In the United States Court of Federal Claims

OFFICE OF SPECIAL MASTERS

Filed: December 18, 2025

DOUGLAS BILLING	*	
Petitioner,	*	No. 18-679V
v.	*	Special Master Gowen
SECRETARY OF HEALTH AND HUMAN SERVICES,	*	
Respondent.	*	

Sean Franks Greenwood, The Greenwood Law Firm, Houston, TX, for petitioner
Ryan Daniel Pyles, United States Department of Justice, Washington, DC, for respondent.

RULING ON ENTITLEMENT[1]

On May 14, 2018, Douglas Billing ("petitioner"), filed a petition for compensation pursuant to the National Vaccine Injury Compensation Program.[2] Petition (ECF No. 1). Petitioner alleges that the influenza ("flu") and Tetanus, Diphtheria, and Pertussis ("TDaP") vaccines he received on September 30, 2015, caused him to suffer New Daily Persistent Headache ("NDPH"). *Id*. Based on a review of the evidence and testimony presented, the undersigned finds that petitioner has established that he is entitled to compensation.[3]

[1] Because this Ruling contains a reasoned explanation for the action taken in this case, it must be made publicly accessible and will be posted on the United States Court of Federal Claims' website, and/or at https://www.govinfo.gov/app/collection/uscourts/national/cofc, in accordance with the E-Government Act of 2002. 44 U.S.C. § 3501 note (2018) (Federal Management and Promotion of Electronic Government Services). **This means the Ruling will be available to anyone with access to the internet.** In accordance with Vaccine Rule 18(b), Petitioner has 14 days to identify and move to redact medical or other information, the disclosure of which would constitute an unwarranted invasion of privacy. If, upon review, I agree that the identified material fits within this definition, I will redact such material from public access.

[2] The National Vaccine Injury Compensation Program is set forth in Part 2 of the National Childhood Vaccine Injury Act of 1986, Pub. L. No. 99-660, 100 Stat. 3755, codified as amended, 42 U.S.C. §§ 300aa-10 to 34 (2012) (hereinafter "Vaccine Act" or "the Act"). Hereinafter, individual section references will be to 42 U.S.C. § 300aa of the Act.

[3] Pursuant to Section 13(a)(1), in order to reach my decision, I have considered the entire record, including all of the medical records, expert testimony, and literature submitted by the parties. This opinion discusses the elements of the record I found most relevant to the outcome.

I. Procedural History

Petitioner initiated his claim on May 14, 2018, alleging that the flu and/or TDaP vaccines caused him to develop NDPH. Petition (ECF No. 1). Petitioner filed supporting medical records and an affidavit with his Petition. Petitioner's ("Pet'r") Exhibit ("Ex.") 1-21 (ECF No. 4-6, 10, 19, 22).

On August 15, 2019, petitioner filed an expert report from Dr. Marcel Kinsbourne[4]to support his claim. Pet'r Ex. 22 (ECF No. 26). On November 4, 2019, respondent filed an expert report from Dr. Dara G. Jamieson.[5] Respondent's ("Resp't") Ex. A (ECF No. 29). Respondent filed a Rule 4(c) report on November 14, 2019, stating that the "DICP, have reviewed the petition and accompanying documents filed in this case and have determined that this case is not appropriate for compensation under the terms of the Act." Resp't Report at 1-2. Respondent further argued that petitioner failed to meet any of the *Althen* criteria required to establish causation. *Id*. at 7.

A Rule 5 status conference was held on January 9, 2020, and petitioner was ordered to file all outstanding medical records. *See* Scheduling Order at 2 (ECF No. 34). On July 10, 2020, petitioner filed a supplemental expert report from

---

[4] Dr. Kinsbourne obtained a Bachelor of Arts degree from the University of Oxford in 1952 and a medical degree from the University of Oxford School of Medicine in 1955. He has obtained licenses to practice medicine in England, Canada, and the United States and is board-certified in pediatrics. He had nine years of post-graduate training, then became a professor and clinician in the field of pediatric neurology. Dr. Kinsbourne highlighted his experience at the Eunice Kennedy Shriver School as the director of the behavioral neurology department, where he conducted research and consulted on thousands of patients, from 1980 – 1991. He was an attending neurologist at Massachusetts General Hospital during the same time period, Dr. Kinsbourne became a professor of psychology at the New School for Social Research. Dr. Kinsbourne testified that this encompassed "matters related to the brain, neuroscience, cognitive neuroscience, and of course, neurology."

[5] Dr. Jamieson is a board-certified neurologist licensed in New York. Resp. Ex. B at 2. She received her medical degree from the University of Pennsylvania, followed by a neurology residency and a cerebrovascular fellowship at the University of Pennsylvania Hospital. *Id*. Dr. Jamieson was a practicing neurologist for 32 years before transitioning to a voluntary faculty appointment in 2018. *Id*. She is currently a Clinical Associate Professor of Neurology at Weill Cornell Medicine, where she teaches medical students in neurology courses and clinical inpatient clerkships, as well as lectures to residents and fellows. *Id*. She has also lectured extensively nationally and internationally on neurological topics. *Id*. at 2. Dr. Jamieson serves on several editorial boards, including the *Journal of Neuroimmunology*, *Current Treatment Opinions in Neurology*, and *Neurology Alert*. *Id*. She has authored or co-authored numerous publications in peer reviewed journals as well as authored books and book chapters on various neurological topics. *Id*. at 13-14. Dr. Jamieson has diagnosed patients with new daily persistent headaches. Tr. 189. Dr. Jamieson was offered and admitted without objection as an expert in neurology, in addition to a subspecialty of headache medicine. *Tr*. 190.

immunologist, Omid Akbari PhD.[6] Pet'r Ex. 41 (ECF No. 41). Respondent filed a supplemental expert report from Dr. Dara Jamieson and an initial expert report from immunologist, Andrew Saxon, M.D.[7] Resp't Ex. C; Resp't Ex. D (ECF Nos. 47-48). After filing supplemental expert reports, the parties appeared for a status conference to discuss the complex diagnostic problem involving the identification of voltage-gated potassium channel antibodies and ordered petitioner to consult with a qualified neurologist on seven questions included in the scheduling order. (ECF No. 50). This issue, having been raised by respondent, had been dropped prior to the hearing.

Petitioner filed a supplemental report from Dr. Akbari, addressing the questions in the scheduling order, along with updated medical records. Pet'r Ex. 101-102 (ECF No. 57). Petitioner also filed a supplemental expert report from Dr. Kinsbourne. Pet'r Ex. 108 (ECF No. 62). On September 14, 2021, petitioner filed a motion for an entitlement hearing. Motion ("Mot.") for Hearing (ECF No. 65).

On October 21, 2021, respondent filed a second supplemental expert report from Dr. Jamieson and a supplemental expert report from Dr. Saxon on December 2, 2021. Resp't Ex. C; Resp't Ex. G (ECF Nos. 67, 70). An entitlement hearing was set for and held on March 23-24, 2022. Hearing Order (ECF No. 73). Following the hearing, both parties filed post-hearing briefs. *See* Resp't Post Hearing Brief; Pet'r Post Hearing Reply (ECF Nos. 94, 96).

---

[6] Dr. Akbari received in his Master of Science in medical and general microbiology from the University College London. Pet'r Ex. 101. He received his Ph.D. in cellular and molecular immunology from the National Institute for Medical Research in London. *Id.* Dr. Akbari currently serves as a professor of medicine and professor of allergy and immunology at the Keck School of Medicine, University of Southern California. *Id*. at 2. His particular academic and research interest involve dysregulated immune responses, when immune responses are not regulated properly and can cause injury or pathology. Tr. 107-108. He also serves as an adjunct professor in the department of pediatrics at the David Geffen School of Medicine at UCLA and holds an active adjunct professorship in the department of immunology with Chiba University in Japan. Pet'r Ex. 101 at 2. His research focuses on "the role of immune cells that induce autoimmune and allergic diseases." *Id.* Dr. Akbari's work has been published in the *New England Journal of Medicine*, *Nature Immunology*, *Nature Medicine, Nature Communications, Immunity,* and *Journal of Clinical Investigation. Id.* He has received several national and international grants, including from the National Institute of Health ("NIH"). *Id.* Dr. Akbari serves as a reviewer for more than 25 research journals and has served on several NIH study sections involving Vaccines, Immunization, Allergy and Immunology research. *Id*. at 3. Dr. Akbari was offered and admitted as an expert in immunology. Tr. 109.

[7] Dr. Saxon is a professor of Medicine, Chief Emeritus of Clinical and Immunology/Allergy in the Department of Medicine at the UCLA School of Medicine. Resp. Ex. E at 1. He is a graduate of Harvard Medical School, licensed in California and board certified in Internal Medicine, Allergy and Immunology, and Diagnostic Laboratory Immunology. *Id*. Dr. Saxon is currently the CEO and president of Sixal Incorporated, working to cure acute food allergies. *Id*; Tr. 246. Dr. Saxon has published approximately 190 peer-reviewed research publications and is the founder of the Division of Clinical Immunology-Allergy at the UCLA School of Medicine. *Id*. at 2. Dr. Saxon services on a variety of boards and as a member of a variety of national scholarly organizations, such as the American Academy of Allergy and Immunology and the American Association of Immunologists. *Id*. at 3. Dr. Saxon was offered and admitted as an expert in the field of immunology. Tr. 250.

The matter is now ripe for adjudication.

II. Evidence Submitted

A. Medical History

Petitioner, 53 years old at the time, received both the flu and TDaP vaccines on September 30, 2015. Pet'r Ex. 2 at 2; Pet'r Ex. 12 at 1. Three days later, on the morning of October 3, 2015, petitioner woke up with "a sensation like [he has] …never had before." Tr. 19. Petitioner testified that

> It was as if somebody hit me in the back of the head…just throbbing, this intense pressure behind my eyes, ringing in my ears, pain starting to radiate down my neck and shoulders. My scalp was tingling to the touch, just felt like somebody was pulling the skin over the top of my head and at the same time somebody was squeezing around my head, and I had inward and outward pressure…

Tr. 19. At this point, petitioner's pain level was a 4-5 out of 10. Tr. 14. His pain level progressively worsened through October 14, 2015, at which point he was unable to look at a computer screen and spent his days "sleeping or getting up and sitting in [his] bed, squeezing [his forehead], putting [on] cold cloths, and taking ibuprofen." Tr. 14, 20. He was also unable to drive and was "basically disabled." *Id.* at 14-20. Petitioner had no prior history of a headache disorder and did not see a primary care provider for six years prior to the vaccinations which he received at Sam's Pharmacy. Pet'r Ex. 1 at 2; Tr. at 14-15.

On October 27, 2015, petitioner presented to optometrist, Dr. Jenny Kisner, with complaints of "headaches for 2 weeks." Pet'r Ex.3 at 1. Dr. Kisner noted that the "timing [was] described as constant" and that "quality [was] worsening." *Id.* She also noted that "after [petitioner] is up for a while he gets a headache. [He] feels like it is worse when he has been reading. [The] pain starts behind his left eye and moves across the front of his head." *Id*. He complained of blurry vision. She noted increased intraocular pressure; however, his readings were 18 in the right eye and 14 in the left, which are within normal range. *Id.* at 2.

On November 2, 2015, petitioner presented to his primary care physician, Brian Hull, M.D., with complaints of headaches for three weeks. Pet'r Ex. 16 at 66. Petitioner reported 1/10 pain at the time of the appointment. *Id.* A review of systems was positive for fatigue, dizziness, sinus pressure, blurred vision, eye pain, photophobia, vision changes, headache, and neck stiffness. *Id.* at 67. The assessment included "acute intractable headache, unspecified headache type," and petitioner was given a Toradol injection. *Id*. at 69. Dr. Hull ordered a "headache workup," including a CT scan and labs.

Petitioner returned to Dr. Hull on November 6, 2015, for a follow-up on his CT scan and labs. The CT scan, taken November 4, 2015, was normal. *Id.* at 65. Labs revealed elevated cholesterol (228), A1C (5.7), TSH (5.62), and LDL (165) as well as low HDL (39). *Id.* at 60. At this appointment, petitioner reported 0/10 pain but noted that "the problem" had not changed. *Id.* The headache was located occipitally, with onset occurring upon waking and during the daytime. *Id.* The symptoms were noted to be "associated with stress" and "relieved by darkness." *Id.* Aggravating factors included anxiety and bright lights. *Id.* Dr. Hull prescribed Fioricet and Flexeril for a "tension headache." *Id.* at 63.

Dr. Hull saw petitioner again on November 13, 2015. The symptoms were noted to be intermittent. The location of the headache now involved the occipital and frontal areas. Petitioner reported no pattern to the timing of the headaches. Aggravating factors included allergies, bright lights, and head position. Associated symptoms included blurred vision, photophobia, and neck stiffness. *Id.* at 56. Petitioner had no relief from the previously prescribed medications. Dr. Hull noted that petitioner had an appointment with a neurologist and planned to treat the headache as a sinus headache with antibiotics, Medrol, and Afrin. Dr. Hull also ordered a head MRI with and without contrast. *Id.* at 58.

The MRI, done on December 9, 2015, revealed a "very small, enhancing extra-axial lesion or neoplasm…anterior to the left pons." The primary consideration was "a small extra-axial neoplasm such as a small meningioma." *Id.* at 55. Other impressions included left maxillary sinus disease. *Id.* Dr. Hull referred him to a neurologist, Jessica Schultz, M.D.

Petitioner had his first neurology appointment with Dr. Schultz on December 15, 2015. He reported a severe headache for nine weeks that started when he was

reading. Sleep was the only relieving factor. Petitioner reported that he had a headache as soon as he woke up and could not go back to sleep due to the pain. The pain started in petitioner's neck and moved up the neck and into the head. Pet'r Ex. 6 at 5. Dr. Schultz's diagnosis was "persistent migraine aura (sic, likely meant without aura) without cerebral infarction with intractable migraine …with status migrainosus." *Id.* at 6. Dr. Shultz prescribed verapamil, naproxen, and Flexeril, and provided petitioner with triptan samples. *Id.* at 7.

Three days later, on December 18, 2015, petitioner had an MRI follow-up appointment with Dr. Hull and reported that nothing helped the headache, which was now worse. Pet'r Ex. 16 at 51. Petitioner reported 4/10 pain. *Id.* at 53. Dr. Hull consulted Dr. Schultz and admitted petitioner to United Regional Medical Center for management. *Id.*; Pet'r Ex. 4 at 21. Petitioner was hospitalized for five days and was discharged on December 23, 2015. Pet'r Ex. 4 at 21. Throughout his admission, petitioner was administered numerous medications including Depakote, Toradol, Dilaudid, Phenergan, Imitrex, and Solu-Medrol to break the headache. However, none of these relieved petitioner's headache. *Id.* By December 23, with the headache persisting with no significant improvement, petitioner decided to go home for Christmas and follow-up with a second neurologist on an outpatient basis. *Id.*

Petitioner saw a second neurologist, Steven Herzog, M.D., on February 1, 2016. Pet'r Ex. 7 at 28. Petitioner's reported symptoms were consistent with that of prior appointments. *See id.* Dr. Herzog noted the presence of a meningioma on the December 9, 2015 MRI. *Id.* at 29. Dr. Herzog noted petitioner's family history of migraine but pointed out that petitioner's present headaches had "mild" migrainous features. *Id.* at 28. He diagnosed petitioner with chronic pain syndrome, intractable chronic migraine without aura and without status migrainosus, neck pain, or cerebral convexity meningioma. *Id.* at 29. Petitioner received a trigeminal nerve block at this appointment and was prescribed amitriptyline, naratriptan, and isometheptene. *Id.*

Throughout early 2016, petitioner also received physical therapy, chiropractic, and acupuncture treatment. Pet'r Ex. 4 at 343-47; Pet'r Ex. 13; Pet'r Ex. 15. After failing all treatments, Petitioner traveled to the Mayo Clinic to see headache specialist, Mark Keegan, M.D., on May 13, 2016. Petitioner reported no relief from the numerous treatments provided by his local physicians. He reported

that the headache "beg[an] occipitally and radiates in the vertex bilaterally. It involves the face and jaw and pressure behind the eyes. There is significant photophobia . . . He does not have phonophobia, nausea, vomiting, or osmophobia but action clearly worsens the headache." Pet'r Ex. 8 at 14. Petitioner was wearing sunglasses at the appointment due to photophobia. *Id.* Dr. Keegan suspected that recommended treatments were not of sufficient dose or duration to help petitioner, and offered to make recommendations, or, alternatively, to do a repeat MRI, cerebral spinal fluid ("CSF") examination, and an MR venography to rule out alternative causes of headache. *Id.* at 17. Petitioner opted to have further workup of his headache. *Id.* Petitioner was diagnosed with "intractable migraine without aura (status migrainosus)." *Id.* A lumbar puncture was performed on May 16, 2016, and revealed mildly elevated CSF protein at 57 (Ref. Range 0-35). Pet'r Ex. 8 at 1. The MRI revealed an "8 mm enhancing nodule adjacent to the left clinoid process, projecting into the subarachnoid space," which "presumably represents a meningioma." *Id.* at 27. The presumed meningioma had "little clinical significance [g]iven its size, location, and appearance." *Id.* The MR venography showed a "benign developmental venous anomaly [in] the right basal ganglia, a small cyst or polyp in the left maxillary sinus, and a lipoma overlying the occipital calvarium." *Id.* The overall impression of both studies noted there was "nothing to explain headaches." *Id.*

For the next year and a half, petitioner saw multiple physicians of various specialties, underwent many tests, and tried many treatments. Tests included at least two EMGs, a trapezius muscle biopsy, MRIs, and MRVs. Petitioner received Botox injections, nerve block injections, chiropractic treatment, and acupuncture treatments. No test explained the cause of petitioner's headaches, and no treatment provided relief.

Petitioner's wife came across a condition called new daily persistent headache ("NDPH") while researching on the internet in the fall of 2016. About a year later, in the fall of 2017, she discovered an NDPH specialist, Duren Michael Ready, M.D., in Temple Texas and made an appointment for petitioner. At his initial consultation on December 20, 2017, Dr. Ready took an extensive history that encapsulated his course over the prior two years:

> History of present illness.: Doug is a 55 year old male. In the beginning of October 2015. He received a vaccination. Three days later he developed a

continual holocephalic headache that has not resolved. This pattern has been stable since October 3rd, 2015. He has been told that these are migraine headaches. He has had multiple interventions for these headaches, including IV medications, injections of local anesthetic, Botox, and multiple courses of typical preventive migraine therapy. Headaches are made worse by walking, warm showers, movement, light and riding in a vehicle. They are made better by sleep as he is unconscious and unaware of any pain.

He has had a complete workup for headache which has been negative. These included an MRI of the brain, MRA, MRV, neck MRI, CT scan, lumbar puncture, and multiple neurological evaluations. He has also had physical therapy. And acupuncture. He has not had a positive response to these. He has not been exposed to the concept of the behavioral management of pain. He does snore at night. He had previously worked as an accountant, but he is unable to do so presently. He is currently on Social Security disability. He does not exercise on a regular basis, and he does not typically engage in hobbies or enjoyable activities. He believes he has headaches secondary to the flu shot. And the diphtheria vaccination that he received on September 30th, 2015. He believes he needs an appropriate diagnosis for his headaches as he is skeptical that they are migraine type headaches. They are seeking care from us as he believes that he is suffering from new daily persistent headache.

Midas score incalculable. HIT6 score of 76. GAD 7 score of 6 PHQ 9 score of 11. When he has a headache. He will typically take Xanax and Tylenol 3 and sit down. He will do this seven days a week. Acutely he has taken treximet naratriptan, eletriptan, prednisone, naproxen, tramadol, Excedrin migraine, Tylenol, and midrin. For prevention, he has taken topiramate, extended release, topiramate., depakote, gabapentin, amitriptyline, verapamil, duloxetine and memantine.

Headaches may be triggered by stress, sunlight, glittering lights, straining, exercise, and coitus. He denies any visual auras. Pain is bilateral. Radiating up the occiput to the vertex over the frontalis and temporalis. Pain is between a 7 and 8 out of 10. Described as a throbbing, aching, pounding, constant pressure. There may be a tight band around the head. And exploding out. During the attacks, he will complain of photophobia, neck muscle tenderness, tinnitus, dizziness, weakness, irritability, anxiety, difficulty concentrating, and blurry vision. He believes the headache feels like a full blown concussion.

Pet'r Ex. 11 at 5.

His physical examination was essentially normal, and Dr. Ready diagnosed NDPH. He did considerable counseling as to give petitioner guidance in terms of behavioral approaches to manage headache pain. He wrote, "given the absence of a [word missing] and given the proximity of the vaccination to the onset of the headaches, I believe that it is reasonable to suspect that the precipitating event for his NDPH was the vaccination." *Id*. NDPH was discussed at length. Dr. Ready explained that this is a very challenging condition to take care of. Dr. Ready wrote prescriptions for doxycycline and Singulair for pain management. He also increased his memantine to 30 milligrams, instead of 20 milligrams a day, and indicated that he would consider increasing this dosage to 40 milligrams. A prescription for tizanidine was also written.

The behavioral management of pain was discussed at length. Dr. Ready suggested switching from Xanax to Clonazepam. He advised that he was unsure whether Tylenol 3 is an appropriate analgesic medicine for petitioner to take on a regular basis. He recommended that petitioner try to walk for 20 minutes every day and use audio relaxation techniques. He suggested consideration for DHE and lidocaine infusion therapy. Pet'r Ex 11 at 7.

Petitioner had three more appointments with Dr. Ready between April and November 2018. Pet'r Ex. 11 at 12; Pet'r Ex. 18; Pet'r Ex. 20.[8] During the same time, petitioner began seeing a local neurologist, Danny Bartel, M.D., who treated petitioner for his headaches through July 2021. He ordered numerous diagnostic tests that did not shed additional light on the condition. On July 21, 2021, petitioner's last appointment with Dr. Bartel as of the entitlement hearing, Dr. Bartel noted that petitioner's pain "[had] been intractable and not relieved by routine medication. Numerous investigations have not shown any other causes and treatments have produced only temporary benefit." Pet'r Ex. 119 at 2.

On June 5, 2018, Dr. Ready also recommended that he look into a trial of an eNeura device, and he also suggested that they coordinate with his family physician about magnesium infusions. He noted that petitioner was working with an attorney to obtain vaccine compensation as "he believes, and I would agree, that

[8] Dr. Ready's office is in Temple Texas, about 240 miles from the petitioner's home in Wichita Falls, Texas.

this headache was the result of a vaccination that he received." He could not tolerate imipramine, which had been trialed, and was having significant photophobia with his headaches and occasional nausea. *See* Pet'r Ex 18. Dr. Ready recommended and ordered a free, two-month trial of Aimovig, a CGRP antibody used to treat migraine symptoms. Pet'r Ex. 18 at 1.

At his final appointment with Dr. Ready on August 16, 2018, petitioner reported that he had had 61 severe headaches over the last two months. Petitioner noted difficulty tolerating some of his headache medications, including Buprenorphine transdermal patches and nortriptyline, and was not getting sufficient muscle relaxation with clonazepam. He consented to initiating the Aimovig trial, as Dr. Ready had obtained the drug from the manufacturer as part of a free, two-month trial program. He received the first injection at this appointment. Pet'r Ex. 20 at 1-5.

Petitioner testified at the hearing via Zoom, wearing sunglasses throughout the proceeding. He described that on the morning of October 3, 2015, he sat up in bed, and "it" hit him immediately; "it" was a sensation he never felt before, as if somebody hit him in the back of the head, resulting in a full-blown concussion. The sensation encompassed throbbing, intense pressure behind his eyes, ringing in his ears, and pain radiating down his neck and shoulders. His scalp was tingling, and he felt as though somebody was pulling the skin over the top of his head at the same time. Tr. at 5. He described how the headache became worse over the next two weeks. He initially consulted an optometrist because of blurry vision, who prescribed him glasses that ultimately did not help. He began using a neck brace because of pain getting in and out of the car. Tr. at 22. Petitioner described how, while he used to read voraciously and play stocks on his computer, he could no longer do these activities. He also described a treatment he received during an appointment with Dr. Herzog: the provider twice inserted a vial of Lidocaine down petitioner's nasal cavity to calm the trigeminal nerve, but petitioner did not get relief from either attempt. Tr. at 30-31.

Petitioner was asked how he was doing at the time of the hearing. He said that his ears were ringing, that his jaw was tightening up, and that he felt as though someone was squeezing his head and pulling the skin down over his head. He characterized the pain as an internal pressure, as if his head were going to explode. He described that he frequently felt and observed that his temples went "thump-

thump" when looking in the mirror. *Id*. at 51. Petitioner demonstrated that he had had a neurostimulator inserted that he uses when the headaches get particularly bad, at which point he must turn it up to the highest setting to get relief. *Id*. at 52.

B. NDPH Defined

According to one of the most recent articles on NDPH, *Evans & Turner*,[9] NDPH was initially described in 1986 in a study of 45 patients, 70% of whom were headache free after two years. Studies since have reported a persistent headache type which is among the most treatment-resistant of all primary headaches. The authors wrote that the diagnosis is one of exclusion, as there are many secondary causes of NDPH or NDPH mimics.

While the defining characteristics of NDPH have evolved somewhat since it was initially described, the syndrome has been recognized as a distinct category of primary headache in the *International Classification of Headache Disorders, 3d Edition* (ICHD-3). The current classification defines NDPH, as described in the *Evans & Turner* article, as follows:

> NDPH is a "persistent headache daily from its onset, which is clearly remembered. The pain lacks characteristic features and may be migraine-like or tension-type-like or have elements of both… The diagnostic criteria are the following: (A) Persistent headache fulfilling criteria B and C. (B) Distinct and clearly remembered onset with pain becoming continuous and unremitting within 24 h[ours] of onset. (C) Present for [greater than] 3 months. (D) Not better accounted for by another ICHD-3 diagnosis.

Pet'r Ex. 160 at 3 (internal quotations omitted). There is little question that petitioner's condition meets the definition: he clearly remembers the date of onset; the pain became persistent within the first 24 hours from onset; and, he has suffered from the condition for well over three months. Additionally, the headaches have characteristics of both tension type headaches and migraines, and his symptoms are not better defined by another condition. He has also had extensive medical evaluations, and no alternative cause has been identified.

[9] R.W. Evans & D.P. Turner, *Clinical Features of New Daily Persistent Headache: A Retrospective Chart Review of 328 Cases*, 61 Headache 1529 (Nov. 2021).

The questions for resolution in this case is whether the condition, in at least some cases—including this one—, is autoimmune in nature and whether the vaccines received three days before onset were more likely than not the cause-in-fact of his headaches.

C. Expert Opinions in Support of Petitioner

1. Dr. Marcel Kinsbourne

Dr. Marcel Kinsbourne submitted two expert reports on behalf of petitioner and testified at the hearing as an expert in neurology, capable of reviewing and understanding the literature based on his extensive training in neurology and years in practice—albeit his practice did not focus on headaches. Tr. at 58- 60; Pet'r Ex. at 22; Pet'r Ex. at 108. He was so admitted.

i. Diagnosis

Dr. Kinsbourne testified that he reviewed the petitioner's medical records and many of the articles submitted in the case. He discussed the different types of headaches including migraines and tension headaches which often have well-described symptoms by which they are identified. He testified that in New Daily Persistent Headache ("NDPH"), the literature indicates that the headaches often have elements of either or both migraine or tension headaches, which makes the diagnosis less clear. Tr. at 61. However, the literature, which describes a heterogenous set of symptoms that occur in NDPH, also identifies the consistent criteria by which it has been defined. In NDPH, the headache begins at a distinct time, which is often remembered by the patient, and that it persists for more than three months before it can be officially diagnosed as NDPH. In petitioner's case, the onset was clearly remembered, and the pain endured without remission, despite a wide range of treatments initiated since its onset in 2015.

Dr. Kinsbourne, reflecting on the literature filed in this case, testified that 45% of NDPH patients identify a trigger, while a small majority do not recognize a trigger, and he considers these categories of patients to be two subtypes of NDPH. Tr. at 55. He opined that when there is a trigger, it is more often post-infectious. *Id*. He further testified that he thinks petitioner's headaches more closely fit the

tension category with some migrainous features. He referred to petitioner's description that the headache is all over his head and his description of it coming up from the neck, up the back of the head, all the way forward on both sides of the head, indicating that this is a typical description of a tension headache. Tr. at 66.

Dr. Kinsbourne primarily relied on three articles during his testimony to support his conclusion that petitioner satisfied the criteria for a NDPH diagnosis. A 2019 review of the literature, *Yamani & Olesen*,[10] stated that NDPH "is a rare primary headache disorder, characterized by persistent headache with a particular temporal profile as it starts [one] day with a clearly remembered onset and continues in a daily pattern without remitting," and noted that that the most recent diagnostic criteria for NDPD "did not use any special clinical features, only sudden onset and persistence." He referenced the most recent study, *Evans & Turner*, which studied 328 patients and was consistent with *Yamani & Olesen*. *Yamani & Olesen* described NDPH as "mostly bilateral in location and can occur anywhere in the head with mild to severe intensity (moderate intensity in most cases). The pain is constant and lacks special characteristic features but in some has characteristics of migraine (including unilateral pain, pulsating quality, worsening by physical activity, photophobia, phonophobia nausea and vomiting." Pet'r Ex. 2 at 1-2. In some cases, the headache more closely resembles a tension type headache.

Dr. Kinsbourne testified that petitioner fit the diagnostic criteria for NDPH. Tr. at 62-64. Specifically, Dr. Kinsbourne opined that petitioner met the criteria based on his clear memory of onset, headaches continuing daily for an indefinite period, his lack of previous history of headache, and the condition being disabling and detrimental to the quality of life. *Id.* He also observed that one of petitioner's treating physicians, the headache specialist, Dr. Ready, diagnosed petitioner with NDPH and had implicated the vaccines as a cause. Tr. at 65-66. Dr. Kinsbourne opined that petitioner's headaches fell into the "tension category" of NDPH as opposed to the "migraine phenotype" because petitioner had described the headache as being "all over his head." *Id.* at 66. With a tension headache, it is typical for the pain to come up from the neck to the back of the head and "all the way forward on both sides" whereas migraines are typically unilateral." *Id.* at 66-67. He noted, however, that "some people, including the petitioner, with tension

[10] N. Yamani & J. Olesen, *New Daily Persistent Headache: A Systematic Review on an Enigmatic Disorder*, 20 J. Headache & Pain 80 (Jul. 2019).

headaches do have some more migrainous-like manifestations," such as photophobia. *Id.* at 68.

ii. Causation

The *Evans & Turner* article also discusses pathogenesis, finding that "a significant portion of NDPH patients [studied] describe that they experienced infection or a flu-like illness at the onset of headache." Pet'r Ex. 160 at 4. The *Yamani & Olesen* article suggests that inflammation and cytokine production might play a role in NDPH. Pet'r Ex 28. at 5-6. Dr. Kinsbourne also pointed to the article, *Riddle & Smith*,[11] to further support his opinion that NDPH can be post-infectious. Tr. at 70-72; Pet'r Ex. 159. That article states that "prior infection is one of the more commonly identified triggers for NDPH. This raises the possibility that NDPH is a post-infectious immune disorder." Pet'r Ex. 159 at 3. In fact, in multiple articles, including *Rozen & Swidan.*[12] and others studying characteristics of multiple patients with NDPH, found fairly consistently that about half of the patients could not identify a trigger, while most of the other patients identified either a preceding infection, a stressful life event or surgery.

Rozen & Swidan studied TNFα, an inflammatory cytokine, in patients with NDPH and migraines, and the authors found that most members of the cohort had elevated TNFα in the CSF. Pet'r Ex. 26; Resp't Ex. A, Tab 7. *Rozen & Swidan* studied 38 hospital-admitted headache patients, 20 of whom were diagnosed with NDPH. Thirty percent of the NDPH patients had a prior infection. The authors examined the presence of TNFα in the CSF and in the serum. They found that in 19 of the 20 NDPH patients, there was elevated TNFα in the CSF, and the same was identified in all the migraine patients. They found that most patients with elevated CSF levels, the serum levels were normal. *Id*. at 5. Significantly, those patients who had NDPH for more than 2 years, had had higher mean levels of TNFα in the CSF than did those who had daily headaches for less than 2 years. *Id*.

---

[11] E. Riddle & J. Smith, *New Daily Persistent Headache: A Diagnostic and Therapeutic Odyssey*, 19 Current Neurol. & Neuroscience Rep.s 21 (2019).

[12] T. Rozen & S.Z. Swidan, *Elevation of CSF Tumor Necrosis α Levels in New Daily Persistent Headache and Treatment Refractory Chronic Migraine*, 47 Headache 1050 (Jul.-Aug. 2007).

at 3-4. The authors noted that whether elevated TNFα can cause head pain can only be postulated:

> There is recent evidence that TNFα will induce calcitonin gene-related peptide (CGRP) production. TNFα receptors are located on rat trigeminal ganglia neurons and CGRP release is increased after cultured trigeminal neurons are treated with TNFα. CGRP is a known factor in the migraine pathogenesis cascade. It is believed to cause dilation of meningeal and cerebral arteries, release of inflammatory compounds from mast cells and be involved in the transmission of nociceptive signals from blood vessels and the trigeminal sensory system. CGRP is believed to be involved in the pathogenesis of most trigeminal based head pain syndromes.

Id. at 4.

Dr. Kinsbourne, having reviewed the consistently significant number of patients in different studies with prior infections, theorized in a manner similar to the authors of the studies finding that infections may have led to autoimmunity. He theorized that the vaccines, which are designed to stimulate an immune response to achieve their purpose, could generate the same or similar immune response in patients, such as petitioner, through inflammatory cytokines generating an attack on the sensory nerve endings in the meninges. Quoting *Riddle & Smith*, Dr. Kinsbourne testified that an "infection, or vaccination by a similar process, trigger[ed] an inflammatory state in, or around the brain, maybe in the meninges, maybe in the upper cervical nerves, and these are nerves that actually suppl[y] the surface of the head, as described in tension headache and by [petitioner] and that [gave him], as a neurologist, a reason to suspect the autoimmune response." Tr. at 71. Dr. Kinsbourne noted that every article on NDPH posits that it is triggered by prior infection, yet there was not a single example of a patient who was currently infected. Tr. at 70. Accordingly, he concluded that infections generate an autoimmune response, and the response, in rare cases, led to a chronic inflammatory disorder, which was what caused petitioner's injury. Tr. at 71. He further said that prior infection was one of the more commonly identified triggers for NDPH. This conclusion raised the possibility that NDPH is a post-infectious immune disorder. Tr. at 71.

Dr. Kinsbourne said that he thought petitioner's description of his headache was most similar to a tension headache, which is a disorder involving the sensitization of nerve endings that enervate the meninges. Tr. at 100. He explained that the sensory nerve endings in the cranial vault are in the meninges, as opposed to in the interior of the brain, and would explain why an inflammatory attack on sensory nerves may give rise to tension-like headaches, such as the headaches suffered by petitioner. Tr. at 104. He said that inflammation can persist. Tr. at 101. As such, he concluded that petitioner's vaccinations gave rise to the sudden onset of a severe headache, with pain gradually increasing over the course of a day and persisting for two weeks thereafter. He deferred to Dr. Akbari to explain the molecular mechanisms involved in this clinical course.

Rozen & Swidan's finding that TNFα was elevated in participants' CSF, even years after the onset of their conditions, "[was] consistent with a chronic inflammatory condition." Tr. at 88. When asked about how cytokines from vaccination could lead to TNFα-induced chronic headaches, Dr. Kinsbourne noted that "TNFα is a cytokine, and the TNFα causes inflammation." *Id.* He further clarified that the cytokines "[were not] actually going into the brain but, rather, that they [went] to the meninges, which wrap around the brain and the nerves that supply them." *Id.* He also noted that there was "no evidence that [petitioner's headaches were] due to demyelination," but deferred to Dr. Akbari as to whether molecular mimicry was a causal explanation. *Id.* at 93. Dr. Kinsbourne also agreed that he had not seen specific evidence that petitioner suffered an injury to either his trigeminal nerve or vagus nerve. *Id.* at 94.

Additionally, Dr. Kinsbourne opined that petitioner's autoimmune response was more likely triggered by the flu vaccine he received. Tr. at 73. He further stated that where an infection triggers NDPH, "that the infection generates an…immune… response and that the immune response gets out of control for rare reasons and that sets up a chronic inflammatory disorder, which is what's causing [petitioner's] suffering." *Id.* at 70.

As to whether there is a logical sequence of cause and effect between petitioner's vaccinations and his NDPH, Dr. Kinsbourne testified that petitioner's receipt of flu and TDaP vaccines are a "strikingly unusual event," where "three days later," petitioner experienced symptom onset. Tr. at 79. He stated that "there is a reasonable probability that there is a connection between the two." *Id*. He also

testified that there was a reasonable proximate temporal relationship between the vaccinations and the injury in this case. *Id.* He opined that the theory presented met the criteria of convincing circumstantial evidence, and a lack of stronger evidence can be attributed to the fact that NDPH is not a well-investigated condition. *Id*.

During cross examination, Dr. Kinsbourne explained that vaccines are designed to stimulate an immune response to protect against exposure to the wild antigen, and in order to do so, the vaccines trigger the release of inflammatory cytokines such as TNFα, which is a pathway that has been studied. Dr. Kinsbourne characterized this process as normal, but clarified that in petitioner's case, his immune system responded to the vaccines and overreacted, causing damage that triggered his severe headaches. Tr. at 86-87. He reiterated that the vaccines stimulated the inflammatory cytokines that caused the pain.

To counter respondent's argument that petitioner's headaches may be attributed to polypharmacy, Dr. Kinsbourne opined that petitioner's symptoms were not attributable to medication overuse "when they began… [when petitioner] wasn't taking medication." Tr. at 56. However, he conceded that, since petitioner had been prescribed regular opioid treatments due to the refractory nature of petitioner's headaches, opioids, "if taken in excess, can cause a headache." *Id.* Regardless, if petitioner's opioid therapy has exacerbated his symptoms, this side effect would be attributable to petitioner's underlying diagnosis; polypharmacy would not defeat a causation analysis as petitioner's medications were initiated after his primary headache, which allegedly occurred after his receipt of the flu and TDaP vaccines. Tr. at 77.

2. Dr. Omid Akbari

Dr. Akbari has a PhD in cellular and molecular biology from the National Institute for Medical Research in London. He currently serves as a professor of medicine and as a professor of allergy and immunology at the Keck School of Medicine at the University of Southern California. His academic and research interests involve dysregulated immune responses, particularly when immune responses are not regulated properly or how they can cause injury or pathology. Tr. at 107-108.

Dr. Akbari submitted two expert reports and testified at the entitlement hearing on petitioner's behalf. *See* Pet'r Ex. 36 (ECF No. 41); Pet'r Ex. 101 (ECF No. 57). Dr. Akbari opined that petitioner's NDPH was a result of his receiving the flu and TDaP vaccines. Tr. at 152. He presented a complex, multifactorial explanation to explain how the flu and TDaP vaccines caused petitioner's NDPH.

Dr. Akbari testified that petitioner's NDPH was caused by a complex immune response involving multiple mechanisms in the immune system. When he received the flu and TDaP vaccines, petitioner was a healthy 53-year-old man. Three days later he awoke with a severe headache. The headache gradually worsened over the following two weeks and has persisted well beyond six months.

Dr. Akbari testified that the cause of petitioner's development of NDPH was a dysregulated response to the vaccines, which initiated a complex immune response to the vaccines. He explained that once the vaccines are administered, the innate immune system recognized a foreign invader and began to respond. Macrophages, dendritic cells, toll-like receptors, and NK cells recognized the antigenic components of the vaccines, referred to as pathogen-associated molecular patterns ("PAMPS"), and began to attack them.

In his first report, Dr. Akbari highlighted that meningeal and perivascular macrophages, which comprise two major populations of resident macrophages in the CNS, play a crucial role during the CNS inflammatory phase following immunization. These macrophages are a major source of pro-inflammatory cytokines, including TNFα, which is often associated with autoimmunity and CNS-related inflammation—including onset of persistent headaches. Pet'r Ex. 36 at 6. His description supports Dr. Kinsbourne's testimony that the macrophages in the cranial vault are in close proximity to the meninges.

Dr. Akbari explained that a critical part of the initial immune response involves the activation of the inflammasome, which are immune pathways involving multiple immune cells that actively convert pre-IL-1 and pre-IL-18 to IL-1 and IL-18. The inflammasome comprises the pathways that initiate the immune response of innate cells. Tr. at 136-137. The inflammasome may be initiated by multiple PAMPS, and involve Toll-like receptors, NOD-like receptors, NALP receptors, C-type lectin receptors, and several others.

Dr. Akbari noted that, in the present case, petitioner received two vaccines at the same time, with only the TDaP vaccine containing an alum adjuvant. With this

context, Dr. Akbari cited to the article *Eisenbarth et al.*,[13] Pet'r Ex. 149 (ECF No. 64), which analyzed the importance of the inflammasome and its role in producing the antigenicity of vaccines. The authors wrote that the Nalp3 inflammasome plays a crucial role in the immune stimulatory properties of alum adjuvants. *Eisenbarth et al.* explained that alum adjuvants are used in human vaccines to induce a potent humoral response and to induce T-helper cell-mediated inflammation. The authors wrote that there must be two signals to activate the inflammasome: one from the antigen and one from the alum adjuvant.

The adjuvant must be encountered simultaneously with the antigen in vivo for efficient priming, which suggests that the antigen might provide the first signal either directly or indirectly by inciting the production of local pro-inflammatory cytokines from resident monocytes or specialized cells recruited by adjuvant. Once the first signal has primed the cell, the adjuvant provides the second signal, activating the Nalp3 inflammasome. Pet'r Ex. 149 at 1125. The study concluded that an adjuvant's effectiveness turns on activating the Nalp3 inflammasome, which then activates the production of the inflammatory cytokine IL-1B and other members of the Il-1 family, including IL-18 and Il-33. The authors noted that the Nalp3 inflammasome is part of the innate immune response and can also direct a humoral adaptive immune response, which can further sense either pathogen or damage patterns resulting in an additional stimulus to the immune response that helps to sustain the response.

As Dr. Akbari noted, adaptive cells have sensors as well. Tr. at 139. The inflammasome triggers the release of inflammatory cytokines, in particular IL-1 and TNFα, and activates CD4 T-helper cells, which in turn release more inflammatory cytokines and give rise to continued inflammation. Importantly, as noted in the article *Petrilli*,[14] Pet'r Ex. at 152, the Nod-Like Receptors can also recognize "Danger Associated Molecular Patterns," and mutations in these pathways are associated with chronic autoinflammatory conditions.

Dr. Akbari argued that the sensors that activate the inflammasome can sense foreign substances, and they are critical to mounting an immune response. He opined that there is a large variety of these sensors in human immune cells that

[13] S.C. Eisenbarth, et al., *Crucial Role for the Nalp3 Inflammasome in the Immunostimulatory Properties of Aluminium Adjuvants*, 453 Nature 1122 (Jun. 2008).

[14] V. Petrilli et al., *The Inflammasome: A Danger Sensing Complex Triggering Innate Immunity*, 19 Current Opinion Immunol. 615 (Dec. 2007).

are capable of sensing a pathogen, which can turn on the inflammasome. The switching on of the inflammasome is the innate immune response that causes the release of cytokines including IL-1, Il-6, IL-18 and TNFα. This pathway is relevant because it has been linked to reactions to both the flu and DTaP vaccines, particularly when they are given together. These findings become particularly persuasive because the inflammasome, if activated in the neck or head in close proximity of the trigeminal nerve, can cause migraines. Tr. at 135-136. Such migraines also involve chemokines and leukotrienes, which encourage the trafficking of other cells to the area and exacerbate the symptom. Tr. at 139.

Dr. Akbari testified that the flu TDaP vaccines stimulate the innate immune system through activation of the inflammasome, producing other cytokines that trigger or worsen headaches. He described that when genetic wide association studies ("GWAS") were conducted in his lab, one of the elements frequently associated with headaches was TNFα, a finding that suggests that people with headaches or migraines may have more epigenetically exposed TNFα levels or a genetic susceptibility to headaches either by stimulating excess TNFα or from the inability to control it. Tr. at 123.

His conclusions were consistent with *Rozen & Swidan*, one of the leading studies of NDPH, which found elevated levels of TNFα in CSF in 19 of 20 NDPH patients and all the migraine patients that were included in the study. While Dr. Saxon criticized the study because the lab involved did not establish TNFα norms for CSF samples as opposed to serum samples, the result appears to be consistent with other studies and showed TNFα to be present at levels somewhat higher in the CSF samples.

Dr. Akbari's theory of the etiology of petitioner's alleged injury also relied on the activation of neuropeptides, which—in cases of NDPH—may respond to inflammation of the meninges and/or the trigeminal nerve. Dr. Akbari testified that over 100 neuropeptides have been discovered and characterized them as forming the language of the nervous system. They are secreted by nerve cells to coordinate with surrounding cells. Dr. Akbari said that they are the focus of a new area of research in his lab. His work has already demonstrated that many of the neuropeptides induce T cells and macrophages to produce TNFα. Dr. Akbari said that different peptides have different effects, but he posited that the role of peptides is particularly important in partitioner's case, explaining that researchers have

injected neuropeptides into a group of volunteers and induced migraine headaches. Tr. at 141.

Dr. Akbari opined that CGRP is one of the peptides that is most associated with the generation of headaches. He indicated that the FDA has recently approved a therapy targeting an anti-CGRP receptor for the treatment of headaches and migraine. Tr. at 140. Dr. Akbari said that the fact that an anti-CGRP receptor therapy has been shown to be safe and effective in the treatment of migraines and headaches supports the theory that, after nerve cells are injured during inflammatory phases, neuropeptide proliferation exacerbates the symptoms. Tr. at 139. Different neuropeptides have different functions, but some of them can stimulate the production of additional inflammatory cytokines. Continuous secretion of the neuropeptides has a perpetuating and enhancing effect, causing more inflammation and more headaches. When the neuropeptides were blocked by the medication, the cycle was interrupted, alleviating headaches. Tr. at 141.

Molecular mimicry can also play a role in NDPH, as the adaptive immune cells are activated, sustaining the immune response and the production of inflammation, and then contribute to the chronicity of headache. Tr. at 116. The initiation of the adaptive immune response is controlled by innate immune signals. The NOD like receptors, in addition to being able to sense stimuli of microbial origin, can sense markers of cellular damage in "damage associated molecular patterns" that in turn can be recognized for clearance by adaptive cells. Pet'r Ex. 149.

Dr. Akbari stated that the immune system is generally structured to prevent its effector cells, such as cytotoxic T cells and antibodies, from attacking host cells. Citing to the article, *Dejaco et al.*,[15] Dr. Akbari explained that the main role of the regulatory system is to prevent autoimmune disease:

> The breakdown of mechanisms assuring recognition of self and non-self by the immune system is a hallmark feature of autoimmune diseases. The primary mechanism leading to self-tolerance has recently been termed as 'recessive tolerance' which is induced by the thymic deletion of autoreactive T cells. However, [in instances of autoimmunity] thymic selection is incomplete, and self-reactive cells occur, even in healthy individuals. On the other hand, 'dominant tolerance' is an additional mechanism for maintaining

[15] C. Dejaco, *Imbalance of Regulatory T Cells in Human Autoimmune Diseases,* 117 Immunol. 289 (Mar. 2006).

> peripheral self, which is mediated by regulatory T cells actively modulating immune responses.

Id. at 1.

Dejaco et al. found that several subtypes of T regulatory cells have been defined with different phenotypes, including among CD8, CD4, and important regulatory cytokines. The authors noted that the mechanism-potential of T regulatory cells is not fully understood; nonetheless, they provided examples of possible T regulatory mechanisms' failures that result in disease. They theorized that patients who have overreactive immune systems may ultimately suffer autoimmune responses that are not down-regulated, even after the triggering pathogen is resolved.

Dr. Akbari opined, as had the authors of *Dejaco et al.*, that there must be balance between the inflammatory and regulatory arms of the immune system. *Id*. at 121-22. Dr. Akbari explained that whether the T effector cells are high or low was not necessarily a critical issue, rather, the ratio between T effector cells and T regulatory cells must be kept in balance. He opined that before vaccination, some vaccinee's ratios are equal and tightly controlled. Tr. at 121. But after vaccination, some vaccinee's T effector cells are activated in increasing numbers, and after several days, their T regulatory cells eventually begin to compensate and control the inflammatory response. In certain individuals, however, this ratio can be disturbed such that the T regulatory cells never control the inflammatory response so that the vaccinees enter chronic inflammation. Tr. at 122.

Here, Dr. Akbari opined that the innate immune system, triggered through inflammasome pathways, recognized the molecular patterns of the two vaccines, whose antigenic components were enhanced by the simultaneous stimulation of the TDaP's adjuvant. He said that the H1N1 flu virus had been shown to cause the secretion of large amounts of TNF. *See* Pet'r Ex. 86. The adjuvanted TDaP also provokes a strong innate response through the Nalp 3 inflammasome, and the two given together potentiate each other, overproducing TNF and IL-1. It follows, Dr. Akbari opined, that vaccinees are particularly susceptible to such negative effects if they have impaired regulatory mechanisms and are genetically predisposed. He concluded that petitioner more likely than not suffered in this manner. Tr. at 148-49.

Considering the question of whether petitioner's case involves a logical sequence of cause and effect, Dr. Akbari testified that the innate immune response typically activates at around one to three days after exposure to an antigenic component, and at such time, the immune response is most likely to produce large amounts of TNF, IL-1, and IL-18. The inflammasome senses the foreign molecular patterns with Toll-like receptors. These couplings initiate the inflammatory cascades that cause nerve cells to produce more neuropeptides.

At this point of the cycle, the adaptive immune response and the regulatory system are activated. When these components fail, the host may suffer NDPH. If the regulatory system is chronically unable to balance the inflammatory response, headaches will remain persistent. Tr. at 151-52. These complex processes occur in tissue beds, as opposed to having systemic effects, and, in the case of NDPH, in the tissues supporting the trigeminal nerve and meninges. These locations are vulnerable because the unregulated response to vaccines is facilitated by macrophages and other immune cells known to accumulate in these areas.

In his rebuttal testimony at the conclusion of the hearing, Dr. Akbari again referenced the *Rozen & Swidan* study as evidence for the role of TNFα in NDPH and emphasized that the production of this cytokine is a local—and not systemic—phenomenon with higher levels occurring in the CSF. Ex 82

He also cited to the article, *Tariq et al.*,[16] in which the authors reported treating a 24-year-old male patient who had developed a severe and persistent headache on a day that he remembered. The headache intensified over 24 hours. He had failed multiple treatments and clearly fit the category of NDPH. The patient began a trial of daily administration of Venlafaxine, which is a serotonin-norepinephrine inhibitor usually used to treat major depressive disorder. Venlafaxine is also a TNFα-inhibitor. Over the course of three months, with his daily dosages increasing from 37.5 mg to 300 mg, the patient's headaches significantly improved. When the Venlafaxine was discontinued, after a three-week "washout period," the headaches returned. *Id*. The patient was then put on a six-month regimen of Venlafaxine, after which, the headaches resolved completely. The authors commented that NDPH is a heterogenous condition with multiple associated triggers including stressful life events, viral infection and

[16] Z. Tariq et al, *Resolution of New Daily Persistent Headache by a Tumor Necrosis Factor Alpha Antagonist, Venlafaxine*, 7 SAGE Open Med. Case Rep.s 6 (May 2019).

surgery. They concluded that the one common mechanism among cases of NDPH was an increase of the inflammatory cytokine TNFα in the CSF. Dr. Akbari argued, as did the authors he references, that the inability to regulate TNFα was driving the pain. Pet'r Ex. 89 at 1-3; Tr. at 327-28.

D. Expert Opinions in Support of Respondent

1. Dr. Dara Jamieson

Dr. Jamieson submitted three expert reports in this case and testified for respondent at the entitlement hearing. Resp't Ex. A (ECF No. 29-1); Resp't Ex. C (ECF No. 46); Resp't Ex. F (ECF No. 67-1). Dr Jamieson was admitted as an expert in neurology and the subspecialty of headache medicine. Tr. at 189-90. Dr. Jamieson is board certified in Psychiatry and Neurology and has focused her career on headache medicine. *Id.* at 187. Notably, she has diagnosed and treated patients with NDPH. *Id.* at 189.

Dr. Jamieson opined that the neither the flu vaccine nor the TDaP vaccine administered to petitioner played a causal role in his development of NDPH. Tr. at 197. While Dr. Jamieson agreed that NDPH was the proper "label" for petitioner's headaches, she argued that it was not a disease entity because it does not have "a distinctive or known pathophysiologic mechanism." *Id.* at 197. Rather, NDPH is "just a descriptor for headaches that come on suddenly and last for three months or longer." *Id.* at 197-98. She further indicated that it is "not known why some people have headaches that fit" the label of NDPH. *Id.* at 198. Her testimony is also consistent with her expert reports, in which she states that "NDPH is a chronic primary headache syndrome, defined solely by its temporal profile as a persistent headache, daily from an onset that is clearly remembered." Resp't Ex. A at 6. She further stated that "the term N[DP]H describes a heterogeneous group of different headache symptoms that represents a syndrome (i.e., a group of symptoms that occur together) rather than any specific disease entity." *Id.*

Dr. Jamieson conceded that "a vaccination can trigger a headache for a number of reasons," noting that "you can have a headache as an acute reaction to having a vaccination." *Id.* at 199-200. However, she noted that such an acute reaction is "an attack of a headache, which is a one-and-done phenomenon" that should be distinguished from "a chronic headache disorder where you have had a

persistent daily headache for days, weeks, months, years. Those are two entirely different phenomena." *Id.* at 200.

Dr. Jamieson strongly disagreed with the opinions of petitioner's experts that NDPH is a post-infectious immune disorder and disagreed with the medical literature upon which they based such opinions. Tr. at 202. She testified that she was not aware of any "chronic primary headache disorders that are thought to be autoimmune in nature or have an immune pathophysiology." *Id.* at 200. The literature relied upon by petitioner's experts indicates that a certain number of NDPH cases follow infection. However, Dr. Jamieson indicated that "infection is but a very, very small number of cases where there has been an identified premonitory event." *Id.* She also noted that it is difficult "to look for what has been called the precipitating event, or a triggering event, because you don't make the diagnosis of NDPH until the patient has had headaches for at least three months." *Id.* Then, once the diagnosis is made "you go back and say…I'm giving you this label of NDPH; tell me what happened before the headaches came on." *Id.*

Dr. Jamieson pointed to the *Rozen & Swidan* article, in which 53% of patients had no triggering event; 22% had infection; 9% had stressful life event; and 9% had a surgical procedure. Tr. at 203; *see also* Resp't Ex. A, Tab 10. Next, Dr. Jamieson turned to the *Evans & Turner* article, which found that "precipitating factors were seen in a minority of individuals[.] [T]hey had stressful life event as being a precipitating factor in 21.5% of patients…20.4% had stress, 10.1% had infection, and 1.5% had surgery." Tr. at 204; *see also* Pet'r Ex. 160. Dr. Jamieson took these statistics to mean that "you can't assign a disease or a pathophysiologic mechanism, or any scientific basis to causation of this headache label." Tr. at 205.

Though admitting that the causal mechanism for NDPH is unknown, Dr. Jamieson disagreed that the report of infection as a triggering event indicates that there may be "an autoimmune subset of NDPH that has yet to be discovered." *Id*. She pointed to the *Goadsby* article[17] to support such opinion, noting that the author did not believe that there was any infectious etiology for NDPH. Tr. at 206.

She disagreed, as posited by Dr. Akbari and Dr. Kinsbourne, that TNFα inhibitors were an appropriate treatment for patients with chronic headaches. Tr. at

[17] P.J. Goadsby, *New Daily Persistent Headache: A Syndrome Not a Discrete Disorder*, 51 Headache 650 (2011).

198-99. In looking at the *Rozen & Swidan* study, Dr. Jamieson opined that "there is no way to reach any conclusion from the [*Rozen & Swidan*] study other than to say that presumably CSF TNFα is elevated in lots of patients with lots of kind[s] of headaches." *Id.* at 210. She does not believe that an increase in TNFα in the CSF indicates an immune or inflammatory process or acts as a trigger for headaches. Rather, she stated that elevated TNFα levels are seen because of a headache, but that they are not indicative of a particular type of headache. Tr. at 234. However, she agreed that there might be some degree of inflammation associated with the presence of TNFα. *Id.*

In her last two expert reports, Dr. Jamieson insinuated that petitioner's headaches were the result of medication overuse. However, on cross examination, Dr. Jamieson admitted that petitioner would not have taken the medications were it not for the NDPH, and that all the medications he took were prescribed by a treating physician, or that there was indication that petitioner took more medication than what was prescribed to him. Tr. at 221.

Overall, Dr. Jamieson argued that little is known about NDPH and its causal mechanisms. Tr. at 241. She agreed with the treatments petitioner received for his NDPH. *Id.* As noted in her initial expert report, Dr. Jamieson opined that "common events, such as vaccinations, cannot be retrospectively assigned to the subsequent development of an unusual syndrome, such as NDPH," especially when there is absolutely no pathophysiological explanation or mechanism for what appears to be a coincidental sequence of events." Resp't Ex. A at 11.

2. Dr. Andrew Saxon

Dr. Andrew Saxon submitted two expert reports on behalf of respondent and testified at the entitlement hearing. Resp't Ex. D (ECF No. 47-1); Resp't Ex. G (ECF No. 70-1). Dr. Saxon was admitted as an expert in the field of immunology at the entitlement hearing. Tr. at 250. Dr. Saxon started the Division of Clinical Immunology and Allergy at UCLA, where he spent most of his career. Tr. at 246. As of the hearing, he was the CEO of a biotech company working to cure food allergy. *Id.* Prior to 2008, Dr. Saxon saw patients as part of his immunology and allergy practice. *Id.* at 247. His research has revolved around different aspects of immune regulation in humans, including "immune deficiency, the genetic basis of how we get dysregulated responses, [and] how exogenous factors [such as] 'diesel

activities dysregulate the immune system.'" *Id.* He is board certified in internal medicine, clinical immunology and allergy and diagnostic laboratory immunology. *Id.* at 248.

In his first expert report, Dr. Saxon opined that petitioner "does not have a defined autoimmune disease nor…any form of autoimmunity (self-reactivity) that had a causal role in his chronic headaches" and that "the medical records show that [petitioner] did not initially, nor has he subsequently, [shown] evidence of systemic inflammation." Resp't Ex. D at 4. He primarily based these opinions on petitioner's nonrevealing laboratory results. *Id.*

As to causation, Dr. Saxon opined that petitioner's "headache disorder is not causally related to or significantly altered by the vaccinations he received on September 30, 2015, regardless of when various symptomatology began." *Id.* at 5. This opinion was based on "mechanistic/immunological and epidemiological data." *Id.* Dr. Saxon noted that "vaccinations, as given to the petitioner, *generally* do not lead to systemic inflammation or systemic changes in immune mediators such as TNFα…and the petitioner had no evidence of any unusual local or any systemic inflammatory changes following his September 30 vaccinations." *Id.* at 6. Dr. Saxon agreed that molecular mimicry has been established as a mechanism between *C. jejuni* and Guillain-Barre syndrome as well as streptococcal infections and rheumatic heart disease. Tr. at 252. He also agreed with Dr. Akbari's testimony that activation of the inflammasome is necessary for a primary immune response to a vaccine. *Id.* at 257. However, he disagreed that petitioner had any issues with his inflammasome process, because "all of the known inflammasome issues lead to some symptoms that you can see," which, in his opinion do not include headaches. *Id.* at 264. Similarly, he argued that there was no evidence of molecular mimicry in petitioner's case. *Id.* at 269. He emphasized that Dr. Akbari's testimony was "simply a theory." Tr. at 271.

Specific to headaches, Dr. Saxon notes that "the immune system, in the absence of some underlying autoimmune disease of the CNS, is not *generally* accepted by immunologists as being the direct or primary cause of chronic headaches, e.g. NDPH." Resp't Ex. D at 7. However, he went on to state that "while the immune system may secondarily participate in inflammation of the brain in autoimmune, infectious, and even acute trauma related headaches, [petitioner]'s headaches do not fall into these categories." *Id.* In direct response to

Dr. Akbari's theory, Dr. Saxon stated that "there is no generally accepted hypothesis for non-autoimmune immune mechanism" by which he meant that there is "no evidence that directly or indirectly supports the over secretion of cytokine exposure to the vaccines at issue would lead to [a] long-term inflammatory response in the nervous system." *Id.* He relied on the Institute of Medicine's statement on their review of literature related to the vaccine and adverse event combinations. *Id.* This statement was offered as being consistent with his testimony that petitioner does not have autoimmune dysregulation. Tr. at 251. However, Dr. Saxon testified that immune cells, taken in the broadest category, probably play a role in NDPH, as they are involved in pain, and he agreed that headaches can result from inflammation. Tr. at 299-300.

Dr. Saxon explained that cytokines "are language and are the 'ways that cells talk.'" Tr. at 273. He noted that TNFα affects the skin, blood vessels, bone, the pro-inflammatory response, and other things in the body. *Id.* at 273-74. He argued that the cytokine response to active infection is not comparable to the cytokine response with vaccination because the response to a vaccination is controlled and local, whereas it is more robust with a live infection. *Id.* at 274-75. Moreover, he criticized the *Rozen & Swidan* paper's study of TNFα and headaches, noting that there was no reference range for normal levels of TNFα. He did, however, state that it would not surprise him if TNFα levels were elevated secondary to a headache but indicated that it would be a question that remains to be answered. *Id.* at 317. He opined that just because a headache is present and TNFα levels are elevated, does not mean that the elevated TNFα is causing the headache. *Id.* at 318. In explaining neurogenic inflammation in reference to Petitioner's Exhibit 158, Dr. Saxon testified that "this is not *classic* inflammation" and was instead "crosstalk between nerves" that was not responsive to steroid therapy. Tr. at 300-02. Pointing to CGRP, Dr. Saxon argued that it "causes non-immune effects such as vasodilation" and swelling. *Id.* at 302-03. He further explained that "the immune system and the nervous system have a huge amount of crosstalk," but questioned whether this was "pathogenic in the sense of the cause of" petitioner's migraine pain or if it were "simply the downstream events." *Id.* at 304.

Dr. Saxon testified that three days from vaccination to onset of petitioner's symptoms was too fast for molecular mimicry to be the causal mechanism, as three days is too short to generate an adaptive immune response. Tr. at 254, 322. Dr. Saxon also disagreed that getting two vaccines at the same time increased

petitioner's chance of an injury, indicating that "we don't see any evidence that [petitioner] had any reaction to suggest there would be any vascular crosstalk between the two vaccines." Tr. at 295.

III. Legal Standard for Entitlement

The Vaccine Act was established to compensate vaccine-related injuries and deaths. § 10(a). "Congress designed the Vaccine Program to supplement the state law civil tort system as a simple, fair and expeditious means for compensating vaccine-related injured persons. The Program was established to award 'vaccine persons quickly, easily, and with certainty and generosity.'" *Rooks v. Sec'y of Health & Hum. Servs.*, 35 Fed. Cl. 1, 7 (1996) (quoting H.R. Rep. No. 908 at 3, reprinted in 1986 U.S.C.C.A.N. at 6287, 6344).

Petitioner's burden of proof is by a preponderance of the evidence. § 13(a)(1). The preponderance standard requires a petitioner to demonstrate that it is more likely than not that the vaccine at issue caused the injury. *Moberly v. Sec'y of Health & Hum. Servs.*, 592 F.3d 1315, 1322 n.2 (Fed. Cir. 2010). Proof of medical certainty is not required. *Bunting v. Sec'y of Health & Hum. Servs.*, 931 F.2d 867, 873 (Fed. Cir. 1991). Petitioner must prove that the vaccine was "not only [the] but-for cause of the injury but also a substantial factor in bringing about the injury." *Moberly*, 592 F.3d at 1321 (quoting *Shyface v. Sec'y of Health & Hum. Servs*., 165 F.3d 1344, 1352-53 (Fed. Cir. 1999)); see also *Pafford v. Sec'y of Health & Hum. Servs.*, 451 F.3d 1352, 1355 (Fed. Cir. 2006). A petitioner who satisfies this burden is entitled to compensation unless respondent can prove, by a preponderance of the evidence, that the vaccinee's injury is due to factors unrelated to the administration of the vaccine." § 13(a)(1)(B).

To receive compensation through the Program, petitioner must prove either (1) that he suffered a "Table Injury"— i.e., an injury listed on the Vaccine Injury Table — corresponding to a vaccine that he received, or (2) that he suffered an injury that was actually caused by a vaccination. *See* §§ 11(c)(1), 13(a)(1)(A); *Capizzano v. Sec'y of Health & Hum. Servs.*, 440 F.3d 1317, 1319-20 (Fed. Cir. 2006). Because petitioner does not allege that he suffered a Table Injury, he must prove that a vaccine he received caused his injury. To do so, he must establish, by preponderant evidence: (1) a medical theory causally connecting the vaccine and his injury ("*Althen* prong one"); (2) a logical sequence of cause and effect showing

that the vaccine was the reason for his injury ("*Althen* prong two"); and (3) a showing of a proximate temporal relationship between the vaccine and his injury ("*Althen* prong three"). § 13(a)(1); *Althen v. Sec'y of Health & Hum. Servs.*, 418 F.3d 1274, 1278 (Fed. Cir. 2005).

The causation theory must relate to the injury alleged. The petitioner must provide a sound and reliable medical or scientific explanation that pertains specifically to this case, although the explanation need only be "legally probable, not medically or scientifically certain." *Knudsen v. Sec'y of Health & Hum. Servs*., 35 F.3d 543, 548-49 (Fed. Cir. 1994). The Federal Circuit has reiterated that proof of causation does not "require identification and proof of specific biological mechanisms[.]" *Kottenstette v. Sec'y of Health & Hum. Servs.*, 861 F.App'x 433, 441 (Fed. Cir. 2021) (citing *Knudsen*, 35 F.3d at 549). Causation "can be found in vaccine cases…without detailed medical and scientific exposition of the biological mechanisms." *Knudsen*, 35 F.3d 543 at 548-49. It is not necessary for a petitioner to point to conclusive evidence in the medical literature linking a vaccine to the petitioner's injury, as long as the petitioner can show by a preponderance of evidence that there is a causal relationship between the vaccine and the injury, whatever the details of the mechanism may be. *Moberly*, 592 F.3d at 1325.

Petitioner cannot establish entitlement to compensation based solely on his assertions, rather, a vaccine claim must be supported either by medical records or by the opinion of a medical doctor. § 13(a)(1). In determining whether petitioner is entitled to compensation, the special master shall consider all material in the record, including "any…conclusion, [or] medical judgment…which is contained in the record regarding…causation." § 13(b)(1)(A). The undersigned must weigh the submitted evidence and the testimony of the parties' proffered experts and rule in petitioner's favor when the evidence weighs in his favor. *See Moberly*, 592 F.3d at 1325-26 ("Finders of fact are entitled—indeed, expected—to make determinations as to the reliability of the evidence presented to them and, if appropriate, as to the credibility of the persons presenting that evidence."); *Althen*, 418 F.3d at 1280 (noting that "close calls" are resolved in petitioner's favor).

The Federal Circuit in *Althen* held that the preponderance standard permits the use of circumstantial evidence and to do otherwise would negate the system created by Congress, in which close calls regarding causation are resolved in favor of injured claimants. *See Knudsen*, 35 F.3d at 549 (explaining that "to require

identification and proof of specific biological mechanisms would be inconsistent with the purpose and nature of the vaccine compensation program").

While this case involves the possible link between a tetanus toxoid-containing vaccine and a CNS injury, "*a sequence hitherto unproven in medicine,"* the purpose of the Vaccine Act's preponderance standard is to allow the finding of causation in a field "*bereft of complete and direct proof*" of how vaccines affect the human body. *Althen*, 418 F.3d at 1280 (emphasis added). Accordingly, the first *Althen* prong may be satisfied without resort to medical literature, epidemiological studies, demonstration of specific mechanisms or a "generally accepted" medical theory. *Andreu*, 569 F3d at 1378-79. Special Masters, despite their expertise, are not empowered by statute to conclusively resolve what are essentially thorny scientific and medical questions, and thus scientific evidence offered to establish *Althen* prong one is viewed "not from the lens of the laboratorian, but instead from the vantage point of the Vaccine Act's preponderance of the evidence standard." *Althen*, 418 F.3d at 1380. Accordingly, Special Masters must take care not to increase the burden placed on petitioners in offering a scientific theory linking the vaccine to the injury. *Contreras v. Sec'y of Health & Hum, Servs.*, 121 F.Cl 230, 245 (2015).

In Vaccine Program cases, expert testimony may be evaluated according to the factors for analyzing scientific reliability set forth in *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 594-96 (1993); *see also Cedillo v. Sec'y of Health & Hum. Servs.*, 617 F.3d 1325, 1339 (Fed. Cir. 2010) (citing *Terran v. Sec'y of Health & Hum. Servs.*, 195 F.3d 1302, 1316 (Fed. Cir. 1999)). In Vaccine Program cases, the *Daubert* analysis has been used in weighing scientific evidence proffered and heard rather than as a tool for the pre-trial exclusion of expert testimony. *Davis v. Sec'y of Health & Hum. Servs*., 94 Fed. Cl. 53, 66–67 (2010) ("uniquely in this Circuit, the *Daubert* factors have been employed also as an acceptable evidentiary-gauging tool with respect to persuasiveness of expert testimony already admitted"), *aff'd*, 420 F.App'x 923 (Fed. Cir. 2011). The flexible use of the *Daubert* factors to determine the persuasiveness and/or reliability of expert testimony in Vaccine Program cases has routinely been upheld. *See, e.g.*, *Snyder v. Sec'y of Health & Hum. Servs.*, 88 Fed. Cl. 706, 742–45 (2009).

Where both sides offer expert testimony, a special master's decision may be "based on the credibility of the experts and the relative persuasiveness of their

competing theories." *Broekelschen v. Sec'y of Health & Hum. Servs.*, 618 F.3d 1339, 1347 (Fed. Cir. 2010) (citing *Lampe v. Sec'y of Health & Hum. Servs.*, 219 F.3d 1357, 1362 (Fed. Cir. 2000)). However, nothing requires the acceptance of an expert's conclusion "connected to existing data only by the *ipse dixit* of the expert," especially if "there is simply too great an analytical gap between the data and the opinion proffered." *Snyder*, 88 Fed. Cl. at 743 (quoting *Gen. Elec. Co. v. Joiner*, 522 U.S. 146 (1997)). Weighing the relative persuasiveness of competing expert testimony, based on a particular expert's credibility, is part of the overall reliability analysis to which special masters must subject expert testimony in Vaccine Program cases. *Moberly*, 592 F.3d at 1325–26 ("[a]ssessments as to the reliability of expert testimony often turn on credibility determinations"); *see also Porter v. Sec'y of Health & Hum. Servs.*, 663 F.3d 1242, 1250 (Fed. Cir. 2011) ("this court has unambiguously explained that special masters are expected to consider the credibility of expert witnesses in evaluating petitions for compensation under the Vaccine Act").

Close calls regarding causation must be resolved in favor of the petitioner. *Althen*, 418 F.3d at 1280 (holding that Congress created a system in which "close calls regarding causation are resolved in favor of injured claimants"); *Knudsen*, 35 F.3d at 551 ("If the evidence (on alternative cause) is seen in equipoise, then the government has failed in its burden of persuasion and compensation must be awarded.").

IV. Analysis

A. NDPH as a Defined and Recognized Injury

Before considering vaccine causation, petitioner must first "make a showing of at least one defined and recognized injury" and must show more than "merely a list of symptoms or manifestations of an unknown injury." *See Lombardi v. Sec'y of Health & Human Servs.*, 656 F.3d 1343, 1352 (Fed. Cir. 2011) (holding that "identification of a petitioner's injury is a prerequisite to an *Althen* analysis of causation."); § 300aa – 11(c)(1)(C)(ii)(I) (requiring a showing that petitioner "sustained . . . any illness disability, injury or condition . . .which was caused by a vaccine…"). To satisfy this standard, petitioner must show that he suffered from "any medically recognized injury." *Lanetski v. Sec'y of Health & Human Servs.*, 696 Fed.Appx. 497, 504 (Fed. Cir. 2017) (upholding the special master's decision that petitioner failed to prove an injury because she did not show by a

preponderance of the evidence that she suffered from any medically recognized injury) (internal quotations omitted). In other words, there must be "medical recognition of the injury claimed." *See Broekelschen*, 618 F.3d at 1349.

NDPH is a relatively newly recognized disease entity, first recognized in 1986 and added to the second iteration of the International Classification of Headache Disorders in 2004. Pet'r Ex. 28 at 1. It has continued to be recognized as a separate category of headache in the ICDH-3. Petitioner's experts, Drs. Kinsbourne and Akbari, filed not less than eight articles discussing the history, pathophysiology, etiology, and diagnostic criteria for NDPH. The articles and the International Classification described a syndrome in which the onset of the headache is clearly remembered, the headache becomes constant from the outset, though some present with a thunderclap headache and others with a headache that progresses to a plateau over days to weeks. About half of the patients cannot recall a trigger and most of the remainder identify a prior viral illness, a stressful life event or surgery. A prior viral illness was described by between 10% and 30% of patients in different studies. The headaches must last for more than three months to qualify as NDPH and the studies also describe one category of NDPH, which resolves over time, and another, which persists and is refractory to essentially all forms of treatment.

In this case, respondent contends, based on Dr. Jamieson's opinion, that petitioner has failed to show by preponderant evidence that NDPH is a "defined and recognized injury." *See* Resp't Post-Hearing Brief at 11 (ECF No. 94). Respondent argues that, while he "does not take issue with the characterization of petitioner's diagnosis as NDPH, the diagnosis is solely descriptive of symptomatology when a patient does not meet the criteria for a more concrete diagnosis." Respondent asserts that NDPH is a diagnosis of exclusion and is not a disease of known pathophysiology or etiology. *Id.* at 11-12

Respondent likened NDPH to the condition in *Lanetski* and argued that "it is not scientifically sound to apply a proffered causation theory to symptomatology of an etiologically unknown disease." Resp't Post Hearing Brief at 12. *Lanetski*, however, is factually distinct from the instant case. In *Lanetski*, the petitioner merely alleged that the HPV vaccine she received caused sensory dysesthesias, an idiosyncratic severe reaction to vaccination.

Nearly every article submitted by petitioner concerning NDPH lists specific diagnostic criteria, all of which petitioner meets. Dr. Jamieson argued that because the diagnosis cannot be made until three months from onset has passed, that

patients do not remember the onset or prior conditions. However, that is certainly not the case with petitioner, who clearly recalls the date of onset, the fact that he received two vaccines three days prior, and that the headache became persistent and refractory to treatment from its onset. He also meets the test of a diagnosis of exclusion, as he has been evaluated by numerous physicians, and no alternative disease or explanation for his headaches has been made—including by respondent's experts.

Moreover, NDPH is undoubtedly recognized in the medical community. Despite Dr. Jamieson's argument that NDPH is not a "disease entity" per se, she nevertheless agreed that the term is appropriate to describe petitioner's condition. Moreover, petitioner's treating providers, Drs. Ready and Bartel, diagnosed petitioner with NDPH.

There is no question in my mind that petitioner has shown that he suffers from a refractory headache condition, whether it be a disease or a syndrome that is well-described in the literature. It has been listed In the International Classification of Headache Disorders as a distinct entity since 2004. The diagnostic criteria listed therein he certainly meets.

Accordingly, I have concluded that petitioner has demonstrated that he suffers from a distinct condition that is described in the medical literature and is sufficiently defined as a recognized diagnostic entity, even if it is not well understood by the medical community.

B. Causation

Petitioner claims an off-Table injury, alleging that the flu and/or TDaP vaccines caused his NDPH. Therefore, petitioner must prove that one or both of the vaccines he received caused his injury by establishing through preponderant evidence: (1) a medical theory causally connecting the vaccine and his injury ("*Althen* prong one"); (2) a logical sequence of cause and effect showing that the vaccine was the reason for his injury ("*Althen* prong two"); and (3) a showing of a proximate temporal relationship between the vaccine and his injury ("*Althen* prong three"). § 13(a)(1); *Althen*, 418 F.3d at 1278.

1. Althen *Prong One*

Under *Althen* prong one, petitioner must provide a "reputable medical theory," demonstrating that the vaccine received can cause the type of injury alleged. *Pafford*, 451 F.3d at 1355-56. Such theory must only be "legally probable, not medically or scientifically certain." *Knudsen*, 35 F.3d at 548-49. Petitioner may satisfy the first *Althen* prong without resort to medical literature, epidemiological studies, demonstration of a specific mechanism, or a generally accepted medical theory. *See Andreu v. Sec'y of Health & Hum. Servs.*, 569 F.3d 1367, 1378-79 (Fed. Cir. 2009) (citing *Capizzano*, 440 F.3d at 1325-26). However, a "petitioner must provide a 'reputable medical or scientific explanation' for [his] theory." *Boatmon v. Sec'y of Health and Hum. Servs.*, 941 F.3d 1351, 1359 (Fed. Cir. 2019) (quoting *Moberly*, 592 F.3d at 1322). While the theory need not be medically or scientifically certain, "it must still be 'sound and reliable'" *Id.* (quoting *Knudsen*, 35 F.3d at 548-49). The petitioner must provide a sound and reliable medical or scientific explanation that pertains specifically to this case, although the explanation need only be "legally probable, not medically or scientifically certain." *Knudsen*, 35 F.3d at 548-49. In *Kottenstette*, the Federal Circuit reiterated that proof of causation does not "require identification and proof of specific biological mechanisms[.]" 861 F.App'x at 441 (citing *Knudsen*, 35 F.3d at 549). Causation "can be found in vaccine cases…without detailed medical and scientific exposition of the biological mechanisms." *Knudsen*, 35 F.3d at 548-49.

In this case the petitioner filed numerous medical records and testified at the hearing. He has shown that he was a healthy 53-year-old man at the time he received the flu and TDaP vaccines at the same time. He did not have any infections or serious health issues in the time before he was vaccinated, and in fact, he had not been to his doctor for nearly six years. He was vaccinated at Sam's Pharmacy primarily because his daughter was pregnant and was due in November 2015. Her gynecologist told her that anyone who was going to be around the baby in the first six months would have to have received these vaccinations. Tr. at 17. He had received childhood vaccines without problem, he recalled, because they had to get a lot of shots when his father, who was in the Air Force, was transferred to Japan and they were moving there. Tr. at 17.

He and his wife had sold their business in June of 2015, and he said they were now free without the demands of running a pizza business in which they were used to working seven days a week. Tr. at 11. He said it was an exciting time in their lives, and he was happy that they were able to get 12 hours of sleep and wake up late, as he did on October 3, 2015. Thus, the evidence shows that he had not suffered from a recent viral illness, he was not reacting to a recent stressful event,

and he had not had surgery, leaving the vaccines received three days prior as the only potential trigger.

Dr. Kinsbourne testified that he met the criteria for NDPH, as explained above. *Supra* § II(C)(1)(i). He noted, in reading the literature, that a significant minority of people who were diagnosed with NDPH and who participated in various studies described in the literature had had a prior infection or virus prior to onset. Conversely, Dr. Jamieson contended that it was only a very small minority of NDPH patients who can identify a premonitory event. Tr. at 202. A review of the papers submitted, including *Rozen & Swidan*, *Yamani & Olesen*, *Evans & Turner*, and *Riddle & Smith*, with minor variation, makes clear that, in the patient populations of NDPH sufferers of their studies, about half could not remember a premonitory event, but between 10% and 30% identified a prior infection. A stressful life event and surgery were also mentioned in significant numbers, but usually less than infection.

Dr. Kinsbourne noted that in all the articles on NDPH that he reviewed, infection was mentioned, but not a single case of a current or active infection was mentioned. This observation led him to opine that, most likely, NDPH was a post-infectious autoimmune disorder, and, in at least a category of NDPH cases, the autoimmune response was not controlled. Tr. at 70-71. As vaccines are designed to stimulate immune response to wild pathogens, he theorized that it was likely that the immune response to the two vaccines, by stimulating the intended immune response "for rare reasons," got out of control and set up a chronic inflammatory disorder, causing petitioner's headaches. Tr. at 70.

He recognized that NDPH headaches have been described as having a closer resemblance to tension headaches in some people and more similarity to migraines in others. In this case, Dr. Kinsbourne concluded that petitioner's headaches were more similar to tension headaches, even though he had some migrainous symptoms such as photophobia. He referred to petitioner's descriptive testimony about the way the headache began, which he described as being like someone hitting him in the back of the head, and then he felt the pain in the neck and occipital area, which rapidly went up to the vertex and over his entire head, like someone was pulling his skin over the top of his head, and squeezing around his head. He had inward and outward pressure. Tr. at 19. Dr. Kinsbourne indicated that this description very much resembled a tension type headache. Tr. at 66-67.

Dr. Kinsbourne noted the focus on TNFα in the literature on NDPH as well as in migraine. He observed that the vaccines, particularly the flu vaccine in his

view, were designed to and did produce an inflammatory response activating innate immune cells and, in particular, the inflammasome pathways, which together produced inflammatory cytokines. In normal circumstances, the immune response to the vaccines would also produce regulatory cells. He explained that the inflammatory cytokines generated by the response to the vaccines likely triggered an inflammatory state in the meninges or in the trigeminal nerve which supplies sensory innervation to the meninges within the cranial vault. Dr. Kinsbourne explained that the sensory nerve endings within the cranium are in the meninges as opposed to in the interior of the brain which does not have pain nerve endings within it. Tr. at 104. He opined that a tension headache is a disorder in the meninges, which wraps around the brain. It is called a sensitization of sensory nerve endings that supply the meninges and cause pain. Tr. at 100. He observed that in *Rozen & Swidan*'s study of NDPH and migraine patients nearly all had elevated TNFα and a significant number of the NDPH patients had elevated TNFα in the CSF more than two years after the onset of the headache.

Thus, it appeared that the inflammation became self-sustaining likely caused, at least in part, by TNFα that was not controlled by the regulatory system. The inflammatory cytokines continued to generate inflammation for years as evidenced by the continued presence of the cytokines years after onset in the studies, in particular in *Rozen & Swidan*. Tr. at 99. He also opined that the timing between the vaccinations and the onset of the headache in this case was appropriate as these innate processes would have been active within the time period between the vaccinations and the onset of pain.

Dr. Kinsbourne theorized that there are likely several subsets of NDPH based on the triggering events. In the case of infection as a prodrome, if there is no active infection at the onset of the headache, the alternative is that the infection or—as in this case—vaccines caused an abnormal or excessive immune response that was not controlled, which he opined is the case with petitioner. Tr. at 95.

2. Dr. Omid Akbari

The petitioner also presented extensive testimony from immunologist Omid Akbari. While Dr. Akbari demonstrated considerable knowledge about immunology, his presentation was often disorganized and difficult to follow. This may have been in part caused by counsel's pressing him to assert a significant causal role for molecular mimicry at the outset in this case, when after considerable review of the testimony, I have concluded that it was not likely to

have been a factor in initiating the inflammatory response to the vaccines, which gave rise to NDPH three days after vaccination.

As is true for many cases in the Vaccine Program, the pathogenesis of NDPH is not well understood. However, the Federal Circuit in *Knudsen* and *Althen*, supra, has held that the petitioner may prevail by demonstrating with circumstantial evidence a sound and reliable theory to explain how the vaccine could cause the harm and logically that it did even though the body of generally accepted medical knowledge has not come to that understanding as yet. To support his multi-step theory Dr. Akbari filed approximately 160 exhibits in support of his testimony, some of which were helpful and others tangential and having the effect of reducing the focus of his testimony.

However, when carefully reviewed, Dr. Akbari's theory had essentially six parts. First, the vaccines stimulated a significant response from the innate immune system, as they are intended to do. Second, petitioner's genetic makeup likely made him susceptible to an aberrant response. Third, by presenting antigen and adjuvant together, the vaccines activated the inflammasome, in particular the Nalp3 inflammasome, which is necessary for the vaccines to generate a strong response. Fourth, the inflammatory cytokines generated by the inflammasome and other innate cells caused the nervous system to secrete neuropeptides, probably in particular CGRP, which triggered the release of more inflammatory cytokines causing and increasing inflammation. Fifth, after several days the adaptive immune response became active in response to signaling from the innate cells, which helped to sustain the immune response. Sixth, and likely very importantly, petitioner's regulatory system failed to control the immune response to the vaccine, allowing the effector arm to remain active and uncontrolled, causing sustained inflammation and the new daily persistent headaches.

Petitioner, who likely had some genetic susceptibility to a dysregulated immune response, was healthy and had no other explanatory condition when he received the flu and TDaP vaccines on September 30, 2015. TDaP contained the alum adjuvant intended to enhance the immune response to the vaccine and activate the inflammasome. *See Eisenbarth et al.*, supra. The flu vaccine, which did not have an adjuvant, was given at the same time. Dr. Akbari argued that, when given together, the two vaccines can potentiate each other. Tr. at 149. As intended, the vaccines stimulated an innate immune response within the first day or two after injection. They stimulated the inflammasome which Dr. Akbari testified was critical to the effectiveness of the vaccines, with which proposition Dr. Saxon agreed. Tr. at 257. Dr. Akbari testified that these vaccines stimulate the immune

system to produce multiple cytokines including Il-1 and TNFα, which appears to be important in the cause of headaches. *Rozen & Swidan* focused on TNFα, as did other studies on headaches, whether they be NDPH or the more common migraine. *See* Pet'r Ex. 26. He said that when they have done GWAS in his lab, one of the main components that always comes up in association with headaches is TNFα. He opined that this suggested a genetic susceptibility to headaches either by stimulating excess TNFα in response to stimuli or the inability to control it. Tr. at 123.

This testimony was consistent with the findings in the *Rozen & Swidan* study. Dr. Saxon criticized the study because the lab in Utah to which the CSF and serum samples were sent did not do enough, in his view, to establish a TNFα normal baseline in CSF particular to their lab. The journal that had published the original study eight years before, published Dr. Saxon's letter and a response from Dr. Rozen. Resp't Ex. D, Tab 13. The lab had apparently considered that the TNFα norms for CSF could be established by establishing it from the same serum samples. Dr. Saxon contended that Dr. Rozen could not say that the TNF in the CSF was elevated without having conducted a norming study for TNF for that lab. While there may be legitimacy to that criticism, it may be more important that the TNFα levels in the CSF were higher than those in the serum in both NDPH and migraine patients.

Dr. Saxon also argued, producing the article, *Sachelli et al.*,[18] that the elevated levels of TNFα resulted from the headache rather than caused it. In that study of migraine patients, the highest TNF levels were found in the first hours after onset in migraine patients who were tested when they arrived at the emergency room and had samples taken at different intervals after they arrived. Obviously, it would be difficult to sample patients before the migraine began as there would be no way to tell when that was going to happen. So, it does appear that *Sachelli et al.* did confirm the presence of TNF in migraine patients after their arrival at the hospital, but it is not known if the TNF had arisen prior to the beginning of the symptoms or if it played a role in triggering the headaches or resulted from the headache as Dr. Saxon contended.

Regardless of that dispute, there can be little doubt that the vaccines stimulate an innate immune response and stimulate the activation of the inflammasome, likely within one or two days. Dr. Akbari testified that once the

[18] P. Sachelli et al., *Proinflammatory Cytokines, Adhesion Molecules, and Lymphocyte Intergrin Expression in the Internal Jugular Blood of Migraine Patients without Aura Assessed Ictally*, 46 Headache 200 (Feb. 2006).

innate process was activated and inflammation begun, neuropeptides, which are cells within the nervous system that respond to the inflammatory stimulus, become active. He testified that sometimes the neuropeptides, of which there are about 100, will signal to control the inflammation but in others they enhance it. Tr. at 140. He discussed CGRP which has been recognized as a neuropeptide that appears to be active in stimulating headaches, such that the FDA has approved an antibody to the CGRP receptor as a treatment for headaches, in particular migraines. *Id*.

The innate immune system also signals to the adaptive system to become active, which occurs most likely after several days. The adaptive system in response to the signaling of the cytokines releases CD4 and CD8 T-cells and causes the production of antibodies. The T cells and antibodies continue the response to the vaccine antigens, as they are intended to do, emitting inflammatory cytokines as well, and perhaps, attacking damaged tissue within the trigeminal nerve or the meninges. Dr. Akbari testified that the adaptive immune response would help to sustain the headache and enable it to become chronic. He suggested that molecular mimicry could play a role at this stage in promoting antibodies and T cells to attack self-cells in the meninges but it would seem that the role of the adaptive system may be better explained by its role in generating more inflammation and/or by attacking cells that were damaged by the initial immune response, particularly in the setting of a failing T regulatory system.

The final element of Dr. Akbari's theory may be the most important in the regulatory system. He explained that when the innate and adaptive immune systems are stimulated to attack a foreign antigen or damaged tissue the effector cells of the innate system and the T helper cells would rise in response to the invading antigens whether they be from a wild virus, bacteria or a vaccine. He testified that there is evidence that the H1N1 peptides in the vaccine are able to trigger T cells in particular and those T cells are able to cause injury in the nervous system. Tr. at 117. Dr. Akbari said that because the central nervous system is considered an immune privileged site with immune cells, such as macrophages in the meninges, that the effector cells can cause damage if uncontrolled. Tr. at 119.

In animal models researching neuropathology, findings frequently demonstrate that the pro-inflammatory cells, whether they be macrophages, other T cells, or mast cells, dominate the regulatory pathways and cause pathology. Tr. at 120. Scientists rely on animal models for this type of examination because they cannot take samples from the brain in humans. But he said that he thinks that all scientists agree that for a chronic autoimmunity, the T effectors are increased significantly. *Id*.

In the normal scenario the effector and regulatory cells begin in balance, and the effector cells go up when stimulated by a pathogen or vaccine. But after several days, the T regulatory system should begin to produce T regulatory cells to bring the response in the affected tissue back into balance and prevent the immune system from attacking the host. Tr. at 123. He explained that it is not critical whether the T effector cells were high or low in a given patient. The key consideration is that they come back into balance. Tr. at 121. He testified that prior to the vaccination, the ratio was equal and tightly controlled. After the vaccination, the T effector cells went up. After several days, the T regs go up to bring the levels back into balance. Tr. at 121. Conversely, in some individuals, the regulatory system fails to control the effectors, and autoimmune disease occurs. Dr. Akbari testified that in certain individuals the T regs cannot compensate and the effector cells will remain high and cause chronic inflammation. Tr. at 122

He opined that, in this case, it is likely that petitioner, through some level of genetic susceptibility, has an immune system that is capable of providing a strong immune response, but is not able to bring the effector and regulatory levels back into homeostasis. This has given rise to a continual inflammatory state and his chronic headaches. While the prolonged nature of his condition and disability is a function of the failure of his T reg system to bring the immune response to the vaccines back down, the step-by-step explanation for how his NDPH was initiated by his immune system response to the vaccines appears to be a sound and reliable theory to explain vaccine causation.

Dr. Jamieson, a neurologist with expertise in headaches, disputed the petitioner's theory. She argued that NDPH is just a collection of symptoms that cause chronic headache pain without a defined pathophysiology. She did acknowledge that there may be a subset of NDPH that involves an autoimmune response but that has not yet been discovered. She discounted the importance of CGRP, which she said is just evidence of cross talk among immune cells.

Dr. Saxon agreed with her that he does not believe that petitioner has a provable autoimmune condition. He said that he bases his opinion on mechanistic, immunological, and epidemiolocal data that vaccines, such as those given to the petitioner, do not *generally* lead to systemic inflammation or systemic changes in immune mediators such as TNFα. He also argued against an autoimmune inflammatory response because the petitioner did not have evidence of a local reaction at the vaccine site. He said that the immune system, in the absence of some underlying autoimmune disease of the CNS, is not *generally* accepted by

immunologists as being the direct or primary cause of chronic headaches such as NDPH. He also said there is not a *generally* accepted hypothesis for an autoimmune cause of chronic headache.

He was shown the abstract the article, *Ramachandran*,[19] Pet'r Ex. 158, and he replied that the author was not talking about *classic* inflammation and were carving out a new definition. Tr. at 301-02. However, upon review of the entire article, that does not appear to be the case. The author wrote, "recent work has provided convincing evidence that afferent evoked activation of neuroaxial neurons is robustly enhanced by neuroimmune and neuroglial interactions and these systems may play a role in persistent pain states." As mentioned above, enhanced expressions of IL-1β and TNFα in the CSF, and cascades in migraine pain, and the causative role of mast cells, are well-appreciated. *Id*. at 8.

While there is no doubt that the administration of these vaccines does not *generally* result in autoimmune disease or lead to systemic inflammation or to inflammation in the meninges, it is not the petitioner's burden to show a *general outcome or general acceptance of a theory.* Certainly, NDPH is also a condition, such as that described by the petitioner in *Althen*, that is not well understood. It is rare, relatively newly defined, and inadequately studied to date. The theory presented by petitioner is one that is proposed in a field "bereft of complete and direct proof of how vaccines affect the human body," *Knudsen*, *Althen*. But, as the Federal Circuit has made plain in similar cases, petitioner is not required to show specific proof, or epidemiology. He must show a sound and reliable theory of causation. After evaluating all the evidence and recognizing that there is much to be learned by the medical profession about NDPH and other chronic headache disorders, I have concluded that the petitioner has provided a sound and reliable theory to explain how the vaccines in conjunction with his own genetic susceptibility and failure of his regulatory system could have caused his injury. As such petitioner has satisfied prong one.

3. Althen *Prong Two*

To satisfy *Althen* prong two, petitioner must show, by a preponderance of the evidence, that there was a "logical sequence of cause and effect showing that the vaccine was the reason for the injury." *Capizzano*, 440 F.3d at 1324 (quoting *Althen*, 418 F.3d at 1278). "Petitioner must show that the vaccine was the but for

[19] R. Ramachandran, *Neurogenic Inflammation and Its Role in Migraines*, 40 Seminars in Immunopathol. 301 (Mar. 2018).

cause of the harm…or in other words, that the vaccine was the 'reason for the injury.'" *Pafford*, 451 F.3d at 1356. In evaluating whether this prong is satisfied, the opinion and views of treating physicians are entitled to some weight. *Andreu*, 569 F.3d at 1367; *Capizzano*, 440 F.3d at 1326. Medical records and medical testimony are favored in vaccine cases, as treating physicians are likely to be in the best position to determine whether there is a logical sequence of cause and effect. *Althen*, 418 F.3d at 1280; *see also Capizzano*, 440 F.3d at 1326. The petitioner need not make a specific type of evidentiary showing, *i.e.*, "epidemiologic studies, rechallenge, the presence of pathological markers, genetic predisposition, or general acceptance in the medical community to establish a logical sequence of cause and effect." *Capizzano*, 440 F.3d at 1325. Petitioner may satisfy his burden by presenting circumstantial evidence and reliable medical opinions. *Id.*

The fact that petitioner has satisfied *Althen* prongs one and three (as will be discussed below, *infra* § IV(B)(4)) is significant to the *Althen* prong two analysis. *See Capizzano*, 440 F.3d at 1326. Both of petitioner's experts opined that there was a logical sequence of cause and effect between petitioner's vaccination and the development of NDPH.

Petitioner's medical records likewise support a logical sequence of cause and effect between the vaccination he received and his NDPH. The petitioner sought treatment from multiple providers for his refractory headache condition. Dr. Ready, who is a headache specialist, recorded in his notes that he agreed that it was likely that the vaccines caused the petitioner's NDPH. His treating neurologist, Dr. Bartel, did as well. The treating physicians' opinions are entitled to some weight in the Vaccine Program. This is particularly true when they are well supported by the expert testimony offered at trial as they were in this case. Having shown by preponderant evidence that the vaccines could cause the petitioner's injury. The fact of the headaches beginning about three days post vaccination is particularly logical when the activation of the inflammasome and other innate pathways, the first responders of the immune system, is theorized to be the cause of the injury. The combination of the activation of inflammatory cytokines in particular IL-1 and TNFα as likely generators of inflammation is also logical and consistent with an innate immune response.

The vaccine antigens likely provided the initial signal, perhaps as an irritant or pathogen associated molecular pattern recognized by the Nod-Like Receptors and by the antigen/alum stimulation of the Nalp3 inflammasome causing a massive upregulation of inflammatory cytokines. When this signaling occurs in a susceptible trigeminal ganglion, it then can stimulate the pain fibers in the ganglion

which provides sensory innervation to the dura and the blood vessels in the brain. The trigeminal ganglion is known to play a key role in the pathophysiology of migraines and other primary headaches. *See B.A. v. Sec'y of Health & Human Servs.*, No. 11-51V, 2018 WL 6985218, at 30 (Fed. Cl. Spec. Mstr. Dec. 6, 2018).

The step-by-step progression of the immune response combined with the failure of the T regulatory system to control the inflammatory response have provided a logical cause and effect explanation sufficient to satisfy prong two.

4. Althen *Prong Three*

Althen prong three requires petitioner to establish a "proximate temporal relationship" between the vaccination and the injury alleged. *Althen*, 418 F.3d at 1281. This phrase is further defined as a "medically acceptable temporal relationship." *Id.* A petitioner must offer "preponderant proof that the onset of symptoms occurred within a timeframe for which, given the medical understating of the disorder's etiology, it is medically acceptable to infer causation-in-fact." *de Bazan*, 539 F.3d at 1352. Although a temporal association alone is insufficient to establish causation, under the third prong of *Althen*, a petitioner must show that the timing of the injury fits with the causal theory. *See Althen*, 418 F.3d at 1278. A special master cannot infer causation from temporal proximity alone. *Thibaudeau v. Sec'y of Health & Hum. Servs.*, 24 Cl. Ct. 400, 403-04 (1991); *see also Grant v. Sec'y of Health & Hum. Servs.*, 956 F.2d 1144 (Fed. Cir. 1992).

In this case, onset of NDPH within three days of the receipt of two vaccines fits well and is entirely logical with the petitioner's theory that the headaches were stimulated by the innate immune response to the vaccines, which occurs within a day or two of the vaccinations. The progression from being completely healthy, to vaccinations, to a likely excessive innate inflammatory response that the petitioner's regulatory system was unable to control is entirely logical. While respondent often argues that three days, or slightly less than three days, as they do in this case, is too fast, that is not the case when the evidence shows that the triggering of the NDPH was initiated by the innate immune system, which is always faster than the adaptive response in response, is entirely logical. Petitioner has accordingly satisfied prong three.

V. Conclusion

In accordance with the above, petitioner has established by preponderant evidence that he is entitled to compensation, demonstrating that the flu and/or TDaP vaccines administered on September 30, 2015, was the cause-in-fact of his NDPH. He is entitled to compensation. A separate ruling on damages will be issued.

IT IS SO ORDERED.

s/Thomas L. Gowen
Thomas L. Gowen
Special Master