**PARO, THE NEUROLOGICAL THERAPEUTIC MEDICAL ROBOT USED FOR NON-PHARMACOLOGICAL THERAPY**

In 2050, it’s expected a high raise in the elderly population around the globe, mainly in Europe and Japan.[[1]](#footnote-1) And in this latest country, with a population of 127 million people, there has been an ongoing increase of demand for assistive technologies demand since the beginning of the millennium, summing up a total of approximately 35 million elders for only 3 million caregivers.[[2]](#footnote-2) In context, Japan has a birth rate crisis - it’s estimated that the number of babies born in the country in 2019 fell to 864 000, which is the lowest since records began in 1899. Deaths in 2019 also hit a postwar record high of 1.376 million, with a natural population decline of 512 000, the highest ever.[[3]](#footnote-3) The average of people in a Tokyo household has dropped significantly, and living alone will be the norm in Japan from 2020.[[4]](#footnote-4) Which means that more and more people will die alone – the *kodokushi* phenomenon.

With so many elderly people in need of health care attention, mental illnesses tend to develop more frequently among the “+65 year old” group, especially dementia and Alzheimer's.[[5]](#footnote-5) The costs of dementia to society are very large and have been estimated to have reached 1 trillion dollars globally in 2019.[[6]](#footnote-6) The scale of these costs is widely used for advocacy, in order to argue for a public health policy response, and also to make the case for increased public and private funding on research to find a disease modifying treatment. While the argument that “the costs of dementia are so large that unless we find a cure, dementia will bankrupt us” may work well in terms of persuading donors and policymakers to support biomedical research, there is a danger that it may also contribute to structural stigma, by suggesting that our health and social care systems cannot do anything about addressing the challenges posed by dementia. There have long been concerns that advocacy campaigns that use cost of dementia studies to promote the idea that dementia is an economic catastrophe could be hampering the development of policies to address the care, treatment and support of people who are currently living with dementia and their carers.[[7]](#footnote-7)

Since pharmaceutical companies have failed to produce a drug that treats Alzheimer's successfully[[8]](#footnote-8), the impact of new healthcare technologies, such as AI and robotics, has been measured through ongoing and independent evaluation. Robotic personal assistants can be built to look friendly and Japan have taken the lead on this front. In 2013, the Japanese government developed a national project focused on assisting elderly people through robots and AI, mainly using the technologies for health monitoring/checking, assisting daily living, assisting fall detection, companionship and anti-aging.[[9]](#footnote-9) Some of these technologies are for caregivers, some are designed to be used by elderly people themselves and some are exclusively for monitoring those with dementia, to help preventing accidents or assist in urgent situations (eg.: at night or when home alone). Overall, robots can be categorized by 2 types: Industrial robots (the ones that are at factories) and Service robots (the ones that improve our daily life and the same ones funded but the 2013’s Japanese government’s project). To be more precise, Service robots can also be divided by 2 sub-types: Physical Service (like the DaVinci Surgical System) and Mental/Emotional Service (in which PARO is included).[[10]](#footnote-10)

PARO – a word that combines the first syllables of the Japanese words for “personal robot” – is a therapeutic and companion robot developed by Dr. Takanori Shibata of Japan’s National Institute of Advanced Industrial Science and Technology. It has the appearance of a baby harp seal and has the intended of being very cute and cuddly, thus having a calming effect on patients and positive emotional responses from those in hospitals and nursing homes.[[11]](#footnote-11) It was first introduced in 1998 and now it is in its eighth generation and used as a clinical tool in Japan, Europe and America. PARO is not only an FDA approved biofeedback device, but it’s also classified as a Class 2 medical device by U.S. regulators in 2009.[[12]](#footnote-12)

Animal robots can be categorized in three classes: familiar animals (like the dog and the cat), unfamiliar animals (like a harp seal) and imaginary animals (like unicorns). Before designing PARO as a baby harp seal, Dr. Shibata ran a study with subjective evaluations of a cat robot and a seal robot. Both robots were evaluated highly, however, subjects complained about the softness and reactions of the cat robot in comparison with their knowledge of real cats. On the other hand, most people do not have much knowledge of seals, and hence were unable to compare the seal robot with what they knew about them. So, the evaluation of the seal robot following the interaction was higher and these results revealed that more people accepted the unfamiliar animal shaped robot.[[13]](#footnote-13)

As mentioned before, PARO looks like a stuffed toy animal, but it’s in fact a medical device: has tactile sensors, moves its tail and flippers, opens its eyes when petted and produces sounds similar to a real baby harp seal that Dr. Shibata recorded while traveling in Canada.[[14]](#footnote-14) Artificial intelligence software changes the robot’s behaviors based on an array of sensors that monitor sound, light, temperature and touch. It responds to sounds, can learn its name and learns to respond to words its owner uses frequently. It can show emotions such as surprise, happiness and anger and will cry if it is not receiving sufficient attention.[[15]](#footnote-15)

It really does sound like animal-assisted therapy, since patients can benefit from psychological merits (cheer and motivation), physiological merits (stress reduction and rehabilitation) and social effect (stimulation of communication among other patients and caregivers).[[16]](#footnote-16) Robot therapy targets the people in medical and welfare institutions where animals are not allowed, offering an alternative to traditional pet therapy. Recent research has revealed that robot therapy has the same effects on people as animal therapy.[[17]](#footnote-17) Robot therapy, in particular, is recognized as a new method of mental health care for elderly people (including dementia patients). In Asia, pets are popular, but their status can be lower than that of humans, and animal therapy is not known or trusted very much.[[18]](#footnote-18) On the other hand, in western countries pets are loved and their status is somewhat equal than that of humans, and animal therapy is well known and practiced. However, robots are considered to be dangerous or even evil, and there is a fear that jobs might be taken by them.[[19]](#footnote-19)

So, the ultimate question for robotics in healthcare is whether they will take jobs away from humans. There are several reasons why machines will not replace their human counterparts, and one of them is that most hospitals simply cannot easily afford brand new technology.[[20]](#footnote-20) On the other hand, robots can not only undertake monotonous and repetitive tasks, but also those that are potentially dangerous for humans – such as moving heavy boxes or testing solutions. Mental-commitment robots are not intended to perform physical work, as their function as personal robots is to engender mental effects, such as pleasure and relaxation. These robots have a purpose and act independently, although, like living organisms, they receive stimulation from the environment and their actions during interaction with people make it seem that they have hearts and feelings. It’s also useful in emergency situations that are too dangerous for humans.[[21]](#footnote-21) Mental/emotional service robots are able to stimulate the different senses of human beings through physical interaction, thus, the primary characteristic of these robots is nonverbal communication. So, ultimately, robotic assistants cannot replace basic human contact, but they can be a huge help. [[22]](#footnote-22)

Various robots have been developed and are being introduced into our lives, mainly as commercial products with specific purpose. As for PARO, it was designed to maintain a long-term relationship with people and provide them with psychological, physiological, and social benefits. Alas, there was this uncertainty that people with dementia would be left alone with PARO when the caregiver left them to interact with him. In the end, the opposite has proved true, as PARO acts as a social mediator, providing a common topic for the elderly and encouraging them to communicate with each other. They tend to accept PARO as their companion more than as a therapeutic tool. Currently, the methods used in robot-therapy are the responsibility of the caregivers and its effects are influenced by them.

Approximately 1700 PARO units have been sold worldwide (about 1500 in Japan, 120 in Denmark, and 100 in other countries, including Portugal in which PARO is called *Amália*), it has a high rate of acceptance and similar psychological effects are seen in each country.[[23]](#footnote-23) Robot therapy in medical and welfare facilities is spreading in our society. Further studies should be conducted to integrate robot therapy into our societies at large. And even though the technology is expensive and some of it is years from being implemented, the use of robots is changing healthcare and—in ways we can only imagine— will continue to do so.

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3. https://edition.cnn.com/2019/12/25/asia/japan-birthrate-hnk-intl/index.html [↑](#footnote-ref-3)
4. https://medicalfuturist.com/the-top-12-social-companion-robots/ [↑](#footnote-ref-4)
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6. https://pubmed.ncbi.nlm.nih.gov/27583652/ [↑](#footnote-ref-6)
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8. https://www.abc.net.au/news/health/2020-02-26/alzheimers-drug-failure-raises-questions-about-research/11996258 [↑](#footnote-ref-8)
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23. https://www.bbvaopenmind.com/en/articles/life-innovation-with-therapeutic-robot-paro/ [↑](#footnote-ref-23)