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POLICY FORUM

Evaluation of major national dementia policies and health-care system preparedness for early medical action and implementation

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Abstract

With population growth and aging, the number of people with dementia and related disorders will grow substantially in the years ahead, bringing with it significant societal, health-care, and economic challenges. Here, we analyze dementia policies of seven major countries in Asia/Pacific, Europe, and North America to identify opportunities for early actions to mitigate disease burden. We find that most countries are addressing this need by including a specific focus on early action in their national dementia strategies (five of seven countries), implementing public health initiatives for risk reduction, prevention, and early detection and diagnosis (six of seven countries); supporting enabling research for early detection and risk reduction (six of seven countries); and enacting a system for early, regular brain health screening (one of seven). We discuss risks and opportunities for integrating early action policies and conducting additional systematic research to understand the potential benefits and impacts of these policies.

1 | INTRODUCTION

The dramatic increase in aging populations around the world has ushered in a global dementia syndrome crisis and medical pandemic that has already begun to take a grave toll on individuals, families, regional and national health systems and societies, and the global economy. Worldwide, ≈55 million people live with dementia and related disorders today—a number that is projected to increase to 78 million by 2030—and dementia is the seventh leading cause of death among all diseases.¹ The annual global societal costs of dementia are expected to grow to >\$2.8 trillion by 2030.

In its 2020 update, the Lancet Commission on dementia, prevention, intervention and care declared that as many as 40% of dementia

cases could be prevented or delayed by addressing modifiable risk factors, and it called on nations to pursue ambitious targets for dementia prevention.² There are also efforts on a range of novel modalities for early detection and diagnosis. A blood-based biomarker test for brain amyloid is commercially available and is being used in a clinical trial that aims to prevent or delay the clinical progression of Alzheimer's disease (AD).^{3,4}

Several initiatives have recently been launched to tackle the issue of an early detection and management of AD. For example, Early Detection of Neurodegenerative diseases (EDoN; <https://edon-initiative.org>), the Alzheimer's and Neurodegeneration Precision Medicine Initiatives (APMI and NPMI; <https://npmiweb.net>), the Enhancing Neuro Imaging Genetics through Meta-Analysis (ENIGMA) Consortium

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(<http://enigma.ini.usc.edu/>), among others, aim to detect dementia before symptoms emerge by using multi-modal biomarkers, machine and deep learning models, and digital health technologies.⁵ Besides bodily fluids, studies indicate that retinal scanning could represent a suitable diagnostic tool for large-scale screening of AD-related early amyloid beta (A β) deposition.⁶ Finally, polygenic risk scores have shown potential for predicting significant risk of AD.⁷ These efforts seek to address the major challenge of ensuring early accurate diagnosis; currently, it's estimated that 75% of people with dementia globally are not diagnosed, and this rate is likely even higher in some countries.⁸

Further, there is growing consensus that novel disease-modifying therapies (DMTs) for AD would be appropriate and more likely to deliver benefit when used at earlier stages in the disease evolution, potentially at the prodromal stage.^{9,10} In 2018, the US Food and Drug Administration (FDA) issued guidance on the development of drugs for early AD, defined as “before the onset of overt dementia.”¹¹ In Europe, improving rates of AD awareness, early screening, and early detection and diagnosis have been recognized as imperative to implement future DMTs, improve quality of life, and address growing disease burden.¹² In the United States, the FDA has approved aducanumab for patients with mild cognitive impairment or the mild stage of dementia.¹³ Other potential DMTs, including lecanemab, donanemab, and gantenerumab, are currently in phase III clinical trials.^{14–16}

However, there is evidence that health systems are not yet sufficiently prepared to quickly and effectively provide such a DMT to those who need it. Projections find that people with AD in Europe would have to wait, on average, between 5 and 19 months to receive a new DMT due to health-care system capacity constraints.¹⁷ In the United States, it is projected that wait times for a specialist visit would reach 50 months if referrals relied on a brief cognitive test; however, wait times are projected at around 12 months if referrals relied on a blood-based biomarker test.¹⁸ Using a blood-based biomarker test in combination with a brief cognitive test, like the Mini-Mental State Examination, is projected to end wait lists after 3 years in the United States and reduce average annual costs by \$400 to 700 million.¹⁹

In addition to these scientific and research developments, the World Health Organization (WHO) has noted the need for policies that enable actions early in disease progression, as well as created a specific global target for risk reduction, as part of its global action plan for dementia.^{20,21} The plan's second action area, “Dementia awareness and friendliness,” calls for public health programs that “enhance the general population's ability to recognize early symptoms and signs of dementia” and “promote early diagnosis.” The plan's third action area, “Dementia risk reduction,” notes that addressing modifiable risk factors for dementia should be done “beginning in childhood and extending throughout life,” and the WHO's dementia risk reduction guidelines recommend risk reduction activities for cognitively normal adults. The plan's fourth action area, “Dementia diagnosis, treatment, care and support” notes that sustainable dementia care requires “timely diagnosis,” that continuous care should be provided “from the first symptoms of dementia,” and that there should be “available services to allow

RESEARCH IN CONTEXT

- 1. Systematic Review:** The authors analyzed public information about national dementia policies, focusing on official government documents and global policy reviews. There have been other recent high-level policy reviews from the World Health Organization and Alzheimer's Disease International, but reviews have not specifically examined early action.
- 2. Interpretation:** Our analysis contributes a high-level policy review that applies the lens of early action and discusses the novel policy relevance to this perspective.
- 3. Future Directions:** The article proposes a number of areas for further research on dementia policy. These include detailed research on the effectiveness of national policies for early action; comparative analysis of the differences between national policies; and research on sub-national policies, such as regional, state, or municipal efforts.

timely diagnosis.” The global action plan also calls for “innovative health technologies in prevention, risk reduction, [and] early diagnosis ...”

With these scientific developments and the high-level objectives defined by the WHO, there is an opportunity for a more detailed discussion of the importance of early action as a primary objective for dementia policy. Several analyses have been completed to capture and track the patchwork of proposed and adopted national plans on dementia, including works tracking national health system readiness for a DMT and dementia-related innovation.^{22–25} However, there is a paucity of targeted reviews assessing a country's dementia policy readiness with specific focus on early action. This article begins to address this deficiency. To do so, this paper will: (1) review the current state of national dementia policy in seven countries across the globe, with a particular focus on early action; (2) determine whether a country has national policies in four key categories for early action (full framework described below); (3) provide commentary on each country's national dementia policies, where they exist, and (4) present an overall discussion about the policy landscape as it relates to early action.

2 | METHODS

This paper evaluates national dementia policies across seven countries around the globe: China, Germany, Japan, South Korea, Sweden, the United Kingdom, and the United States. These countries were selected because they have an active national dementia plan; aged or rapidly aging societies; are diverse geographically and in their socioeconomic development profiles; reflect a variety of governance models for health and social care; and, together, represent > one quarter of the global

TABLE 1 Research framework for policy assessment

National plan focused on early action	Does the country's national dementia plan include high-level pillars and/or goals focused on risk reduction, prevention, and/or early detection and diagnosis?
Public health initiatives that promote risk reduction, prevention, and early detection	Does the national government have public health initiatives on dementia that include the following? (1) Promote awareness of the importance and benefits of early diagnosis, prevention, and/or early lifestyle interventions; (2) provide information on the diagnostic process; and/or (3) describe steps for risk reduction/early lifestyle intervention?
Research efforts on enabling early detection and risk reduction	Does the national government have a coordinated, funded strategy on dementia research that supports projects that enable early detection/diagnosis, prevention, and/or risk reduction (e.g., biomarkers, imaging, diagnostics, genetic risk profiling etc.)?
Programs that enable early and regular brain health screening	Does the country have a national system to enable early brain health screening on a regular basis? Does the country facilitate the use of specialized tests to support early detection?

population, close to half of the global population over 65, and nearly two-thirds of global gross domestic product.²⁶⁻²⁸

2.1 | Search strategy and selection criteria

For each of the countries examined in this paper, we gathered and analyzed public information about active national dementia policies. This included a review of official national dementia plans, descriptions of national dementia efforts from public health agencies, academic commentary on these plans and policies, resources from medical societies and advocacy associations, and reports from international organizations. We focused on dementia policies from national governments while excluding draft policies, subnational/regional efforts, and non-governmental initiatives. This paper also examined global policy reports published by the WHO and Alzheimer's Disease International.

2.2 | Evaluation of policies

Based on this research criteria, we developed a framework that evaluates countries on four policy categories that enable early action on dementia. These include: (1) having a national dementia plan that includes a focus on early action; (2) public health initiatives that promote risk reduction, prevention, and early detection and diagnosis; (3) enabling research for early detection and risk reduction; and (4) programs that enable early and regular brain health screening. Countries were then evaluated for national policies in each of these categories. In each of these categories, we discussed the questions listed in Table 1.

3 | RESULTS

3.1 | Results across all countries

Our findings for each of the countries in the four policy categories are summarized in Table 2. Countries are listed by geographic regions North America, Europe and Asia, and alphabetically within each region. An "X" indicates that a country has policies in place to meet the category criteria we defined in Table 1. A list of relevant national policies can be found in Appendix in [supporting information](#).

As shown in Table 2, the countries in order from the most policies for early action to the least are: Republic of Korea (four), United States (three), United Kingdom (three), China (three), Japan (three), Germany (two), and Sweden (one). Of the seven countries, five have a national dementia plan with a focus on early action. Six of the seven have public health initiatives on risk reduction, prevention, and early detection; six of the seven have enabling research to support risk reduction and early detection; and one has programs in place to enable early and regular brain health screening.

4 | ANALYSIS

These findings emphasize the opportunity for national leaders to design and implement additional policies that specifically focus on enabling early action on dementia. Of the seven countries, only one, Republic of Korea, has policies in place for all four categories. In short, every country can improve their dementia policies to better enable the kinds of early actions that offer the best opportunities to address the disease.

Additionally, each country has a distinct policy profile. Even within each category, countries are taking different policy approaches to pursue similar objectives, and each country has its own national realities that affect policy efficacy. This indicates the need for tailored national dementia plans that build on a country's policies and target remaining gaps. Ideally, each country would target future dementia policies to fill its current gaps, as well as improve and enhance those areas in which it already has policies in place. Indeed, even when a country has an active dementia policy, additional work can still be done to improve the policy's implementation and effectiveness.

Within the four broad policy areas, countries are mostly likely to have awareness campaigns and enabling research supporting risk reduction and early detection. Even countries with active national dementia plans can do more to incorporate a focus on early action. The greatest outstanding need lies in the area of early, regular brain health screening, where just one country has policies that meet the criteria of this review (South Korea).

4.1 | Country-specific case study results

Countries are listed by geographic regions North America, Europe and Asia, and alphabetically within each region.

TABLE 2 Early action policy areas

Country	Number of categories met (out of four total)	National plan focused on early action (5/7)	Public health initiatives that promote risk reduction, prevention, and early detection (6/7)	Research efforts on enabling early detection and risk reduction (6/7)	Programs that enable early and regular brain health screening (1/7)
United States	3	X	X	X	
Germany	2		X	X	
Sweden	1			X	
United Kingdom	3	X	X	X	
China	3	X	X	X	
Japan	3	X	X	X	
Republic of Korea	4	X	X	X	X

Note: Parentheses denote the number of categories met (X's) out of total.

4.2 | United States

The United States has national dementia policies in three of the four categories that support early action: (1) a national dementia plan with a focus on early action; (2) public health initiatives that promote risk reduction, prevention, and early detection; and (3) research efforts on enabling early detection and risk reduction.

4.2.1 | National plan

The United States first enacted a national plan on AD in 2011 with the National Alzheimer's Project Act, and the plan is updated annually. The 2021 update to the national plan represents the first iteration to feature risk reduction as a specific overarching goal, supported by six underlying strategies: research on risk factors, translation of research into clinical practice, accelerated public health action, expanded interventions through the National Aging Network, addressing inequities among marginalized populations, and coordinated public engagement.²⁹ The plan also includes efforts to detect early and pre-symptomatic stages of the disease, with the overall goal of preventing and effectively treating AD and dementia by 2025.

4.2.2 | Public health initiatives

The US federal government promotes prevention and early detection through both direct public resources and partnerships with advocacy organizations, state public health agencies, and local communities.²⁹ In particular, the Centers for Disease Control and Prevention (CDC) provides funds for Building Our Largest Dementia (BOLD) public health programs at the state and local level, including campaigns to "educate and empower" the public about brain health and the benefits of early detection and diagnosis.^{30,31}

4.2.3 | Enabling research

The United States has significantly expanded research funding on dementia in recent years, including efforts to enable early detec-

tion. National Institutes of Health spending on dementia research has increased from \$721 million in 2015 to an estimated \$2.85 billion in 2021.³² To work toward the research goals outlined in the national plan, the United States has initiated specific national research initiatives focused on genetic risk factors and molecular pathways involved in AD and related dementias.²⁹ The US research plan has also invested in the development of the precision medicine paradigm; for example, through a large-scale project called the "All of Us Research Program," with the ultimate goal to prevent and treat all major age-related diseases, including dementia.

4.3 | Germany

Germany has national dementia initiatives in two of the four categories that support early action: (1) public health initiatives that promote risk reduction, prevention, and early detection, and (2) research efforts on enabling early detection and risk reduction.

4.3.1 | Public health initiatives

The federal government funds public relations efforts, workshops, and campaigns that cover early diagnosis, prevention, and risk reduction themes.³³ For instance, the Federal Seniors and Health Ministry funds a "dementia partners" program to raise public awareness of dementia. Information on this campaign and more can be found on the federally managed "Guide to Dementia" website, and is highlighted during Germany's annual dementia campaign week.³⁴

4.3.2 | Enabling research

Advancing dementia research is a key pillar in Germany's updated 2020 National Dementia Strategy. The government supports individual research and health-care projects in partnership with German institutes and European programs; many of which focus on early detection, diagnosis, and prevention. For example, the German Center for

Neurodegenerative Diseases (DZNE) supports the Longitudinal Cognitive Impairment and Dementia Study (DELCODE), which examines at-risk groups and individuals with early stages of dementia to better characterize the earliest indicators of the disease, improve disease course prediction, and identify markers enabling early diagnosis;³⁵ as well as a recent study linking elevated microRNAs to early signs of dementia.³⁶ The government is also involved in a translational research partnership with local governments and civil and scientific organizations to develop scientific proof that prevention strategies can delay or slow cognitive decline.³⁵

4.4 | Sweden

Sweden has national dementia initiatives in one of the four categories that support early action: (1) research efforts on enabling early detection and risk reduction.

4.4.1 | Enabling research

A key strategic area of the national strategy for dementia care is monitoring and evaluating the progression of the disease. The government funds two registries: The BPSD is a registry focused on tracking the behavioral and psychological symptoms of dementia, while the Swedish Dementia Registry (SveDem)—one of the largest dementia registries in the world—aims to analyze and improve the quality of dementia diagnosis and care based on data from tens of thousands of patients.^{37,38} The government also initiated the Swedish National Study on Aging and Care, a longitudinal study to evaluate the elder care system in Sweden that includes dementia risk factors, early detection, and progression as key focus areas.³⁹ Finally, the Swedish government supports the BIOFINDER study, which aims to help develop early and accurate diagnostic tests, identify novel treatment targets, and deepen understanding of the disease and its symptoms.^{40,41}

4.5 | United Kingdom

The UK has national dementia initiatives in three of the four categories that support early action: (1) a national dementia plan with a focus on early action; (2) public health initiatives that promote risk reduction, prevention, and early detection; and (3) research efforts on enabling early detection and risk reduction.

4.5.1 | National plan

Each of the UK nations—England, Scotland, Northern Ireland, and Wales—have national plans that include strategies to promote early access to diagnosis.^{42–45}

4.5.2 | Public health initiatives

The UK supports campaigns to reduce stigma and increase understanding of dementia to promote early detection and prevention efforts. The Welsh Government launched its ACT NOW campaign in 2017 to disseminate risk reduction guidance.⁴⁶ Since 2018, England has used its National Health Service (NHS) Health Check program to provide people aged 40 to 74 with information on healthier lifestyle interventions to reduce their dementia risk.⁴⁷ Finally, NHS organizations support local authorities to promote several initiatives focused on awareness and prevention, including the One You campaign and the dementia-friendly communities initiative.⁴⁸

4.5.3 | Enabling research

The government funds research initiatives enabling early detection and diagnosis. The UK Dementia Research Institute, a public–private partnership funded in part by the government's Medical Research Council, promotes projects that support early-stage science to enhance understanding of dementia's development and progression. In 2019, the government also announced plans to establish the Accelerating Detection of Disease (ADD) challenge, now called Our Future Health, a £79 million research cohort of up to five million people for early detection and diagnosis for dementia and other diseases. Our Future Health is expected to attract up to an additional £160 million in private-sector support to research artificial intelligence (AI) capabilities for early diagnosis and biomarker discovery and the validation of diagnostic tools at scale.⁴⁹ In 2021, Our Future Health piloted participant recruitment processes for pilot studies that will launch in 2022.⁵⁰

4.6 | China

China has national dementia initiatives in three of the four categories that support early action: (1) a national dementia plan with a focus on early action; (2) public health initiatives that promote risk reduction, prevention, and early detection; and (3) research efforts on enabling early detection and risk reduction.

4.6.1 | National plan

China's national dementia plan was enacted in 2020 as part of the broader Healthy China Action Plan (2019 to 2030): Campaign to Prevent Disease and Promote Health.⁵¹ The Action Plan establishes the goal of reducing the growth rate of dementia in people age 65 and older, calling for public health initiatives at the regional and local levels to address common risk factors and regular cognitive screening and monitoring a part of elderly health examinations to support early interventions. It also establishes the goal that “the public's awareness rate of Alzheimer's prevention and control knowledge will increase to 80%”

and that “the cognitive function screening rate of the elderly in the community (village) reaches 80%.”

4.6.2 | Public health initiatives

There have been a number of campaigns in China to increase public awareness and understanding of the condition.⁵² For instance, in 2019, the National Health Commission released the Prevention and Treatment Guide for Alzheimer's Disease to educate the public on active prevention of AD, early signs and symptoms, and steps to take to intervene.⁵³ Prior to the enactment of China's national dementia strategy, public health efforts on dementia were housed within the national social psychological service system.⁵⁴

4.6.3 | Enabling research

China's Ministry of Science and Technology (MOST) has funded several research projects relevant to early dementia diagnosis and intervention, including cohort studies on risk reduction and efforts to establish consensus on cognitive testing.^{55,56} In 2018, the MOST launched a request for proposals on Active Health and Technology Against Aging to promote research on risk reduction and prevention of common diseases associated with aging, including AD and related dementias.⁵⁷

4.7 | Japan

Japan has national dementia policies in three of the four categories that support early action: (1) a national dementia plan with a focus on early action; (2) public health initiatives that promote risk reduction, prevention, and early detection; and (3) research efforts on enabling early detection and risk reduction.

4.7.1 | National plan

Japan first enacted a national dementia plan in 2012, followed by an update in 2015.⁵⁸ The current National Framework for Promotion of Dementia Policies will run from 2019 until 2025 and builds upon its predecessors' focus on developing dementia-friendly communities and environments, as well as a pillar that promotes risk reduction.⁵⁹

4.7.2 | Public health initiatives

The Japanese government has enacted public health campaigns to facilitate early action. Since 2005, a “dementia friends” initiative has trained more than 7.7 million people on dementia prevention, recognizing symptoms, the role of different health professionals, and the process for diagnosis.⁶⁰

4.7.3 | Enabling research

Japan's National Center for Geriatrics and Gerontology has led a number of studies on dementia prevention and risk reduction. In 2019, it launched the Japan-Multimodal Intervention Trial for Prevention of Dementia (J-MINT) as part of the World-Wide FINGERS Network.⁶¹

4.8 | Republic of Korea

South Korea has national dementia policies in all four of the categories to support early action: (1) a national dementia plan with a focus on early action; (2) public health initiatives that promote risk reduction, prevention, and early detection; (3) research efforts on enabling early detection and risk reduction; and (4) programs that enable early and regular brain health screening.

4.8.1 | National plan

South Korea first enacted a national dementia plan in 2008, and the fourth iteration was released in 2020. South Korea's first and second national plans took a health-care provider-centric approach to promoting early detection and diagnosis.⁶² The fourth national plan maintains pillars dedicated to prevention, early detection, and early post-diagnosis management of AD.⁶³

4.8.2 | Public health initiatives

South Korea's national plan includes awareness campaigns that support early action. In particular, the national “Dementia Partner” strategy features public-facing activities and volunteer training to promote dementia prevention and provide information about available dementia screening.⁶⁴

4.8.3 | Enabling research

The Korean government funds enabling research to develop diagnostics and biomarkers for early detection. In 2019, the Ministry of Health and Welfare and the Ministry of Science and Information and Communication Technology announced a ≈\$170 million research initiative, running from 2020 to 2028, in part to develop new predictive and diagnostic technologies.⁶⁵

4.8.4 | Programs for early and regular screening

South Korea has policies in place to support early, regular brain health screening. Since 2010, its National Dementia Early Detection Programme and nationwide network of more than 250 local dementia

centers, or “ansim,” have worked to increase early dementia screening and diagnosis.^{63,66} Studies of the program have found a cost per quality-adjusted life-year gained that ranges from \$24,150 to \$35,661⁶⁷ as well as resulting improvements in health-care service use, including a 55.4% increase in physician-diagnosed dementia.⁶⁸

5 | DISCUSSION

This article reviews the current state of national policies to support early action on dementia in seven countries across the globe. As we continue to learn the benefits of brain health, risk reduction, early detection, and initiating treatment and care earlier in disease progression, conducting national dementia policy evaluation efforts through the prism of early action, and building future plans and policies with this goal in mind, can help align dementia policy with ongoing scientific developments.⁶⁹

The analysis above indicates that a national policy approach centered around early action will include a specific focus on early action in the national plan. In contrast, the pillars of Sweden's national plan and Germany's national plan focus on services and support after diagnosis, but do not include early action as a major focus. This demonstrates that even advanced economies and leaders in the global community can still evolve their national dementia policies to reflect the latest scientific developments.

Furthermore, even where countries have policies for early action in place, they can continue to expand and strengthen these policies for greater efficacy. For example, while China and Japan are participating in the WW-FINGERS risk reduction study, they could also bolster national funding for research on novel modalities for detection and diagnosis. This more nuanced analysis of national policies is an area in which further research is needed, as well as research on subnational programs at the state, provincial, municipal, or local level. In some cases, these subnational programs may offer benefits such as greater flexibility or faster implementation.

China's national strategy and the 2021 update to the national plan for the United States indicate that a national risk reduction and prevention goal may be emerging as a new “best practice” for dementia policy focused on early action. In the United States, risk reduction has now been established as one of six overarching national goals. In China, the national plan establishes a specific level of public awareness of AD prevention as an overarching goal.

National policies on enabling research for early detection and risk reduction is an area of focus for the countries included in the analysis. This policy area promises to grow more important as new modalities for detection and diagnosis continue to advance and enter the market. Germany, Sweden, the UK, the United States, and South Korea all have national policies directing research into earlier detection, including leading-edge approaches like blood-based tests and applying artificial intelligence capabilities. Modalities that enable earlier, accurate, and more widespread detection and diagnosis, compared to current methods, are potentially vital to a more effective response, especially given the prospect for novel DMTs.

Finally, our analysis indicates that most countries do not support early, regular, easily accessible brain health screening. While there has been policy and scientific debate about the value of brain health screening, especially with limited therapeutic options, studies have indicated that the majority of surveyed older adults would want to know if they had AD, and that many of those included in screening programs initiate behavioral change and share their results with family.⁷⁰⁻⁷³ The cost-effectiveness of South Korea's National Dementia Early Detection Programme remains inconclusive; nevertheless, the program demonstrates that when governments make early and regular dementia screening programs available, the public will use these services, and that such programs yield benefits, including increasing diagnosis of dementia. The South Korean experience suggests that further research into more cost-effective models of national early dementia screening programs can be fruitful. In addition, as new detection modalities and DMTs become available, it seems likely that the benefits of screening programs would increase.

Of course, enacting dementia policies may not be sufficient without also assessing and adjusting those policies to ensure efficacy based on unique national realities, including coverage policies that incentivize policy adoption. Such an assessment is beyond the scope of this article, but it is an important area for further research and policy focus.

Finally, this paper explores four specific ways countries are working toward meeting the WHO's global targets. A review of how these policies have impacted or advanced prevention, risk reduction, and early detection goals in each of these countries may help inform the next iteration of the global action plan and further align it with new scientific developments and policy environments.

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CONFLICTS OF INTEREST

HH is an employee of Eisai Inc. He serves as Senior Associate Editor for the journal *Alzheimer's & Dementia* and has not received any fees or honoraria since May 2019; before May 2019 he had received lecture fees from Servier, Biogen, and Roche; research grants from Pfizer, Avid, and MSD Avenir (paid to the institution); travel funding from Eisai, Functional Neuromodulation, Axovant, Eli Lilly and company, Takeda and Zinfandel, GE-Healthcare and Oryzon Genomics; consultancy fees from Qynapse, Jung Diagnostics, Cytox Ltd., Axovant, Anavex, Takeda and Zinfandel, GE Healthcare, Oryzon Genomics, and Functional Neuromodulation; and participated in scientific advisory boards of Functional Neuromodulation, Axovant, Eisai, Eli Lilly and company, Cytox Ltd., GE Healthcare, Takeda and Zinfandel, Oryzon Genomics, and Roche Diagnostics. He is inventor of 11 patents and has received no royalties: (1) In Vitro Multiparameter Determination Method for The Diagnosis and Early Diagnosis of Neurodegenerative

Disorders Patent Number: 8916388; (2) In Vitro Procedure for Diagnosis and Early Diagnosis of Neurodegenerative Diseases Patent Number: 8298784; (3) Neurodegenerative Markers for Psychiatric Conditions Publication Number: 20120196300; (4) In Vitro Multiparameter Determination Method for The Diagnosis and Early Diagnosis of Neurodegenerative Disorders Publication Number: 20100062463; (5) In Vitro Method for The Diagnosis and Early Diagnosis of Neurodegenerative Disorders Publication Number: 20100035286; (6) In Vitro Procedure for Diagnosis and Early Diagnosis of Neurodegenerative Diseases Publication Number: 20090263822; (7) In Vitro Method for The Diagnosis of Neurodegenerative Diseases Patent Number: 7547553; (8) CSF Diagnostic In Vitro Method for Diagnosis of Dementias and Neuroinflammatory Diseases Publication Number: 20080206797; (9) In Vitro Method for The Diagnosis of Neurodegenerative Diseases Publication Number: 20080199966; (10) Neurodegenerative Markers for Psychiatric Conditions Publication Number: 20080131921; (11) Method for diagnosis of dementia and neuroinflammatory diseases based on an increased level of procalcitonin in cerebrospinal fluid: Publication number: United States Patent 10921330. AV is an employee of Eisai Inc. He has not received any fees or honoraria since November 2019. Before November 2019, he had received lecture honoraria from Roche, MagQu LLC, and Servier. MC and HRK are employees of Eisai Inc. HW has provided consultation to Eisai Inc., Lundbeck, Roche, and Signant Health pharmaceutical and assessment companies. HW owns the copyright of the individualized management system of neuropsychiatric symptoms (NPSIMS). CC has provided consultation to Cerecin, Danone, Eisai Inc., Lundbeck, Moleac, and Senescence. TI and KK have no conflicts to report.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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