The Alzheimer’s Epidemic: Implications for the Medical Physicist

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The U.S. Alzheimer’s epidemic

The number of Americans 65+ living with Alzheimer’s disease is expected to nearly double by 2050.

*Alzheimer’s disease is not an inevitable consequence of aging!*

Risk Factors:
- Age
- Gender
- Race/ethnicity
- Family history
- Hypertension/diabetes
- Head injury
U.S. Alzheimer’s facts and figures

- Nearly 7 million Americans are living with Alzheimer’s disease or another dementia
- Since 2000, death from heart disease has decreased 7% while death from dementia has increased 145%
- 1 in 3 seniors dies from or with dementia
- Dementia accounts for more deaths than breast and prostate cancer deaths combined
  - Women are now more likely to die from dementia than breast cancer
- The cost of dementia care
  - The nation: 1/3 billion dollars/year now, 1 trillion in 2050
  - Per person: average annual cost is $65K (life expectancy for person with dementia is 8–10 years)
What is dementia?

- Dementia is the most common of the so-called neurodegenerative diseases
- The other common neurodegenerative diseases include:
  - Parkinson’s disease
  - Amyotrophic lateral sclerosis (ALS/Lou Gehrig’s disease)
  - Huntington’s disease

*Limbic–predominant age–related TDP–43 encephalopathy
Clinical symptoms of dementia

- Alzheimer’s disease – short-term memory loss, executive dysfunction, and visuo-spatial challenges
  - LATE – primarily short-term memory loss
  - Vascular dementia – stroke sequelae plus Alzheimer’s-like symptoms
- Fronto-temporal dementia – behavioral disinhibition, language problems
- Lewy body dementia and Parkinson’s disease dementia – psychotic symptoms and nightmares, movement disorder/tremor, and autonomic dysfunction with variable cognitive loss
What causes Alzheimer’s disease?

What if we had a drug that could dissolve the amyloid plaques?

We do!

But …
## Pathologic proteins in dementia

<table>
<thead>
<tr>
<th>Pathologic Protein</th>
<th>Alzheimer’s</th>
<th>FTD</th>
<th>LBD/ PD</th>
<th>LATE</th>
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</thead>
<tbody>
<tr>
<td>Amyloid</td>
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<td>Tau</td>
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<td>TDP–43</td>
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<td>Alpha synuclein</td>
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Amyloid PET Scan

- Negative Scan
- Positive Scan
Dementia Diagnosis

- History and physical exam
- Medication reconciliation
- Depression assessment
- Cognitive function evaluation
- Blood tests
- MRI scan of the brain
- PET scan of the brain
  - FDG PET
  - Amyloid PET
- Spinal tap
Cancer staging

TNM System for Staging Breast Cancer

**T**

- **T-1**: 0-2 centimeters
- **T-2**: 2-5 centimeters
- **T-3**: >5 centimeters
- **T-4**: Tumor has broken through skin or attached to chest wall

**N**

- **N-0**: Surgeon can't feel any nodes
- **N-1**: Surgeon can feel swollen nodes
- **N-2**: Nodes feel swollen and lumpy
- **N-3**: Swollen nodes located near collarbone

**M**

- **M-0**: Tested nodes are cancer-free
- **M-1**: Tested nodes show cancer cells or micrometastasis

![Images of medical scans](cancer_scans.png)
Dementia staging is based solely on the cognitive and functional abilities of the affected individual.
Domains of Cognitive Function: an overview

Cognitive functions

- Paying attention
- Multitasking
- Remembering
- Speaking/understanding language
- Spatial skills

Related functions

- Personality
- Emotions
Mild Cognitive Impairment (MCI) | Early Stage Dementia
---|---
One or more cognitive functions impaired for age and education but functionally independent in IADLs and ADLs

**Progressive loss of cognitive function in multiple domains resulting in dependence in some IADLs, independent in ADLs**

**MMSE 24 - 26**

**Progressive loss of cognitive function in multiple domains resulting in dependence in all IADLs, independent in some ADLs**

**MMSE 20 - 23**

**Progressive loss of cognitive function in multiple domains resulting in dependence in all IADLs and ADLs**

**MMSE <10**

*Normal Mini–Mental Status (MMSE) score 27–30

ADVANCED RESEARCH PROJECTS AGENCY FOR HEALTH (ARPA-H)
Our family’s journey

The timeline:
• Diagnosis 2007
• 2007–2008 Mild Cognitive Impairment (MCI)
• 2009–2012 Early Stage AD
• 2013–2014 Middle Stage AD
• 2015–2016 Late Stage AD
• Death 2016

Despite 25 years as a radiation oncologist, I was not prepared for this ...
Thank You!
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