

# Aging and Technology

Rosemarie Santora Lamm<sup>1</sup>, Edwin Roth Lamm<sup>2</sup>

<sup>1</sup>Ph.D., Advanced Registered Nurse Practitioner. University of South Florida Lakeland, Rath Senior ConNEXTions and Education Center

<sup>2</sup>M.D., Fellow of The American College of Surgeons, Lakeland Regional Medical Center

**Abstract.** This paper presents the physical and mental changes related to the aging process and the limitations it presents for the elderly. Chronic diseases also limit function and ability to be independent. This limitation results in social isolation with psychological alterations including dementia. Technological interventions are a promising approach for minimizing these limitations. Technologies are also being developed to monitor elders and provide information to caregivers and health care providers. Automated living assistance systems promote elderly individuals' ability to "age in place".

**Keywords:** Aging, Physical changes, functional limitations, technology, automated living assistance

## 1 Introduction

Aging populations in the post-industrialized societies have increased from 12% to an astounding 22% in many European countries. In the United States the population of elders has remained at 13.5% because of immigration while the demographics are changing. The many improvements in nutrition and health care have intervened to prevent death in early life. The elderly age while developing many chronic illnesses! (Lamm 1997).

## 2 Chronic diseases and Imposed Limitations on the Elderly

The profound influence on the aged of the development of one of many chronic illnesses is sometimes overlooked. It would be helpful to consider both normal aging and then the effects of these factors on chronic illness.

Aging and Senescence are not synonymous terms. Aging refers to the process of growing old. Senescence refers to the state of old age in the late years of the life span. Normal biological aging is associated with loss of complexity in the dynamics of organ system function. This results in an impaired ability to adapt to physiological stress. Mortality and morbidity increase markedly in these disorders. (Peterson, M. 1994)

Altered hepatic and renal function, diminished respiratory and cardiac reserve are some of the changes seen in elderly persons. Therefore, the onset of one or more chronic illnesses tends to disturb the normal homeostasis.

Let us look at some of the more common chronic diseases that alter function and transpose these into situations that require adaptation to modern technology. The most devastating disease seen today in Medicine, with the worldwide effects overwhelming all medical systems is Diabetes Mellitus. This is a disease characterized by impairment of the output of the Islet cells of the pancreas, and/or resistance of end-organ receptors to utilize insulin. The results are loss of muscle strength and atrophy, weakness of cardiac muscle, inability to metabolize lipids, and changes in endothelial lining of arteries throughout the body. Alterations of cerebral, renal, cardiac, and peripheral vasculature result. Impaired mental functioning, inability to walk but short distances, lethargy related to impaired renal output, and visual deficits all impede use of developing technologies to assist elderly in utilization of computers and new methods of assisted living advances.

The results from the onset of one or more chronic illnesses is a tendency to isolate the individual from family and friends, development of depression and sometimes what looks like dementia but in reality is pseudo-dementia. These findings occur whether the disease process is cardiovascular, malignancy, impairment of pulmonary function, and Alzheimer's disease or other causes of dementia.

What should be obvious is early intervention in some of these diseases, particularly those that may be preventable, would enable many of the aging population to function better in a technological world. Smoking cessation, obesity control, early diagnosis of diabetes and heart disease, environmental changes in the workplace to reduce inhalants that are toxic would extend the useful lives of the aging population so they would be able to learn to accept the rapidly changing world of innovation and advanced technology.

Normal physiological changes in aging results in slower reaction times, gait changes, decrease in muscle strength and endurance, and decreased sensory perception. Superimposed on these factors are such alternations such as anemia, possibly due to malnutrition, malignant diseases and effects of medication on medical intervention. Other changes resulting in falls include: cardiac arrhythmias, osteoporosis with inherent risk of fractures, Parkinson's disease, urinary incontinence and/or prostatic obstruction. Orthostatic or postprandial hypotension can result in a sudden and unexpected fall. Mental changes including effects of medications can produce confusion and psychotic behavior resulting in injury. Technology can be useful in such areas as prevention of fall by altering the environment to increase safety.

Impaired function due to stroke is devastating to the victim of this disease. Improved technology to assist in rehabilitation needs to go beyond what is currently available. Limb amputations due to peripheral vascular diseases are another avenue of

need of functional improvement in technological advances. Through the adjunctive use of hyperbaric oxygen changes, we have been able to salvage some limbs from amputation, and new materials available in wound care clinics also improve healing of such wounds as pressure ulcer, venous insufficiency ulcers, diabetic foot ulcers, and acute traumatic wounds.

These physical changes cause aging individuals to increasingly become frail and unable to care for themselves. As elders' health status declines their needs are creating increased demands from the health care systems.

### **3 Technological Intervention**

The challenges to the individuals and their caregivers are how to intervene while the elders are "aging in place". Age related changes are often subtle and gradually restrict the normal functioning of the individual while challenging their activities of daily living. Institutionalization has proven to be a choice of last resort! When individuals are placed in care facilities their normal functioning is reduced for many psycho-social and physical reasons. Therefore, living assistance via technology is a valued form of intervention.

Automated living assistance systems represent a promising approach for the prolongation of an independent life for elders while enhancing their quality of life. (Nehmer et al 2006)

Technology will also assist in minimizing the need for institutionalization that is often the choice presently available to families and caregivers.

When individuals "age in place" the costs of care-giving are reduced thus reducing the escalation in health care costs. How then do we construct living assistance systems which are dependable and adaptive to independent living for elders?

The major challenge is rooted in the fact that individuals who have most difficulty with information technology tend to be poorer and less educated. There is a "digital divide" between generations. (Paul and Stegbauer 2007) This divide is growing because the elderly are the most challenged group to utilize IT as a result of their slower adaptation pace and varied educational and socio-cultural experiences. (Burkart and Homberg 1998)

The literacy rates for elders throughout the world remain quite low. In the post-industrialized nation of Germany, of individuals ages 55-64, 10% completed a college education. In the United States it is 20%, while in Italy it is a low 4% (An Aging World 2001). There is a disparity between men and women and it is well to note that women live longer than men creating more dependency in late life. In Greece the literacy rate is 77% for individuals 65 years and older, while women have a 50% rate. (An Aging World 2001). In Southeast Asia and the Arab States the rate is a dismal 11%! These statistics support the need to plan technological interventions related to socio-cultural realities.

There is also a change in the age-dependency ratio in the post-industrialized societies. There are fewer younger persons to support the economic and social needs of dependent elders. The costs for providing care for aging populations are increasing while fewer working adults are available to support the needs. It is quite obvious that innovative solutions for living assistance systems must be developed. (Nehmer et al 2006) This will reduce dependency on caregivers and costly institutionalization.

Cognitive decline and difficulties with daily activities indicate a need for care. Loss of driving ability, inability to manage money, shop for groceries and take initiative in following medical directions promote dependency. (Edwards et al 2005)

The maintenance of cognitive ability is essential is supporting independence in elders. It is imperative that this population adapt by computerized practice of tasks designed to enhance cognitive speed of processing and mental quickness. Quick processing speed is important for performance of everyday functions but also for maintaining health status.

(Rosnick, Small, Borenstein, Graves and Mortimer, 2004)

Driver fitness is a challenge for older persons. One in four drivers will be over 65 years of age by 2030. In order to keep driving safely, older persons must maintain flexibility. In order to accomplish this, adults need to continue maintaining strength in hands, arms, legs, and neck.

In order to truly accomplish success for older drivers, technology enhanced vehicles are options. These include oversize mirrors, pads to raise the pedals, easy reach seat belts, and adjustable handles of car doors. Presently there are options such as sensors for parking, high intensity headlights, rearview cameras or sensors, adaptive cruise control, and electronic mirrors that adjust in bright light. These technological support systems that will be adapted to automobiles for senior adults can enhance safety for all persons in society. Modifications will also support elders in remaining active and involved in their communities. This will also allow older persons the option of remaining in their homes supporting their desire to “age in place”.

Technologies are being developed to monitor and improve gait problems, monitor blood sugar levels, visually monitor dementia patients to prevent or abort wandering behaviors, and sensors to monitor pulse and blood pressure changes in home-bound individuals.

It is apparent that knowledge of physiologic changes and pathology of many chronic diseases are essential to improve the technology to integrate the elderly population into the twenty-first century of advances for their benefit. This is not merely to extend their longevity but to help make longer life more fruitful and more enjoyable. As the health care professional identifies the barriers to successful “aging in place” science and technology are in the process of providing a vision of intervention and support.

## References

- Bromberg, Y.-D., Issarny, V. (2005): INDISS: Interoperable Discovery System for Networked Services. In: ACM/IFIP/USENIX 6th International Middleware Conference (Middleware). Grenoble, France
- An Aging World (2001), United States Department of Health and Human Services
- Burkart, R. and W. Homberg: "Elektronisch Mediatisierte: Gemeinschaftskommunikation", Multi-Media-Mania: Reflexionen zu Aspekten neuer Medien Konstanz: UVK-Median, pp. 19-36
- Edwards, L et al (2005): ACTIVE, University of South Florida
- Lamm, R: Association Between Depression, Chronic Illness and Health Culture, Among the Elderly in Three Ethnically Distinct Communities, University of South Florida, Dissertation
- Nehmer, J.; Karshmer, A.; Becker, M.; Lamm, R. (2006): "Living Assistance Systems – An Ambient Intelligence Approach", in Proceedings of the 28th International Conference on Software Engineering (ICSE 2006), Shanghai, China
- Paul, G., Stegbauer, C. and K Titz: "Senioren und Sozialberatung: Eine Studie zu Wohnbedürfnissen, Unterstuzung und Beratung im Alter" Frankfurt/Celle: Manuskript (2004)
- Peterson, M: Physical Aspects of Aging: Is there such a thing as "Normal", Geriatrics 2, pp. 49-51
- Rosnick, C. B. et al: "Health Predictors of Cognition in the Charlotte County Healthy Aging Study", Aging, Neuropsychology and Cognition, 11, pp. 89-99