

# Quality of Assistive Technologies in the Home Care for Elderly

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**Abstract.** Due to demographic changes, the number of elderly people who are in need of care is increasing. Assistive technologies make it possible for many elderly people to remain home despite their health conditions, which many prefer. Quality is an essential element of nursing care, and the elderly are becoming increasingly aware of this and are beginning to make high demands. The aims of this paper, which is based on a master's thesis, were to identify quality criteria in the field of assistive technologies and to present indicators for measuring quality. An extensive literature research was conducted for the theoretical part, and the empirical part employed a qualitative survey. The results show that the elderly's contentment and quality of life are the decisive factors for quality. A catalogue of quality indicators was developed by merging the results from literature with those from the expert consultation. To conclude, further research in this context, based on the results of this paper, is needed, in order to support the increasing use of assistive technologies.

**Keywords.** Assistive technologies, quality indicators (health care), quality assurance (health care).

## 1. Introduction

According to studies on the population development in Austria conducted by Statistics Austria, a population increase from 8.5 million people in 2013 to more than 9 million people in 2025 is expected. In addition, the population's age structure will shift towards more elderly people [1]. Physical limitations and chronic diseases increase at an older age, as well as multimorbidity (i.e. suffering from more than one condition at the same time). Therefore, the need for care and assistance increases [2].

Many elderly want to live independently in their own homes for as long as possible [3], even when they need care [4]. In most cases, relatives care for the dependent persons at home, but this resource is declining due to the increased employment of women and changing family patterns. Therefore, several social challenges are emerging, as there are not enough health care professionals to meet the great demand for home care [5].

The use of assistive technologies and systems may be one way to make up for the lack of professional health care personnel for home care, while also allowing elderly people to remain in the home environment [6]. Assistive technologies reduce (age-related) physical limitations by supporting the user's mobility, perception and everyday activities. These technologies range from simple devices (e.g. walking or vision aids) to electronic equipment (e.g. movement detectors or stove control systems) [7]. The concept of ambient assisted living (AAL) merges all approaches, devices and services that connect assistive technologies and the social surroundings in order to enhance the user's quality of life [8].

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The persons currently in need of care are becoming increasingly informed citizens [3] and therefore make much higher demands on the quality of care and assistance [9]. The quality of AAL devices is of great significance, particularly in some critical situations, as there can be serious consequences if there are difficulties in operating the device [6]. Quality assurance contributes to the secure and successful use of assistive technologies [10]. Therefore, both objective and subjective quality must be considered [6], since the user's contentment with the device is a central aspect of quality. Satisfaction can only be guaranteed if the device meets the user's requirements, which is only possible if it suits the user's lifestyle or can be integrated into daily life. In order to gauge quality, the objective of this paper was to identify quality criteria in the field of assistive technologies and to present indicators for measuring quality.

### *1.1. Quality of home care*

It is difficult to determine the quality of care, as it is a person-centered service that features two key characteristics: first, the care-giving person has direct contact with the person who is in need of care, and second, the dependent person actively participates in the service performance. These factors affect the result and the process of the service. Therefore, professional expertise, nursing experience and, above all, the interaction with the dependent person determine the subjective quality [11]. A qualitative survey of assistance and care arrangements of elderly people in the home environment was used to determine which factors are crucial for the quality of home care. The results of this survey show that, overall, the quality of home care is perceived to be high just by virtue of the fact that the person can remain home. This circumstance, along with a good relationship with the care-giving person, mitigate the objective inferior quality of care that results from more frequent nursing problems, such as pressure sores or decubitus [12].

### *1.2. Assistive technologies and quality*

Quality assurance is essential for the secure and successful use of assistive technologies. This includes the quality of both the service provided and any relevant devices. The quality of the device is the result of achieving defined performance targets via assistive technologies [10], improving the quality of life and increasing the well-being of the respective user. Quality is essential because any error in critical situations can lead to severe consequences. Therefore, methods must be developed to protect the user from operating errors, to ensure the correct device functionality, to guard person-specific data against theft and misuse, to eliminate barriers and to ensure the improvement of well-being by using assistive technologies [6].

Few approaches exist for developing indicators for the quality of assistive technologies. The Scottish researcher Hersh provides a detailed list of criteria that should be used to assess assistive technologies. These criteria are classified in the following four groups: compliance and good practice, technical issues, end-user issues and resource and financial issues [13]. In Germany a working group of the innovation partnership AAL has examined this issue and provided a whitepaper with a detailed illustration of quality criteria, which are classified in general and product-specific criteria, as well as quality requirements for the services. However, they emphasize that precise criteria have to be compiled individually and product-specifically [6].

## 2. Methods

The research for the present paper involved an extensive literature search for the theoretical part and a qualitative survey for the empirical part. In order to achieve the objective, a catalogue of quality criteria was developed.

The following paragraphs provide a brief description of the methods used.

### 2.1. *Literature research*

First, a literature research on assistive technologies, home care and quality of home care and quality in the context of assistive technologies was conducted. Initially, this was done using the Online Public Access Catalogue of the University of Applied Sciences Burgenland and the University of Vienna, as well as in the Search Engine of the Austrian Library Network. Additionally, Google, Google Scholar and the Electronic Journals Library of the University of Regensburg were searched for documents and journal articles. Moreover, the bibliographies of the initial literature identified were reviewed in order to identify additional sources.

### 2.2. *Qualitative survey*

The empirical survey consisted of eight semi-structured interviews, which were conducted with experts from IT and social sciences, one user of assistive technologies, one professional caregiver who has experience with assistive technologies and decision-makers. Expert interviews were used to obtain specific information on a certain topic [14]. The persons chosen were interviewed as experts in the field of assistive technologies for different reasons. The IT experts have experience with the technical aspect, and the social sciences experts have knowledge regarding the needs of an aging population. The user of assistive technologies represented the actual needs and demands of the users, the professional caregiver has experiences from her practical work, and the decision-makers work in the field of geriatrics, which means they have important insights into the potential of assistive technology usage. The interview guideline included questions about assistive technologies, quality and future trends. The interview guideline was shortened and adapted for the interview with the user of assistive technologies. The interviews were analyzed using qualitative content analysis in accordance with the approach of Lamnek. This analysis consists of four steps. Firstly, the interviews are transcribed. Secondly, the relevant statements from each interview are assigned to the defined categories. Thirdly, similarities and differences between the statements are valued. Fourthly, the conclusions are checked in order to avoid misinterpretation [15].

### 2.3. *Development of the catalogue of quality criteria*

By merging the results from the literature with those from the qualitative survey, a catalogue of quality indicators from the user's point of view was developed. The structure of the catalogue was based on the list from Hersh [13]. The categories compliance, device, user and financing were filled with indicators derived from the findings of the literature search and the expert interviews.

### 3. Results

To sum up the results of the literature research, assistive technologies have a high potential to enable elderly people to remain in the home environment despite their need for care. It is difficult to determine the quality of care, as the subjective quality is the main factor for high quality from the dependent person's point of view. Clearly, the objective quality of assistive technologies is crucial, as there are many dangers for physical harm. But finally also in this area is the subjective quality the decisive factor from the dependent person's point of view.

The following paragraphs describe the results of the qualitative survey using defined categories. To a significant degree, the experts' statements corresponded with the results of the literature research.

#### *3.1. What are assistive technologies, should they be used, and what ethical aspects have to be considered?*

The experts consistently define assistive technologies as systems and products which support elderly people, foster their independent living and thus facilitate remaining in the home environment. This is also the general core benefit of assistive technologies. In particular, potential benefits can emerge in the following areas of life: health (health monitoring), safety, household and social issues.

Sensor systems, such as movement detectors, fall detectors and other household alert systems, are very widely known among the persons interviewed. Medical alert systems, monitoring and electronic transmission of vital signs, lifting devices and special mattresses are also known. The interviewed user of assistive technologies has a tablet computer for controlling light and heating in her flat, movement detectors, an alert clock and a specifically programmed smartphone, which can transmit data measured by the weighing machine, the blood pressure meter and the blood glucose meter to a protocol via near field communication.

According to the results of one interviewed expert and the literature, professional health care personnel tend to develop a negative attitude toward assistive technologies because of the potential reduction of professional caregivers through the increased use of technology. However, the interviewed professional caregiver did not express such concerns. She actually showed a very positive attitude, as did the other individuals who were interviewed. Nevertheless, two experts are of the opinion that personal contact is indispensable. One expert views the use of assistive technologies very critically because he has seen that devices that are meant to foster independence often have the opposite effect.

Regarding ethical issues in the area of assistive technologies, the experts have differing opinions. On the one hand, much sensitive data is collected, which has to be protected, and it is legally prescribed that ethical considerations must be taken into account. On the other hand, elderly people seem to have no concerns regarding ethical aspects.

#### *3.2. Do elderly people at home need or even want assistive technologies?*

One expert is of the opinion that elderly people do not need to purchase assistive technologies and that the subjective appraisal depends on the level of education. Other

experts note that the appraisal is affected by the acceptance of the user and the relevant condition.

Four experts estimate that elderly people's need for assistive technologies in the home environment is large or very large. Another expert indicates that the need results from the increase in single-person households.

### *3.3. Prospects and limits of establishing assistive technologies*

The use of assistive technologies brings numerous prospects and limitations. Above all, financing of the devices is a major obstacle because of its complexity in Austria. However, it is highly likely that the use of assistive technologies in the home environment can postpone long-term care or even prevent it in some cases. This would result in a big potential financial benefit for the health care system, as long-term care is much more expensive and the seemingly urgent extension of the availability of inpatient programs could be mitigated. However, to achieve these benefits, an overlapping financing for the development and purchase of assistive technologies is needed.

Further prospects are the improvement of the user's quality of life and the improvement of the quality of care. However, technical barriers are problematic, as most of the available devices are still not sufficiently user-friendly. Additionally, the level of the user acceptance is currently not very high.

### *3.4. Quality of home care and in the context of assistive technologies*

The persons interviewed are consistently of the opinion that the dependent person's subjective perception or contentment with the service is the decisive factor for the quality of home care. Instruments for measuring the quality of life are one way to measure the dependent person's subjective contentment in a standardized way. For example, objective criteria could include hospitalization rates or the number of admissions to nursing homes, although these criteria have some restrictions. The ability to remain as independently as possible in the home environment despite needing a certain level of care is a criterion that is both objective and subjective.

Despite some basic objective quality standards, the subjective quality is the most important aspect from the user's point of view in the context of assistive technologies. Additional criteria include the reduction of health implications through timely recognition and intervention, as well as the ability to live with largely independently at home despite needing a certain level of care.

With regard to the quality measurement, a means has to be found to measure the fulfilment of the benefit. One possible option is the measurement of the quality of life. However, what gets measured, how the data will be analyzed and interpreted and who will carry out the measurement and the interpretation must be carefully determined.

### *3.5. Future necessities and expectations*

According to the people interviewed, there is a need for significant modification and developments in order to enable a successful future use of assistive technologies. As already mentioned, the financing system has to be improved, among other factors. Furthermore, the devices have to be made suitable for the masses, to be widely used and financially affordable. The experts mentioned further developments regarding the

precision of sensor systems and the connection with national or international emergency call organizations.

### 3.6. Catalogue of quality indicators

By merging the results from the literature search with those from the qualitative survey, a catalogue of quality indicators from the user's point of view was developed, which is shown in Table 1. The indicators are classified in the following groups: compliance, device, user and financing.

**Table 1.** Catalogue of quality indicators from the user's point of view

<b>Compliance</b>	<ul style="list-style-type: none"> <li>• Legislation</li> <li>• Standards</li> <li>• Culture-specific ethical values</li> </ul>
<b>Device</b>	<ul style="list-style-type: none"> <li>• Safety</li> <li>• Functionality (e.g. battery runtime, measurement accuracy, measurement speed, memory space)</li> <li>• Efficiency and effectiveness (e.g. appropriate relation from sensitivity to specificity, reliability, reduction of health implications through timely recognition)</li> <li>• Usability (e.g. ergonomic and age-appropriate design, possibility of individual adjustment, wearing comfort, integration into lifestyle)</li> </ul>
<b>User</b>	<ul style="list-style-type: none"> <li>• Contentment</li> <li>• Quality of life</li> <li>• Change of the dependency due to the respective need of care by the use of assistive technologies</li> </ul>
<b>Financing</b>	<ul style="list-style-type: none"> <li>• Purchase costs</li> <li>• Maintenance costs</li> <li>• Costs for instruction, training and support</li> <li>• Possibility and costs of the integration of further devices and systems</li> </ul>

The first group, compliance, includes the compliance of the device or system with legislation and standards. However, it must also conform to culture-specific ethical values.

The second group, device, includes indicators related to product-specific characteristics, such as an adequate functionality or design. For example, the risk of injury through the device has to be eliminated.

The third group, user, includes indicators for the contentment and quality of life, and the last group, financing, includes various indicators related to the financing of the device.

This catalogue consists of the major objective quality indicators of assistive technologies, as well as subjective indicators that have to be generally considered. Depending on the device and the individual expectations and demands of the user, several indicators may be supplemented or specified.

## 4. Discussion

In summary, assistive technologies contain high potential in several respects, which is due to demographic changes. Quality is crucial in this context because of the potential risks. Therefore, it is necessary to identify ways to measure the quality in a standardized manner. However, most of the currently available measurement instruments focus on

objective quality. Although this is crucial, it is important to consider the individual's needs and requests from the start. In this area, this paper shows that the subjective quality is a decisive factor. The catalogue of quality indicators presented in this paper constitutes a basis for a measurement instrument for assistive technologies which adequately incorporates the subjective quality. It can be used, for example, in projects where assistive technologies are implemented to support home care. However, it is recommended that further quantitative and qualitative studies with (potential) users of assistive technologies be conducted to verify the quality indicators.

Furthermore, the methods used had some limitations, as a relatively small number of people were interviewed. Nevertheless, it is positive to note that at least one user of assistive technologies could be interviewed.

In order to support the development and widespread use of assistive technologies, further research and (inter-) national cooperation in this context are recommended.

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