Exhibit 553

Michael J. Young, MD, MPhil
Board-Certified Neurologist
Phone: 410-808-1196

Date: 8 May 2025

RE: *Edgar A. Peterson, IV, v United States, Case No. 7:23-cv-01576*

I, Dr. Michael Young, M.D. am a board-certified neurology physician. This independent medical report is being conducted for the purpose of independent neurologic medical legal review and assessment. This report is strictly for independent review purposes only and no medical treatment or clinical recommendations will be made. All of the opinions herein are offered based on a reasonable degree of medical certainty. A review of prior medical documentation was carried out, as was an independent medical examination of Mr. Peterson.

A copy of my curriculum vitae, which includes a list of publications, is attached hereto as Exhibit A.

I have not testified as an expert in the last four years.

My rate is $525 per hour

1. Overview of Report

This report provides a review of Mr. Edgar Peterson's pertinent medical records, deposition testimony, and current scientific literature, with a focus on the diagnosis, progression, and etiologic factors of Parkinson's disease. Also incorporated is a summary of an independent medical evaluation (IME) of Mr. Edgar Peterson, conducted on April 10, 2025. The following sections detail his clinical history, diagnostic evaluation, and an assessment of potential risks, culminating in my independent neurologic opinion regarding his condition and underlying risks.

2. Expert Opinion

Based on my training, clinical experience, a thorough review of the records provided to me, and IME, it is my medical opinion, to a reasonable degree of medical certainty, that Mr. Edgar Peterson has Parkinson's disease. Additionally, it is my opinion that there is insufficient evidence to conclude to a reasonable degree of medical certainty that his condition is definitively caused by exposure to contaminated water at Camp Lejeune.

I reserve the right to modify my opinions based on the acquisition of additional information that might arise in the future.

3. Methodology

In formulating this opinion, I reviewed Mr. Peterson's medical records and deposition testimony and all records referenced in this Report, as well as relevant and up-to-date medical literature concerning the diagnosis and potential etiologies of Parkinson's disease. I also performed an IME of Mr. Peterson on April 10, 2025, using a secure videoconferencing platform. I formulated a

differential diagnosis and comprehensive evaluation to come to my opinion on causation, which includes an evaluation of all potential risk factors and etiologies, including idiopathic.

4. Medical Records and Other Records Reviewed

Prior medical and legal documentation was reviewed, including the following documents:[1]

- Records from:
  - Dr. Tulio Bertorini
  - Dr. Ronald Pfeiffer
  - Dr. Shawn Haden
  - Houston Methodist Texas Medical Center
  - Baptist Memorial Hospital
  - Dr. Joseph E. Allen II
  - Dr. Mark Ledoux
  - Dr. Eugene Lai
  - Dr. Karl Sillay
  - Dr. Vishad Kumar (Semmes-Murphey Clinic)
  - Encompass Health Rehab Hospital of Memphis
  - Methodist Hospital, Memphis
  - Lakeside Behavioral Health System
  - Walgreens
  - NARA
  - VHA
  - VBA
- Treater Depositions, including by:
  - Dr. Allen
  - Dr. Bertorini
  - Dr. Kumar
- Depositions of:
  - Jerry Potter
  - Lori Peterson
  - Edgar Peterson
- Radiology Reports
- Specific Causation Expert report by Dr. Barbano, February 7, 2025
- Life Care Planning report of Kay Hairston, February 7, 2025
- Economic expert report of Chad Staller, February 7, 2025
- Housing Report of Eric Anderson, February 7, 2025
- Expert Report on Edgar Peterson of Judy LaKind, May 8, 2025
- Expert Report on Edgar Peterson of Lisa Bailey, May 8, 2025
- Discovery Pool Profile Form
- Short Form Complaint
- Administrative claim form
- Social Security Administration records

[1] All materials considered are provided in the attached Appendix A.

- Mr. Peterson's responses to the United States' Requests for Admission
- Mr. Peterson's responses to the United States' First Set of Interrogatories
- Mr. Peterson's responses to the United States' Second Set of Interrogatories

5. Background on Parkinson's Disease

What is Parkinson's Disease (PD)?

Parkinson's disease (PD) is a gradually progressive neurodegenerative disorder that impacts both motor and non-motor functions.[1] James Parkinson first described the condition in 1817 in *"An Essay on the Shaking Palsy"* and in 1872, Jean-Martin Charcot dubbed the condition Parkinson's disease.[2,3] PD involves the loss of dopamine-producing neurons in the subtantia nigra (a part of the midbrain, in the upper part of the brainstem), that results in a dopamine deficiency.[4] Dopamine is a neurotransmitter – a chemical substance that plays a key role in nervous system signaling.[5] Disruptions of dopamine signaling in PD is associated with a range of motor and non-motor symptoms.[6] Abnormal aggregates of proteins including a-synuclein have been identified in the central, autonomic and enteric nervous systems of individuals with PD, and have been associated with cell dysfunction and cell death,[7] though the exact pathophysiologic mechanisms in PD are not fully understood, and are being actively researched.[8] Prototypical symptoms of PD include motor symptoms (e.g., bradykinesia, muscle rigidity, rest tremor, gait disturbance)[9] and non-motor symptoms (e.g., constipation, REM-sleep disorders, impaired sense of smell, autonomic changes).[10,11] While PD was initially considered a disorder of the brain alone, there is increasing recognition that PD affects multiple systems throughout the body, and as evidenced by identification of a-synuclein aggregates not only in the brain but also in the gut, peripheral autonomic nervous system, skin, olfactory system, and salivary glands of individuals with PD.[12-15]

How Common is PD?

PD is considered the second most common neurodegenerative disease worldwide.[16] It has been estimated to affect over 6 million people globally, and over 900,000 people in the United States.[16,17] The Global Burden of Disease (GBD) project found that between 1990 and 2016, the number of people diagnosed with PD increased by approximately 76%.[18,19]

How is PD Diagnosed?

There is no single test that can definitively diagnose PD.[20-23] Diagnosis of PD relies principally on comprehensive medical history and meticulous neurological examination.[1,20-23] It is a clinical diagnosis, and no single laboratory or neuroimaging test has been identified that can definitively diagnose PD with 100% sensitivity and 100% specificity, though research efforts are underway to identify biomarkers that may be used to diagnose, subclassify and track disease progression in the future.[24-27]

In 2015, the Movement Disorder Society (MDS) published Clinical Diagnostic Criteria that provided a more detailed method for diagnosing PD based on movement symptoms, response to medication, and other clinical factors.[28-30] The first essential requirement for a diagnosis is parkinsonism, which is defined as bradykinesia (slowness of movement) in combination with at least one of the following: resting tremor or muscle rigidity.[28] Once parkinsonism is established, the diagnostic process

determines whether the patient meets criteria for Clinically *Established* PD or Clinically *Probable* PD. This determination requires assessment of supportive criteria, exclusion criteria, and red flags.[28]

Supportive criteria increase confidence in a Parkinson's diagnosis.[28] A clear and dramatic response to dopaminergic therapy is one of the strongest indicators, where the patient returns to near-normal function with medication.[28] If detailed records of the initial response are unavailable, a dramatic response can still be confirmed by marked improvement with dose increases or significant worsening with dose decreases.[28] Additional supportive criteria include the presence of levodopa-induced dyskinesia; rest tremor documented in a clinical exam; and either olfactory loss (loss or diminution of smell) or cardiac sympathetic denervation on MIBG scintigraphy.[28]

Absolute exclusion criteria are features that definitively rule out a Parkinson's diagnosis.[28] These include cerebellar abnormalities (e.g., cerebellar gait, limb ataxia, or cerebellar oculomotor abnormalities); downward vertical gaze palsy or significantly slowed downward eye movement; a diagnosis of probable behavioral variant frontotemporal dementia or primary progressive aphasia within the first five years of disease; Parkinsonian symptoms that are restricted to the lower limbs for more than three years; treatment with dopamine receptor blockers or dopamine-depleting agents at doses that could cause drug-induced parkinsonism; and a lack of an observable response to high-dose levodopa despite significant disease severity.[28] Additional exclusions include unequivocal cortical sensory loss (e.g., loss of graphesthesia or stereognosis with intact primary sensory modalities), clear limb ideomotor apraxia, progressive aphasia, or normal presynaptic dopaminergic neuroimaging, which suggests the absence of dopaminergic degeneration.[28] If another condition known to cause parkinsonism better explains the patient's symptoms, or if an expert physician determines that an alternative syndrome is more likely, PD is ruled out.[28]

Red flags are warning signs that suggest another condition may be responsible for the patient's symptoms.[28] A major red flag is rapid progression, where the patient develops significant gait impairment requiring regular wheelchair use within five years of symptom onset.[28] A complete absence of motor symptom progression over five or more years, unless the stability is due to treatment, also raises concerns.[28] Other red flags include early bulbar dysfunction, such as severe speech impairments (dysphonia or dysarthria) or swallowing difficulties (dysphagia), within the first five years, as well as respiratory dysfunction, including inspiratory stridor or frequent sighing.[28] Severe autonomic failure in the first five years is another red flag; this may present as orthostatic hypotension, defined as a drop in blood pressure of at least 30 mmHg systolic or 15 mmHg diastolic within three minutes of standing, in the absence of dehydration or medications that could explain it.[28] Severe urinary retention or incontinence within the first five years is also concerning, unless it is part of a long-standing or mild stress incontinence history or attributable to prostate disease.[28] Recurrent falls (more than one per year) due to balance issues within three years of onset is another red flag.[28] Additional red flags include disproportionate anterocollis (dystonic neck posture) or contractures of the hands or feet within the first ten years, as well as the absence of common non-motor features of Parkinson's despite five years of disease duration, such as sleep dysfunction (insomnia or symptoms of REM sleep behavior disorder), autonomic dysfunction (constipation, urinary urgency, symptomatic orthostasis), reduced sense of smell, or psychiatric symptoms (depression, anxiety, or hallucinations).[28] Unexplained pyramidal tract signs, such as pathologic hyperreflexia or pyramidal weakness, is also detailed as a red flag, as is bilateral symmetric onset, where both sides of the body are equally affected from the beginning with no side predominance.[28]

The diagnostic thus process follows a systematic approach. If a patient meets the basic movement symptom criteria (bradykinesia plus either rest tremor or rigidity), the neurologist first checks for absolute exclusion criteria.[28] If any are present, Parkinson's is ruled out.[28] If no exclusion criteria are found, the neurologist then assesses the number of red flags and supportive criteria.[28] If the patient has at least two supportive criteria and no red flags, they meet the criteria for Clinically Established PD.[28] If there are no more than two red flags, but the number of supportive criteria equals or outweighs them, Clinically Probable PD can be diagnosed.[28]

A diagnosis of Clinically Established PD requires three conditions: the absence of absolute exclusion criteria, the presence of at least two supportive criteria, and no red flags that could indicate an alternative condition.[28] Clinically Probable PD, which allows for some uncertainty, also requires the absence of absolute exclusion criteria, but it permits the presence of red flags, provided that they are counterbalanced by supportive criteria. If one red flag is present, at least one supportive criterion is needed to offset it.[28] If two red flags are present, at least two supportive criteria are required.[28]

Why Might Someone Develop PD?

A person's risk of developing PD is influenced by a complex interplay of risk factors.[6,31-33] Risk factors are characteristics or conditions that may independently or in combination increase the likelihood of (but do not necessarily guarantee) a person developing PD. Risk factors can be extrinsic (e.g., environmental factors, lifestyle behaviors, physical factors) or intrinsic (e.g., genetic vulnerability, medical comorbidities that may place one at higher risk of PD).[16,34] Some risk factors are modifiable (such as physical inactivity), whereas others are nonmodifiable (such as genetic mutations).[35]

General examples of PD risk factors include genetic vulnerabilities (e.g., pathogenic mutations in SNCA, LRRK2, GBA, parkin, PINK1, DJ-1, ATP13A2, PLA2G6, FBXO7; VPS35; ATP13A2; PLA2G6; FBXO7; SMPD1; APOE; ATP1A3, C19orf12, CSF1R, DCTN1, DNAJC6, FTL, GCH1, GRN, LYST, MAPT, OPA3, PANK2, PRKRA, PTRHD1, RAB39B, SLC30A10, SLC39A14, SLC6A3, SPG11, SPR, SYNJ1, TH, TUBB4A, VPS13A, and WDR45)[36-38]; environmental factors (e.g., exposures to air pollution/particulate matter,[39] certain chemicals, micro/nanoplastics,[40-42] pesticides,[40,41] certain infectious diseases[42-45] and autoimmune conditions,[46,47] diabetes/prediabetes,[48] cardiovascular disease,[49] PTSD,[50-52] upper gastrointestinal mucosal damage as may occur in GERD)[53,54]; and lifestyle factors (e.g., physical inactivity, certain dietary choices).[55] Also among non-modifiable risk factors are older age (PD is rare in individuals under age 50, with increase in incidence after age 60[56]), male sex, and positive family history.[57,58]

While the presence of risk factors may increase the likelihood of developing PD, no single risk factor is categorically deterministic. This means that no risk factor's presence absolutely guarantees disease onset; many individuals with known risk factors never develop PD, and conversely, some individuals without identifiable risk factors nonetheless develop PD. Most cases of PD (estimated at around 70-80%) are considered idiopathic, meaning that they arise without a definitive, singular known cause.[59,60] Even when a specific cause is uncovered, the presentation can vary considerably across individuals, underscoring the multifactorial and heterogeneous nature of PD and its progression.[60,61]

Notably, risk factors do not necessarily constitute mechanisms of causation. While epidemiology frequently identifies risk factors through the observation of statistical associations with a disease on

a population level, risk factors themselves do not inherently carry sole causal power to drive disease pathogenesis.[62] For example, while being male is a risk factor for PD (insofar as male sex is associated with increased risk of developing PD), being male does not cause PD. Risk factors alone, derived from population-level statistical associations, neither provide mechanistic explanations nor establish individual-level disease causation.[63] I defer to Dr. Goodman's meticulous report discussing PD causation more generally.

Prognosis and Management of PD

The prognosis of PD typically involves progressive neurodegeneration, leading to increasing motor and nonmotor symptom burden; however, the tempo and nature of symptom progression varies considerably among individuals.[64] Even as PD leads to deterioration in neurological function, quality of life may be maintained through multifactorial symptom management involving multidisciplinary care and therapeutic management.[65,66] Dopaminergic pharmacotherapy, lifestyle interventions (e.g., exercise-based strategies), and careful symptomatic treatment, are among main strategies to manage PD, and neurotechnological approaches such as deep brain stimulation (DBS) may also play a role in some cases.[67,68]

6. Independent Medical Examination

On April 10, 2025, I conducted an IME with Mr. Peterson. Mr. Peterson appeared wearing a blue checkered shirt and glasses, seated in a motorized wheelchair, in no acute distress, breathing comfortably on room air, and using a computerized text-to-speech device to compensate for dysarthria. Mr. Peterson described that he was the second of four children; he recalls a supportive upbringing, describing his parents as "kind and loving," with his father working in finance. He attended multiple grade schools and junior highs, enjoyed hunting and fishing in his youth, enlisted in the military, and ultimately completed college and law school. He recalls serving as a district attorney for 23 years until his retirement in May 2001, remarking that the courtroom was his "natural habitat." He reports first noticing difficulties in 1998 while competing for a judgeship: "I felt like my voice was quivering." Following the onset of his speech symptoms, he recalls developing reduced olfaction, illegible handwriting ("undiscernible to me"), weakness in his left leg, and slower gait. At first, he attributed these changes to the aging process but was later diagnosed with PD. Regarding his deteriorating functional status, he stated, "I feel like I am a ghost… ignored and useless." Over time, Mr. Peterson's symptoms have included frequent falls and difficulty ambulating, though he emphasizes, "I cannot put an exact date on my inability to ambulate." He also reports experiencing a prolonged episode of psychiatric decompensation, during which he spent one night in a Memphis police holding cell and was subsequently hospitalized for ten days at Lakeside Behavioral Health. He described being recruited for the VA's deep brain stimulation (DBS) study program and undergoing subsequent procedures to replace the DBS battery. He describes his current mood as persistently low, "my mood sucks." He stated that he is no longer participating in formal speech, occupational, or physical therapy. Nonetheless, he engages in 20 minutes of Theracycle exercise daily and practices transitions from sitting to standing at home. He and his wife share responsibility for managing the household finances. Regarding past injuries, Mr. Peterson recalls a 1971 waterskiing accident in which he injured his leg after being thrown from a tube. He also describes a football-related head impact, "left side of skull came into contact with a wall and I may have lost consciousness for a few seconds", but denies any formal diagnosis of concussion. Mr. Peterson reports minimal childhood illness aside from having tubes placed in his ears and undergoing a tonsillectomy.

During the examination, Mr. Peterson wore glasses and remained comfortable on room air. His speech was dysarthric requiring use of the text-to-speech device. Extraocular movements were intact, facial sensation was symmetric, and he had no difficulty turning his head or shrugging his shoulders. There was a slight right upper extremity drift with hands outstretched, subjective distal numbness in both hands and feet, and limb strength remained at least antigravity. No tremor was appreciable. Rapid alternating movements revealed mild motor block bilaterally, and finger-to-nose testing was intact. Praxis and higher-level sequencing (Luria) were preserved. Drawing was constructionally intact but micrographic. Serial 7s were performed correctly. Although his initial abstract reasoning was off (for instance, pairing "watch" and "calculator" by their shared function of "measuring time"), he corrected with minimal prompting ("they both have numbers"). Despite the severe dysarthria, Mr. Peterson remained cognitively engaged, demonstrating insight, cooperative demeanor, and overall preserved higher-order function. Mr. Peterson transitioned from a seated to standing position and ambulated slowly and cautiously with a shuffling gait using a walker. Mr. Peterson stated that he is able to dress himself, though it is time-consuming, and he brushes his teeth using an electric toothbrush. Sleep is delayed, often after watching television, and he notes that his current daily routine is limited by both motor and speech impairments. Mr. Peterson stated that he is not currently engaged in physical therapy, occupation therapy, or speech language pathology, but was in the past. He underscores his inability to construct a precise timeline of his decline.

7. Mr. Peterson's Relevant Medical History

Mr. Edgar Allen Peterson IV is a 76-year-old right-handed male born in Jonesboro, Arkansas, with a history that includes gastroesophageal reflux disease (GERD), hyperlipidemia (HLD), coronary artery disease (CAD), impaired fasting glucose, vitamin D deficiency, iron deficiency anemia, bilateral cataracts, hiatal and umbilical hernias, arthritis, C5-6 fusion, left eye retinal surgery, left inguinal hernia, left calf traumatic hematoma requiring drainage in 1971, remote varicocele surgery, remote tonsillectomy, and hypertension, who served in the U.S. Marine Corps from 1974 to 1977 as an active-duty U.S. Marine Corps Officer (01576_PETERSON_DPPF_0000000026), separating with honorable discharge.

Records indicate that Mr. Peterson sustained a head injury while playing football in 1974 (Peterson_0000002588-89; Deposition, Lori Peterson, p. 62). Dr. Barbano's Expert Report (p. 16) states this event "would be consistent with a mild concussion with 15- 20 second loss of consciousness but immediately able to drive and function afterwards and with no evidence of post-concussive symptoms nor any other sequelae." On 6/24/ 1975, Mr. Peterson was referred to physical therapy for evaluation and treatment of "chronic musculoskeletal pain in neck" (01576_PETERSON_0000002553). On 6/27/1975, he was evaluated in the Physical Therapy department and diagnosed with chronic musculoskeletal pain of the neck region, reportedly dating back to a fall sustained in 1967. He was prescribed shortwave diathermy therapy for 20 minutes daily over a period of 10 days targeting pain localized to the side and rear of the cervical area (01576_PETERSON_0000002553).

Mr. Peterson has been treated for many years with Dr. Joseph E. Allen II of Internal Medicine. In the earliest notes available for my review from Dr. Allen, problems for which he was monitored included hypercholesterolemia (noted in 1996), bilateral inguinal hernias and lipoma, herpes keratitis (noted in 1997), genital herpes, weakness and fatigue (noted in 1997 to be "probably combined

effects of a lot of stress, poor sleeping habits, and other benign reasons"), and benign prostatic hyperplasia (BPH) (01576_PETERSON_0000004056-4154). Note from 4/16/1996 from a visit with Dr. Allen indicated that he was previously treated with and developed sensitivity to corticosteroids for "exacerbation of herpes and fever blisters", had a left calf traumatic hematoma requiring drainage in 1971, remote varicocele surgery, remote tonsillectomy, had a family history of breast cancer, prostate cancer, diabetes mellitus, hypertension and heart disease; and physical exam at that time was notable for scar from left calf surgery, mildly enlarged prostate, and few hemorrhoids (01576_PETERSON_0000004154).

During a visit on 3/18/1997, Mr. Peterson presented to Dr. Allen "URI with pharyngitis, postnasal drip and cough" for which he was prescribed Biaxin 500 mg x 10 days. During a visit on 4/21/1999 with Dr. Allen, it was noted that "he is getting over a cervical herniated disc with a left arm radiculopathy. He had surgery 11/97 by Dr. Clark and he did well. His left arm is still slightly weaker than the right, but it has improved a lot since the early days. He has a few paresthesias in the hand, but not many." On 7/1/1997, he was started on Aspirin 81 mg qD for prophylaxis given concern for atherosclerosis. On 7/16/1999, he started taking "cholesterol lowering medicine" (Baycol) with a plan to retest in 3 months. On 11/4/1999, he presented to Dr. Allen for "left arm shoulder pains for a few weeks…he has chronic stable mild parasthesias and weakness in the left hand that is related to previous cervical spine surgery…he has some mild parasthesias of the right big toe off an on." The assessment included "left shoulder pain (probably rotator cuff tendinitis)."

On 3/23/2000, Mr. Peterson presented with "recurrent left ear swimmers ear infection lately…similar to the ones he has had in the past…prescribed cortisporin drops." On 4/11/2000, he presented to Dr. Allen when it was noted that he was "getting over a URI slowly. He finished a Zithromax Z-Pak and a course of Augmentin but he is still having sinus symptoms" with suspicion for "sinusitis with postnasal drip." Mr. Peterson was prescribed Tequin 400 mg daily and Duratuss daily for 10 days. On 5/9/2000, he was seen by Dr. Allen, where it was noted that he "has had increasing amount of anxiety in social situations, decreased energy level, insomnia, et cetera. These are similar symptoms to those he had a few months ago when he diagnosed him as having anxiety or depression. He had been on a new job from about seven days and under a lot of stress with it. He enjoys it, but it is still stressful being at a new job after all of these years…" He was thereupon started on Effexor (01576_PETERSON_0000004123).

On 10/26/2000, Mr. Peterson followed up with Dr. Allen, who described

> mild tremor of the left leg continues but he is not really worried about it…and Dr. Craig Clark (neurosurgeon) suspects it might be from lumbar radiculopathy. He is not having any back pain or other symptoms in that respect, however. His left cervical radiculopathy is getting better. Depression signs and symptoms are getting better.

At that point, he was on Effexor, Baycol, and Aspirin. He subsequently underwent testing for heavy metals which was within normal limits.

On 5/22/2001, Mr. Peterson was evaluated by Dr. Tulio Bertorini for "slow motion, which was actually noted by a neurologist when he was evaluated by Dr. Wright for numbness in the left foot. No clear cause was found for that. Dr. Clark who operated on him for a cervical laminectomy for a

C7 disc noticed some progressive deterioration. It was initially thought to be due to depression." The exam was notable for a low-pitched, monotonous voice, decreased spontaneous blink, positive glabellar reflex, questionable Babinski sign on the right, resting tremor of the left hand and foot, decreased motility of the left arm, mild rigidity of the right arm, decreased sensation in the right toe, and slight decreased swinging of both arms with gait. The impression was "this patient does have Parkinson's disease" and a diagnostic trial of Sinemet was initiated (01576_PETERSON_VBA_0000000708). Follow-up with Dr. Bertorini on 7/6/2001 revealed walking had improved but "still has mild tremor and rigidity" prompting initiation of Requip (01576_PETERSON_VBA_0000000709). On 10/17/2001, he returned to Dr. Bertorini, who noted that "he is functioning fairly well. He has problems when he is in course, and he starts shaking more and his speech becomes slower." The exam was notable for masked fascies, monotonous voice, mild tremor bilaterally with cogwheel rigidity in the LUE, mildly hyperactive reflexes, and markedly improved gait. He was started on PRN Ambien and Benadryl, and it was noted that "he is still taking the Xanax on occasion when he gets very nervous" (01576_PETERSON_VBA_0000000712).

A note from Dr. Allen on 11/2/2001 details that Mr. Peterson had been diagnosed with PD "based on tremor (primarily of the left arm and leg intermittently, marked facial expression, and mild balance abnormalities. He started medicines and believes he is doing better. He has been quite nervous and upset because of the diagnosis. There have been other life events that have been going on (death and disability of family)." The assessment at that time described "Parkinson's disease of mild degree (managed by another doctor) 2. Weakness and fatigue (possibly due to medication side effects, depression, et cetera) 3. Anxiety and depression (not well enough controlled) 4. Left cervical radiculopathy (mild) 5. Left Lumbar Radiculopathy (mild)" in addition to nonallergic rhinitis, intermittent genital herpes (in remission), and hypercholesterolemia.

On 2/13/2002, Mr. Peterson was evaluated by Dr. Ronald Pfeiffer, Professor of Neurology at the University of Tennessee, "for a second opinion regarding evaluation and treatment of Parkinson's disease" following referral from Dr. Bertorini, who comprehensively reviewed the medical history. At that time, Mr. Peterson dated the onset of his neurological difficulties to November 1997, when experienced "impairment of muscle strength in his left arm when swimming." Prior to that it was detailed that he had been "experiencing some cervical pain and in conjunction with the onset of left arm weakness he also noted the appearance of some impaired sensation involving the first and second fingers of his left hand." MRI of the cervical spine was reported to demonstrate "a herniated disc at the C6-7 level and on November 28, 1997 Mr. Peterson underwent surgical removal of the herniated disc" by Dr. Craig Clark. He recalled a "rather dramatic deterioration" in the left arm strength prior to surgery and stated that by the time of the operation he had "lost total use" of the left arm. Although he experienced some postoperative improvement, left arm function "never did return to normal," estimating "return of function was in the 60 to 65% range." In May 2000, Mr. Peterson began to notice a left leg "twitch" when crossing the legs and some L toe parasthesias. In June 2000 Dr. Lance Wright to whom Mr. Peterson was referred for these symptoms observed "reduced blink rate, some facial masking, some reduced spontaneous use of the left arm, and mild rigidity of the neck and left arm", findings that raised concern for "early Parkinson's disease." Soon thereafter Mr. Peterson "had also begun to note some difficulty with fine motor control of the left hand, such as when tying ties or buttoning cuff buttons" and mentioned that "acquaintances were also commenting that he seemed 'stiff' in his appearance." It was noted that in "May 2001 Mr. Peterson first noted the appearance of tremor involving his left arm" and was referred to Dr. Bertorini. During the May 2001 evaluation, Dr. Bertorini noted a constellation of features: chronic

fatigue, bradykinesia, left hand and foot tremor, "low or soft voice," "reduced facial expression," and "diminished blink frequency." He diagnosed Parkinson's disease and initiated treatment with Sinemet 10/100, later increased and augmented with ropinirole. By July 2001, Mr. Peterson experienced "significant improvement in overall functional status". Dr. Pfeiffer concurred with Dr. Bertorini's assessment, stating:

> The history provided by Mr. Peterson and the findings on neurological examination today are certainly consistent with the diagnosis of idiopathic Parkinson's disease. The positive response to anti-Parkinson medication also favors this diagnosis. Mr. Peterson mentions to me that he has never been 'normal' since the cervical disc surgery in November 1997 and wonders whether his current symptoms could in any way be accounted for by the cervical disc or complications from the surgery[,]

but did not consider this likely (01576_PETERSON_0000003569-72).

On 7/1/2002, Mr. Peterson followed up with Dr. Bertorini, who noted that Mr. Peterson was "having a rough time. His sister died and he's not been very active or exercising. He feels tired all the time." At that point, medications included carbidopa-levodopa, Requip, Lescol, Paxil, Ambien, and Inderal, and Requip was increased to 3 mg (01576_PETERSON_VBA_0000000714). On 9/23/2002, he presented to Dr. Allen for mild dysuria and was diagnosed with chlamydia urethritis, treated with Levaquin. On 11/15/2002, he followed up with Dr. Bertorini, where it was noted that "He is drinking more than he should and he's concerned about that." Comtan (entacapone) was started to address "periods of fading off." Other meds at that time included Requip, Sinemet, Xanax, Propranolol, and "an anticholesterol medicine."

On 6/10/2003, Mr. Peterson was seen by Dr. Allen for constipation and referred to Dr. Towne (GI expert) for consideration of colonoscopy (01576_PETERSON_0000004078). A note dated 11/18/2003 indicated that Mr. Peterson was evaluated by Dr. Thomas Bannister and treated with Lexapro and Depakote for a "clear hypomanic episode" (01576_PETERSON_0000004055). He presented to Dr. Bertorini on 11/25/2003 "with several problems with his inhibited behavior and compulsive gambling."

Mr. Peterson resigned from work on 12/31/2003. Later expounding upon the circumstances surrounding his resignation in a narrative supplement (01576_PETERSON_VBA_0000001165-67), Mr. Peterson wrote that:

> [o]n several occasions in the summer of 2003, the president of the law firm, Mr. David M. Cook, spoke with me in an attempt to find out what had happened to cause me to become unproductive, unpredictable and lethargic….there was nothing anyone could say or do to halt my rapid decline… The firm had always treated me with the utmost courtesy and had provided me with a tremendous degree of latitude as my trial skills diminished. And on December 31, 2003, out of respect for the firm and Mr. Cook, and a realization that I had lost my skills as a trial lawyer and that I could not perform my job, I resigned from the firm… It was extremely difficult for me to realize and admit, but I could not work anymore. And I could not deny it any longer; I had become disabled. Understanding that I was disabled, and realizing that my wife and two daughters were depending upon me; in the

> spring of 2004, I applied for Social Security disability benefits, which was the only program that I considered available to me.

On 4/14/2004, Mr. Peterson underwent evaluation by Drs. Lai and Atassi, who chronicled that:

> In 2000, he started to complain of slow motion and numbness in his left foot. Dr. Clark, who operated on him for cervical laminectomy for C7 disk herniation, noticed some progressive deterioration. It was initially thought to be related to depression. In 2001, he noticed a tremor in his left hand and leg, which became worse particularly when he was in public, such as when he was in court. He complained of decreased facial expression, soft voice, and stiffness. In May 2001, he saw Dr. Bertorini and he was diagnosed with Parkinson disease…He was started on Sinemet 10/100 mg tid, and later Requip was added in low dose and increased slowly. He had good response to the treatment with feelings of nausea sometimes. His walking was much better, but he still had problems when he was in court. He tended to shake more and his speech became slower. He was very concerned about his performance at work. His tremor got worse in both hands. Inderal and Xanax were added. In November 2002, he was on Sinemet 25/100 mg and Requip 3 mg three times a day. He continued to have periods of on-off. Comtan was discussed at that time. His symptoms worsened gradually and he was depressed. He was started on Lexapro and he noticed several problems such as personality changes, disinhibited behavior and compulsive gambling. He went to New Orleans for a week without notifying his wife and his office. At this time, he complains of vision change, left arm and leg weakness, numbness in the hand, anxiety, and depression. He also has a history of head injury from playing football in 1974 which he suffered brief loss of consciousness. He has a history of exposure to paint. He had a 24-hour urine test for heavy metals and the result was negative. Otherwise, he denies recent headache, dizziness, vertigo, loss of consciousness, hearing change, tingling, incoordination, falling, impotence or incontinence….He is known to have hypercholesterolemia, anxiety, depression, varicules, hematoma of left leg, and ocular herpes….He underwent tonsillectomy in 1958, bilateral hernia repair in 1996, vasectomy in 1996 and cervical laminectomy for C7 disk in 1997…..He complains of decreased facial expression, soft voice, left hand and leg resting tremor, and stiffness. He has periods of on-off fluctuation. On examination, he has hypomimia, hypophonic voice, bradykinesia, rigidity, and left side resting tremor. Therefore, his clinical findings are most consistent with moderate Parkinson's disease.

The plan was made to pursue DBS (01576_PETERSON_VHA_0000000236-8).

A follow-up with Dr. Tulio Bertoni on 5/25/2004 indicated that Mr. Peterson "is going to Houston for a trial of brain stimulation….he complains now of severe inability to concentrate, walk, or do any type of physical activity and typing because of his hand tremors and rigidity. He is having trouble finishing a sentnace when he talks because of the lack of concentration and has poor memory…he's gained a lot of weight and feels tired all of the time" (01576_PETERSON_0000004080). On 9/13/2004, Mr. Peterson underwent clinic evaluation by Dr. Richard Simpson, Chief of Neurosurgery at VA, where DBS was discussed (01576_PETERSON_VHA_0000000234). Mr. Peterson enrolled in VA Cooperative Study Protocol (CSP) #468, led by Dr. Eugene Lai of Baylor College of Medicine, titled "A Comparison of Best Medical Therapy and Deep Brain Stimulation of Subthalamic Nucleus and Globus Pallidus for the

Treatment of Parkinson's Disease," An MRI of the brain on 12/28/2004 revealed nonspecific enlargement of the ventricles, sulci, and cisterns, without evidence of hydrocephalus or midline shift, and mild nonspecific white matter hyperintensities (01576_PETERSON_VHA_0000000230). He underwent implantation with a Medtronic deep wave stimulator in 2004.

In follow-up with Dr. Bertorini on 2/1/2005, it was noted that "he has received stimulation [DBS] in Houston and has done extremely well without any complaints. He said it has been very successful." Examination revealed that "his voice is clearer…he is not hemiplegic, weak or rigid. He does have some dyskinetic movements on the left side." It was advised that "it would be a good idea to taper his L-dopa because he is slightly overmedication…I will give him ambien, however, as he's having insomnia; he's had some tragedy in his family. He said he does not need an antidepressant" (01576_PETERSON_0000004067). On 8/10/2005, he presented to Methodist Hospital with a complaint of "adverse reaction to meds." It was reported that he was taking "double dose" of Requip "and it has caused paranoia – started taking seroquel this afternoon and now feels nervous and twitching" (01576_PETERSON_MH_000001020). He was subsequently admitted to Lakeside Behavioral Health Center from 8/10/2005 to 8/17/2005. Circumstances surrounding that hospitalization are detailed in notes, including a family therapy note from 8/11/2005 stating that:

> Wife reports that husband misunderstood the dose he needed to take for his PD and stimulator medication, taking almost double the prescribed amount, causing episodes of paranoia. …Wife reports that the paranoid thoughts became so severe that she had to call the police the other night when husband had thoughts of someone hiding in his house to kill him. Wife indicated that she felt that husband may have purposely taken more of the medication than what was prescribed, not knowing the significant effect it would have…

(01576_PETERSON_LAKESIDE_0000000059). An entry on 8/15/2005 noted:

> Discussed incidents that lead to patient's admission and aftercare plans. Wife stated that her husband had some how mixed up his dose of PD and brain stimulator medicine that caused him to have paranoid episodes … Wife reported that she would be in charge of administering patient's medicine, as she felt that it would be best, considering the state patient was currently in. Wife and husband also discussed a stressor that has had a huge impact on the family dynamic, indicating that their daughter was in a serious car accident that ended up killing her best friend. Wife reported that their daughter was the one driving the car when the accident occurred, putting them in a legal bind…

(01576_PETERSON_LAKESIDE_0000000083). At time of discharge on 8/17/2005, he was maintained on Seroquel 50 mg and Ambien 10 mg at bedtime with a plan to follow up with the outpatient team (01576_PETERSON_LAKESIDE_0000000005).

Follow-up visits with Dr. Eugene Lai between 2004 and 2009 documented a progressive pattern of parkinsonian symptoms with both "on" and "off" states noted on the Unified Parkinson's Disease Rating Scale (UPDRS) assessment form. In the speech and facial expression domains (Items 18–19), Mr. Peterson consistently exhibited mild to moderate impairments, with speech rated at 2 across all dates and facial expression showing values ranging from 2 to 3, indicating persistent masked facies. Rest tremor (Item 20) was intermittently present, particularly in the left hand and chin, with mild scores (1) observed but mostly absent in the lower extremities and right side. Action tremor (Item

21) was also mild and primarily noted in the left hand. Rigidity (Item 22) scores suggest persistent bilateral axial and limb rigidity, most notable in the neck, left upper extremity, and both lower extremities, with rigidity scores ranging up to 3, particularly in the left lower extremity. Motor fluctuations are indirectly implied by alternating "on" and "off" state ratings across dates. The recorded data reflects a moderately advanced stage of idiopathic Parkinson's disease, with asymmetry favoring left-sided motor findings, axial involvement, and stable but functionally limiting speech and facial motor deficits. (01576 PETERSON 0000002603).

On 1/7/2009 Dr. Lai informed Mr. Peterson in writing that he had been randomized to the Globus Pallidus DBS surgical site group as part of his participation in the VA Cooperative Study #468. The letter expressed the study team's ongoing efforts to analyze data evaluating whether the surgical site of DBS impacts symptom improvement. Dr. Lai emphasized that Mr. Peterson's contribution was highly valued by the study investigators and the broader Parkinson's community, noting that the findings would provide meaningful insights into the optimal treatment of Parkinson's symptoms (01576_PETERSON_0000000682).

In a clinic visit dated 4/28/2009 Mr. Peterson, then age 60, was evaluated by Dr. Cooper at Vanderbilt University Medical Center for ongoing management of "idiopathic Parkinson's disease." At this visit, it was noted that Mr. Peterson "remains pleased with his motor control" but continued to experience left-sided rigidity, gait impairment, and falls. It was described that had been adjusting his own device settings for rigidity but noted diminishing battery life and a history of compulsive behaviors on Requip. Neurological exam showed mild facial hypomimia, mild dysarthria, good strength, and pronounced rigidity and gait dysfunction, including festination and poor en bloc turning. His plan included continued DBS optimization, transition to extended-release Requip to mitigate compulsive side effects, and anticipatory planning for IPG battery replacement in the next 6–12 months. He was strongly advised to engage in daily exercise to minimize fall risk (01576_PETERSON_0000002668–2669).

A Montreal Cognitive Assessment was performed on 9/8/2009, on which Mr. Peterson scored 30/30, indicating no evidence of cognitive impairment (01576_PETERSON_0000002601).

On 1/3/2014, Mr. Peterson was seen by Dr. Bertorini in follow-up for PD. It was noted that he had replacement of a thalamic stimulator as battery power ended. He was taking ropinorole, sertraline, and Sinemet (6 sinemet a day). The exam was notable for frequent dyskinesias impairing gait, impaired balance, and mild dystonia with normal strength.

On 1/29/2014 Mr. Peterson underwent a Compensation and Pension (C&P) examination by Dr. Lois C. Bronstein. Dr. Bronstein concluded that "it is at least as likely as not (50-50 probability) that Vet's parkinson's disease was caused by or a result of exposure to contaminated water at Camp Lejeune" (01576_PETERSON_VBA_0000001214-1220).

On 3/14/2014, Mr. Peterson underwent another Compensation & Pension (C&P) examination performed by Dr. Elizabeth Dillon, PhD, to evaluate his mental health status in relation to his Parkinson's disease. The evaluation concluded that Mr. Peterson met DSM-5 criteria for Depressive Disorder due to Another Medical Condition (Parkinson's Disease), with Depressive Features, with symptom intensity assessed as moderate and functioning markedly impacted across occupational, social, and personal domains (01576_PETERSON_0000002489–2496). Mr. Peterson reported

persistent low mood, sleep impairment, fatigue, apathy, and increasing anxiety, particularly surrounding public exposure and social interactions, all of which were exacerbated by his advanced Parkinsonian motor symptoms. His wife corroborated many of these difficulties during the interview. He denied any current or past psychosis or suicidal ideation and was deemed capable of managing his financial affairs. Behavioral observations confirmed flattened affect, severe bradykinesia, speech impairment, and anxiety-induced exacerbation of involuntary movements. Despite his advanced motor disability, Mr. Peterson demonstrated high cognitive function, insight, and judgment. The Beck Depression Inventory-II score of 23 further supported a moderate depressive state, and the examiner characterized his prognosis for improvement as guarded to poor, citing continued decline despite pharmacologic therapy and the implantation of a DBS device.

On 7/7/2014, during a follow-up with Dr. Bertorini noted "on and off phenomena" with frequent freezing. The exam was notable for orofacial dyskinesias, freezing, bradykinesia, and no rigidity. Dr. Bertorini increased the frequency of the prescribed Ropinorole.

A PD disability benefits questionnaire completed by Dr. Bertorini on 9/3/2014 specified a date of PD diagnosis as "July, 6 2001" (01576_PETERSON_VBA_0000000135), and symptoms included stooped posture, balance impairment, bradykinesia, loss of automatic movements, speech changes, tremor, rigidity, depression, loss of smell, sleep disturbance, difficulty chewing/swallowing, urinary problems, constipation, sexual dysfunction, falls, freezing when walking, fatigue, difficulty speaking, difficulty writing.

On 3/26/2015, Mr. Peterson presented as a new patient to the Semmes-Murphey clinic to establish care for PD, referred by Dr. Allen, with a desire to see Dr. Kumar. The encounter noted a review of systems that included "sleep disturbance, feeling run down, trouble swallowing, ankle swelling, urinary frequency, bladder control, joint pain, joint swelling, arthritis, muscle pain, muscle weakness, stiffness, numbness, tremors, depression, anxiety, excessive urination, itching, dryness." Notable exam features included:

> ambulates with a walking cane assist. He is awake, alert and oriented x3. Brain stem is intact. Motor strength is intact with 5/5 bilateral upper and lower extremities. He is able to arise to standing with his arms crossed, however ambulates with his assist device. He has freezing of gait upon initiating steps and with left, greater than right side, turning, this is exacerbated by going through our clinic doorway. He has bradykinesia. He has masked face, bradykinesia in bilateral upper and lower extremities. He has cogwheeling and rigidity in the bilateral upper and lower extremities

(01576_PETERSON_HM_00000000175-177). On 4/8/2015, he was seen by Dr. Levin and Dr. Bhaskaran at VA Neurology, where it was noted that he had been:

> diagnosed with Parkinson disease in 2002 by Dr. Bertorini. Patient initial symptoms were left sided tremor and rigidity. Reports that he enrolled in DBS surgery trial in 2004 at Houston. DBS placed in GP [globus pallidus]. Reports that surgery helped his rigidity and tremor. His current symptoms are truncal ataxia and choreiform hand movements. These movements are worsened with stressors, especially worse today (eg. anxiety of meeting new people). He does have 'on and off' symptoms. He is on sinemet 25/100, 2 tabs 6x/day (total

> levodopa 1200mg); ropinirole 4mg 6x/day; rasagiline 1mg qday. He reports that he is on this regimen for more than 5 years…

On 4/30/2015, he had an initial visit with Dr. Kumar, who noted that his symptoms were "uncontrolled on current settings of deep brain stimulation and medications because of complications of severe dyskinesia," adding that exam "showed that he is markedly dyskinetic and has severe generalized dyskinesia affecting his neck, face, upper, and lower extremities to the point that he is unable to sit still on the bed and chair. … His speech is markedly dysarthric due to the dyskinesia." Dr. Kumar down-adjusted DBS settings, discontinued Sinemet, and initiated Rytary (01576_PETERSON_HM_0000000172-174).

On 10/3/2016, Mr. Peterson was evaluated by physical therapy at the VA, where he was supplied with a U-step walker (01576_PETERSON_VHA_0000000034). On 12/30/2016, he underwent evaluation with neurologist Dr. Thomas David, MD, who noted that Mr. Peterson:

> has a long history of Parkinson's disease complicated by severe motor fluctuations. Several years ago he underwent bilateral GPI DBS as part of the VA clinical trial comparing STN to GPI DBS. Reportedly, he did very well for several years but recently has begun to have more difficulty with his speech, balance, and worsening motor fluctuations. His current DBS settings allow him to switch between 3 groups and titrate the voltage within each group. He states that he changes his DBS settings '50 times per day'…He has had hallucinations and disabling paranoia in the past when he took higher doses of ropinirole…He states that he falls 'daily'…During the examination he varied from moderate to severe dyskinesia to mild bradykinesia. He was alert, oriented, fluent, and a good historian…He displayed frequent motor blocks and retropulsion…

Dr. David encouraged a single-group DBS setting, a stable dosing schedule, and emphasized exercise as "the only therapy that has been shown to delay disability in Parkinson's disease."

On 2/28/2017, Mr. Peterson presented to Methodist Hospital with lower back pain and LLE pain after falling twice on stairs, reporting that his leg "got weak and just gave out on me." A computed tomography (CT) scan of the lumbar spine showed significant degenerative changes at L5-S1 without an acute fracture or compression deformity (01576_PETERSON_MH_000000941-943). On 4/7/2017, he was seen in follow-up by Dr. Davis, reporting "unpredictable off periods" throughout the day and frequent freezing of gait. On 9/12/2017, he was evaluated at Methodist Hospital for RLE [right lower extremity] pain and swelling and was diagnosed with thrombophlebitis of the right saphenous vein by Dr. Alan Taylor (01576_PETERSON_MH_000000871).

On 7/3/2018, Mr. Peterson was seen in follow-up with Dr. Kumar, who wrote that "his speech is very dysarthric and difficult to understand. He is also having mild dyskinetic movements in upper and lower extremities. His dexterity is mildly impaired on both sides. He is able to get up from the chair and walk with shuffling and poor balance." The DBS settings were lowered to improve speech and reduce dyskinesia. On 6/3/2019, he again saw Dr. Kumar, who wrote that

> He has been doing fairly well but his symptoms of gait imbalance are getting worse. He has great difficulty in walking and walks with shuffling. He has been adjusting his

> deep brain stimulation all day. Sometimes, when he goes to walk, he uses one program. When he does not walk, then he uses next program. At current setting, he is not having any side effects. He is not very compliant with the medications. He takes medications whenever he likes.

On 8/11/2020, Mr. Peterson was evaluated at Methodist Hospital emergency department following a motor vehicle accident with airbag deployment and loss of consciousness. He was found to have a nondisplaced sternal fracture and an L1 anterior endplate fracture, for which he was fitted with a TLSO brace; no surgery was planned (01576_PETERSON_MH_000000532-4). On 10/29/2020, he was seen by Dr. Kumar and initiated on melatonin 10 mg qhs. Nourianz was also started "to see if that can cut down on his off periods." He was advised not to drive and was referred to a primary care physician for urinary symptoms (01576_PETERSON_HM_0000000105). On 6/30/2021, he was seen again by Dr. Kumar, who noted that "his symptoms of Parkinson's disease are slowly getting worse" and that "his wife is requesting a wheelchair." A wheelchair was prescribed "for long distances to prevent any fall and injuries."

On 3/16/2022, Mr. Peterson was seen by Dr. Shawn Hayden for "left arm pain" following a fall, prescribed Mobic and Medrol, with x-ray revealing "djd [degenerative joint disease] with old fx [fracture]" (0157_PETERSON_MEDRECS_000000000070). On 3/31/2022, he presented to Methodist Hospital after a syncopal event with loss of consciousness. Per neurology assessment by Drs. Marc Malkoff and Hunter Mitchell, these were "syncopal events, likely secondary to cardiac/pulmonary etiology, low concern for neurogenic." At that time, "falling asleep spells" were noted to have been ongoing for 6 months; the exam was notable for masklike facies, minimal rigidity, and bradykinesia (01576_PETERSON_MH_000000183-5). The transthoracic echocardiogram (TTE) was unremarkable, electroencephalography (EEG) showed "right temporal irritability," and the cardiology consultation with Dr. Petit-Frere detailed "syncope vs cataplexy," with no obvious cardiac or structural cause identified (01576_PETERSON_MH_000000196). A referral for a sleep study was made. On 1/27/2022, during follow-up with Dr. Kumar, it was noted that "speech is getting a little slurred and he is having more difficulty in walking." Zoloft was increased from 50 to 100 mg (01576_PETERSON_HM_0000000089-91). On 7/11/2022, a further follow-up described intermittent freezing spells, difficulty speaking, and difficulty sleeping. It was noted that "he was doing better after Ingrezza when he took it as needed. It was helpful for his freezing spells" (01576_PETERSON_HM_0000000081).

Imaging studies conducted between 2017 and 2023 document a range of chronic and degenerative changes consistent with Mr. Peterson's complex medical history, including progressive musculoskeletal and neurologic pathology. A lumbar spine X-ray performed on 2/28/2017, showed significant disc space and endplate degenerative changes at L5-S1, with less pronounced degeneration at L4-L5. Subsequent imaging on August 11, 2020, including a CT of the abdomen and pelvis, identified an upper sternal body fracture, cardiomegaly, a small hiatal hernia, and an endplate fracture at L1. CT imaging of the cervical spine from that same date revealed advanced, multilevel degenerative disc changes and spondylosis, with an acquired fusion at C6-7. A concurrent CT angiogram (CTA) of the head demonstrated mild generalized atherosclerosis involving the aortic arch and carotid bulbs, without evidence of dissection. CT head scans on 8/11/2020 and 4/1/2022 showed no acute intracranial pathology but confirmed the presence of previously placed bifrontal deep brain stimulators (DBS). The CT cervical spine again confirmed diffuse disc space narrowing and bony fusion at C6-7, with widespread cervical spondylosis. A nuclear medicine positron

emission tomography (PET) scan from August 10, 2023, covering the skull to mid-thigh, demonstrated heterogeneous radiotracer uptake by an enlarged prostate gland, interpreted as nonspecific but compatible with a primary prostate neoplasm (01576_PETERSON_MEDRECS_0000000010-59).

On 7/29/2024, Mr. Peterson underwent pulmonary function testing by Dr. Wilons at the Sanders Clinic as ordered by Dr. Allen for shortness of breath. Pulmonary function was normal, in the upper range of normal (SANDERS_CLINIC_0000000028). On 7/17/2024, Dr. Allen summarized his medical history by noting:

> severe speech problems, severe balance problems, variable amounts of dyskinesia, and the stress of having Parkinson's disease. He was told that his DBS battery will need to be replaced sometime in the next few months, as well. Dr. Kumar and Medtronic are handling these issues. He has had some recurrent falling. The falling is related to his poor balance. The poor balance is related to his severe Parkinson's disease. He fell, on 07/03/2024, down some stairs and sustained a few bumps and bruises. He did not lose consciousness or get knocked out or have any new neurological symptoms as a result. He did develop a bruise on the right buttock and a bruise of the right hip and thigh. The areas are sore but getting better. He did fall again a couple of days ago but did not sustain anything more than some bruising on his knees. He does use an electronic wheelchair in the downstairs of his home, and he does use another wheelchair in the upstairs of his home and he uses a walker for very brief transfers. He has a lot of weakness, tiredness and fatigue. He has gradually gotten worse over the last few months. He does not know if it is due to medication side effects, poor sleep, Parkinson's disease itself, depression, or other factors. His depressed mood has also gotten worse recently. He has been taking Zoloft for a couple of years, but he thinks it has stopped working well enough at this dose. He takes 50 mg a day. He does not feel suicidal or homicidal, but he would like to have his mood better. He does get some shortness of breath fairly mild with regular exertion and some mild swelling of his lower legs. These things have become more noticeable in the last few weeks. He does not have any orthopnea or paraoxysmal nocturnal dyspnea (PND) or chest pain or significant coughing. He does not sleep well at night. He is quite restless. He can fall asleep easily during the daytime to 'catch up.' He figures that poor sleep is contributing partly to his low daytime energy level. He has hammertoes of 2 toes of the right foot that bother him somewhat. Both of his hands and feet feel cold to him, although they are not cold to touch from another person. He has chronic left shoulder pain from an old injury. It pops and crackles and hurts when he moves it a certain way. He had a large sebaceous cyst of the right posterolateral neck removed about a year ago and it was benign. He had a melanoma in situ removed in July 2018 with full recovery. He sees a dermatologist for follow-up regularly. The previously noted orthostatic symptoms and syncope have resolved after stopping the Triamterene/HCT. He is not having any abdominal pain, nausea, jaundice, melena, hematochezia, constipation, diarrhea, heartburn, indigestion, dysphagia or regurgitation. Prostate cancer was diagnosed several months ago and he just finished radiation therapy did not long ago. Urinary symptoms are mild currently and he believes it is doing well as he is told by Dr. Shelton and the radiation oncologist. He is not currently having any dysuria, hematuria, pelvic pain or incontinence.

On 10/22/2024, Mr. Peterson underwent a physical therapy evaluation with Ellen Markwell, who noted that:

> Pt with only 75–80 deg bilateral shoulder flexion and abduction in scaption. He reports pain due to OA both shoulders…Pt with gross grasp and release, but reports dependent with fine motor skills such as buttoning and writing. He reports that he uses his index fingers on the computer and phone. Pt with gross grasp and release, but reports dependent with fine motor skills such as buttoning and writing. He reports that he uses his index fingers on the computer and phone. Pt with only 10 m ambulation with parkinsonian gait pattern

(01576_PETERSON_SMC_0000000449-456).

On 1/6/2025, Mr. Peterson was seen by Dr. Brandon Baughman, PhD, for a neuropsych consult at Semmes Murphy Clinic, where:

> patient's wife reported that, over the past 6 months, she has noticed small lapses in memory but noted that it has happened only a handful of times. She speculated that this might be due to Parkinson's-related fatigue...the patient's wife cited his excellent verbal abilities. She indicated that he is able to write very eloquent letters…The patient's wife indicated that the patient's functional impairment is largely restricted to his motor abilities. Pt has an expressive language deficit due to speech motor disorder…On the PROMIS family of measures, minimal to no problems were noted in the domains of anxiety, cognitive function, and pain. Conversely, ratings of his mood (depression), fatigue, and sleep disruption/limitation were all in the clinically elevated range… It is worth noting that all of his functional deficits were attributed to motor dysfunction. Although no formal testing was administered today, based on the pt and spouse report, I do not believe he is showing signs of Parkinson's-related depression. I suspect any observations of memory lapses are likely attributable to PD-related slowing, fatigue factors, or depression. They also reported an inconsistent and fragmented sleep schedule that includes snoring. It may be worthwhile for him to have a formal sleep study in order to rule out sleep apnea, which can be a reversible form of cognitive impairment. Also, while he is on sertraline, he is still endorsing mood symptoms; thus, recommend he f/u with Dr. Kumar or other treating physician to discuss adjusting his dosage. Lastly, I discussed the utility of LSVT Loud as a voice therapy that may be of use in his case.

(01576_PETERSON_SMC_0000000382-385).

8. Prior Medical and Surgical History

Review of Mr. Peterson's medical history reveals past medical and surgical issues that include but not necessarily limited to the following:

- Shoulder arthritis
- Head injury
- Gastrointestinal reflux disease (GERD)
- Hypertension
- Hyperlipidemia
- Retinal detachment

- Bilateral cataracts
- Vasectomy
- Leg hematoma
- Hernia repair
- Ocular herpes keratitis
- Tonsillectomy
- Tinea pedis
- Obesity
- Labyrinthitis
- Irritable colon
- Major depression
- Impaired fasting glucose / prediabetes
- Prostate cancer, s/p treatment with radiation therapy
- Coronary artery disease (CAD)
- Melanoma
- Syncope
- Genital herpes
- Varicocele surgery
- Degenerative disc disease
- Left calf traumatic hematoma

Of these conditions, the following have been described in the medical literature as potential PD risk factors: head injury, [40,41] impaired fasting glucose / prediabetes, [69] GERD,[53] herpes infection,[70,71] CAD.[72,73]

9. Family History

No known family history of neurological disease.
Mother: history of breast cancer, hypertension
Oldest brother deceased in 2001 of liver complications
Sister died in 2002 of leukemia
Father: died at age 89

10. Medications

Per available notes, medications that Mr. Peterson has taken included but were not necessarily limited to: calcium; carbidopa-levodopa; cholecalciferol (vitamin D3); fluticasone propionate nasal spray; loratadine; multivitamin; omeprazole; Orgovyx (relugolix); rasagiline; ropinirole; sertraline; triamterene-hydrochlorothiazide; aspirin; Baycol (cerivastatin); Biaxin (clarithromycin); Augmentin (amoxicillin/clavulanate); Zithromax (azithromycin); Effexor (venlafaxine); Ambien (zolpidem); Benadryl (diphenhydramine); Xanax (alprazolam); Lescol (fluvastatin); Comtan (entacapone); Lexapro (escitalopram); Depakote (divalproex sodium); Seroquel (quetiapine); Mobic (meloxicam); Medrol (methylprednisolone); melatonin; Nourianz (istradefylline); Zoloft (sertraline); Ingrezza (valbenazine); Tequin (gatifloxacin); Duratuss (various combinations, usually guaifenesin + dextromethorphan); Cortisporin (neomycin/polymyxin B/hydrocortisone); Sinemet (carbidopa-levodopa); Rytary (carbidopa-levodopa extended-release); Nexium (esomeprazole); Prevacid (lansoprazole)

11. Social History

Review of Mr. Peterson's medical history reveals the following social history:

- Awarded Certificate from U.S. Naval Justice School in Military Justice and Administrative Matters, April 1975
- J.D., Memphis State University, December 1973
- B.A., Memphis State University, May 1971 (Major Sociology, Minor Psychology)

12. Allergies

No known medication allergies. Sensitivity to corticosteroids (01576_PETERSON_0000004154).

13. Assessment

Mr. Edgar Allen Peterson IV is a 76-year-old, right-handed male, born in Jonesboro, Arkansas (second of four children) who earned a B.A. in sociology/psychology (1971) and a J.D. (1973) from Memphis State University, completed Naval Justice School (1975), served as an active-duty U.S. Marine Corps Officer from 1974-1977 and Reserve Officer through 1983 (honorable discharge), then practiced law for 23 years. His medical history includes hyperlipidemia, coronary artery disease (mild), GERD, impaired fasting glucose (prediabetes), vitamin D deficiency, iron deficiency anemia, bilateral cataracts, hiatal and umbilical hernias, arthritis, C5-6 fusion, retinal surgery, inguinal hernia, left calf traumatic hematoma requiring drainage in 1971, head trauma, remote varicocele surgery, remote tonsillectomy, and hypertension.

In the early 2000s, Mr. Peterson sought treatment for neuromotor symptoms that ultimately led to a diagnosis of PD in 2001. As discussed in prior sections, PD is a neurodegenerative disorder characterized by dopamine-producing neuron loss in the substantia nigra and downstream nervous system signaling disruption, resulting in motor features (e.g., tremor, rigidity, bradykinesia, postural instability) and a range of non-motor manifestations (e.g., autonomic dysfunction, sleep disturbances, mood changes).

Onset and Progression of PD

Review of the records shows that Mr. Peterson's parkinsonian prodrome emerged in his early 50s with changes in voice, hyposmia, leg weakness, and slowness. These features gradually progressed, leading to a neurologic evaluation on 5/23/2001 with Dr. Bertorini documenting masked facies, hypophonia, bradykinesia, an asymmetric resting tremor, rigidity, and a positive glabellar reflex, and improvement with levodopa trial, confirming the PD diagnosis. The PD diagnosis has since been reaffirmed by multiple neurologists, including Drs. Ronald Pfeiffer, Eugene Lai, K. Ray Kumar, and Thomas David. Treatment has spanned high-dose levodopa (including Rytary), ropinirole, entacapone, rasagiline, and bilateral globus pallidus interna deep-brain stimulation implanted in 2004 with subsequent reprogramming. Despite these measures, Mr. Peterson's PD has advanced to a stage marked by increased axial rigidity, freezing and festinating gait, dysphagia, dysarthria, prominent on/off fluctuations, medication- and stimulation-induced dyskinesias, and postural instability. Non-motor complications have included orthostatic intolerance, decreased sense of smell, depressed mood, fatigue, fragmented sleep, and dopaminergic-induced paranoia (2005 psychiatric

admission). Cognition remains largely preserved, though susceptible to fatigue and mood. Collectively, the longitudinal evidence confirms a progressive PD course that limits ambulation, natural speech, self-care, and vocational capacity.

Etiology and Risk Factors

PD is most frequently idiopathic, meaning no singular cause is definitively identified. Commonly cited risk factors include age, possible genetic predisposition, pesticide exposure, lifestyle factors, certain infections and autoimmune conditions, and history of head injury. In Mr. Peterson's case, potential risk factors include head injury,[40,41] male sex,[74,75] herpes infection,[70,71] and CAD.[72,73] While each of these factors could, in theory, incrementally contribute to neurodegenerative risk, no single factor can be definitively pinpointed as causative under the current state of medical knowledge. Even if Mr. Peterson had not been exposed to TCE, it is my opinion, within a reasonable degree of medical certainty, that Mr. Peterson could have still developed PD. Mr. Peterson's Parkinson's disease could therefore be reasonably regarded as idiopathic, potentially arising from multifactorial risk factors rather than from a single, clearly defined cause.

Functional Limitations and Disability

Mr. Peterson's present disability reflects the compounded impact of PD and a constellation of comorbidities that pre-dated or have since evolved alongside his movement disorder. Long-standing degenerative disc disease with cervical and lumbar radiculopathy, bilateral shoulder osteoarthritis, recurrent falls with traumatic sequelae (sternal and L1 fractures), coronary artery disease, prostate cancer treated with radiation, and major depressive disorder have each imposed independent constraints on mobility, endurance, and functioning. Today, Mr. Peterson relies on a motorized wheelchair for ambulation, a walker for transfers, and caregiver assistance for many activities of daily living; dysarthria necessitates typing or text-to-speech technology for communication, and fragmented sleep, fatigue, and chronic pain exacerbate daytime impairment. These concurrent disabilities and chronic conditions now coexist with his PD, substantially affecting his overall clinical status and long-term prognosis. Despite these significant medical complexities, Mr. Peterson appears to be receiving coordinated, multidisciplinary care. Such collaboration, along with Mr. Peterson's commitment and adherence to recommended treatment plan, is crucial for addressing both his PD and the range of comorbid conditions impacting his overall prognosis and quality of life.

14. Conclusions

Based on my comprehensive review of the medical records, I conclude the following within a reasonable degree of medical certainty:

1. Mr. Peterson has a well-established diagnosis of PD, supported by comprehensive neurologic assessments, and characterized by progressively worsening motor features and non-motor features diagnosed in 2001.

2. There is insufficient evidence to conclude to a reasonable degree of medical certainty that Mr. Peterson's Parkinson's disease was definitively caused by exposure to contaminated water at Camp Lejeune. My opinions regarding Mr. Peterson's exposure history relied on a review of toxicological evidence of general causation by Dr. Goodman and exposure

calculations/risk assessment reports of Drs. LaKind and Bailey respectively. Other causes must be considered in this analysis.

3. Mr. Peterson's PD should be regarded as idiopathic, potentially arising from multifactorial risk factors rather than from a single, clearly defined cause. Potential risk factors in Mr. Peterson's case include but are not necessarily limited to head injury,[40,41] male sex,[74,75] CAD,[72,73] and herpes infection.[70,71] While each of these factors could, in theory, incrementally contribute to PD risk, no single factor can be definitively pinpointed as causative under the current state of medical knowledge; while research has demonstrated increased risk in various contexts, current evidence and diagnostic science does not allow for precise weighting or ranking of these risk factors individually or in combination in any given person.

4. Symptomatic management with pharmacotherapy, physical therapy, speech therapy, mental health support, and advanced interventions (e.g., device-assisted therapies such as DBS which Mr. Peterson is now experiencing significant benefits from since undergoing bilateral DBS implantation in 2004) can optimize function and quality of life for Mr. Peterson. Mr. Peterson appears to be under competent, multidisciplinary clinical management, which is appropriate given the complexity of his medical and mental health needs. Re-engagement with physical therapy, occupational therapy and speech and language therapy along with a sleep study as recommended by Dr. Boughman (01576_PETERSON_SMC_0000000382-385) may help to safeguard and optimize function and wellbeing.

5. Ongoing specialized neurologic care, coupled with targeted interventions for mental health, speech and swallow, pain, and autonomic regulation, as well as close monitoring and management of comorbid conditions (including osteoarthritis and degenerative disease of cervical and lumbar spine) will remain paramount to managing Mr. Peterson's complex medical presentation.

PD is a progressive and complex disorder that requires specialized, multidisciplinary care, which Mr. Peterson's appears to be receiving by a highly competent and caring team. Advances in treatment options continue to evolve, offering opportunities to optimize function and quality of life.[76-79]

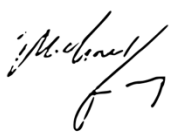
Comments on the Expert Report of Dr. Barbano

I agree with Dr. Barbano's conclusion that Mr. Peterson has Parkinson's disease. I also generally concur with Dr. Barbano's assessment of expected PD prognosis, with the caveat that some individuals may defy prognostic expectations, and innovations in PD therapy may in the future alter anticipated prognosis, offering hope to patients afflicted by PD.[80-82] With respect to etiology, Dr. Barbano remarks that "[m]y opinion has considered other potential causes of Parkinson's disease other than Mr. Peterson's exposure to the contaminated water at Camp Lejeune and is that none are substantial contributors." The potential factors considered in Dr. Barbano's report include head trauma, family history, and "other potential toxins". Regarding head trauma, Dr. Barbano remarks that "[w]hile there is an association between head trauma and Parkinson's disease, the risk increases with more severe head trauma and with multiple episodes of trauma. Medical records indicate that Mr. Peterson had 1 concussion while playing football…His description of the event on 1/14/2025 would be consistent with a mild concussion with 15- 20 second loss of consciousness but immediately able to drive and function afterwards and with no evidence of post-concussive symptoms nor any other sequelae." It is important to note here that even mild head injuries have been shown to increase PD risk[41,83-85] and may have thus contributed as a risk factor in Mr. Peterson's case.

I agree with Dr. Barbano that there is no evidence that family history played a significant role. Although various factors may increase the likelihood of PD, no single factor categorically guarantees its onset; many people with known risk factors never develop PD, while some without any known risk factors nonetheless do. Most cases are idiopathic with no clear cause is identified and even when a specific cause is found, presentations vary widely, reflecting PD's multifactorial and heterogeneous nature. Moreover, risk factors do not necessarily constitute mechanisms of causation. They emerge from population-level associations and do not singularly drive disease processes, known to be multifactorial.[60,61] For a more extensive discussion of PD causation, I refer to Dr. Goodman's thorough report and to the discussion provided earlier in this report starting on page 5.

Based on the detailed analysis above, I diverge from Dr. Barbano's conclusion in that his attribution of causation to TCE exposure does not sufficiently account for the broader range of potential risk factors present in Mr. Peterson's case, including male sex,[74,75] head injury,[40,41] CAD,[72,73] and herpesvirus infection,[70,71] each of which individually or in combination may serve as a contributor to PD risk. Given the current state of medical knowledge and the multifactorial nature of PD, I thus find that there is insufficient evidence to conclude within a reasonable degree of medical certainty that TCE exposure definitively caused Mr. Peterson's PD. I likewise cannot conclude within a reasonable degree of medical certainty that Mr. Peterson would not have developed PD if he were not exposed to TCE. While one cannot know the counterfactual, it is essential to consider the full spectrum of individualized risk factors rather than attributing causation to a single exposure.[6,86]

All of the above opinions are offered within a reasonable degree of medical certainty. I reserve the right to modify my opinions should additional relevant information become available in the future.



Dr. Michael Young, MD

References cited:

1. Bloem BR, Okun MS, Klein C. Parkinson's disease. *The Lancet* 2021; **397**(10291): 2284-303.

2. Parkinson J. An essay on the shaking palsy. *The Journal of neuropsychiatry and clinical neurosciences* 2002; **14**(2): 223-36.

3. Goedert M, Compston A. Parkinson's disease—the story of an eponym. *Nature Reviews Neurology* 2018; **14**(1): 57-62.

4. Lotharius J, Brundin P. Pathogenesis of Parkinson's disease: dopamine, vesicles and α-synuclein. *Nature reviews neuroscience* 2002; **3**(12): 932-42.

5. Klein MO, Battagello DS, Cardoso AR, Hauser DN, Bittencourt JC, Correa RG. Dopamine: functions, signaling, and association with neurological diseases. *Cellular and molecular neurobiology* 2019; **39**(1): 31-59.

6. Morris HR, Spillantini MG, Sue CM, Williams-Gray CH. The pathogenesis of Parkinson's disease. *The Lancet* 2024; **403**(10423): 293-304.

7. Schulz-Schaeffer WJ. The synaptic pathology of α-synuclein aggregation in dementia with Lewy bodies, Parkinson's disease and Parkinson's disease dementia. *Acta neuropathologica* 2010; **120**: 131-43.

8. Simuni T, Chahine LM, Poston K, et al. A biological definition of neuronal α-synuclein disease: towards an integrated staging system for research. *The Lancet Neurology* 2024; **23**(2): 178-90.

9. Shahed J, Jankovic J. Motor symptoms in Parkinson's disease. *Handbook of clinical neurology* 2007; **83**: 329-42.

10. Chaudhuri KR, Healy DG, Schapira AH. Non-motor symptoms of Parkinson's disease: diagnosis and management. *The Lancet Neurology* 2006; **5**(3): 235-45.

11. Poewe W. Non-motor symptoms in Parkinson's disease. *European journal of neurology* 2008; **15**: 14-20.

12. Wakabayashi K. Where and how alpha-synuclein pathology spreads in Parkinson's disease. *Neuropathology* 2020; **40**(5): 415-25.

13. Li Y-y, Zhou T-t, Zhang Y, Chen N-H, Yuan Y-H. Distribution of α-synuclein aggregation in the peripheral tissues. *Neurochemical Research* 2022; **47**(12): 3627-34.

14. Sharabi Y, Vatine GD, Ashkenazi A. Parkinson's disease outside the brain: targeting the autonomic nervous system. *The Lancet Neurology* 2021; **20**(10): 868-76.

15. Gao V, Crawford CV, Burré J. The Gut–Brain Axis in Parkinson's Disease. *Cold Spring Harbor Perspectives in Medicine* 2025; **15**(1): a041618.

16. Ben-Shlomo Y, Darweesh S, Llibre-Guerra J, Marras C, San Luciano M, Tanner C. The epidemiology of Parkinson's disease. *The Lancet* 2024; **403**(10423): 283-92.

17. Maraganore DM. Epidemiology and genetics of Parkinson's disease. Parkinson's disease and movement disorders: Diagnosis and treatment guidelines for the practicing physician: Springer; 2000: 85-90.

18. Grotewold N, Albin RL. Update: Descriptive epidemiology of Parkinson disease. *Parkinsonism & Related Disorders* 2024; **120**: 106000.

19. Su D, Cui Y, He C, et al. Projections for prevalence of Parkinson's disease and its driving factors in 195 countries and territories to 2050: modelling study of Global Burden of Disease Study 2021. *bmj* 2025; **388**.

20. Jankovic J. Parkinson's disease: clinical features and diagnosis. *Journal of neurology, neurosurgery & psychiatry* 2008; **79**(4): 368-76.

21. Tolosa E, Garrido A, Scholz SW, Poewe W. Challenges in the diagnosis of Parkinson's disease. *The Lancet Neurology* 2021; **20**(5): 385-97.

22. Massano J, Bhatia KP. Clinical approach to Parkinson's disease: features, diagnosis, and principles of management. *Cold Spring Harbor perspectives in medicine* 2012; **2**(6): a008870.

23. Kalia LV, Lang AE. Parkinson's disease. *The lancet* 2015; **386**(9996): 896-912.

24. Zarkali A, Thomas GE, Zetterberg H, Weil RS. Neuroimaging and fluid biomarkers in Parkinson's disease in an era of targeted interventions. *Nature Communications* 2024; **15**(1): 5661.

25. Stocchi F, Bravi D, Emmi A, Antonini A. Parkinson disease therapy: current strategies and future research priorities. *Nature Reviews Neurology* 2024: 1-13.

26. Brooker SM, Gonzalez-Latapi P. Biomarkers in Parkinson's Disease. *Neurologic Clinics* 2025.

27. Ebada MA, Mouffokes A, Imran M, et al. Diagnosis and biomarkers of Parkinson's disease and related movement disorders. Translational Models of Parkinson's Disease and Related Movement Disorders: Elsevier; 2025: 39-63.

28. Postuma RB, Berg D, Stern M, et al. MDS clinical diagnostic criteria for Parkinson's disease. *Movement disorders* 2015; **30**(12): 1591-601.

29. Postuma RB, Poewe W, Litvan I, et al. Validation of the MDS clinical diagnostic criteria for Parkinson's disease. *Movement Disorders* 2018; **33**(10): 1601-8.

30. Malek N, Lawton MA, Grosset KA, et al. Utility of the new Movement Disorder Society clinical diagnostic criteria for Parkinson's disease applied retrospectively in a large cohort study of recent onset cases. *Parkinsonism & related disorders* 2017; **40**: 40-6.

31. Noyce AJ, Bestwick JP, Silveira-Moriyama L, et al. Meta-analysis of early nonmotor features and risk factors for Parkinson disease. *Annals of neurology* 2012; **72**(6): 893-901.

32. Schrag A, Bohlken J, Dammertz L, et al. Widening the spectrum of risk factors, comorbidities, and prodromal features of Parkinson disease. *JAMA neurology* 2023; **80**(2): 161-71.

33. Ascherio A, Schwarzschild MA. The epidemiology of Parkinson's disease: risk factors and prevention. *The Lancet Neurology* 2016; **15**(12): 1257-72.

34. Lomeli-Lepe AK, Castañeda-Cabral JL, López-Pérez SJ. Synucleinopathies: intrinsic and extrinsic factors. *Cell Biochemistry and Biophysics* 2023; **81**(3): 427-42.

35. Rajan S, Kaas B. Parkinson's disease: risk factor modification and prevention. Seminars in neurology; 2022: Thieme Medical Publishers, Inc.; 2022. p. 626-38.

36. Kovanda A, Rački V, Bergant G, et al. A multicenter study of genetic testing for Parkinson's disease in the clinical setting. *npj Parkinson's Disease* 2022; **8**(1): 149.

37. Westenberger A, Skrahina V, Usnich T, et al. Relevance of genetic testing in the gene-targeted trial era: the Rostock Parkinson's disease study. *Brain* 2024; **147**(8): 2652-67.

38. Lim S-Y, Klein C. Parkinson's disease is predominantly a genetic disease. *Journal of Parkinson's Disease* 2024; **14**(3): 467-82.

39. Grotewold N, Albin RL. Update: protective and risk factors for Parkinson disease. *Parkinsonism & Related Disorders* 2024: 107026.

40. Balabandian M, Noori M, Lak B, Karimizadeh Z, Nabizadeh F. Traumatic brain injury and risk of Parkinson's disease: a meta-analysis. *Acta Neurologica Belgica* 2023; **123**(4): 1225-39.

41. Edwards S, Corrigan F, Collins-Praino L. Lasting Impact: Exploring the Brain Mechanisms that Link Traumatic Brain Injury to Parkinson's Disease. *Molecular Neurobiology* 2025: 1-24.

42. Zheng J, Shi W, Yang Q, et al. Hospital-treated infectious diseases, infection burden and risk of Parkinson disease: An observational and Mendelian randomization study. *Brain, Behavior, and Immunity* 2024; **120**: 352-9.

43. Smeyne RJ, Noyce AJ, Byrne M, Savica R, Marras C. Infection and risk of Parkinson's disease. *Journal of Parkinson's Disease* 2021; **11**(1): 31-43.

44. Ivan I, Irincu L, Diaconu Ş, Falup-Pecurariu C. Parkinsonism associated with viral infection. *International Review of Neurobiology* 2022; **165**: 1-16.

45. Cheng C-M, Bai Y-M, Tsai C-F, et al. Risk of Parkinson's disease among patients with herpes zoster: a nationwide longitudinal study. *CNS spectrums* 2020; **25**(6): 797-802.

46. Rugbjerg K, Friis S, Ritz B, Schernhammer E, Korbo L, Olsen J. Autoimmune disease and risk for Parkinson disease: a population-based case-control study. *Neurology* 2009; **73**(18): 1462-8.

47. Ma Y, Xiao Y, Zhang S, Liu J, Shang H. Association of Autoimmune Diseases with the Risk of Parkinson's Disease. *Neuroepidemiology* 2024: 1-13.

48. Cereda E, Barichella M, Pedrolli C, et al. Diabetes and risk of Parkinson's disease: a systematic review and meta-analysis. *Diabetes care* 2011; **34**(12): 2614-23.

49. Potashkin J, Huang X, Becker C, Chen H, Foltynie T, Marras C. Understanding the links between cardiovascular disease and Parkinson's disease. *Movement Disorders* 2020; **35**(1): 55-74.

50. Barer Y, Chodick G, Chodick NG, Gurevich T. Risk of Parkinson disease among adults with vs without posttraumatic stress disorder. *JAMA Network Open* 2022; **5**(8): e2225445-e.

51. Weaver FM, Cao L, Stroupe KT, et al. Post-Traumatic Stress Disorder and Risk of Parkinson's Disease in a Veteran Cohort. *Journal of Parkinson's Disease* 2024; **14**(6): 1265-9.

52. Jones MB, Gates R, Gibson L, et al. Post-Traumatic Stress Disorder and Risk of Degenerative Synucleinopathies: Systematic Review and Meta-Analysis. *The American Journal of Geriatric Psychiatry* 2023; **31**(11): 978-90.

53. Chang JJ, Kulkarni S, Pasricha TS. Upper gastrointestinal mucosal damage and subsequent risk of Parkinson disease. *JAMA Network Open* 2024; **7**(9): e2431949-e.

54. Fasano A, Visanji NP, Liu LW, Lang AE, Pfeiffer RF. Gastrointestinal dysfunction in Parkinson's disease. *The Lancet Neurology* 2015; **14**(6): 625-39.

55. Veronese N, Nova A, Fazia T, et al. Contribution of nutritional, lifestyle, and metabolic risk factors to Parkinson's disease. *Movement Disorders* 2024; **39**(7): 1203-12.

56. De Lau LM, Breteler MM. Epidemiology of Parkinson's disease. *The Lancet Neurology* 2006; **5**(6): 525-35.

57. Hubble JP, Cao T, Hassanein R, Neuberger J, Roller W. Risk factors for Parkinson's disease. *Neurology* 1993; **43**(9): 1693-.

58. Liu B, Chen H, Fang F, Tillander A, Wirdefeldt K. Early-life factors and risk of Parkinson's disease: a register-based cohort study. *PLoS One* 2016; **11**(4): e0152841.

59. Armstrong MJ, Okun MS. Diagnosis and treatment of Parkinson disease: a review. *Jama* 2020; **323**(6): 548-60.

60. Schriml LM, Lichenstein R, Bisordi K, Bearer C, Baron JA, Greene C. Modeling the enigma of complex disease etiology. *Journal of Translational Medicine* 2023; **21**(1): 148.

61. Kaiser S, Zhang L, Mollenhauer B, et al. A proteogenomic view of Parkinson's disease causality and heterogeneity. *npj Parkinson's Disease* 2023; **9**(1): 24.

62. Giroux É. Risk factor and causality in epidemiology. Classification, disease and evidence: New essays in the philosophy of medicine: Springer; 2014: 179-92.

63. Broadbent A. Causation and models of disease in epidemiology. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 2009; **40**(4): 302-11.

64. Post B, Merkus MP, De Haan RJ, Speelman JD, Group CS. Prognostic factors for the progression of Parkinson's disease: a systematic review. *Movement disorders* 2007; **22**(13): 1839-51.

65. Van der Marck MA, Kalf J, Sturkenboom IH, Nijkrake MJ, Munneke M, Bloem BR. Multidisciplinary care for patients with Parkinson's disease. *Parkinsonism & related disorders* 2009; **15**: S219-S23.

66. Fereshtehnejad S-M. Strategies to maintain quality of life among people with Parkinson's disease: what works? *Neurodegenerative disease management* 2016; **6**(5): 399-415.

67. de Bie RM, Katzenschlager R, Swinnen BE, et al. Update on Treatments for Parkinson's Disease Motor Fluctuations–An International Parkinson and Movement Disorder Society Evidence-Based Medicine Review. *Movement Disorders* 2025.

68. Marsili L, Bologna M, Chen LY, Espay AJ. Treatment of Motor Symptoms of Parkinson's Disease. *Neurologic Clinics* 2025.

69. Jin X, Lu Y, Gong Z, Huang W, Wang Z. Prediabetes and the incidence of Parkinson's disease: A meta-analysis. *Biomolecules and Biomedicine* 2024; **24**(4): 722.

70. Caggiu E, Paulus K, Arru G, Piredda R, Sechi GP, Sechi LA. Humoral cross reactivity between α-synuclein and herpes simplex-1 epitope in Parkinson's disease, a triggering role in the disease? *Journal of neuroimmunology* 2016; **291**: 110-4.

71. Vlajinac H, Dzoljic E, Maksimovic J, Marinkovic J, Sipetic S, Kostic V. Infections as a risk factor for Parkinson's disease: a case–control study. *International Journal of Neuroscience* 2013; **123**(5): 329-32.

72. Chua SKK, Saffari SE, Lee SJY, Tan E-K. Association between Parkinson's disease and coronary artery disease: a systematic review and meta-analysis. *Journal of Parkinson's disease* 2022; **12**(6): 1737-48.

73. Acharya S, Lumley AI, Devaux Y. Cardiovascular history and risk of idiopathic Parkinson's disease: a cross-sectional observational study. *BMC neuroscience* 2024; **25**(1): 33.

74. Van Den Eeden SK, Tanner CM, Bernstein AL, et al. Incidence of Parkinson's disease: variation by age, gender, and race/ethnicity. *American journal of epidemiology* 2003; **157**(11): 1015-22.

75. Cattaneo C, Pagonabarraga J. Sex Differences in Parkinson's Disease: A Narrative Review. *Neurology and Therapy* 2024: 1-14.

76. van Munster M, Pedrosa AJ, Künkler C, Pedrosa DJ. The Quality in Quality of Life in Parkinson's Disease: A Qualitative Meta-Synthesis. *Movement Disorders Clinical Practice* 2024; **11**(7): 761-9.

77. Jost ST, Aloui S, Evans J, et al. Neurostimulation for advanced Parkinson disease and quality of life at 5 years: a nonrandomized controlled trial. *JAMA network open* 2024; **7**(1): e2352177-e.

78. Murcia Carretero S, Petermann K, Debove I, et al. Quality of Life after Deep Brain Stimulation in Parkinson's Disease: Does the Target Matter? *Movement Disorders Clinical Practice* 2024; **11**(11): 1379-87.

79. Ahn S, Chen Y, Bredow T, Cheung C, Yu F. Effects of non-pharmacological treatments on quality of life in Parkinson's Disease: a review. *Journal of Parkinson's disease and Alzheimer's disease* 2017; **4**(1): 10.13188/2376-922X. 1000021.

80. Svendsen SP, Svendsen CN. Cell therapy for neurological disorders. *Nature Medicine* 2024: 1-15.

81. Park T-Y, Jeon J, Cha Y, Kim K-S. Past, present, and future of cell replacement therapy for parkinson's disease: a novel emphasis on host immune responses. *Cell Research* 2024; **34**(7): 479-92.

82. Vijiaratnam N, Lawton M, Heslegrave AJ, et al. Combining biomarkers for prognostic modelling of Parkinson's disease. *Journal of Neurology, Neurosurgery & Psychiatry* 2022; **93**(7): 707-15.

83. Gardner RC, Byers AL, Barnes DE, Li Y, Boscardin J, Yaffe K. Mild TBI and risk of Parkinson disease: a chronic effects of neurotrauma consortium study. *Neurology* 2018; **90**(20): e1771-e9.

84. Sharma A, Muresanu DF, Nozari A, et al. Mild traumatic brain injury exacerbates Parkinson's disease induced hemeoxygenase-2 expression and brain pathology: Neuroprotective effects of co-administration of TiO2 nanowired mesenchymal stem cells and cerebrolysin. *Progress in Brain Research* 2020; **258**: 157-231.

85. Jones JD, Timblin H, Baxter F. Cumulative effect of head injuries on nonmotor outcomes in Parkinson's disease. *The Journal of neuropsychiatry and clinical neurosciences* 2023; **35**(2): 165-70.

86. Müller-Nedebock AC, Dekker MC, Farrer MJ, et al. Different pieces of the same puzzle: a multifaceted perspective on the complex biological basis of Parkinson's disease. *npj Parkinson's Disease* 2023; **9**(1): 110.