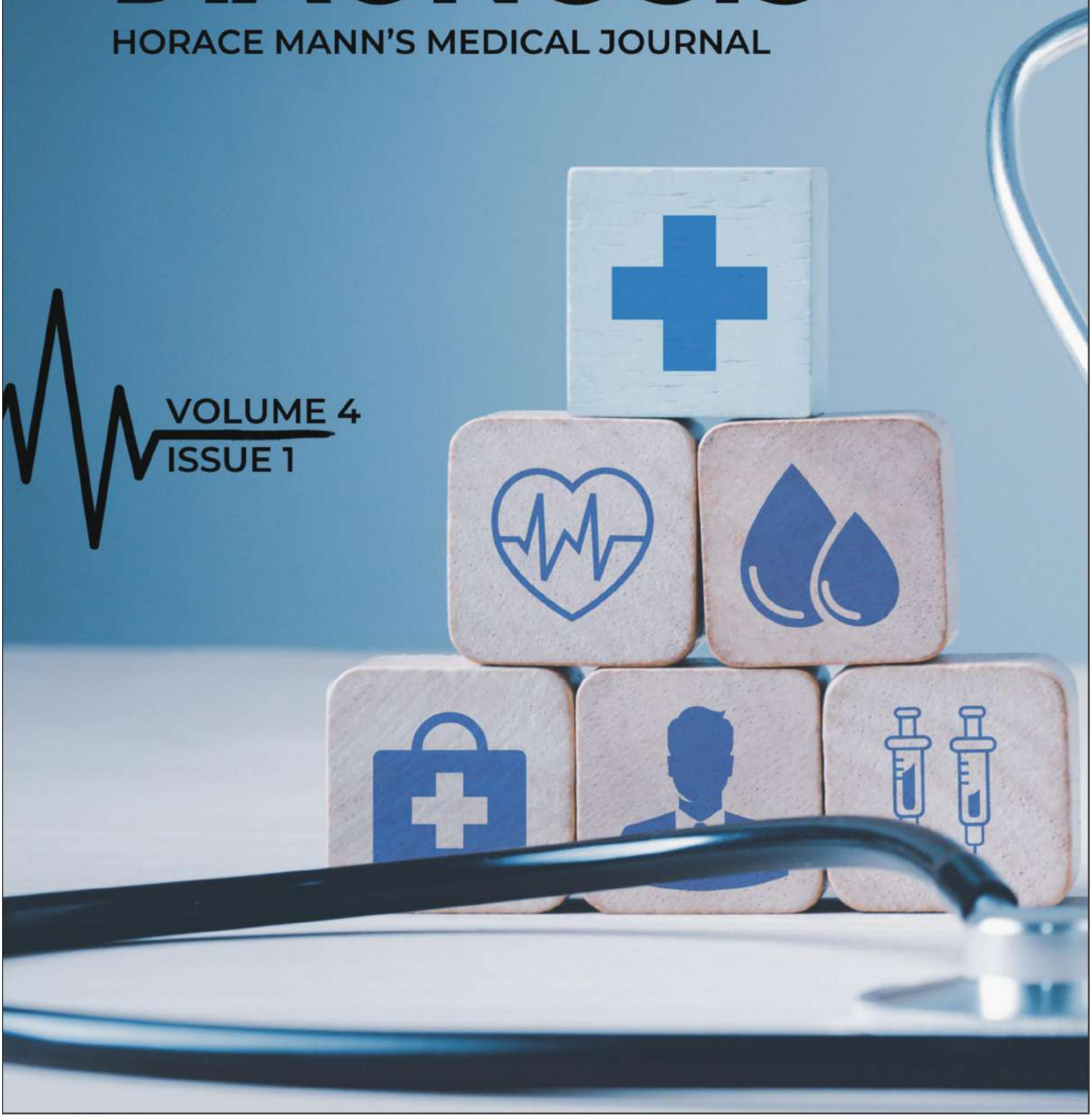
DIAGNOSIS

HORACE MANN'S MEDICAL JOURNAL

VOLUME 4
ISSUE 1



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Can Music be the Cure for Alzheimer's Disease?

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https://videohive.net/item/floating-musical-notes-on-an-abstract-purple-background-with-flares/21626222

Every three seconds, someone in the world develops dementia—the loss of memory, language and thinking, and the ability to carry out simple daily tasks. Alzheimer's disease (AD), the most common form of dementia, is a progressive and debilitating neurodegenerative disorder. With the number of people with AD estimated to increase from 55 million in 2019 to 139 million in 2050, AD has been often called the biggest health challenge we face this century.

There is currently no cure for AD, and available treatments attempt to manage symptoms or slow the progression of the disease. Music therapy, such as active participation in music-making, listening to music, or reminiscing with music has been shown to reduce neuropsychiatric symptoms and improve cognitio. However, its use as a non-pharmacological intervention in AD, while popular as there are no side effects and it's cost-effective, is still considered only to be an adjunct to medication.

This may be about to change, as music may be the ingredient that unlocks memories and other cognitive capacities in AD patients.

Musical Memory

Memory as a cognitive process is generally categorized into episodic/semantic, short-term/long-term, or implicit/explicit. Episodic memory such as housework, use of transport and management of money is crucial for daily living, and is affected early in AD. Thus, loss of memory in AD is a major contributor to functional disability.

Musical memory is the neural coding of musical experiences. While research has focused on the therapeutic benefits of music therapy, a very limited number of studies over the last 50 years have examined music's conceptual link with cognitive functions, primarily due to the non-availability of noninvasive tools to study the human brain in vivo.

Penfield and Perot (1963) were the first to identify the role of the temporal cortex in encoding musical memory. Subsequent research confirmed that musical memory seems to use multiple brain networks, and different types of musical-related memories appear to involve different brain regions. For example, when one recollects the lyrics of a song, it may involve memory networks which differ from when one recalls historical biographical events associated with a piece of music. Brain processes for semantic and episodic memory aspects of music differ.

We also know that memory for music can be severely damaged

while other memory functions remain mostly unimpaired, and conversely that musical memory can be found preserved in patients with vast lesions. This suggests that the network encoding musical memory is at least partially independent of other memory systems.

The Anatomy of Alzheimer's Disease Progression

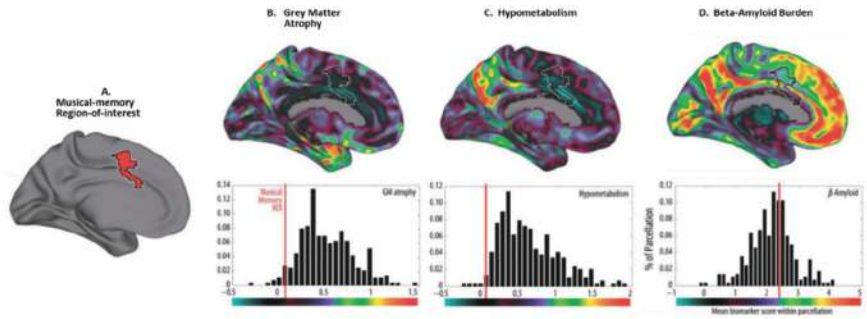
Three biomarkers are often used to track the progression of AD in the human cortex: grey matter atrophy, glucose hypometabolism, and the accumulation of amyloid beta protein in senile plaques. Exhibit B, C, and D display the 3-D renderings of the brain with the pictorial and graphical depiction of the biomarker levels for AD patients. Early degeneration in AD patients is found mainly in the temporal and parietal lobes and precuneus and other large neocortical areas. The primary sensory, motor, visual, and anterior cingulate cortices are spared till late stage.

The development of functional MRI employing pattern classification, provides the ability to investigate memory by determining the coding of information in distributed patterns, rather than analyzing brain activity.

Connecting Musical Memory and Alzheimer's Disease

Musical memory is known to be well preserved in AD patients, at least until a late stage. Jacobsen et al. (2015) hypothesized that the late-degenerating brain structures in AD, namely the motor cortices, the anterior cingulate gyrus, and the orbitofrontal cortex, may play a crucial role in preserving long-known musical memory in AD patients.

They used different musical stimuli and examined the brain network mediating the effect and coding of each music stimulus using fMRI. Unknown music was used to reflect first time music exposure and recently known music was used to investigate the exposure effect of familiar music. Finally, the effect of long-known music was examined. On examining the brain areas that encode each type of musical experience, they were able to identify the region of the brain where long-known musical memory resides, which was distinct from the other two stimuli. Exhibit A shows this as the region of interest.



(A) Musical memory region of interest (ROI) in red on a 3-D brain render. Alzheimer's biomarker maps and biomarker levels for various regions, with ROI biomarker level shown in red: (B) Cortical atrophy biomarker, (C) Hypometabolism biomarker, (D) Beta-amyloid burden biomarker. (Jacobsen et al., 2015).

Further, they found practically no overlap between the pattern for cortical degeneration and hypometabolism in AD with the region of interest, which evidenced the lowest level of atrophy and hypometabolism in the whole brain. Beta-amyloid deposition was found not to be significantly different in the region of interest compared to the rest of the brain, which is consistent with the fact that this is an early-stage biomarker. This provides the first concrete and objective evidence confirming why musical memory is well preserved in AD patients.

Future Possibilities

If our brain has a mechanism to preserve long-known musical memory, even in the presence of AD, and we know that listening to an old song can bring back memories of historical experiences with people we love, connecting these two opens possibilities for using music to enhance memory in AD patients. Neurodegenerative research continues to search for comprehensive psychopathological models which can help us understand and anticipate the effects of AD. Music as a whole-brain experience, which is intimately linked with our emotional history, may well be that model. The brain mechanisms that support the preservation of long-known music memory may well be the key to understanding and illuminating the specific neural architecture that underlies AD. Music, which has been a language not just for humans, but for all animal species through time, may well transition in our thinking to be not just a therapy for symptomatic relief, but a cure for our most complex neurodegenerative challenges

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