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Assessing assistive technology outcomes with dementia

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Purpose This article presents a review of the available evaluation of quality of life (QOL) outcomes as a result of assistive technology (AT) interaction among older adults with cognitive impairment and the further development of an outcome assessment framework specific to this area of research. The framework is based on a previous version first proposed by the authors in 2010¹ and results derived from working on the ISISEMD-project^{2,3}. **Method** A literature review compiled relevant AT-outcomes assessments specific to QOL-results of dementia interventions, describing strengths and weaknesses. Furthermore, during the course of the ISISEMD-trials, issues arose that highlighted the lack of appropriate assessments for evaluating QOL in dementia with AT-interventions. This needed to be addressed in order to further develop the fields of AT-outcomes measurement, QOL-assessment, and dementia care. The original framework, describing the development and application of an electronic QOL-assessment format incorporating the AT-enhanced environment for those with dementia, aims to close the variance between AT-use and AT-outcomes with empirical demonstration. **Results & Discussion** Results include: (i) Assessment of current outcomes measurement tools and methods; (ii) Analysis of the issues involved in AT-outcomes measurement; and (iii) Description of the framework and its application for dementia AT-outcomes assessment. There is a significant lack of appropriate measurement tools that examine QOL-outcomes as a result of AT-interaction in dementia care. Through the use of the proposed framework, researchers and clinicians can better determine which ATs will stimulate the desired intervention outcomes as well as measure their effectiveness. This has implications for dementia care, technology development, socioeconomic benefits and policy.

Keywords: *aging-in-place, technology outcomes assessment, quality of life, dementia*

INTRODUCTION

Research on Quality of Life (QOL) is complex due to the subjective natures of reflection and communicating perceptions involved. This is even more convoluted when the person has dementia and the accompanying decreasing cognitive functioning. Dementia is a syndrome characterized by a progressive decline in memory and cognitive capabilities and is one of the leading causes of institutionalization in older adults. The main focus of treatment and care is on maintaining QOL. One way in which QOL can be influenced is through technology, ranging from an electronic calendar to Smart Homes. QOL is a broad concept yet all of the domains identified as influential on QOL can be affected by technologies in the home, referred to as Assistive Technologies (ATs). If the goal is to maintain or improve QOL, the evaluation tools should address this in an appropriate manner. One of the main issues when integrating ATs into the care plan is determining which technologies and services will achieve the most desirable (QOL) outcomes. This article describes relevant QOL assessment tools that would assess ATs in dementia care – this is with the premise that their goal is to detect fluctuations in QOL as an outcome indicator of the AT. If the technology is the prescription, then a higher QOL is the expected side effect. There will also be

other side effects (i.e. a better understanding of how those with dementia perceive and use technologies), but this paper focuses primarily on AT-related QOL outcomes. Specific to that, it aims to reflect the importance of environmental influences on QOL and presents a revision of a QOL evaluation framework specific to ATs for dementia care services. Additionally, some of the lessons learned during European trials with end users are presented to illustrate the need for further AT outcome research and development.

QUALITY OF LIFE ASSESSMENT IN DEMENTIA

QOL is a multidimensional concept that consists of psychological, social, physical, objective and subjective factors in a person's life. The World Health Organization (WHO) defines QOL as one's perception about their current status in the perspective of their culture, mores and concerning their aspirations, opportunities and interests⁴. Although the WHO is the main authority cited for defining QOL, there has been incongruence in how QOL should be defined and discrepancy in the theoretical basis of how that can be measured; this presents obvious issues in determining how to view QOL and effectively assess it. MP Lawton⁵ recommended a hierarchical view that holds behavioral capabilities and subjective life

quality as central divisions and psychological well-being as the desired outcome⁶. Lawton's conceptualization of QOL in dementia has thus far been the most prominent influence in the development of disease-specific instruments and many of the tools are modeled after his constructs. Lawton's work is influential here in that he proposes the environment as a criterion or facilitator to achieve psychological well-being, yet Jonker, et al.,⁷ report that there is a lack of research that presents a paradigm to explain the underlying correlations between QOL and the domain of home environment.

With the intentions of using AT in the home to increase life quality, the authors recognize several perspectives. One is the subjective experience of the individual whose QOL is being assessed (e.g. the person with dementia), another being objective measures (e.g. biological outcomes, closer related to HRQOL) and finally the subjective perception of the proxy individual (e.g. physician or caregiver). Formerly, researchers thought it was impossible to ask the persons with dementia to accurately rate their QOL due to the nature of cognitive impairment and perceived lack of insight; therefore, proxy ratings of patient QOL were the focus of development. Fortunately, later research has shown that those with dementia can still convey their wishes and desires about their life quality to caregivers and researchers⁷⁻¹². Current theoretical modeling emphasizes incorporation of the individual view of QOL by directly asking older adults with cognitive impairment what is important to them in life quality and why¹²⁻¹⁷, which also shifts the theoretical paradigm of QOL towards individual perceptions and desires. Although it proves most beneficial to directly ask the older adult with dementia about their QOL, the proxies bring another dimension to the understanding of the situation and care outcomes; they are certainly not discouraged to give reports of QOL, but they are no longer the primary source of QOL information.

It must also be recognized what the intervention strategy is for the individual user, so as to know what the assessment is intending to evaluate. A compensation strategy will attempt to compensate for physical and cognitive decline (e.g. through medication reminders) while a rehabilitation strategy will appraise the level of functioning an individual successfully regains (e.g. walking the dogs). Particularly in dementia where there can be personality changes or behavioral disruptions, there are also cognitive-behavioral strategies, which attempts to help the older adult and their caregivers reduce stressful situations and behavioral outbursts. It is anticipated that a combination of strategies will be most often used in environmental modifications with dementia to

accommodate the individual preferences and idiosyncrasies.

Main Domains of QOL in Dementia

This section presents an overview of the primary domains of QOL in persons with dementia, and environment is further discussed in terms of how AT can have an impact. This is a basic, yet complex, step to classify which variables comprise and which change QOL, and is by no means finite. The goal of this section is to provide a better understanding of environmental press and why the home is vital to QOL in older adults with dementia. The domains are based on Lawton's constructs and research reported on focus groups with older adults with dementia^{5,12-17}. Please keep in mind that QOL is influenced by many factors but as the scope of this paper is on QOL in relation to ATs for dementia care, i.e. environmental interventions, the dimensions and domains that AT influence in this regard are primarily discussed.

- Affect
- Self-esteem and Self image
- Socialization
- Attachment
- (Physical and Mental) Health
- Enjoyment of (meaningful) Activities
- Security and Personal Privacy
- Being Useful
- Physical Environment and Aesthetics
- Finances
- Spirituality
- Self-determination and Freedom

A Closer Look at Physical Environment

When considering ATs as a nonpharmacological intervention for dementia care, it is essential to understand how the home environment affects older adults' functioning and perception of their life quality. In this way, developers, researchers, clinicians and caregivers are better equipped to identify and implement alterations that will be most beneficial. Presently, the WHO defines ATs as environmental factors in their International Classification of Functioning, Disability and Health (ICF)¹⁸, acknowledging that capabilities occur in the context of milieu. The ICF takes the focus off of a biological cause and places it on the impact, allowing representation of the disability in all contexts, not just from a medical standpoint. As people age, particularly when Aging in Place, it is common for them to become increasingly reliant on their surroundings to offset functional decline¹⁹. Older adults spend a significant amount of time in their homes so a principal research goal has been in determining how home environments can support aging. In the field of gerontology, assessments of environmental factors in go back some forty years, including research on residential aspects of

private homes, neighborhoods and environmental dimensions, such as safety.

The **environmental press theory** incorporates an individual's personal competencies (i.e. cognitive, social, physical and psychological capabilities) and their environmental demands (i.e. support or hindrances when interacting with their surroundings)²⁰⁻³³. This theory explains the **person-environment fit** which rationalizes that too much or too little challenge for the personal competencies result in adverse effects in response to the environment^[20]; the home would serve best in facilitating equilibrium. Here, the **competence-environmental press model**^{20,32} is used to analyze the relationship between the home and functional outcomes, emphasizing that each individual person will have optimal combinations between their coping capabilities and environmental factors that will facilitate optimum outcomes. It is a model to derive the best person-environment fit through the viewpoint that the less competent a person is, the more impact the environment will have. In 1939, Lewin presented his equation for behavior to explain how nature and nurture combine to shape a person, thus to better explain the person-environment interaction³⁴:

$$[B = f(P, E)]$$

He states that the behaviors are functions of both the person and their environment; this places significance on a transitory context to explain a person's behavior. Hobfoll's **conservation of resources theory**³⁵ says that the home and objects are resources that have perceived value based on what they can provide for the individual. Their personality characteristics shape their locus of control, life conditions will alleviate or aggravate stress (e.g. retirement, grandchildren), and socialization aspects function to augment or diminish stress in other resources. The authors in³⁵ state that older adults who register the lowest levels of (mental and physical) functioning also register the lowest levels of agreement with their environment and face the greatest challenges in environmental press.

ISISEMD Lessons

When determining the service package of ATs for the individual user, requirements were gathered through caregivers, family members, self-reports and, and an Occupational Therapist was specifically employed to evaluate how the home could better fit the person's capabilities. As none of our end users reported disturbing behavioral expressions, we largely employed the compensation and rehabilitation strategies. Unfortunately, by attempting to understand several variables at once, although valuable information was gathered (i.e. on satisfaction with AT services, physical and cognitive functioning), a controlled delineation of the environmental intervention and QOL out-

comes was not possible. Rather, our goal was to detect changes in QOL, but not in QOL limited to environmental factors. Some of the notable outcomes for the end users (n=31) with dementia were:

- 77.42% felt safer about living in their home
- 64.52% reported increased QOL
- 51.61% reported increased independent living
- 90.32% were satisfied with the ISISEMD services

REVIEW OF DEMENTIA QOL ASSESSMENTS + AT

Particularly when working with a person with dementia, it is much easier for care providers to affect QOL than it is for them to affect the course of the disease process, which is highly individual. As mentioned earlier, one of the focus areas in measuring QOL is in assessing the efficacy of treatment; the idea is that if we assess QOL, then we are also a step closer to better assessing AT. This section presents current QOL outcomes measurement tools relevant to ATs for dementia care.

The Cochrane Library Collection supports systematic reviews of health care outcomes; specifically, the Patient Reported Outcomes (PRO) methods group is interested in "health status, quality of life, adherence to treatment recommendations and satisfaction with treatment"³⁶. The Cochrane search for "Alzheimer's Disease," "dementia," "quality of life" and "Health Technology Assessment" resulted in 3 documents. One was on pharmacological interventions, one as a proxy report and the last on neuroimaging techniques. Health and QOL Outcomes (HQLO)³⁷ is an open access, peer-reviewed journal that disseminates information on Health-Related QOL. The HQLO search for "technology" and "dementia" resulted in 19 documents, all of which were related to severe dementia, frail elderly, other conditions than dementia and other assessments than straightforward QOL. The Patient-Reported Outcomes and Quality of Life Instruments Database (PROQOLID)³⁸ was also searched for "Alzheimer's Disease" and "dementia," which resulted in a total of 22 instruments, none of which are administered via computer or in electronic format.

- 7 were designed for caregivers alone, excluding self-reports by person with dementia
- 10 tested other measures than QOL, such as memory or apathy
- The 5 remaining, all modeled after Lawton, include:
 1. QOL-AD – Quality of Life in Alzheimer's Disease^[11] is a questionnaire answered by the person with dementia and caregiver separately and weight is given to the older adults responses but it is not AT-specific
 2. CBS – Cornell-Brown Scale for Quality of Life in Dementia³⁹ is a semi-structured joint interview

with the person with dementia and their caregiver, if discrepancies in responses occur, weight is given to the proxy and it is not AT-specific

3. D-QOL – Dementia Quality of Life Instrument⁹ is an mixed interview and questionnaire self-report but is not AT-specific
 4. DEMQOL – Measurement of Health-Related Quality of Life with Dementia⁴⁰ is another interview-based tool that is not specific to AT
 5. QOLAS – Quality of Life Assessment Schedule⁴¹ is also interview-based for the person and their caregiver which can be tailored to fit the individual but is not AT-specific
- No tools were found to be dementia-specific evaluations of QOL *and* allow for AT influence.

Supporting Tools

- Impact Assessment
 - The World Health Organization (WHO) has defined Health Impact Assessments (HIA) as “a combination of procedures, methods and tools by which a policy, programme, or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the health population,”⁴². Although they tend to focus on broader issues of environmental impacts on health quality and do not yet have collective tools to carry out HIAs, the WHO is working to develop methodologies and tools to measure the impact of health on citizens.
 - The HIA group is closely tied to the International Association for Impact Assessment (IAIA), the leading global network on impact assessments with the goal to develop competencies in forecasting and organizing outcomes of development on QOL⁴³. They have two relevant sections, on health impact assessments and on social impact assessments. A search for dementia in both returned 0 results; however, a search for “quality of life” returned 2 results in the social impact section, a citation summary and international principles for social impact assessment, mentioning that QOL is one of their core values.
 - The National Institutes of Health’s Patient-Reported Outcomes Measurement Information System (PROMIS)⁴⁴ seeks to provide researchers and clinicians with data regarding therapeutic effects that otherwise cannot be found in current assessment tools. It is a computerized adaptive testing system (CAT) for the collection of patient-reported outcomes in health status and social well-being to be used for clinical research and practice⁴⁵. The PROMIS group is also striving for a consensus on definitions and domains. It will be interesting to see if and how

the mode of administration affects the psychometrics of the instruments; indeed, a system such as this is needed. A search for “quality of life” returned 27 hits but no instruments were available for either dementia or QOL from their assessment database

(www.assessmentcenter.net/).

- The Consortium for Assistive Technology Outcomes Research (CATOR) has recommended outcome measures for ATs and the further improvement of AT outcome indicators⁴⁶. A search for “quality of life” returned 2 hits, although no information was found on the website regarding dementia.
- Intervention Classification
 - The WHO is additionally working on an International Classification of Health Interventions (ICHI) tool to describe and calculate the distribution and advancement of health interventions⁴⁷.
- Disease and Functioning Classification
 - The WHO’s Family of International Classifications (FIC) network cooperates with international health information systems in the development, implementation, updating and dissemination of health classifications for statistical analyses⁴⁸.
 - The American Psychiatric Association publishes the Diagnostic and Statistical Manual of Mental Disorders (DSM)⁴⁹, a manual with a standardized ontology and evaluation methodology for clinical and legal use.
 - The DSM is intended to be compatible with the International Classification of Diseases and Related Health Problems (ICD)⁵⁰; however, because revisions are not conducted simultaneously, there are incongruities. The ICD is a well-known classification system for diseases, symptoms and causes.
- QOL and Assistive Technology
 - The Psychosocial Impact of Assistive Devices Scale (PAIDS) looks at AT outcomes on QOL in people with functional limitations through three dimensions (competence, ability and self-esteem) but is a generic measure⁵¹. It consists of 26 items and investigates QOL outcomes of AT interaction (including low-technologies), but may not be suitable for people with dementia.
 - The Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST 2.0)⁵² is a similar assessment to measure a device and the service it provides; however, questions like “how satisfied are you with the dimensions of your assistive device,” which may be outside the scope of understanding for persons with dementia.
 - The Assistive Technology Device Predisposition

Assessment (ATD-PA)⁵³ consists of too many items (i.e. 63) to be feasible for persons with dementia.

- The FLAIR QOL assessment⁵⁴⁻⁵⁶ is a computerized QOL evaluation format to assess ADL functioning as an indicator of QOL. Although the tools are not designed for use in dementia care nor are specified to AT interventions, very important groundwork has been laid in computerized QOL assessment that can be applied to disease-specific evaluations.
- Agree and Freedman⁵⁷ reported findings that AT have greater potential to affect QOL when there are greater levels of functional limitations (e.g. more room for improvement). They developed a measure to exemplify the effects of ATs on older adults (ATQoL); however, this is not dementia-specific.
- The Kwaliteit van Zorg (KWAZO)⁵⁸ is a Dutch instrument to evaluate the quality of AT services from the user point of view in 7 questions, but is for general ATs (including dentures, glasses and orthopedic shoes) and is not dementia-specific.

Supporting Studies

As no one sufficient tool was found, additional information was sought out in gerontechnological studies on AT and QOL outcomes in dementia. Many of the studies look at a combination of the desired variables (ATs in the home, QOL and dementia) and provide valuable insights, but there is lack of cohesion in evaluating the results of AT outcomes. To illustrate, Mann, in⁵⁹, states that while it can't be said that utilization of ATs necessarily prevents further decline during the disease course, a lack of ATs can lead to greater decline and higher personal and socioeconomic costs in the long run. Mann⁶⁰ relates home modifications (ATs) to decreasing functional decline; however, Thielke⁶¹ states that recent meta-analysis reveals there is no precise reporting on ATs impact on individual health status or in care outcomes. In⁶², Gitlin summarizes research into the outcomes of home modifications in dementia. She finds the Home Environmental Assessment Protocol (HEAP) as an observational tool to assess modification outcomes in home safety, orientation and support of function. Gitlin summarizes that when findings do support functional outcomes, they are often correlated to a particular modification (i.e. directed interventions). Wahl and colleagues found 0 studies that involve dementia-related disorders but report that targeted modifications have a larger impact than general interventions (perhaps as they address a specific design to increase functional ability)⁶³. They go on to say that the more involved the home intervention is, the better the perceived improvement is. However, the Mann article⁶⁰ was on frail older adults and the Wahl article⁶³ is focused on disability-related

outcomes and thus cannot accurately be applied broadly to dementia. Although several studies investigate home modifications and functional outcomes, the Housing Enabler⁶⁴ was found to be the only assessment to generate a person-environment index (physical features are rated based on the individual's capabilities, i.e. the person-environment capacity for access to the home features). Researchers from the Netherlands⁶⁵ have compiled an excellent overview of environmental interventions in dementia care. These are largely related to low-level innovation i.e. removing mirrors or installing grab bars) but do mention some high-level technologies (i.e. infrared motion detection and GPS). They point out that there are plenty of ideas for interventions and design guidelines to achieve defined goals, but we are lacking in studies that evaluate and report the effect of interventions on these goals and on the effect of these goals on QOL. "Guidelines alone are thus not yet a guarantee that all goals are achieved"^{65,p. 271}. Ettema et al.⁶⁶ find 1225 publications on QOL and dementia but only 6 applicable tools, 3 of which rely on proxy assessments (the other three are instruments 1-3, above). Hacker⁶⁷ finds over 600 available instruments to evaluate QOL yet significant insufficiencies in resources, data and in a unified conceptualization of QOL. Although her focus is on oncology nursing, not dementia, the data compiled is quite relevant and globally promotes the development and use of computer- and internet-administered QOL assessments. Brandt and colleagues⁶⁸ identified 1739 studies on user-centered outcomes of environmental control systems and Smart Homes, of these, only one involved participants with cognitive impairment (brain injury)⁶⁹ and reported increased QOL with the use of electronic calendars. As with other reviews, they found that no discernible conclusions could be drawn, largely due to lack of unification of data, small sample sizes and the majority being descriptive studies. It is also worth noting that not only is there a lack of proper assessment tools, there is also a lack of a cohesive database where they can all be accessed.

ISISEMD Lessons

When preparing the assessment methodology for the ISISEMD project, there were no computer-administered or electronic versions of QOL for dementia and the normative tools available were mostly non-individualized, tested on smaller sample sizes and not specific to ATs for dementia. Furthermore, administrators of the assessments noted that the way in which the tests were worded sometimes emphasized a sense of deficit and we considered rewording some of the questions to avoid distressing end users. The tools to elicit QOL and caregiver burden in the informal caregivers were also worded in a manner that needed attention. Some of the

caregivers emphasized that they also enjoy their caregiving but noted that the language was depressing and a negative view was inappropriate and limited in scope. As an adjustment, we refer to caregiver *burden* as caregiving *stress*.

Because it is not easy to gather appropriate end users with dementia to test and evaluate the AT equipment, when a project is successful in obtaining groups of end users, they try to assess as much about the situation as feasible. This means a trade-off between all the things we may want to measure and how many we can actually measure without taxing the participants or skewing the data. As clinicians and researchers, we could not find a QOL tool that would effectively evaluate the outcomes of using our AT system. In turn, we developed an eclectic mix of tools to elicit the information we were investigating (we did, however, use QUEST 2.0 as a guide when creating our user satisfaction evaluation and the QOL-AD as our primary QOL tool). This means that the QOL+AT assessments are quite specific to this study and have been tested on a small number of older adults. One important drawback from the trials was that the technologies were not optimized before installation. Some of these issues were unforeseen, like a monitor not working, insects that live in one region of the European trials but not others and were drawn to the computer glow and cultural idiosyncrasies of opening windows when cooking. After the small-scale initial pilot, we opted to test the equipment in controlled conditions to avoid stressing end users with false alarms and faulty services. Although our methodology³ may not be applicable to all AT interventions for dementia care, it has been highly influential in shaping this framework.

REVISIONS TO THE FRAMEWORK

Groundwork has been laid in the field of QOL research and several main influential factors have been identified, although this is subject to change with societal, technological and care modifications over time. As social and health care is shifting to computerized collection and storage of data, an increase is also expected in the number of QOL tools modernized from pen and paper format to computerized and internet-based. The initial framework for the iQOL assessment tool is presented in¹, and proposes the development of an electronic QOL assessment tool to be used by people with dementia. Here, we present some revisions to the areas of domain selection, administration and assessment functions. Although the iQOL framework is not complete, it is believed that disseminating information during and on development will help other researchers and developers in their work towards the same goal.

Table 1. Challenges in ISISEMD trials, related research

and projected trends

ISISEMD Project Trials	Supplementary Research	Projected Trends
Issues with AT outcome assessments	Gap in synergy in implementation and evaluation	Devices will be able to gather information on AT use themselves
Challenges with measuring QOL in dementia care	Lack of appropriate methodology for assessing QOL outcomes as a result of AT interaction	QOL tools will incorporate AT outcomes; integration of electronic assessments
Successful AT design must incorporate the user's individual requirements	Phenomenological perspectives in residential dementia care plans	Phenomenological perspective in AT incorporation; merging of environmental design and outcome assessments

QOL Domains in Dementia + AT

Selecting domains of QOL to be assessed is quite central to the use and interpretation (value) of the derived results. Their definition and selection is a fundamental step, it is also be one of the most debated steps, as there is no consensus on how this theoretical and methodological phase should be carried out. The domains are still based on Lawton's seminal work but considerations are being made for gerontechnology as a dimension in its own right to discern home technologies as influential on QOL. It is expected that these domains will be amended in the future as a subject such as QOL is not static throughout time, cohorts or geographical areas.

Electronic Assessment

One of the most important benefits of being Internet-based is the ability to collect data from multiple geographic locations and increased potential participants. The assessment itself can be viewed as adaptive to the functioning capabilities of the person, making the elicitations more individualized. For example, it could detect if the wording of the questions is appropriate for the communication abilities or integrate internal consistency checks by asking the same (or similar) questions to ensure similar responses. When used longitudinally, the QOL assessment is tailored to that person's pattern of QOL, permitting the user to define what life quality means to them. Being able to individualize the assessment to the user increases the comprehension of their situation and outcomes. This means the assessment is better able to determine which areas of QOL the AT may be impacting; it will be clearer to identify care priorities, set goals and evaluate directed interventions. Furthermore, it alleviates some of the difficulties encountered by the one-on-one modality and human errors in administrating the assessment and

evaluating results. It is hypothesized that this will increase the reliability and internal consistency of the data and remove interviewer bias as a factor. However, the effects of the mode of administration (i.e. computerized versus paper questionnaire) have yet to be explored.

The Standard-Gamble (SG) technique is no longer the only utilities method exercised. Instead, this will become an amalgamation of elicitation incorporating questions, multimedia illustrations, Visual Analogue Scales (VAS), Time Trade-Offs (TTOs), Quality-adjusted Life Years (QALYs), Disability-adjusted Life Years (DALYs), Investigating Choice Experiments for the Preferences of Older People Capability Index (ICECAP-O), among other health utilities, to better personalize the assessment to the user (e.g. their cognitive and communication capabilities). The framework revisions allow for incorporating multi-attribute utilities but further research and development is needed in this area.

The individual end user would be the primary source of information on QOL, but provision will allow information to be obtained through self-reports, proxies and through the data the integrated AT system could collect itself. It would be ideal to have a regulated AT database which would be integrated and updated with iQOL versions so that new ATs could be selected and evaluated. ATs would be registered in a database with a categorization of which domains the AT is connected to. Being able to select which technologies and services that have been implemented into the care routine provides a great deal of data on the functioning of the device as well as the effect on QOL and in achieving care goals. This could connect several international classification systems, like the ones mentioned earlier in the article, as represented in Figure 1.

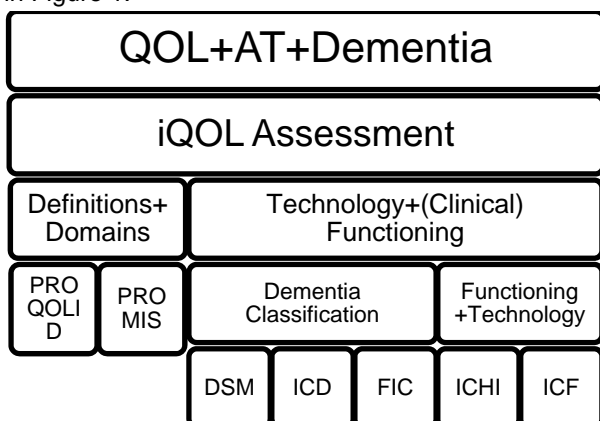


Figure 1. Example of anticipated evaluation cohesion

DISCUSSION AND CONCLUSIONS

ATs that are developed to achieve wide-ranging goals (i.e. independent living and increased QOL) are becoming more commonplace in dementia research and care and this trend is expected to con-

tinue. Having the appropriate design of the home environment for older adults with dementia has tremendous potential to positively affect QOL. In the future, this will be done increasingly through the use of technologies. Two key concepts for successful care are appropriateness and comprehensiveness of services for the end user. Yet a search for appropriate evaluation tools reveals that research in assessing QOL outcomes of AT interaction in dementia is lacking. In fact, there are no appropriate tools to assess Assistive Technology's QOL outcomes in dementia care. As a result, not only may many technologies be inadequately matched with users, but suitable evaluations of the person-(AT) environment fit and resulting outcomes are not well defined, much less available.

In the future, gerontechnology may be incorporated as a dimension in QOL assessments; however, much more research and development is needed in the areas of gerontechnology and more pervasive use is needed by older adults in order to determine the accurate dimensions of ATs influence. The fact is, we know the development of such a framework and assessment tool is necessary, but as a scientific field that is quite young and increasingly interdisciplinary, we are still learning why, in which ways and what influences ATs have on QOL in dementia and how to successfully interpret the results.

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