INTERNAL ENVIRONMENT AND ASSISTIVE TECHNOLOGY TO PROVIDE SAFETY FOR PERSONS WITH DEMENTIA IN DEVELOPING COUNTRIES

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Abstract - Dementia is a syndrome that leads to the deterioration in memory, thinking and behavior as well as the ability to perform activities. The aim of this study is to explore ways of fulfilling the safety of persons with Dementia especially in Developing countries. And that is expected to be done by applying a theoretical and analytical method. This aim could be achieved through the use of Assistive Technology and careful design of internal environments. The study concludes that developing countries need to encourage more research leading to more awareness about the issue, about ways of dealing with persons with dementia and about more expertise in the field of Assistive Technology.

Index Terms - Dementia; Prevalence of Dementia; Assistive Technology; Internal Environment Design; Developing Countries

I. INTRODUCTION

As researches and statistics revealed the wide spread and high prevalence of dementia worldwide, as well as the speed of its expansion,- a person is diagnosed with the case every 3.2 seconds[1]-, there is a need than for greater attention and more care to be allocated to persons afflicted with dementia and more support for their families and care givers. Dementia costs 818 billion US dollars in 2015 of which 86% is in High Income countries. The increase in the number of persons with Dementia globally that reached 47.5 millions in 2015 would be the main factor in the rise in Dementia cost. By 2018, the global cost of dementia will rise above a US$ trillion. The rise is cost per person although "Low income countries account for 1% of the total worldwide costs and 14% of the prevalence while Middle income countries account for 10% of the costs and 40 % of the prevalence of dementia and high income countries account for 89% of the costs and 46%of the prevalence of dementia. Two main regions of the world that include Western Europe and North America account for 70% of the global costs of Dementia" [2]. All this data reveal the importance of providing ways to assist in facilitating care for these persons while enabling them to maintain their independence, perform their daily living activities and managing the risks they could face at home and reducing their families stress. Through a theoretical review of literature, this research paper aims at exploring how a carefully studied design of the internal environment and the use of Assistive Technology together could help Persons with Dementia live a safer, more rewarding life.

II. DEMENTIA WHAT IS?

A. Dementia Meaning

Dementia as a" syndrome is a set of medical signs and symptoms that are correlated with each other", Webster Dictionary [3]. It is a broad term that characterizes many conditions caused by several brain disorders.

Dementia leads to "significant loss of intellectual abilities such as memory capacity that could be of a severity that interferes with social or occupational functioning ". The person diagnosed with dementia reveals and shows signs of impairment of attention, memory(inability to recognize things or persons), judgment(poor), language (difficulty speaking or even completing a sentence or finding the right word to say), motor and spatial skills and function. There should be evidence of problems of two areas of cognition to confirm this diagnosis.

Dementia is divided into stages that include mild, moderate and severe categories. Sometimes a patient is classified to be into two different stages at the same time according to the symptoms he is experiencing. The stages could not be a measure for predicting the speed with which the person's condition might deteriorate. Sometimes it could be years and other times it could take few months. Evidence has shown that every patient disease progression is different.

B. Different causes of Dementia

Dementia is not due to major depression or schizophrenia. The main cause of Dementia is Alzheimer's disease, nearly 60% of the cases [4].

"Alzheimer's dementia/Alzheimer's disease (AD) is the most common form of dementia. The cause has not yet been identified. While patients with AD have amyloid plaques (an accumulation of any abnormal protein) identified in certain areas of their brain, it is

unclear if these plaques are the cause of the disease or a result of the disease. Although most cases of Alzheimer's disease begin after the age of 65, in some cases symptoms begin when someone is in their 40s or 50s. This early onset of Alzheimer's disease can progress more rapidly than later onset of AD.

Vascular dementia is the second most common cause of dementia, and is due to multiple strokes occurring within the brain. Often, these strokes may have been unnoticed and patients may not have any associated symptoms such as weakness, visual loss, or numbness. Patients with untreated high blood pressure or heart disease may be at risk of developing vascular dementia. Frontotemporal dementia is associated with pronounced atrophy or shrinkage of the frontal and temporal lobes in the brain. In addition to forgetfulness and word finding problems, patients may have marked personality changes as well as impulsivity, or poor judgment. Lewy body dementia/It is a disease caused by Lewy bodies, which are abnormal clumps of certain proteins, accumulating inside of neurons (nerve cells). Forgetfulness and other signs of cognitive decline are the primary features of this condition, but patients can also develop hallucinations. Creutzfeldt-Jakob disease is a rare condition where an abnormal protein leads to destruction of brain cells and dementia. While most cases occur without an underlying cause, in some patients there is a family history of this disorder. Even less often, patients might be exposed to the abnormal protein. Mad cow disease constitutes an external exposure. Mixed dementia refers to patients who have evidence of two (or more) types of dementia. Alzheimer's disease and vascular dementia are its most common causes. Normal pressure hydrocephalus is an abnormal enlargement of the ventricles, or fluid filled spaces within the brain that causes pressure on areas of the brain. This leads to problems with walking, memory, and ability to control urine flow (incontinence). Huntington's disease causes abnormal movements, called chorea. In some cases, problems with memory can precede the development of chorea by many years. Alcoholic dementia is caused when patients drink heavily and develop deficiency in one of the B vitamins. When this happens, brain cells are unable to function normally and memory loss may occur. This is called Korsakoff syndrome. Traumatic brain injury (concussion)/dementia pugilistica can lead to memory problems. In some cases, recurrent brain injuries can contribute to the underlying changes identified in Alzheimer's disease. Dementias caused by other conditions can lead to changes within the brain and associated cognitive decline. These include Parkinson's disease, HIV (AIDS), Multiple Sclerosis, Wilson's disease, meningitis (infection of the brain coverings), blood clots in the brain, and heart attacks. Additionally, Pick disease (named after Arnold Pick) that is a rare neurodegenerative disease causing dementia, or memory loss in patients. In a neurodegenerative disease, nerve cells (neurons) in the brain die and this results in irreversible damage. Pick disease results in aphasia (impaired ability to speak) and behavioral changes. Some patients with brain tumors may develop memory problems which resemble dementia. But not every case leads to developing dementia and these include age and family history. These are "non-modifiable risk factors" [4]. High blood pressure, high cholesterol, or diabetes increase the risks of developing either Alzheimer's disease or multi-infarct dementia [4]. Dementia cannot be absolutely prevented. However, maintaining normal blood pressure, cholesterol and sugar levels, and avoiding head injuries, tobacco and heavy drinking may reduce the likelihood of contracting dementia. That, especially, when staying physically active and participating in social events [4].

III.SAFETY OF PERSONS WITH DEMENTIA IN THE INTERNAL ENVIRONMENT

The Variety of physical changes which the person endures with age could make surrounding environmental conditions real hazards. With Dementia these conditions become worse threats with a potential peril with the progression of the disease [5]. "Memory is not the only thing affected by dementia. Sense of place and even sense of time can be affected by dementia; Changes in vision and perception are responsible for many of the accidents involving people with dementia". ...."Vision, or sight, is the physical or physiological component of seeing; it depends on the health of the eye, the optic nerve and the part of the brain known as the visual cortex" [4. It is a passive process through which light enters the lens of the eye forming an image that is sent to the brain. Perception of the seen image is what the brain does by interpreting information, and allowing us to make sense of what our eyes see [4]. The following figure (1) reveals how the brain of a person with Dementia interprets a floor pattern that is shown on the left and perceived on the right. Impairment of the perception could lead to dangerous situation A dark pattern in a rug or carpet might be interpreted as a change in the level of the floor. It may be perceived as a step or even as a hole in the floor. The floor of the following bathroom picture Figure (2) could become a problem and make walking hard.

These changes in Perception should be taken in consideration during the design process.

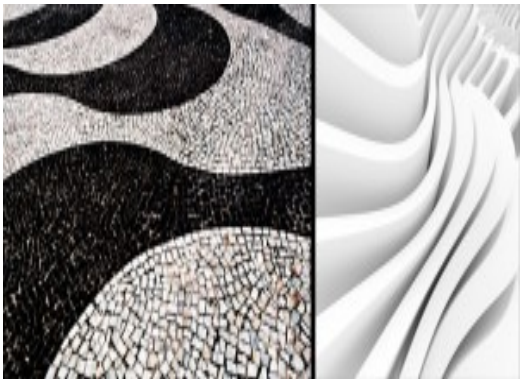


Fig. 1 Showing Floor Pattern Left and Dementia Brain Perception Right



Fig. 2: Black tiles might look like holes in the floor

A.Safe Environment Creation

In order to create a safe environment knowing how the brains of persons with Dementia compromise perception, the following points are suggested [5]:

a) Floor: The floor should be as flat as possible and there is no need for unnecessary steps, rises or threshold. Carpets should be well fixed and the ceramic of the bathroom could be chosen with a different color to be a cue to the difference with the bedroom. Floors should not be too dark to allow better depth in perception.

b) Walls: walls need to be decorated or colored or patterned in order to differentiate it from floors or it might be interpreted as a continuation of floors. The use of pictures and decorations provide visual cues about the distance to the vertical surface.

c) Furniture: This should be discernible from the background to avoid accidents from walking into.

d) Lighting: Improper or insufficient lighting can make seeing difficult and cause dangerous situations. Bright light causes glare or make certain details, as threshold not visible and become a hazard. Natural light is better than artificial. Indirect light is better and there is a need to use dimmers or curtains and to eliminate shadows.

e) Kitchens and Bathrooms: As with furniture the bathroom and kitchen appliances need to be in contrasting colors in order to prevent accidents or embarrassing situations.



Fig. 3 Wall should contrast with appliances color.

f) Storage areas: There should also be care in storing cleaning substances as these might be caustic or poisonous.

IV. CARE FOR PERSONS WITH DEMENTIA

Caring for a person with Dementia is a very demanding tenuous job. Care giver needs an extensive support network to be able to cope with the patient needs in order to have some relief time. The caregiver job, at the early stages of Dementia, becomes giving reminders for performing tasks, but in later stages he might have to help with basic services in daily living activities. The availability of Assistive Technologies and new innovations help in facilitating work and reducing the stress upon caregivers and family members of these persons.

V. ASSISTIVE TECHNOLOGIES

A. What are Assistive Technologies for Persons with Dementia?

Being subjected to an incurable overwhelming disease, persons with dementia need to use the devices or pieces of technology that could enable them to complete their daily living activities, maintain their independence while reducing stress for families and care givers [6]. Assistive Technologies include those items that help manage risks and improve the quality of life. Among these we find [7]:

1) Clocks: Devices that could be simple as the clocks that are easily read and help remove the person confusion between night and day.

2) Reminders: to help the person perform certain tasks by recording messages on a device to be played at the appropriate time; as when leaving home to lock the door or to remind the patient of taking his/her medication at the appropriate time or even to remind the patient and his/her caregiver of set appointments. It could be also

used to alert the patient of not opening the door and sometimes of the need to go back to bed.

3) **Medication management technology:** that provides a pillbox marked with the week days or the sophisticated one that provides an automated pill dispenser that beeps and opens to remind the care giver and the patient of medication that should be taken. Some reminders could be a vibrating alarm on a watch.
4) **Picture phones:** designed for people who cannot remember phone numbers and contacts names. Some of these phones come with clear buttons where photos can be placed of the family members or the loved ones, in order to allow the person with dementia to just push the button of the person he wants to contact [6].
5) **Location tracking Devices:** that can be worn by the patient to allow emergency personnel to recover the patient if he leaves the house of the area he lives in.
6) **Electrical** use monitoring that provides monitors that alert the caregiver, if he is not living with the patient ,if the "commonly used appliances have not been turned on or off" [7] by plugging into a wall outlet or power strip that shows signals of the use of these appliances .
7) **Falling** sensors for safety of the patient, especially, at night. Such devices work through Telecare system that locates or fixes sensors around the house so that these devices could send signals to a base unit (a company or centre responsible for monitoring through connection to a mobile phone or landline) to alert if the person falls to the ground and does not get up. Sensors could also alert of smoke or heat or carbon monoxide and also alert if help is needed.
8) Switching off electrical and gas appliances and water dispensers.
9) Switching on the lights if the person gets up at night.
10) Alarm system If the person tries to go out of home or the place where he lives.

B. Ethical Considerations for the Use of Assistive Technologies

When using assisting technologies there should be consideration for the user safety, dignity and independence.

Users should be allowed to understand how the equipments and the service work. Using Telecare could have the drawback of reducing human contact with the service users [8].

Additionally such equipments should not be installed without the approval of the persons for whom these devices would be used, even if they have mental difficulties.

Care should be taken not to intrude upon the privacy of the individual who would be monitored.

Care should be taken not to contribute to making persons with Dementia lose some of the abilities or skills they might still have by depending on these technologies sooner.

Concerns about passing private data stored in computers negligently into wrong hands if they were confidential.

Concerns are about complicating the lives of these individuals, if there is anxiety of damaging used equipments. Additionally, concerns that Tele care used equipment would focus on problems and not remaining abilities of individuals. The following issues should be considered when studying the ethical considerations of the used technological devices: Care not to ignore the preferences of the expected user and to allow his involvement into the introduction of equipment in his life, and taking his agreement to their use.The user's living arrangements, the family involvement and the needs of the care giver should not be ignored, also. That as well as the safety of the equipment Telecare and whether there is a real need for using this technology.

There should also be additional ethical considerations that include [9]:

1) The persons' right to voluntary consent based on sufficient information.
2) The importance of the need to provide help, especially in emergency cases.
3) Balancing harm avoidance, respect of decisions, dignity and preferences.
4) Fair treatment of the person taking into account people's differences and diversity.

C. Assistive Technologies in Developing Countries

In most developing countries, the prevailing culture does not favour sending the person with Dementia to nursing homes or care centres. Families take care of the patient sometimes with the help of the caregiver, in most cases. But still there are care centres of which some patients are sent in case nobody in the family would be willing to accommodate or take care of. The available assistive technology that could be used is the simple one that does not require expertise for maintenance, or fixing problems with the devices. Therefore, the devices that could be used would be the alarm clock, the reminders, the medication management dispensers having only the week days marked, the picture phones, Switching off of electrical and gas appliances, the alarm system alerting of the person leaving the house. Although Assistive Technologies could improve the quality of life for persons with dementia, they still have limitations. With people's different needs and abilities assistive technologies do not fit all, and could bring an artificial sense of security while people might unplug them or switch them off. We could say they will never be a replacement for human care and assistance.

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