2 below)



Because FutureCare solution can detect worrisome problems such as person with dementia falling and wandering and provide caregivers with alerts even when the caregiver is attending to other matters inside or outside the home, the hypothesis of the studies was that it has the potential for reducing the state of constant vigilance that caregivers often experience and enabling them to engage in other health-promoting activities (9).

STUDY 1: Impact of monitoring technology on caregiver Anxiety

For this study, researchers set up a Randomized Controlled Trial to determine whether a sensor-based in-home support system for Caregivers caring for a family member with dementia, reduced Caregiver's self-reported anxiety and depression, and increased their subjective well-being.

Figure 1. FutureCare hardware sensors.



Figure 2. Stream of information in FutureCare system.



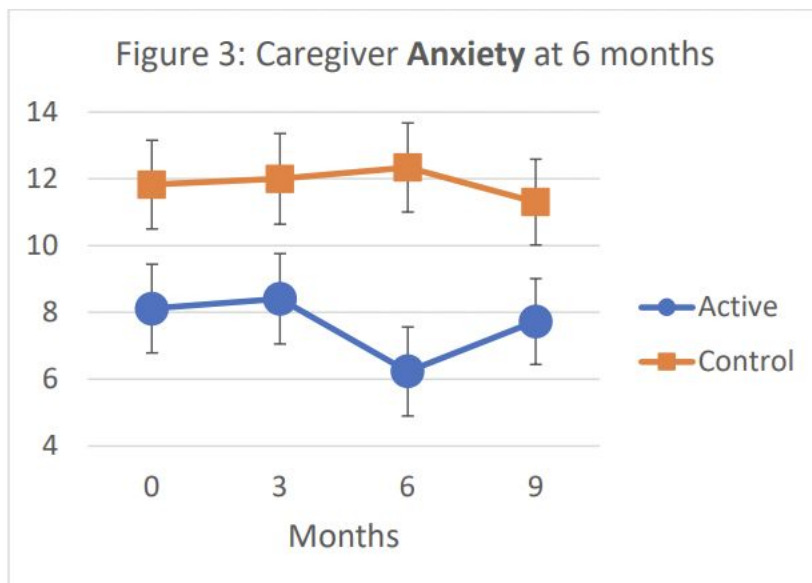
FutureCare - a sensor-based, in-home technology system designed for caregivers living with their care recipients was installed in the homes. (Figure 1)

FutureCare utilized internet connectivity to enable software “bots” (algorithms) to monitor hardware sensors (e.g., motion and entry/exit sensors) and provided real-time feedback to caregivers via a smartphone app (Figure 2)

Participants	Method	Measurement
63 familial caregivers of people with dementia 78% female 63 years mean age	<p>Participants were randomly assigned to two different groups.</p> <ol style="list-style-type: none"> Group 1, called the fully active group received FutureCare with all sensors activated Group 2, called the control group received FutureCare with only water-leak and temperature/humidity sensors activated <p>The sensors were installed based on which group the participant were and automatic alerts were sent to the caregivers.</p>	Questionnaires to assess caregiver anxiety, depression, and well-being were administered at four time points over the nine-month period. Caregivers' personality was also assessed at baseline.

Study Results

Caregivers in the fully active group, experienced a significant decline in anxiety between months 3 to 6 as shown in the figure 3.



Caregivers who are more conscientious, experienced a more significant reduction in anxiety

Caregivers who received more text message alerts from the system, and who sent more text message responses to the system, experienced greater reduction in anxiety

Condition at 6 months $t(62)=2.702, p=.009$

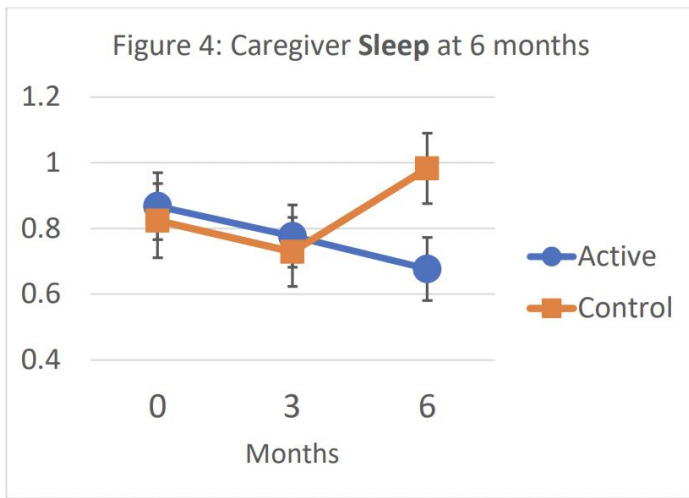
STUDY 2: Impact of monitoring technology on caregiver Sleep Quality

For this study, family caregivers for people with dementia were again selected as they often experience negative health effects compared to non-caregivers.

Participants	Method	Measurement
178 familial caregivers of people with dementia 65% female 64 years mean age	Participants were randomly assigned to two different groups. <ol style="list-style-type: none">1. Group 1, called the fully active group received FutureCare with full functionality and all sensors activated2. Group 2, called the control group were assigned to a waiting-list control condition	Self-report questionnaires assessing Caregiver sleep quality (e.g., global sleep quality, sleep efficiency, sleep disturbances, and daytime dysfunction) were administered at three time points within the 6-month study period.

Study Results

Caregivers in the control group, but not the active group, experienced a significant decline in sleep efficiency between months 3-6, which suggests that FutureCare intervention helped to buffer Caregivers in the active group from declines in sleep efficiency as shown in figure 4.



Condition Assessment $F(2,237)=3.46, p=.033$

Researchers believe that this benefit may have been driven by FutureCare providing caregivers with real-time information about their Care recipient (e.g., nocturnal bathroom or kitchen visit) that would otherwise require hypervigilance on the part of the Caregiver.

What did the UC Berkeley professor have to say about the studies?

In a recent interview on KCBS Radio news, Robert Levenson, Ph.D., Director of the Psychophysiology Department at UC Berkeley, who led these studies, has this to say:

“What makes the FutureCare system unique instead of just saying yes or no or on or off, there is a background intelligence system that is working that learns the normal pattern in every home. Then, if something happens that is atypical like a door opening at 11:00pm at night, the system would notice this unusual activity and would alert the caregiver and family members to check on the person for whom they are caring.”

“This is the first rigorous controlled study to see if we could keep the mental health of the caregivers from declining. What we found, after about 3 months with the system, is that the anxiety in the active group declined whereas the anxiety level in the controlled increased. These results were statistically reliable and fairly clinically significant.”

- Bob Levenson, Ph.D., Director of the Psychophysiology Department at UC Berkeley

Dr Levenson further described that “this personalized system can give caregivers a break. This is particularly important as the dementia progresses, the care is a round the clock concern. The caregiver becomes increasingly worried and anxious thinking that something may happen when their attention is diverted. As a result, the caregiver stops leaving the home and the responsibility becomes almost impossible to keep up every day, every hour. The FutureCare system provides a backstop and a degree of confidence that someone is looking out for that person requiring the care even if the caregiver has to do something else.”

He goes on to say, “If you can keep caregivers healthy, it is really good for the people in their care.”

“We are trying to take the pressure off what we think is leading to anxiety and depression for familial caregivers who are on duty 24/7,” Levenson said. “Though we don’t have a cure for declines in caregiver health, we have evidence that this approach is a step in the right direction.”

“If it’s a false alarm, the software learns and readjusts the threshold,” Levenson said. “If it turns out that something bad has happened, the alert can be directed to a friend or family member to come over and help, or escalated to call an emergency service, if needed.”

“The point is, this goes on all the time, even when the caregiver is asleep or watching TV or out at the store or at work,” he added. “It’s not perfect, but it offers an important backstop, some much-needed extra support for caregivers.” (11)

What did the study participants have to say about their experience?

The study participants had an average age of 64 years, with 65% females, 75.8% non-Hispanic whites, from across 42 states. It was insightful to hear them talk about their experience and what they go through. Here are some quotes from the participant Caregivers.

"I was a brand new, sleep-deprived caregiver when FutureCare came along, running up and downstairs every time my father made a noise. FutureCare gave me back my peace of mind. I could glance at the app, check his whereabouts, and close my eyes again reassured that he was safe. As his only child, I was taking care of him by myself and FutureCare became one of the first offers of true support in helping me protect both his safety and his desire to feel independent again."

Kellye F., daughter, female caregiver

"The motion alerts were great because I would know of my mother's whereabouts and what she was up to. It gave me incredible peace of mind to know that she was safe and it was a relief for me to know this without having to always look for her. The system helped take the stress out caring for my mom by having knowledge of her movements at my fingertips."

Linda M., daughter, female caregiver

"Caring for a loved one with dementia is the most difficult job I've ever had. This system is super helpful for a variety of reasons: it gives me real-time data about my loved one and alerts me to situations that need my attention."

Deb W., daughter, female caregiver

"The FutureCare Family Kit offered several benefits to me as I care for my husband. Specifically, the exit/entry sensors were quite useful in letting me know when a door was opened, and which door was opened. It helps knowing my husband's whereabouts since I cannot be everywhere. Because of these helpful notifications, the Family Kit helped keep my husband safe and sound."

Anne H., wife, female caregiver.

The key takeaways

Familial caregivers for people with dementia experience higher levels of psychological symptoms and greater burden than their age-matched counterparts without caregiving duties. Because Anxiety is exceptionally prevalent among caregivers of dementia patients, and in many cases associated with suicidal ideation, and this is an important target for interventions.

In the first study where the impact on caregiver anxiety was measured, the group that used ambient monitoring and alerting solution from FutureCare experienced a statistically significant reduction in anxiety, compared to the group that didn't, and which reported an increased level of anxiety over the same period.

Takeaway #1:

Impact on caregiver's Mental Health

Deploying ambient monitoring and alerting technology can bring peace of mind for the caregivers by reducing anxiety and improving caregiver's emotional wellbeing.

In the second study where the impact on caregiver sleep quality was measured, the group that used ambient monitoring and alerting solution from FutureCare did not have a deterioration in their sleep quality.

Takeaway #2.:

Impact on caregiver's Physical Health

Since there is direct correlation between sleep quality and physical health, use of ambient monitoring and alerting technology can prevent negative physical health outcomes resulting from deteriorating sleep quality from caregiving.

The study authors believe that this benefit may have been driven by FutureCare providing caregivers with real-time information about their care recipient (e.g., nocturnal bathroom or kitchen visits) that would otherwise require hypervigilance on the part of the caregiver.

Applying the findings to your work

This is what Stanford University Research Professor Emerita, Dept. of Psychiatry & Behavioral Sciences - Dolores Gallagher-Thompson, PhD, had to say about the study findings:

“This relatively inexpensive and innovative approach to reducing caregiver distress will make it possible for more caregivers to get the support they need so that they can stay in their role longer, and more effectively – without leaving their homes and without having to travel somewhere to talk to a mental health provider.

The real time nature of this product is invaluable to those of us who are trying to juggle jobs / careers and the demands of home care for a person with advancing cognitive decline. It’s unfortunately true that most stressed caregivers do not allow themselves the time to get the services they need to take care of their own mental and physical health – not until there’s a crisis and they literally ‘burn out.’ Widespread implementation of easy to use, home-based technology will help to meet some of these key unmet needs.”

We believe, the findings from the study have implications on housing providers, solutions providers and payers who pay for the care of seniors and their caregivers.

Senior housing providers

As FutureCare’s solution demonstrated, Senior housing providers can deploy a validated ambient monitoring solution for them to feel safe in their space, whether if it is a senior independent apartment or assisted living situation, by ambiently monitoring their quality and quantity of activity. With real time data, the solution can meaningfully aggregate and provide it in a centralized location, and remotely monitor seniors in their facilities, prioritized based on their risk factors. Sharing this information in real time with family caregivers brings peace of mind to them, who are typically the decision makers.

- The use of these technologies can be marketed as a differentiator to attract new customers.
- For current customers this can bring a peace of mind thereby increasing the average length of stay.
- The staffing demands can be reduced due to ambient monitoring technology in place.

Age-Tech Solutions developers

Solution developers can embed AI based insight solutions like FutureCare into their offering to offer safety and security monitoring features geared towards caregivers, while respecting the privacy of seniors. This is especially important when their loved one is an older adult living alone or with a disability and at risk for a fall or other conditions that will increase their care needs.

The system can let a remote family member know that their loved one is safe and keeping to their daily routine such as:

- getting out of bed at the usual time
- taking a shower
- keeping to their medication regimen

This gives the care recipients freedom while those who care for them have a sense of security that all is well and, if it is not, they can rely on the system to let them know.

Health systems and Insurance companies

Evidence suggests that aging-in-place in one's home or community may yield:

- better quality of life for seniors
- cost savings for value-based health systems
- cost savings for health insurers

Equally as important, aging in one's familiar surroundings has been shown to have health and emotional benefits over the alternatives, for the seniors. Solutions like FutureCare can help seniors and caregivers decide in favor of aging-in-place as opposed to choosing assisted living facilities, which are much costlier options.

Conclusion

As the scientific studies and user quotes from the study demonstrate, intelligent assistive technology can ease at least some of the physical and mental burden experienced by informal caregivers of persons living with dementia. Caregivers can deploy these tools in the homes of their loved ones and have them act as, what Professor Levenson refers to as the “eye in the sky”, when the caregivers are not around. Senior housing providers and solution/service providers can differentiate their offerings to their target their customers, who are typically the caregivers of seniors, by deploying these tools in their facilities. The same tools can be effective in reducing the staffing demands and reducing the risk of the resident population by targeting higher risk patients.

Further studies are planned to measure the impact on caregiver well-being, positivity and sleep quality. In future work, FutureCare will work with U.C. Berkeley in two underserved populations of caregivers (Spanish-speaking caregivers and those living in rural areas).

Learn More

For further information about this paper or to explore how AI powered assistive technology can help your customers, please reach out to the FutureCare team.

CONTACT US

Email

info@futurecare.ai

Website

www.futurecare.ai

References

1. Urban Institute. *The US Population is Aging*. Center on Labor, Human Services and Population.
<https://www.urban.org/policy-centers/cross-center-initiatives/programretirement-policy/projects>
2. AARP (March, 2016). *Better Together: Age-Friendly and Dementia Friendly Communities*. AARP Network of Age-Friendly States and Communities.
<https://www.aarp.org/livablecommunities/network-age-friendly-communities/info-2016/dementia-friendlycommunities.html>
3. Melo, Andrew. (2022, April 15). The aging US population is creating many problems—especially regarding elderly healthcare issues. Insider Intelligence.
<https://www.insiderintelligence.com/insights/aging-population-healthcare>
4. Alzheimer’s Association. (2022). 2022 Alzheimer’s Disease Facts and Figures. *Alzheimers Dementia*, 2022;18.p.39.
<https://www.alz.org/media/documents/alzheimers-facts-andfigures.pdf>
5. Pinquart, M., & Sörensen, S. (2003). *Associations of stressors and uplifts of caregiving with caregiver burden and depressive mood: a meta-analysis*. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 58(2), P112-P128.]
6. Mahoney, R., Regan, C., Katona, C., & Livingston, G. (2005). *Anxiety and depression in family caregivers of people with Alzheimer disease: the LASER-AD study*. *The American Journal of Geriatric Psychiatry*, 13(9), 795-801.
7. Xu, N.Y., Yokoyama, S., Chen, Y., Brown, C.L., Levenson, R.W. (2021, May 26-27). *Anxiety Is Associated With Suicidal Ideation In Dementia caregivers*. Association for Psychological Science 2021 Convention, Online.
8. Bossen, A. L., Kim, H., Williams, K. N., Steinhoff, A. E., & Strieker, M. (2015). *Emerging roles for telemedicine and smart technologies in dementia care*. *Smart homecare technology and telehealth*, 3, 49.]
9. Diana M. Heath, Yuxuan Chen, Darius T. Levan, Claire I. Yee, Ph.D., Kuan-Hua Chen, Ph.D., Julian A. Scheffer, Ph.D., Scott L. Newton, Deepak Paul, Gene Wang, Dolores Gallagher Thompson, Ph.D., Robert W. Levenson, Ph.D. University of California, Berkeley, People Power Company, Stanford University. (2022). Abstract: Sensor-Based In-Home Technology Reduces Anxiety and Prevents Sleep Quality Declines in Dementia caregivers. NAC.
10. Yuxuan Chen, Darius T. Levan, Clarissa M. Munoz, Gene Wang, David Moss, Kuan-Hua Chen, Ph.D. , Claire I. Yee, Ph.D., Casey L. Brown, Ph.D., Robert W. Levenson, Ph.D. University of California, Berkeley, People Power Company. (2021). Poster Presentation: Evaluating In-Home Technology for Reducing Anxiety in Dementia caregivers. Association of Psychological Science.

11. Culross, Melissa. (2021, May 31). *UC Berkeley uses AI sensors to ease anxiety of caretakers for dementia patients*. <https://omny.fm/shows/kcbsam-on-demand>
12. Anwar, Yasmin. (2021, May, 28). 'Eye in the sky' sensors reduce stress of in-home dementia care. Berkeley News.
13. Darius T. Levan, Yuxuan Chen, Diana M. Heath, Breanna M. Bullard, Julian A. Scheffer, Ph.D., Kuan-Hua Chen, Ph.D., Claire I. Yee, Ph.D., Robert W. Levenson, Ph.D. (2022) Poster Presentation: In-home assistive technology prevents declines in sleep quality in caregivers for people with dementia. The Society for Personality and social Psychology.
14. Hoffman D, Zucker H. A Call to Preventive Action by Health Care Providers and Policy Makers to Support Caregivers. *Prev Chronic Dis* 2016;13:160233