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Assessment of Healthcare Resource Requirements for Disease-Modifying Dementia Therapies in Türkiye

Abstract

Alzheimer's disease is a growing public health issue in Türkiye due to its aging population and the associated economic and societal burden. Emerging disease-modifying dementia treatments, which slow disease progression, require extensive healthcare resources for screening, treatment, and monitoring. This study aimed to estimate the additional resource capacity needed to deliver disease-modifying dementia treatments in Türkiye. Secondary data from national and international sources were analysed to the healthcare resources required for the implementation of disease-modifying dementia treatments in Türkiye, based on three recently developed treatments. The analyses show that Magnetic Resonance Imaging and Positron Emission Tomography scans would require the most significant increases in capacity if Alzheimer's treatments like donanemab, aducanumab, or lecanemab were introduced in Türkiye. Donanemab shows the highest forecasted demand increase, with a 9.94% rise in Magnetic Resonance Imaging and a 5.72% rise in Positron Emission Tomography scans, followed by lecanemab and aducanumab. In contrast, the additional need for full-time healthcare personnel (General Practitioners, specialists, nurses, and radiologists) and hospital beds remains relatively low, with increases mostly under 1%. The findings highlight the need for targeted investment in healthcare resources to accommodate the growing demand for dementia-related care. Türkiye faces critical capacity challenges in deploying disease-modifying dementia treatments. Expanding diagnostic capacity and increasing the radiology workforce are immediate priorities to ensure timely and effective treatment. Addressing these issues is crucial to ensure equitable access to these potentially transformative therapies and to minimize the societal burden of dementia.

Keywords: Alzheimer disease, amyloid beta-protein precursor, healthcare rationing, Türkiye.

Türkiye'de Demans Hastalığını Modifiye Eden Tedaviler İçin Sağlık Kaynakları Gereksinimlerinin Değerlendirilmesi

Öz

Alzheimer hastalığı, yaşlanan nüfusa bağlı ekonomik ve toplumsal yük nedeniyle Türkiye'de giderek büyüyen bir halk sağlığı sorunudur. Hastalığın ilerlemesini yavaşlatan ve demans için ortaya çıkan yeni nesil tedaviler, tarama, tedavi ve izleme için ciddi sağlık hizmetleri kaynakları gerektirir. Bu çalışma, Türkiye'de Alzheimer hastalığı demansına yönelik tedavilerin sağlanması için gereken ek kaynak kapasitesinin tahmin edilmesini amaçlamıştır. Ulusal ve uluslararası kaynaklardan elde edilen ikincil veriler, son zamanlarda geliştirilen üç tedaviyi temel alarak, Türkiye'de Alzheimer hastalığına yönelik hastalık değiştirici tedavilerin uygulanması için gerekli sağlık kaynaklarına göre analiz edilmiştir. Aducanumab, donanemab ve lecanemab dahil olmak üzere demans için geliştirilen bu tedaviler tarama, tedavi ve izleme için önemli sağlık hizmetleri kaynakları

gerektirir. Donanemab, %9.94'lük Manyetik Rezonans Görüntüleme taramaları ve %5.72'lik Pozitron emisyon tomografisi taramaları artışıyla en yüksek öngörülen talep artışını göstermektedir; onu lecanemab ve aducanumab takip etmektedir. Buna karşılık, tam zamanlı sağlık personeli (aile hekimleri, uzman doktorlar, hemşireler ve radyologlar) ile hastane yatağı ihtiyacındaki artış görece düşüktür ve çoğunlukla %1'in altındadır. Türkiye, Alzheimer hastalığından kaynaklanan demans tedavilerinin dağıtımında kapasite zorluklarıyla karşı karşıyadır. Bulgular, Alzheimer ile ilgili bakıma yönelik artan talebi karşılamak için sağlık hizmetleri kaynaklarına hedeflenen yatırım ihtiyacını vurgulamaktadır. Türkiye, hastalık değiştirici tedavilerin uygulanmasında kapasite sorunlarıyla karşı karşıyadır. Tanı ve teşhis kapasitesinin genişletilmesi ve radyoloji iş gücünün artırılması, zamanında ve etkili tedaviyi sağlamak için acil önceliklerdir.

Anahtar kelimeler: Alzheimer, amiloid beta-protein prekürsör, sağlık kaynakları dağılımı, Türkiye.

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Introduction

Alzheimer's disease (AD) is a significant global health problem due to its growing prevalence, profound personal and societal impacts. Globally, 416 million people with AD, with around 15 million living in Europe.[1] This neurodegenerative disorder leads to progressive cognitive and functional decline and dementia, severely impairing the quality of life for patients and placing an immense physical and emotional burden on caregivers.[2] The costs associated with AD per person, including medical care and informal caregiving, are ranging 468 USD in mild and 171,283 USD in severe cases, straining healthcare systems worldwide.[3] Disparities in access to care and resources make the burden of AD particularly pronounced in low and middle-income countries, highlighting its importance a critical global health issue.[4]

Although there is limited data, the prevalence of dementia in Türkiye is estimated to be around 0.7% amongst those aged 65 and older and expected to rise sharply to 1.8% in 2050.[5] The disease imposes significant challenges on Türkiye's healthcare system, with high costs associated with medical care, and the provision of support services for patients and caregivers.[6] Informal caregiving, often provided by family members, adds an additional layer of economic and emotional strain, particularly in a society where intergenerational caregiving remains common.[7] Limited access to specialised memory care centres and resources for early diagnosis further exacerbates the disease's impact, especially in rural areas.

Although there is no cure for AD, new generation disease-modifying drugs are able to slow down the progress of dementia, especially when intervened at an earlier stage (mild cognitive impairment-MCI).[8-10] These drugs work by reducing β-amyloid accumulation in the brain. the U.S. Food and Drug Administration (FDA) approved Aducanumab in 2021, lecanemab in 2023, and donanemab in 2024.[11]The European Medicines Agency (EMA) also approved lecanemab in 2024, although aducanumab was withdrawn and donanemab is still under review.[12]

At the current price levels, the disease-modifying dementia treatments (DMDT) have been found unaffordable even in high-income countries.[13] National Institute for Health and Care Excellence (NICE) found donanemab not cost-effective in the United Kingdom (UK).[14] Similarly, published studies indicate that currently, available DMDTs are unlikely to be cost-effective in Türkiye due to high drug costs and small improvements in quality of life.[6] However, many drugs in the same class are in development, 119 being recorded as of January 2022, and their cost-effectiveness might improve over time.[15] When cost-effective and affordable disease-modifying treatments are available, if Türkiye does not have the infrastructure needed to deliver these drugs, it risks significant delays in patient access, widening health disparities, and exacerbating the societal and economic burden of AD.

Implementation of these drugs requires screening a large number of individuals to be able to diagnose those with MCI due to AD, identifying amyloid levels.[16] Screening is conducted using cerebral spinal fluid (CSF) analysis or positron emission tomography (PET). The drugs are implemented through intravenous (IV) infusions, and monitoring with magnetic resonance imaging (MRI) is needed throughout the treatment. Additional resource use might be needed if adverse events (i.e., amyloid-related imaging abnormalities- ARIA) are developed.[17] Thus, DMTDs could bring a substantial burden on healthcare systems.[18]

Understanding whether Türkiye's healthcare infrastructure is prepared for AD treatments is critical, given the anticipated rise in the prevalence of the disease due to the country's aging population. Effective treatment and management of AD dementia require a robust system capable of supporting early

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diagnosis, providing access to advanced therapies. If the infrastructure is inadequate, patients may face delays in receiving treatment, limited access to specialized facilities, and high out-of-pocket expenses, exacerbating health inequalities. Additionally, as new Alzheimer's treatments, including DMTDs, become available globally, ensuring that Türkiye's healthcare system can adopt and distribute these treatments efficiently will be essential. Therefore, this study aimed to evaluate the country's healthcare infrastructure and estimate potential budget impacts of new-generation dementia drugs.

Materials and Methods

This study is a descriptive analysis based on data from international and national datasets, as well as published literature, to forecast the healthcare resources required for the implementation of DMDTs in Türkiye.

The following sources were used for the estimates:

- National demographic data from the Turkish Statistical Institute (TUIK) to estimate the population aged 60 and above,[19]
- International literature to inform prevalence estimates,[18]
- Ministry of Health (MoH) reports for current healthcare infrastructure statistics, including the number of MRI and PET scanners, hospital beds, and healthcare personnel,[20]
- Published clinical trial data for aducanumab, donanemab, and lecanemab and NICE health technology assessments to determine treatment protocols, potential adverse events, and resource use (e.g., number of infusions, imaging requirements)[8-10],

This study was conducted using the most recent national health resource data available for Türkiye from the year 2023. Based on these data, treatment need projections were made for individuals aged 60 years and older as of the year 2025. The methodology involved the following steps: First, the potential number of people with MCI due to AD was estimated based on national demographics and the published evidence. The anticipated resource utilisation associated with DMDTs was identified, drawing upon published evidence on three recently developed treatments. Next, the ratio of additional resources need to available resources was calculated. The ratio helps identify the degree of expansion required in resources like diagnostic facilities, staffing (e.g., neurologists, radiologists), and infrastructure (e.g., hospital beds or specialised clinics). A high ratio signals an urgent need for investment in capacity-building measures, guiding policymakers in resource allocation and funding decisions.

Results

Prevalence of MCI due to AD

Although 0.7% of the population was reported to have dementia, data on the prevalence of dementia due to AD is lacking in Türkiye. It was estimated to be around 3% of the whole population in Europe.[1] However, this was criticised for not considering low detection rates and barriers to diagnosis.[13] A more recent, US-based study estimated 0.9% of individuals aged 60 years and older to have amyloid-positive MCI due to AD that was diagnosed by a doctor.[21] Using this data and the number of people who are 60years old and over (12.758.616),[19] the number of people with MCI due to AD can be extrapolated to be approximately 111.000.

Expected resource use related to disease-modifying AD treatments

Resource use needed to deliver three recent disease-modifying treatments includes initial screening to identify people eligible for treatments, delivery of treatments, and monitoring and ARIA-related adverse events. Table 1 provides the list of resources needed for the three disease-modifying drugs as reported in recent studies. Resource use reported for three drugs are very similar, except for the number of IV infusions needed, which is twice a month for aducanumab and monthly for donanemab and lecanemab. Additionally, due to the lack of published data on hospitalisation due to ARIA when treated with aducanumab and lecanemab, the analysis assumes to be the same as those reported for donanemab: 4% of all patients experiencing symptomatic ARIA require hospitalisation, with an average stay of 11.6 days.

Table 1. Resource use related to disease-modifying treatments

Disease-modifying treatments	Aducanumab[8]	Donanemab[10]	Lecanemab[9]
Diagnostics to identify per person for treatment*			
PET Scan or CSF	1.44	3.63	1.44
GP appointments	1.44	2.59	1
Specialist doctor's appointment	2	2	2

Treatment and monitoring			
MRI scans	2	2	5
PET scans or CSF	0	2	0
Specialist doctor's appointment	1	1	1
IV infusions	12	12	24
Adverse events			
Prevalence of symptomatic ARIA	10%	6%	3%
MRI	3	3	2
Hospitalisation of those with ARIA[22,23]	NA**	4% - 11.6 days	NA**
Specialist appointment	1	1	1

***** This includes screening patients presenting with symptoms to identify those with MCI even if they are not diagnosed with MCI.
******Assumed to be the same as Donanemab in the analyses.
ARIA: amyloid-related imaging abnormalities, CSF: cerebral spinal fluid, MRI: magnetic resonance imaging, GP: general practitioner, NA: Not available, PET: positron emission tomography.

Türkiye's available resources and additional capacity need

According to the most recent available report by the Ministry of Health,[24] Türkiye has 1.001 MRI scanners and 169 PET scanners. Number of general practitioners (GPs) is 60.229, and nurses is 232.442. In addition, there are 3.000 specialist doctors in neurology and geriatrics. A list of Türkiye's available resources that are of interest are provided in Table 2.

Table 2. Türkiye's available resources

Resources (Total)	**Number**
Number of MRI scanners[24]	1.001
Number of PET scanners[24]	169
Number of hospital beds[24]	266.594
Number of GPs [24]	60.229
Number of specialist doctors (neurology, geriatrics)[25]	3.000
Number of nurses[24]	232.442
Number of radiologists[26]	5.000

MRI: magnetic resonance imaging, GP: general practitioner, PET: positron emission tomography.

In the absence of data, some assumptions were made to estimate the total capacity of devices and healthcare professionals based on published studies (Table 3). According to the MoH statistics, the annual number of MRI scans per device was18,898 scans per device per year.[27] Assuming each device is available 340 days a year, number of scans per day would be approximately 56 (18.898/340). According to the MoH statistics, annual number of PET scans per device was 3,120, which means 19 scans per device (3.120/167).[27] Regarding hospital bed capacity, the occupancy rate reported by the MoH (58%) was used, resulting with 212 available bed days per year (0.58 X 365).[27] When estimating the number of patients one GP, specialist doctor and nurse can see, and the number of reports radiologist can generate, it was assumed that they would work 40 hours a day over 230 days a year, considering weekends and holidays. A recent regulation from the Ministry of Health set a target of 75 patients a day for GPs and one study estimated that neurologists see up to 120 patients a day.[28,29] It was assumed that each nurse could conduct 2 lumbar punctures per day for the cerebrospinal fluid (CSF) test,[27] and they could deliver 14 IV infusions, assuming one IV would take around 30 minutes.[30]

Based on the data and assumptions about capacity (Table 3), annual resource need for three DMDTs was calculated by multiplying per patient resource use (Table 1) by the estimated number of patients. The findings highlight notable variations in resource requirements, reflecting differences in the intensity and complexity of treatment administration among the three therapies.

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Table 3. Current healthcare resource use

Current healthcare resource use	Number
MRI appointments per device per day[31]	56
PET appointments per device per day[27]	19
Hospital bed days per year per bed[20]	212
GP appointments per GP per day[29]	75
Specialist doctor's appointments per day[28]	120
Lumbar puncture per nurse per day[27]	2
IV infusions/day per nurse[30]	14
Number of reports per radiologist[32]	100

CSF: cerebral spinal fluid, MRI: magnetic resonance imaging, GP: general practitioner, PET: positron emission tomography.

As reported in Table 4, Donanemab demonstrated the highest demand for MRI scans (n=1.894.769), followed by lecanemab (1.436.339) and aducanumab (n=1.178.820). Similarly, the need for PET scans was substantially greater for donanemab (62.493) compared to aducanumab and lecanemab (15.984). For CSF analysis, donanemab would require a significantly higher volume (562.437) relative to aducanumab and lecanemab, which both require 143.856 analyses. IV infusion needs were notably higher for lecanemab (2.663.999), approximately double the requirement for aducanumab and donanemab (1.332.000 each).

Table 4. Annual resource use need for DMDTs

Resource use	Aducanumab	Donanemab	Lecanemab
MRI scans	1.178.820	1.894.769	1.436.339
PET scans	15.984	62.493	15.984
CSF analysis	143.856	562.437	143.856
IV infusions needed	1.332.000	1.332.000	2.663.999
Hospital bed days	5150	3090	1545
FT GPs	19	19	19
FT specialist doctors (neurology, geriatrics)	34	33	33
FT nurses	95.431	96.269	190.574
FT radiologists	52	85	63

CSF: cerebral spinal fluid, MRI: magnetic resonance imaging, GP: general practitioner, IV: intravenous, PET: positron emission tomography.

Hospital bed days were highest for aducanumab (5.150), followed by donanemab (3.090) and lecanemab (1.545). Staffing demands also varied across treatments: while full-time GPs remain constant (19 for each treatment), the number of full-time specialist physicians (neurologists and geriatricians) required is marginally higher for aducanumab (n=34) compared to donanemab and lecanemab (33 each). Full-time nursing staff requirements are substantially greater for lecanemab (n=190.574) compared to aducanumab (n= 95.431) and donanemab (n=96.269). Similarly, lecanemab and donanemab require more full-time radiologists (63 and 85, respectively) than aducanumab (n= 52).

To estimate the incremental resource need for delivering DMDTs dementia to the Turkish population as soon as they become cost-effective, the ratio of additional resource use needed to current resource use was estimated (Table 5). The highest ratios were estimated for MRI and PET scanners, and radiologists respectively. This analysis showed that capacity improvements are urgently needed for the MRI and PET scans, and radiologists to accommodate the need for DMDTs. For donanemab, forecasted ratio of additional need for MRI scans was approximately 10%. This means a 10% increase in current resource use would be expected if donanemab treatment was to be made available immediately. This figure would be 6% and 8% for aducanumab and lecanemab. PET scans show a more modest need, with donanemab leading (5.7%), while aducanumab and lecanemab both show only a 1.46% increase.

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Table 5. Forecasted ratio of additional capacity needed in Türkiye

Resources	Current resource use	Forecasted additional need/Currentresource use		
		Aducanumab	**Donanemab**	**Lecanemab**
MRI scans	19.059.040	6.185%	9.942%	7.536%
PET scans	1.091.740	1.464%	5.724%	1.464%
FT GPs	60.229	0.021%	0.021%	0.021%
FT specialist doctors	3.000	0.282%	0.276%	0.272%
FT nurses	232.442	0.302%	0.663%	0.480%
FT radiologists	5.000	1.039%	1.702%	1.263%
Hospital beds	266.594	0.009%	0.005%	0.003%

MRI: magnetic resonance imaging, GP: general practitioner, NA: Not available, PET: positron emission tomography.

Discussion

This study presents an exploratory analysis of the potential impacts of DMDTs for AD dementia treatments on the Turkish healthcare system. The results reveal that a substantial increase in resource use would be needed for the provision of DMDTs, especially in the number of MRI and PET scans conducted, and radiologists. Donanemab generally requires the most additional capacity across most resources. These findings highlight the need to expand diagnostics imaging capacity for the implementation of these therapies effectively. The estimation of increased resource needs was based on a comparative ratio analysis between projected demand and current national capacity, allowing for a clear identification of infrastructure gaps that may hinder timely implementation of DMDTs.

The effectiveness of DMTDs is most pronounced during the early stages of AD, particularly in individuals with MCI due to AD. Delayed access to these therapies could result in patients progressing to more advanced stages, where the treatments may no longer be as effective. Without strategic investment, delays in access could exacerbate the burden of AD dementia. Although recent studies estimated that DMDTs are unlikely to be cost-effective at current prices, this might change as the quality-of-life benefits improve and prices reduce.

To the best of the author's knowledge, this is the first study to analyse the preparedness of Turkish healthcare infrastructure for disease-modifying dementia treatments. Studies from European countries showed that similar capacity constraints are a challenge for high-income countries as well, including Germany, France and the UK.[18,27,33] Similarly, a recent health technology assessment guidance published by NICE highlighted the substantial implementation challenges of these drugs.[14] These studies provide important lessons for Türkiye for preparing the healthcare system to accommodate DMTDs. Enhancing diagnostic infrastructure, including imaging facilities and biomarker testing capabilities, is vital for accurate and timely assessments. Increasing the availability of specialised memory clinics and training healthcare professionals in early diagnosis and management of AD is critical to accommodate the growing demand for DMDTs. Establishing robust referral pathways from primary care to specialists can streamline patient flow and reduce delays. Additionally, introducing digital health technologies to diagnose AD in primary care can enhance early detection, reduce the burden on specialist services, and optimise patient pathways by enabling timely referrals.

The study is limited by the lack of national data on the prevalence of AD-related MCI. The prevalence of MCI due to AD was assumed to be the same as in the US population as this was the only study that estimated the prevalence of MCI due to AD to be diagnosed by a doctor. However, this was a conservative assumption given that European studies reported higher rates.[1,13] Assumptions regarding healthcare professionals' capacity, such as the number of patients a GP or specialist can see per day, might not fully reflect the complexity and time requirements of diagnosing and managing AD patients. These were based on the target of 75 patients a day for GPs set by the Ministry of Health and one study reporting neurologists see up to 120 patients a day. However, as these numbers would not reflect the time required to assess dementia patients, these are expected to be much lower. This would mean that additional capacity need would be likely to be higher than estimated. One limitation of this study is the lack of data on the geographic distribution of healthcare resources, such as MRI and PET scanners, across urban and rural

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regions. Although national totals are available, clustering of devices in central facilities may lead to regional disparities in access, potentially exacerbating health inequalities.

Similarly, while the study highlights deficits in PET scanners, MRI devices, and nursing capacity, it does not account for broader infrastructural requirements, such as specialised training for healthcare professionals, number of radiographers or the establishment of new diagnostic and treatment centres. In addition, the APOE-ε4 gene is a significant risk factor for ARIA, and as a result, genetic testing will likely be required. Therefore, the study assumptions should be considered when interpreting the findings. Addressing these limitations in future studies could provide a more comprehensive understanding of the feasibility and implications of implementing DMDTs in Türkiye.

Conclusion

DMDTs offer an opportunity to alter the course of this devastating disease, but their implementation in Türkiye will require careful planning and investment. Addressing capacity deficits, managing budgetary constraints, and creating a robust strategic plan are critical to ensuring that these therapies can benefit patients without exacerbating existing health disparities.

Given the aging population and the anticipated rise in AD prevalence, Türkiye urgently needs to develop a comprehensive AD dementia strategic plan. This plan should prioritise the establishment of memory clinics to facilitate early diagnosis and management, along with phased drug introductions to mitigate the burden on healthcare resources. Additionally, investments in training and recruitment of healthcare professionals, particularly nurses and specialists, as well as expansion of diagnostic infrastructure, are essential to ensure equitable access to these therapies.

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2. Informed Consent: Not applicable.

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4. Declaration of Interests: The authors declare that there is no conflict of interest.

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