

The Use of Technology in Long-Term Inpatient Care for People with Alzheimer's Disease

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Abstract: Alzheimer's disease is an incurable, neurodegenerative disease. The increasing prevalence of Alzheimer's disease represents a significant challenge in the future. As the number of patients grows, so does the demand for long-term inpatient care. The capacities of long-term inpatient care facilities, however, are already insufficient, and solutions need to be found to provide care to an ever-increasing number of patients. A possible solution is the use of technologies. The aim of this work is to analyze which technologies are in use in long-term inpatient care facilities in the South Bohemian Region and the Vysočina Region in the Czech Republic. A questionnaire survey was conducted in nursing care facilities and nursing care facilities with a special regime. Active use of technologies including patient data digitization, patient transfer technology and brain training tools were found. Only a few respondents employed technologies to monitor patient vital functions as well as track motion and detect falls. A comparison of the regions did not show significant differences in the use of technology. A comparison of facility types revealed the greatest difference was in the more prevalent use of motion tracking and fall detection technologies in nursing care facilities with special regime.

Keywords: Alzheimer's disease; inpatient care; technology

JEL Classification: I10; I11; I19

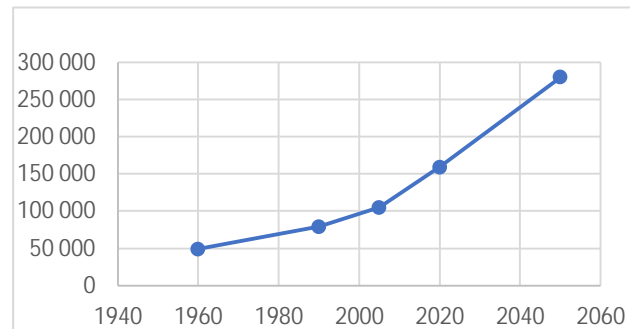
1. Introduction

Alzheimer's disease is a chronic, neurodegenerative disease that is, unfortunately, incurable. Current treatment can only retard the course of the disease. The onset of the disease most often occurs after the age of 65 (Korábečný et al., 2020). In connection with the demographic considerations, the extension of the life of diseased and other influenceable and non-influenceable factors, the prevalence of Alzheimer's disease is increasing. Due to the ever-increasing number of people suffering from Alzheimer's disease, this disease represents a significant threat for the future (Dawson and Phil, 2018).

According to the Česká alzheimerovská společnost (2022), there are currently approximately 161,000 cases of Alzheimer's disease in the Czech Republic. Alzheimer's disease is a problem not only for the Czech Republic, but for the entire world. Zissimopoulos et al. (2015) predicted that the number of people over 70 suffering from Alzheimer's disease would increase by more than 153% between 2010-2050. Chain (2010) estimated that the number of people suffering from Alzheimer's disease would almost triple by 2050. Mátl et al.

(2016) estimated that the number of people suffering from Alzheimer's disease would more than double between 2020 and 2050. Although the estimates of individual authors differ slightly, the result of all sources is similar - the number of people suffering from Alzheimer's disease will increase. Figure 1 depicts the predicted increase in the number of people suffering from Alzheimer's disease in the Czech Republic.

Figure 1. Development and prediction of the number of persons suffering from Alzheimer's disease (Česká alzheimerovská společnost, 2021)



Alzheimer's disease is associated with the need for help from other persons in the field of health care, social care, and management of patient's daily activities, this need constantly increases with the progress of the disease. This makes caring for people with Alzheimer's disease very demanding on human resources (Holmerová, 2018). The capacity of long-term inpatient care facilities in the Czech Republic, however, are already insufficient, while the demand for services and the number of diseased significantly exceeds the capacity of the facilities (Novák, 2018).

The possibility of the patient living at home under the care of relatives as informal caregivers is offered. But the role of a caregiver is very physically, mentally, time and financially demanding and not every person is able of this. Some people live alone and do not have a person, who can be an informal caregiver (Holmerová, 2018). The role of informal caregivers also has an impact on the country's economic situation. People who decide to become an informal caregiver often have to leave their profession in favor of caring for a relative. These caregivers become economically inactive and do not perform their jobs. As the prevalence of the disease increases, so does the number of people who leave their profession to care for a relative. The system is losing many workers of various professions because they cannot get inpatient care facility for their relatives. Caring for the relative is limited in time and after the death of the diseased person, the caregiver can return to work. However, dropping out of the work profession causes a loss of qualification. Returning to the work environment is thus difficult for informal caregivers (Geissler et al., 2015).

With the increasing prevalence of the disease, the important question is, how we will be able to take care of all diseased people who will need help. Human resources, and especially qualified human resources, are limited and there may be a situation where, due to the increasing prevalence of Alzheimer's disease, there will be an acute shortage of caregivers. A possible solution is the use of technology. Technology cannot be understood as a complete replacement of workers. Human power is absolutely irreplaceable and will always be needed (Sugihara, 2013).

Technology is a way to provide better, more accurate and faster care (Reedy, 2021). This has a positive effect on the patient and on the burden on the caregivers. Reducing the burden on caregivers while maintaining at least the same level of service quality allows them to provide care to more patients. Acquisition costs are associated with the advent of technology, but their use represents a reduction in labor costs.

In the Czech Republic, the real level of technology usage in long-term inpatient social-health care facilities is currently unknown. This work contributes to mapping the real level of technology use in long-term inpatient care facilities. Thus, the primary research question is: What technologies are currently employed in long-term inpatient care facilities in the South Bohemian Region and the Vysočina Region?

1.1. Types of Technology

The concept of technology is very broad. Unable to find an existing comprehensive framework of usable technologies for people suffering from Alzheimer's disease, one is offered here. Figure 2 describes the concept. The basis is to cover all the needs of patients with Alzheimer's disease. According to the Česká alzheimerovská společnost (2022), symptoms of Alzheimer's disease include memory loss, speech problems, disorientation, poor rational judgment, personality changes, changes in initiative, movement problems. These are progressive and, at present, there are no curative treatments. Patient care needs include assistance with daily activities and mobility, health care, patient safety, social contact, and cognitive training.

As the available technology review publications always only cover part of the needs of people suffering from Alzheimer's disease, more existing technology reviews were used. Miwa et al. (2021) presents a list of technologies to assist movement and daily activities and technologies for social contact. Boulton et al. (2016) deal with technologies for maintaining patient safety using monitoring technologies. An inseparable basis for the use of technology is the digitization of patient data (McQuivey et al. (2020)). A total of five groups of technologies were proposed, which cover all the care needs of patients suffering from Alzheimer's disease: patient data digitalization (1), patient transfer (2), monitoring of vital functions (3), motion tracking and fall detection (4) and social activities and brain training (5).

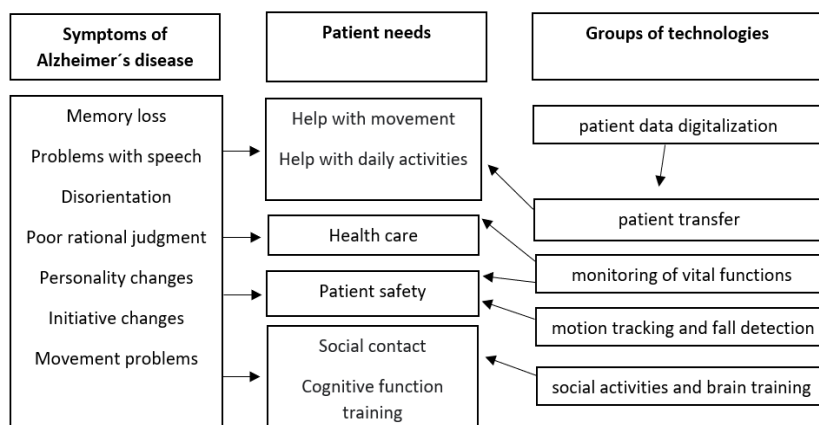


Figure 2. Groups of technologies in the care of people with Alzheimer's disease

An important cornerstone is the digitization of patient data. McQuivey et al. (2020) find in patient data digitization likely facilitates necessary tasks, predicts and warns of dangers, and improves the accuracy of diagnoses and targeted care.

Similar views are published by Priyanadan and Brahm (2016), who perceive digitization as a precursor to future of care that permits early identification of likely problems and complications while providing cost savings and improved equipment performance. The digitization of data represents the basis for future integration of smart devices or artificial intelligence tools.

A basic area where technology can be used is patient transfer. Transfer devices include, for example, electronic beds, electronic lifts, electronic walkers and more. These technologies are not suitable for collecting patient data and then using the information with artificial intelligence, but they are a great help for reduce the burden of staff, reducing falls and their consequences and saving time (Sivashankar et al., 2019).

Results flowing directly from the used technologies can enter the patient's electronic evidence. There are many wristbands, bed pads or other devices that detect basic vital functions such as heart rate, blood pressure, respiration rates, temperature, blood sugar level and others. Mesquita et al. (2016) mention that the use of these tools produces benefits for both patients and staff. Breasail et al. (2021) describes motion detectors, GPS locators, fall detection and other devices that store and evaluate client movement data as also a great help. Groups of technologies for vital function monitoring and movement monitoring consist of part of data collection and part of the use of artificial intelligence tools for evaluation and prediction of possible dangers.

The last major area of use of modern technologies is the social part of care. You can use computers and tablets here not only to communicate with relatives or medical specialists, but also to train your memory and cognitive functions. There are a huge number of applications to support the cognitive functions of the brain (Miwa et al., 2021). Social robots, of which there are many types, are also an important helper. Social robots resemble a human or a pet. An example of a therapeutic robot that is used in long-term inpatient care is the PARO robot. Paro (2022) states that this robot is suitable for therapy in places where it is not possible to perform therapy with a live pet.

2. Methodology

Quantitative research was conducted on long-term inpatient care facilities in the Vysočina region and the South Bohemian region. The interviewed subjects were nursing care facilities and nursing care facilities with a special regime. According to § 49-50 (Act no. 108/2006 Coll.), only nursing care facilities with a special regime are intended for people suffering from Alzheimer's disease, while nursing care facilities are not. However, the reality is different and people with Alzheimer's disease are also live in nursing care facilities (Hanzalová et al. 2020). For that reason, both types of facilities are included in the research sample.

The research sample and the number of respondents is described in Tables 1 and 2 below of the Vysočina region and the South Bohemian region. Information about the facilities was

obtained from the database of the services of the Czech Alzheimer's Society. Data were collected using a questionnaire protocol guiding collection via personal interviews or telephone calls. The survey was conducted during the period August 2022 – October 2022.

Table 1. Characteristics of the respondents in South Bohemian region

| Type of facility | Total number of facilities | Number of respondents | Research coverage |
|---|----------------------------|-----------------------|-------------------|
| Nursing care facility | 25 | 8 | 32% |
| Nursing care facility with a special regime | 20 | 4 | 20% |
| Both types of facilities together | 45 | 12 | 27% |

Table 2. Characteristics of the respondents in Vysočina region

| Type of facility | Total number of facilities | Number of respondents | Research coverage |
|---|----------------------------|-----------------------|-------------------|
| Nursing care facility | 26 | 9 | 35% |
| Nursing care facility with a special regime | 19 | 5 | 26% |
| Both types of facilities together | 45 | 14 | 31% |

The questionnaire consisted of five basic questions. Each question explored about one group of technologies. The specific groups were: patient data digitalization (1), patient transfer (2), monitoring of vital functions (3), motion tracking and fall detection (4) and social activities and brain training (5). If the respondents answered affirmatively, they also indicated the specific type of technology in use.

We subsequently looked for specific types of technologies in publicly available documents (websites and annual reports). For a representative sample of respondents, it was necessary to obtain at least 10% response rate (Pecáková, 2018). This minimum limit was observed in both regions. In the South Bohemian region, 27% of facilities were connected, in the Vysočina region, 31% of facilities were connected.

3. Results

The survey research conducted focused on the use of technology in nursing care facilities and in nursing care facilities with a special regime in the South Bohemian Region and the Vysočina Region. Many technologies are known that can be used in the care of people suffering from Alzheimer's disease. But no one knows what the actual level of technology use in devices is, and this research will focus on that.

3.1. The Level of Technology Use in Long-Term Inpatient Care

Respondents answered the questions whether they use technologies from five basic groups: 1. patient data digitalization, 2. patient transfer, 3. monitoring of vital functions, 4. motion tracking and fall detection and 5. social activities and brain training. Table 3 summarizes the results of the South Bohemian Region. Table 4 summarizes the results of the Vysočina region. These tables represent the number of devices from all respondents that use a given group of technologies. The first column shows the total number of respondents. The following columns indicate how many respondents confirmed the use of technologies from

the given groups. The analyzed values are divided for nursing care facilities and nursing care facilities with a special regime.

In the South Bohemian region (Table 3), a total of 12 respondents took part in the research – 8 nursing care facilities and 4 nursing care facilities with a special regime. All respondents stated that they use technologies from the patient data digitalization group and patient transfer group. In the monitoring of vital functions group, 2 respondents confirmed the use. 3 respondents use technologies for motion tracking and fall detection, and 9 respondents confirmed the use of technologies for social activities and brain training.

Table 3. The use of technology in South Bohemian region

| Type of facility | Total respondents | Patient data digitalization | Patient transfer | Monitoring of vital functions | Motion tracking, fall detection | Social activities, brain training |
|---|-------------------|-----------------------------|------------------|-------------------------------|---------------------------------|-----------------------------------|
| Nursing care facility | 8 | 8 | 8 | 1 | 1 | 6 |
| Nursing care facility with a special regime | 4 | 4 | 4 | 1 | 2 | 3 |
| Both types of facilities together | 12 | 12 | 12 | 2 | 3 | 9 |

In the Vysočina region (Table 4), a total of 14 respondents took part in the research – 9 nursing care facilities and 5 nursing care facilities with a special regime. All respondents stated that they use technologies from the patient data digitalization group and patient transfer group. In the monitoring of vital functions group, 1 respondent confirmed the use. 3 respondents use technologies for motion tracking and fall detection, and 9 respondents confirmed the use of technologies for social activities and brain training.

Table 4. The use of technology in Vysočina region

| Type of facility | Total respondents | Patient data digitalization | Patient transfer | Monitoring of vital functions | Motion tracking, fall detection | Social activities, brain training |
|---|-------------------|-----------------------------|------------------|-------------------------------|---------------------------------|-----------------------------------|
| Nursing care facility | 9 | 9 | 9 | 1 | 0 | 7 |
| Nursing care facility with a special regime | 5 | 5 | 5 | 0 | 3 | 2 |
| Both types of facilities together | 14 | 14 | 14 | 1 | 3 | 9 |

3.2. Types of Technology

Subsequently, the research focused on the identification of specific devices. Table 5 and 6 summarizes which specific types of technologies are used in the facilities. These tables contain a list of specific devices used and the frequency of their use. The frequency of use is expressed in the number of facilities and as a percentage of the total number of respondents. Table 5 presents the use of technology in nursing care facilities. Table 6 represents the use of devices in nursing care facilities with a special regime. Each table presents the results for the South Bohemian region, the Vysočina region and both regions together.

Table 5 contains data on the use of technology in nursing care facilities. A total of 17 nursing care facilities participated in the questionnaire, of which 8 facilities from the South

Bohemian region and 9 facilities from the Vysočina region. All respondents used technologies for patient data digitalization. In the patient transfer technology group, all respondents used electronic beds and electronic lifts. Electronic walkers used 6 respondents. Monitoring bracelets were used by 2 respondents – 1 device from the South Bohemian region and 1 device from the Vysočina region. No respondent used GPS locators. Only 1 respondent used camera systems. A total of 12 respondents used cognitive training games on a shared computer and only 1 respondent used technology to provide personalized cognitive training. For most technologies, there is no difference in the frequency of use between regions. The most significant difference is the use of camera systems, which uses one device from the South Bohemian region and no device from the Vysočina region. In the case of personalized cognitive training, the technology uses one device from the Vysočina region and no device from the South Bohemian region.

Table 5. The use of technology in nursing care facilities

| Group of technologies | Type of device | Respondents who use the device (South Bohemia) | Respondents who use the device (Vysočina) | Respondents who use the device (South Bohemia + Vysočina) |
|-----------------------------------|---|--|---|---|
| Patient data digitalization | - | 8 (100%) | 9 (100%) | 17 (100%) |
| Patient transfer | Electronic beds | 8 (100%) | 9 (100%) | 17 (100%) |
| | Electronic lifts | 8 (100%) | 9 (100%) | 17 (100%) |
| | Electronic walkers | 3 (38%) | 3 (33%) | 6 (35%) |
| Monitoring of vital functions | Monitoring bracelets | 1 (13%) | 1 (11.1%) | 2 (12%) |
| Motion tracking, fall detection | GPS locators | 0 (0%) | 0 (0%) | 0 (0%) |
| | Camera system | 1 (13%) | 0 (0%) | 1 (6%) |
| Social activities, brain training | Cognitive training games on a shared computer | 6 (75%) | 6 (67%) | 12 (71%) |
| | Personalized cognitive training | 0 (0%) | 1 (11%) | 1 (6%) |

Table 6 contains data on the use of technology in nursing care facilities with a special regime. A total of 9 nursing care facilities with a special regime participated in the questionnaire, of which 4 facilities from the South Bohemian region and 5 facilities from the Vysočina region. All respondents used technologies for patient data digitalization. In the patient transfer technology group, all respondents used electronic beds and electronic lifts. Electronic walkers used 3 respondents. Monitoring bracelets were used by 1 respondent. One respondent used GPS locators. Camera systems were used by 4 respondents. 3 respondents used cognitive training games on a shared computer and only 1 respondent used technology to provide personalized cognitive training.

If we compare the results in table 6 for each region, many groups of technologies have the same frequency of use. Compared to the Vysočina region, the South Bohemian region has a higher proportion of use of monitoring bracelets and cognitive training games on a shared computer. The Vysočina region has a higher share of the use of electronic walkers and GPS locators compared to the South Bohemian region.

Table 6. The use of technology in nursing care facilities with a special regime

| Group of technologies | Type of device | Respondents who use the device (South Bohemia) | Respondents who use the device (Vysočina) | Respondents who use the device (South Bohemia + Vysočina) |
|-----------------------------------|---|--|---|---|
| Patient data digitalization | - | 4 (100%) | 5 (100%) | 9 (100%) |
| Patient transfer | Electronic beds | 4 (100%) | 5 (100%) | 9 (100%) |
| | Electronic lifts | 4 (100%) | 5 (100%) | 9 (100%) |
| | Electronic walkers | 1 (25%) | 2 (40%) | 3 (33%) |
| Monitoring of vital functions | Monitoring bracelets | 1 (25%) | 0 (0%) | 1 (11%) |
| Motion tracking, fall detection | GPS locators | 0 (0%) | 1 (20%) | 1 (11%) |
| | Camera system | 2 (50%) | 2 (40%) | 4 (45%) |
| Social activities, brain training | Cognitive training games on a shared computer | 2 (50%) | 1 (20%) | 3 (33.3%) |
| | Personalized cognitive training | 1 (25%) | 1 (20%) | 2 (22%) |

Table 7 presents a comparison of the frequency of use of specific devices in nursing care facilities and in nursing care facilities with a special regime. Respondents are counted for both regions together. The values are expressed as a percentage of the total number of respondents. The table shows that there are no differences in the frequency of use in the areas of patient data digitization, patient transfer and monitoring vital function. The difference is noticeable in the motion tracking and fall detection group. No nursing care facility used GPS locators and only 6% used camera systems. In the case of nursing care facilities with a special regime, GPS locators were used by 11% of respondents and camera systems by 45% of respondents. In the social activities and brain training group, nursing care facilities used cognitive training games on shared computers more than nursing care facilities with a special regime, but in the case of personalized cognitive training, nursing care facilities used technology less than nursing care facilities with a special regime.

Table 7. The use of technologies in nursing care facilities and nursing care facilities with a special regime

| Group of technologies | Type of device | Nursing care facilities | Nursing care facilities with a special regime |
|-----------------------------------|---|-------------------------|---|
| Patient data digitalization | - | 100% | 100% |
| Patient transfer | Electronic beds | 100% | 100% |
| | Electronic lifts | 100% | 100% |
| | Electronic walkers | 35% | 33% |
| Monitoring of vital functions | Monitoring bracelets | 12% | 11% |
| Motion tracking, fall detection | GPS locators | 0% | 11% |
| | Camera system | 6% | 45% |
| Social activities, brain training | Cognitive training games on a shared computer | 71% | 33.3% |
| | Personalized cognitive training | 6% | 22% |

4. Discussion

Technologies represent an important role for the possible increase of the capacities of long-term inpatient care facilities in the care of people suffering from Alzheimer's disease. The capacities of nursing care facilities and nursing care facilities with a special regime are already insufficient, and with the increasing prevalence of Alzheimer's disease, the problem is expanding even further. There is a lack of mapping of the level of technology use in the Czech Republic. The aim of the research was mapping the real level of technology use in long-term inpatient care facilities for people suffering from Alzheimer's disease in the South Bohemian region and Vysočina region.

The results show that all facilities had patient data digitization and used technology for patient transfer. Data digitization and digitalization are a necessary first step in the eventual use of artificial intelligence tools. In the patient transfer technology group, electronic beds, electronic lifts and electronic walkers are used. There is no possible connection with the use of artificial intelligence tools, but these technologies enable faster care, prevention of falls and their consequences, greater comfort for patients and a reduction in the burden on caregivers.

A lower level of technology use was recorded for the monitoring of vital functions and motion tracking group. Only 3 respondents use bracelets for monitoring of vital functions. In the motion tracking and fall detection group, although 6 respondents confirmed the use of technology, 5 of them subsequently described that they only use camera systems. Only one device used location-specific chips.

The last analyzed group consisted of technologies for social activities and brain training. No device used technology for social activities, such as social robots. 18 respondents confirmed the use of programs for cognitive training. Of these, 15 facilities provided a cognitive training program on a shared computer. Only 3 facilities used the possibility of personalized cognitive functions training according to the health status of a specific patient.

For most technologies, there was no difference in the frequency of use between regions. For nursing care facilities, the most significant difference was the use of camera systems, which uses only one device from the South Bohemian region. The technology for personalized training used only one respondent from the Vysočina region. For nursing care facilities with a special regime, the South Bohemian region had a higher proportion of use of monitoring bracelets and cognitive training games on a shared computer. The Vysočina region had a higher share of the use of electronic walkers and GPS locators.

When comparing the use of technologies in nursing care facilities and in nursing care facilities with a special regime there were no differences in the frequency of use in the areas of patient data digitization, patient transfer and monitoring vital function. The difference was noticeable in the motion tracking and fall detection group, which were mostly used by nursing care facilities with a special mode. In the social activities and brain training group, nursing care facilities used cognitive training games on shared computers more and the case of personalized cognitive training less than nursing care facilities with a special regime.

5. Conclusion

There is a trend of increasing prevalence of Alzheimer's disease. As the number of people with Alzheimer's dementia increases, so do the demands for care. Care in the form of informal caregivers is not suitable for everyone and is also a challenge for the whole country. Informal caregivers become economically inactive due to caring for the diseased relatives. However, long-term inpatient facilities already have insufficient capacity and there is a need to increase preparedness for future increases in demand, related to the growing number of people suffering from Alzheimer's disease. However, human resources and especially qualified human resources are limited. This problem can be mitigated by using technology.

An analysis of the use of technology in long-term inpatient care facilities in the South Bohemian and Vysočina regions was carried out. The use of technology proved to be satisfactory (100% of respondents used the technology) only for some groups of technologies. The results show that all facilities in the South Bohemian region and the Vysočina region actively use technologies from the groups of data digitization and patient transfer. Much of the facilities used technologies for cognitive training, although these were only basic capabilities of cognitive games. Only a few respondents use the technologies for monitoring vital functions and for detecting movement and falling was recorded. A comparison of the regions did not show significant differences in the use of technology. A comparison of device types showed the greatest difference in the use of the motion tracking and fall detection technologies, where there was a higher rate of use in nursing care facilities with a special regime.

The research was conducted in only 2 regions of the Czech Republic. For a comprehensive view of the issue, it will be necessary to carry out comprehensive research that will cover the entire territory of the Czech Republic.

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Conflict of interest: none.

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