In the United States Court of Federal Claims

OFFICE OF SPECIAL MASTERS

No. 16-864V

(to be published)

I.J.	*	
	*	Filed: January 4, 2021
Petitioner,	*	
	*	
v.	*	Entitlement Decision; Transverse Myelitis; Spinal Cord Infarction; Tetanus Diphtheria acellular Pertussis; Causation; *Althen* Prong One
	*	
SECRETARY OF HEALTH AND HUMAN SERVICES,	*	
	*	
Respondent.	*	
	*	

Robert J. Krakow, Law Office of Robert Krakow, P.C., New York, NY, for Petitioner.

Catherine Stolar, U.S. Dep't of Justice, Washington, DC, for Respondent.

ENTITLEMENT DECISION[1]

I.J. filed a petition on July 21, 2016, seeking compensation under the National Vaccine Injury Compensation Program ("Vaccine Program").[2] Petition ("Pet.") at 1 (ECF No. 1). Mr. I.J. has alleged that he developed transverse myelitis ("TM") due to the Tetanus Diphtheria acellular-Pertussis ("Tdap") vaccine he received on July 22, 2013. *Id.*

An entitlement hearing was held in this matter on October 22-23, 2019. After consideration of the record and testimony provided at hearing, I deny an entitlement award in this case. As

[1] This Decision will be posted on the Court of Federal Claims' website in accordance with the E-Government Act of 2002, 44 U.S.C. § 3501 (2012). **This means that the Decision will be available to anyone with access to the internet.** As provided by 42 U.S.C. § 300aa-12(d)(4)(B), however, the parties may object to the Decision's inclusion of certain kinds of confidential information. Specifically, under Vaccine Rule 18(b), each party has fourteen days within which to request redaction "of any information furnished by that party: (1) that is a trade secret or commercial or financial in substance and is privileged or confidential; or (2) that includes medical files or similar files, the disclosure of which would constitute a clearly unwarranted invasion of privacy." Vaccine Rule 18(b). Otherwise, the whole Decision will be available to the public in its current form. *Id*.

[2] The Vaccine Program comprises Part 2 of the National Childhood Vaccine Injury Act of 1986, 42 U.S.C. §§ 300aa-10–37 (2012) (hereinafter "Vaccine Act" or "the Act"). Individual section references hereafter shall refer to § 300aa of the Act.

discussed in more detail below, Petitioner *has* preponderantly established that he likely experienced TM, prevailing over Respondent's proposed alternative diagnosis of a spinal cord infarction. But insufficient preponderant evidence offered in this case stands for Petitioner's contention that the Tdap vaccine *can cause* TM, or that it did so in this case.

I. Factual Background

A. *Medical History Prior to Vaccination*

Prior to his vaccination in July 2013, Mr. I.J. was a healthy and active thirty-four-year-old man with no history of neurological problems or clotting disorders. Tr. at 22–24. Earlier that year, Mr. I.J. had undergone a surgical procedure to repair a torn anterior cruciate ligament ("ACL") in his left knee. Ex. 2, filed July 26, 2016 (ECF No. 8-2); Ex. 15, filed Apr. 3, 2017 (ECF No. 28-1). However (and relevant to the claim at hand), Mr. I.J.'s family history was significant for thrombophilia.[3] Ex. 2. at 18, 21, 225.

B. *Onset of Injury*

On July 22, 2013, Mr. I.J. received the Tdap vaccine. Vaccination Record, filed July 26, 2016 as Ex. 1 (ECF No. 8-1); Tr. at 7. No immediate complication or reactions were documented. *See* Ex. 1. A little over two weeks later, on August 6-7, 2013, Mr. I.J. reported feeling ill with what he believed was a minor cold, but he quickly recovered. Ex. 2 at 8. The following day (August 8, 2013), however, Mr. I.J. was reaching into the back pocket of his pants (to retrieve a Metro card needed for public transportation in New York City) when he experienced a "pinch" in his shoulder, broadening to sudden sharp pain and burning sensation in the back of his neck that ran down from both shoulders and arms into his left leg. *Id.* at 7; Tr. at 14–15. These symptoms continued to worsen, and within minutes he began to experience pain, tingling, and numbness that spread throughout his arms and legs. Ex. 2 at 7.

Mr. I.J. walked to NYU Medical Center, where he was immediately admitted to the emergency department. Tr. at 14–15. Within hours, Mr. I.J. lost the ability to use his arms and legs and began to exhibit urinary retention. *Id.* at 20. An MRI of Mr. I.J.'s cervical spine revealed increased signal "predominantly within the central gray matter of the cervicothoracic cord extending from C3 to the T1-2 level, most prominent from the C6 to the T1 level." Ex. 8B at 1, filed Jan. 4, 2019 (ECF No. 50-2). These results were deemed to be compatible with a diagnosis of TM. *Id.* at 1–2.

[3] Thrombophilia is the tendency to form blood clots. Thrombophilia, *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=49901&searchterm=thrombophilia (last visited Nov. 23, 2020); Thrombus, *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=49919&searchterm=thrombus (last visited Nov. 23, 2020).

On August 9, 2013, treating neurologist Dr. Stephen Galetta noted that Mr. I.J.'s symptoms had developed over the course of six hours. Ex. 2 at 20. He also observed that the MRI of Mr. I.J.'s cervical spine showed "high signal extending down the anterior part of the cord," and the signal intensity seemed to be concentrated in the ventral horns of the spinal cord. *Id.* Based on Mr. I.J.'s presentation and MRI results, Dr. Galetta proposed several differential diagnoses, including TM, West Nile Virus, Neuromyelitis Optica ("NMO"), and Acute Disseminated Encephalomyelitis ("ADEM"). *Id.*

From August 9 to 15, 2013 Mr. I.J. was treated with Solumedrol, intravenous immunoglobulin ("IVIG"), and plasma exchange ("PLEX"), and he underwent a series of diagnostic laboratory studies to refine his diagnosis. Ex. 2 at 183, 373–444. One such test was an antinuclear antibodies ("ANA") test, which was performed on August 9, 2013, and resulted in a positive showing (thus suggesting the possible existence of an autoimmune process).[4] *Id.* at 139. Because Mr. I.J. did not have a family history of rheumatologic disease, however, this result was only deemed suggestive of the presence of primary rheumatologic disease. *Id.* at 50. *Mycoplasma pneumoniae*[5] antibody levels were also elevated, but the significance of these findings was not immediately clear given the possibility that they were attributable to the IVIG treatment Mr. I.J. was receiving at the time. *Id.* at 167, 172. Mr. I.J. was also found to be positive for other antibodies, but treaters concluded that such results did not likely explain his condition. *Id.* at 55–56, 61, 139, 169–70, 172. Tests for Rhinovirus and enterovirus were also positive. *Id.* 2 at 49. Additionally, Thrombophilia studies revealed that Mr. I.J. had elevated Factor VIII levels and an activated partial thromboplastin time[6] of 23. *Id.* at 162, 166, 170, 392.

A repeat MRI was performed on August 17, 2013. Ex. 9F, filed Jan. 4, 2019 (ECF No. 51-1). The results of this MRI showed

[4] An ANA test is typically used to assess the presence of systemic lupus erythematosus, as well as other autoimmune diseases (e.g., mixed connective tissue disease, scleroderma, rheumatoid arthritis, Sjögren's syndrome, and polymyositis). However, because otherwise-healthy individuals also often test positive for ANA, follow-up testing is necessary to confirm the existence of an autoimmune condition. *See* K. Pagana, et al., *Mosby's: Manual of Diagnostic and Laboratory Tests* 80, 82 (6th ed. 2018) ("Mosby's").

[5] *Mycoplasma pneumoniae* is a bacterial species responsible for mild respiratory tract disease. Mycoplasma pneumoniae, *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=91174&searchterm=Mycoplasma+pneumoniae (last visited Nov. 23, 2020).

[6] Activated partial thromboplastin time ("aPTT") is the period required for clot formation in recalcified blood plasma after contact activation and the addition of platelet substitutes (e.g. brain cephalin or similar phospholipids); used to assess the intrinsic and common pathways of coagulation. Activated partial thromboplastin time, *Dorland's Medical Dictionary Online,* https://www.dorlandsonline.com/dorland/definition?id=113783 (last visited Nov. 24, 2020). A prolonged aPTT can indicate a deficiency of a number of factors, including prekallikrein, high-molecular-weight kininogen, factors XII, XI, IX, VIII, I, V and II, and fibrinogen. *Id.* The PTT (partial thromboplastin time) test is used to assess the intrinsic system and the common pathway of clot formation. *See* Mosby's at 344–45. Normal findings for aPTT are 30-40 seconds and 60-70 seconds for PTT. *Id.* at 344.

> …a long segment of T2/FLAIR hyperintensity extending from C2 to T3, largest between C4 and C7 where most of the transverse diameter of the cord is noted . . . At T2 and T3, the inferior aspect of the lesion, the T2-bright signal involves predominantly the central gray matter. Patchy enhancement is noted scattered throughout portions of the spinal cord between C4 and T1, with conspicuous enhancement of the anterior horns of the central gray matter at C4. The DWI pulse sequence reveals some small foci of restricted diffusion.

Ex. 9F at 1–2. Based on these results, Mr. I.J.'s differential diagnosis was narrowed to encompass only TM and spinal cord infarction—though the diagnosis of TM was identified as favored due to "the age of [Mr. I.J. the repeat occurrence, and the holocord[7] involvement, and the cervical location" of the lesion. *Id.* at 2.

That same day, Mr. I.J. was evaluated by an infectious disease specialist, Dr. Eddie Louie, M.D., who (mistakenly believing Mr. I.J. had received the Hepatitis B rather than Tdap vaccine) noted that a causal connection between the Hepatitis B vaccine and TM has been identified. Ex. 2 at 61. Dr. Louie dismissed the possibility that the rhinovirus played in the onset of Mr. I.J.'s condition, noting that this sort of viral infection is not associated with neuromuscular diseases in which there is damage to the anterior horn of the spinal cord. *Id.* He also observed that Petitioner's symptoms were improving with steroid and IVIG treatment. *Id.* Because there were some lingering concerns, however, that Mr. I.J.'s condition could partially be the result of mycoplasma myelitis,[8] he was started on intravenous azithromycin. *Id.* at 61, 213.

Dr. Albert Favate—a member of the hospital stroke team—provided a neurology consultation on August 19, 2013, and his assessment differed from the prior proposals that TM explained Petitioner's condition. Instead, Dr. Favate noted that "[i]n view of presentation cord signal on MRI vascular etiology-thrombosed anterior spinal artery origin with prese[r]vation of posterior collu[m]n function. [A]s possible sources are Vertebral artery thrombotic formation w/Hypercoagulable state…Note AVM may be compressed and not seen on cord MRI in initial phase of cord infarct." Ex. 2 at 62. Dr. Favate recommended that Mr. I.J. undergo a coagulopathy work-up with hematology, as well as an MRI and spinal angiogram to visualize spinal circulation. *Id.* He also recommended repeat serological testing to further refine Mr. I.J.'s diagnosis. *Id.*

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[7] Holocord presentation denotes involvement of the entire spinal cord, extending from the cervicomedullary junction to the tip of the conus. Y. Sheikh et al., *Holocord Presentation*, Radiopaedia, https://radiopaedia.org/articles/holocord-presentation?lang=us (last visited Dec. 14, 2020).

[8] Mycoplasma myelitis is a rare form of TM resulting from a *Mycoplasma pneumoniae* infection. An *M. pneumoniae* infection is an exclusionary criterion under the proposed diagnostic criteria for TM. *See, e.g.*, Transverse Myelitis Consortium Working Group, *Proposed Diagnostic Criteria and Nosology of Acute Transverse Myelitis*, 59 Neurology 499, 500 (2002), filed as Ex. 35 on July 21, 2019 (ECF No. 63-4) ("Working Group").

Following Dr. Favate's evaluation, and at his recommendation, Kenneth Hymes, M.D., a hematologist, evaluated Mr. I.J. for thrombophilia. Ex. 2 at 62–65. Dr. Hymes acknowledged that while Mr. I.J.'s first MRI was interpreted as being most consistent with TM, he also noted that a repeat MRI conducted a few days after Mr. I.J.'s admission appeared to be more consistent with a spinal cord infarction. *Id.* at 62. Mr. I.J.'s family history of lethal pulmonary emboli[9] was also quite concerning to Dr. Hymes. *Id.* at 62, 65 ("[t]he positive family history of thrombophilia is noteworthy, and a thrombophilic disorder with venous thrombosis and paradoxical embolization might explain clinical findings"). He concluded that Mr. I.J. had experienced "[a]cute onset of back pain and extremity weakness, possibly due to vascular injury to the spinal cord. A spinal artery dissection or embolic lesion might explain these symptoms." *Id.* at 65. Thus, Dr. Hymes suggested Mr. I.J. undergo thrombophilia studies. *Id.* He allowed, however, that a diagnosis of TM was still also a reasonable explanation for Petitioner's condition. *Id.*

Dr. Stephanie Sterling also provided a follow-up infectious disease consultation with Mr. I.J. on August 19, 2013. Ex. 2 at 66–68. Mr. I.J. told Dr. Sterling at this time that he had received "a bunch of vaccines" approximately two to three days prior to the onset of his condition. *Id.* at 66. Based on such (incorrect) reporting, Dr. Sterling proposed that vaccination could be related to Petitioner's subsequent development of TM. *Id.* at 68. Dr. Sterling, however, reviewed Mr. I.J.'s most recent MRI results, noting that newly-recorded abnormalities were focused predominantly in the anterior horns of the central gray matter of the spinal cord, and might therefore be more consistent with a spinal cord infarction. *Id.* at 68. She also acknowledged that Petitioner's condition was improving with steroids, IVIG, and PLEX treatments. *Id.* Dr. Sterling did agree with Dr. Louie's decision to rule out a rhinovirus infection as causal, since existing literature did not support such a relationship. *Id.* And she expressed some skepticism regarding the role mycoplasma pneumoniae might have played in Mr. I.J.'s condition, though she agreed to continue treatment with azithromycin. *Id.*

On August 20, 2013, Mr. I.J. was evaluated by yet another neurology specialist, Dr. Miguel Litao. Ex. 2 at 213. Mr. I.J. had now developed a fever, exhibited elevated white blood cell counts, and was experiencing difficulty breathing. *Id.* He was prescribed Zosyn and Vancomycin, but his azithromycin treatment was discontinued due to the low likelihood of mycoplasma infection. *Id.* at 213–14. Dr. Litao also observed that the August 17th MRI results were (in his view) most consistent with a spinal cord infarction in the anterior spinal artery area. *Id.* at 213.

Shortly thereafter, Mr. I.J. was transferred to the medical intensive care unit. Ex. 2 at 230–31. A progress note was prepared by critical care physician, Dr. Jessica Leland Taff, at the time of Mr. I.J.'s transfer. *Id.* Dr. Taff observed that Mr. I.J.'s age, holocord involvement,

[9] A pulmonary embolism is the closure of the pulmonary artery or one of its branches by an embolism. Pulmonary Embolism, *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=72763&searchterm=pulmonary+embolism (last visited Nov. 23, 2020).

and cervical location of the spinal cord lesion favored a TM diagnosis. *Id.* She also expressed a desire to obtain Mr. I.J.'s immunization history due to reports of TM following receipt of the Hepatitis B vaccine. *Id.* at 231. Dr. Taff acknowledged, however, that the restricted diffusion seen in the August 17th MRI was suggestive of a spinal cord infarction. *Id.*

At the recommendation of several treating physicians, Mr. I.J. underwent a spinal angiogram[10] on August 21, 2013. Ex. 5 at 41 (filed on compact disc); Ex. 9D at 3, filed Jan. 4, 2019 (ECF No. 50-9). The angiogram demonstrated "a lower cervical watershed corresponding to the region of maximum abnormality…on the spinal MRI." Ex. 9D at 3. The anterior spinal artery was also described as "segmentally narrowed," though it was acknowledged that this narrowing could be due to an earlier thrombotic event. *Id.* But given the extensive distribution of the lesion, passive compression or active inflammation were also considered. *Id.*

A follow-up hematology consultation provided by Dr. Hymes noted evidence of spinal artery occlusion in the angiogram, but he indicated that the results of Mr. I.J.'s thrombophilia studies could also be seen in inflammation and were not likely to have caused an aggressive thrombotic event. Ex. 9D at 76. Additionally, an echocardiogram did not reveal a right-to-left shunt—circumstances commonly associated with an increased risk of embolism. *Id.* at 75; *see also* N. Gomperts et al., *A Broken Heart: Right-to-Left Shunt in the Setting of Normal Cardiac Pressures*, 24 Can. J. Cardiology. 227, 227 (2008), filed on July 21, 2019 as Ex. 32 (ECF No. 63-1). Though he could not yet identify the etiology for his findings, and despite the caveats previously mentioned, Dr. Hymes remained confident that the most likely diagnosis was an embolic lesion. Ex. 2 at 76.

On August 23, 2013, Mr. I.J. was released from the medical intensive care unit and was transferred back to the neurology department. Ex. 2 at 245. Efforts to conclusively diagnose Mr. I.J. were summarized by Dr. Taff, who noted:

> Initial MRI C[ervical] and T[horacic] spine on 8/8 showed long segment, central increased signal [within] cervicothoracic spinal cord [without] enhancement compatible [with] transverse myelitis . . . Repeat MRI done on 8/17 showed decreased diffusion thought to be [consistent with] a spinal cord infarction within the Anterior Spinal Artery territory . . . On 8/22 he had a spinal angiograph showing a mid-cervical filling defect of the Anterior Spinal artery congruent [with] suspected spinal infarct in the cervical watershed region…Hematology was consulted for concern of pro-thrombotic state, but felt that labs were not consistent with Antiphospholipid Ab syndrome or another pro-coagulant state . . . clarify patient's immunizations at occupational health, as there are case reports of TM

[10] A spinal angiogram is a diagnostic procedure in which a contrast dye is injected into the arteries supplying the spinal cord and x-ray images are obtained in order to study blood flow to the area. NYU Langone Health, *Spinal Angiogram*, https://med.nyu.edu/radiology/about-us/subspecialties/neuro-interventional/our-services/patient-information-spinal-angiogram (last visited Dec. 14, 2020).

> following Hep[atitis] B immunization, although this appears a much less likely scenario given angio[gram] and MRI findings.

Ex. 2 at 245–47. Dr. Taff thus acknowledged that the etiology of Mr. I.J.'s condition was still unclear, and hematology specialists felt that the thrombophilia panel results were not likely to have caused such an aggressive thrombotic event—even though she overall seemed to favor infarction as the proper diagnosis. *Id.* at 248.

On August 26, 2013, Mr. I.J. was again evaluated by neurology in anticipation of his being discharged to a rehabilitation facility. Ex. 2 at 276. His active problem list at that time included TM and thrombophilia. *Id.* It was also noted that Mr. I.J. exhibited an Anterior Spinal Artery blockage at the C5 level, but it was again observed that this occlusion could be due to swelling within the spinal cord. *Id.* at 281. This conclusion was echoed the very next day during a neurology follow-up. *Id.* at 291.

Mr. I.J. was discharged from NYU Hospital on August 29, 2013, and was transferred to Rusk Rehabilitation for intensive physical therapy. Ex. 2 at 6, 13. Mr. I.J.'s discharge diagnoses included tetraplegia, spinal cord infarction, and thrombophilia, but notably *did not* include a TM diagnosis. *Id.* at 7. Dr. Foo, a neurologist, mentioned Mr. I.J.'s recent vaccinations, and he indicated that vaccination records should be obtained for further consideration. *Id.* at 8, 12. But he also observed the overall conflict in the medical record between possible diagnoses, noting as follows:

> The differential diagnosis is between spinal cord infarct and transverse myelitis. The age of the patient, the repeat occurrence, and the holocord involvement, and the cervical location favor transverse myelitis. Spinal cord infarction is suggested by the evidence of restricted diffusion in portions of the lesion, the focal gray matter T2-bright lesions noted on the current examination as well as on the prior examination, and the focal gray matter enhancement in portions of lesions.

Id. at 10.

C. *Follow-up Treatment*

For the next several months, Mr. I.J. participated in intensive inpatient rehabilitation. *See generally* Ex. 6, filed Nov. 30, 2016 (ECF No. 17-1); Ex. 11, filed on Feb. 23, 2017 (ECF No. 22-1). Mr. I.J. was later transferred to Brandywine Nursing Home where he received rehabilitation therapy for approximately six months. Ex. 11 at 3–4. On August 22, 2014, Mr. I.J. was again transferred—this time to Lindenwood Nursing facilities for continued nursing and rehabilitative care. *See* Ex. 6. His diagnosis at the time of admission was described as "spinal cord infarction vs. transverse myelitis, paraplegia, thrombophilia…." *Id.* at 380. After seven months at Lindenwood, he was discharged home on March 20, 2015. *Id.* at 380–82. At the time of his

discharge, Mr. I.J.'s diagnosis was characterized as an "unspecified spinal cord disease." *Id.* at 380. There are no records documenting medical or rehabilitative services since March 2015.

II. Witness Testimony

A. I.J.

Mr. I.J. submitted an affidavit and provided testimony at the entitlement hearing. Petitioner's affidavit, filed as Ex. 4 on July 25, 2016 (ECF No. 6-1) ("Affidavit"); Tr. at 7–40. Mr. I.J. first described his past medical history as healthy with no significant problems—having only experienced gall stones in 2006 or 2007 and an ACL tear in his left knee that required arthroscopic surgery in early 2013. Affidavit at 1–2; Tr. at 11–12.

Mr. I.J. explained that in 2013, he was offered a job as a patient advocate at NYU Medical Center, and was required to receive the Tdap vaccine as a condition of his employment. Affidavit at 2; Tr. at 13. He received the Tdap vaccine on July 22, 2013. Affidavit at 2; Tr. at 13. Approximately two weeks later, Mr. I.J. was boarding a bus when he reached into his back, right pants pocket to retrieve his bus pass and felt a sharp, burning pain that ran from the back of his neck to his right shoulder and arm. Affidavit at 2; Tr. at 14. The pain and burning sensation progressed and spread to his left shoulder and arm and down his leg, and he began to experience a tingling sensation and weakness in his limbs. Affidavit at 2; Tr. at 14–16. He reported that at one point, while walking to the hospital, he collapsed to one knee and struggled to get up. Affidavit at 3; Tr. at 17. When Mr. I.J. arrived at NYU Medical Center, he was admitted to the emergency department where he continued to experience progressive weakness, numbness, and a needle-like pain sensation that was predominantly focused in his back and extending into his left arm. Tr. at 20–21. He also experienced urinary retention that required catheterization. *Id.* at 29–30.

Shortly after his emergency department admission, Mr. I.J. underwent an MRI scan. Tr. at 24. Prior to his scan, Mr. I.J. recalled being fully mobile. *Id.* Immediately following his MRI scan, however, Mr. I.J. lost all mobility from the neck down. *Id.* at 25–27. He also exhibited urinary retention, for which he required catheterization, as well as difficulty regulating his body temperature. *Id.* at 28–30. Following treatment with IVIG and plasmapheresis, Mr. I.J. regained some mobility in his arms. *Id.* at 28.

Mr. I.J. then described his extended rehabilitation at Rusk Rehabilitation. Tr. at 31. He was eventually able to push back with his arms and support his own bodyweight with his arms. *Id.* He was then transferred to Brandywine Nursing Home for additional therapy. Affidavit at 3; Tr. at 32. He emphasized that this facility was located two hours away from his home, which made it difficult for his family to visit him regularly. Tr. at 32. Mr. I.J. described his time at Brandywine as lonely and emotionally difficult. *Id.* After approximately six months, Mr. I.J. was again transferred—this time to Lindenwood Nursing Facility. Affidavit at 3–4; Tr. at 33. He was eventually discharged home, but he continues with physical therapy at Rusk Rehabilitation and a

community access program. Tr. at 35–37. He has recovered some strength in his legs and mobility in his upper extremities, but he does not have the dexterity he possessed prior to the onset of his injury. *Id.* at 35–36.

B. *Petitioner's Experts*

1. Dr. Scott Zamvil, M.D., Ph.D.

Dr. Zamvil, a neuroimmunologist, provided testimony at the hearing and offered a single expert report. Tr. at 41–160; Report, filed as Ex. 16 on Sept. 11, 2017 (ECF No. 31-1) ("Zamvil Rep."). Dr. Zamvil opined that the Tdap vaccine can cause TM and did so in Petitioner's case.

Dr. Zamvil received his bachelor's degree in chemistry from Claremont Men's College. Dr. Zamvil Curriculum Vitae, filed as Ex. 17 on Sept. 11, 2017 (ECF No. 35-1) ("Zamvil CV") at 1. He then obtained a Ph.D. in medical microbiology along with a medical degree from Stanford Medical School. *Id.* Dr. Zamvil completed an internship in internal medicine at Pacific Presbyterian Medical Center before completing residencies in internal medicine and neurology at Stanford University Medical Center and Brigham and Women's Hospital respectively. *Id.* He is board certified in neurology. *Id.* Dr. Zamvil has served as a professor of both neurology and immunology at Harvard Medical School and the University of California, San Francisco, and he has published numerous journal articles on these subjects. *Id.* at 1, 14–21.

Some of Dr. Zamvil's research has specifically considered T cell recognition of autoantigens on myelin and central nervous system demyelination. Tr. at 43–44. He does not, however, have expertise in vascular medicine or neuroradiology. *Id.* at 108. Dr. Zamvil has clinical duties at the Multiple Sclerosis clinic at the University of California, and he often sees patients suffering from demyelinating conditions, including multiple sclerosis ("MS") and NMO, but he has only recently started seeing patients with TM when they are concurrently experiencing NMO. Tr. at 42, 48, 107. He explained, however, that TM overlaps with other demyelinating conditions with which he is more familiar. *Id.* at 42, 45, 106. Though he was not able to personally evaluate Mr. I.J. Dr. Zamvil relied on the submitted medical records—including the treating physician opinions and diagnostic test results contained therein. Tr. at 50. He did not, however, review either the MRI studies or angiogram in forming his opinion, and instead deferred to Petitioner's neuroradiology expert, Dr. Watanabe, for her interpretation of those studies. *Id.* at 109–10.

Based on the medical record and the reports contained therein, Dr. Zamvil concluded that Mr. I.J. more likely than not experienced TM. Tr. at 51, 90, 110. He supported this conclusion by noting that the initial onset of Mr. I.J.'s condition—which progressively worsened over the course of six to eight hours—was "stuttering" rather than an acute onset with near immediate maximal deficit. Tr. at 52. This, Dr. Zamvil opined, was consistent with the diagnostic criteria for TM set forth by the Transverse Myelitis Consortium Working Group. *Id.* at 60; Working Group, at 500.

Dr. Zamvil began his testimony with a discussion focused on the diagnostic criteria and pathophysiology of TM, in light of the TM Working Group criteria. Tr. at 49–50, 76–84; Working Group at 500. He described TM as an inflammatory autoimmune response within the spinal cord. Tr. at 44–45. TM may follow an infectious disease process and its pathogenesis is likely the result of specific autoantigens. *Id.* at 44–45, 123–24. In this vein, Dr. Zamvil acknowledged that TM is diagnostically distinct from other demyelinating conditions such as ADEM. *Id.* at 116. Dr. Zamvil next addressed the first inclusionary criterion outlined by the Working Group paper: the development of sensory, motor, and autonomic dysfunction. Tr. at 51, 76–78 (referencing Working Group at 500). Dr. Zamvil concluded that Mr. I.J. satisfied this criterion because the weakness and paralysis he experienced was an obvious example of motor dysfunction. Tr. at 77. Petitioner also had documented spinothalamic[11] sensory dysfunction and autonomic dysfunction resulting in urinary retention. *Id.* at 77–78.

The second criterion—bilateral signs and/or symptoms—was also satisfied in Dr. Zamvil's estimation, because Mr. I.J. exhibited sensory and motor dysfunction bilaterally. Tr. at 78. Dr. Zamvil did acknowledge that these symptoms were worse on Mr. I.J.'s right side than on his left, but noted that this diagnostic criterion did not require precisely *symmetrical* presentation, just bilateral. *Id.*; Working Group at 500. The third criterion discussed was that of a defined sensory level. *Id.* at 78–80. Based on the record alone, Dr. Zamvil was unable to conclude whether Mr. I.J.'s clinical presentation satisfied this criterion. *Id.* at 79–80. Some evidence, such as the loss of sensory perception below the level of T4, favored it, but evidence like the loss of motor function in Petitioner's arms (a level greater than T4), did not. *Id.* at 79. Thus, Dr. Zamvil admitted that additional information was required to determine if this diagnostic criterion had been established. *Id.* at 79–80. But he expressed more confidence that the criterion requiring "the exclusion of extra-axial compressive etiology by neuroimaging" was satisfied, since the MRI imaging in this case did not reveal evidence of a compressive etiology such as spinal stenosis or blood. *Id.* at 80; Working Group at 500.

Next, Dr. Zamvil addressed the criterion requiring evidence of inflammation, as established by pleocytosis[12] or elevated IgG index or Gadolinium enhancement. Tr. at 80–82. Mr. I.J.'s cerebrospinal fluid ("CSF") analysis, Dr. Zamvil admitted, was negative for pleocytosis—yet in his opinion this was an insufficient reason to rule out a TM diagnosis. *Id.* at 68, 81. According to Dr. Zamvil, only fifty-seven percent of patients experiencing TM will exhibit pleocytosis, meaning nearly half do not. *Id.* at 67, 82; P. Barreras et al., *Clinical Biomarkers Differentiate Myelitis from*

[11] The term "spinothalamic" refers to the region extending between the spinal cord and the thalamus. Spinothalamic, *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=46603&searchterm=spinothalamic (last visited Nov. 23, 2020).

[12] Pleocytosis describes an elevated white blood cell count in the cerebrospinal fluid. Pleocytosis, *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=39556&searchterm=pleocytosis (last visited Nov. 23, 2020).

Vascular and Other Causes of Myelopathy, 90 Neurology 12, 17 (2018), filed as Ex. 86 on Oct. 21, 2019 (ECF No. 98-1) ("Barreras"). Dr. Zamvil also agreed that Mr. I.J. did not demonstrate an elevate IgG index or Gadolinium enhancement on his initial August 8, 2013 MRI. Tr. at 81. However, given such a presentation, the TM Working Group diagnostic criteria recommends the performance of repeat MRI and lumbar punctures, between two to seven days following onset. Working Group at 500. In this case, the repeat MRI performed on August 17, 2013 did reveal enhancement consistent with TM, but a repeat CSF study was not performed (based on the filed medical record). Tr. at 69–70. Thus, Dr. Zamvil allowed that this criterion was not technically satisfied—though he speculated that pleocytosis would have been evident in subsequent CSF studies had they been performed. *Id.* at 69–70, 80–82.

The last inclusionary criterion to be addressed was the timeframe in which Mr. I.J. experienced progression to nadir. Tr. at 59–60, 64–66, 82–83. This factor, according to Dr. Zamvil, is the most important in differentiating between myelitis and vascular etiologies. *Id.* at 58 (citing Barreras at 12). The TM Working Group criteria indicates that a patient with TM would be expected to reach nadir no sooner than four hours after the initial onset of symptoms. Working Group at 500. Mr. I.J.'s symptoms progressed over the course of six hours, and Dr. Zamvil concluded that he did not reach nadir until somewhere between eight to nine hours after the onset of his symptoms. Tr. at 60. Thus, this time course was sufficient to meet the last inclusionary criterion. *Id.* at 82–83.

Dr. Zamvil next discussed the *exclusionary* criteria set forth in the TM Working Group paper—those factors that, if present, argue against a TM diagnosis. Tr. at 83–84. He easily concluded that Mr. I.J. did not satisfy most of the exclusionary criteria, but he ultimately deferred to Dr. Watanabe, an expert in neuroradiology, regarding the second exclusionary criterion—clear arterial distribution clinical deficit consistent with thrombosis of the anterior spinal artery. *Id.* at 83–84. Based on his own preliminary review, however, he did not find evidence of embolism or thrombosis despite the "standard" workup that was performed. *Id.* at 90.

Besides vouching for TM as the proper diagnosis, Dr. Zamvil expressed the opinion that the spinal cord infarction diagnosis included in the differential did not accurately characterize the constellation of symptoms Mr. I.J. experienced. Tr. at 55–57. Because a spinal cord infarction was a suspected cause of Mr. I.J.'s condition, he underwent a "bubble study."[13] *Id.* at 55. The results of that study showed that Mr. I.J. did not suffer from a right-to-left shunt—strong evidence contradicting the conclusion that Petitioner's injuries were vascular in nature. *Id.* at 56–57. Additionally, the prolonged, "stuttering" onset Mr. I.J. experienced was more consistent with TM than spinal cord infarction. *Id.* at 60. Mr. I.J. did not reach nadir until at least six hours after the initial onset of his first symptom. *Id.* at 57. This, according to Dr. Zamvil, would be highly

[13] A "bubble study" or a contrast echocardiography is performed most commonly to evaluate heart wall motion (a measure of heart wall function) and to detect valvular disease, evaluate the heart during stress testing, and identify and quantify pericardial fluid. Mosby's at 820.

unusual for a spinal cord infarction, which more commonly presents in an "apoplectic" manner, with patients reaching nadir within minutes of onset. *Id.* at 59–60, 64–66; Barreras at 12, 16 (finding that nearly ninety percent of study participants experiencing spinal cord infarction reached nadir in less than six hours while only four percent of participants experiencing spinal cord inflammation reached nadir within the same timeframe); Working Group at 500 (noting progression to nadir between four hours and twenty-one days following onset of symptoms is an inclusionary criterion for the diagnosis of TM). He acknowledged, however, that members of the stroke team who evaluated Mr. I.J. did characterize the onset of his symptoms as "apoplectic," and although he disagreed with this reading of the record, he acknowledged that he lacked expertise in vascular medicine. Tr. at 141–42.

Dr. Zamvil further supported his opinion by distinguishing the effects TM has on dorsal[14] spinal column function versus the impact of an anterior spinal artery infarction. Tr. at 71–72, 87–88. As he explained, infarction in the anterior[15] spinal artery (located on the front facing portion of the spinal cord) will in turn impact the anterior and lateral portions of the cord itself, thereby affecting motor function and spinothalamic perceptions while preserving dorsal column function. *Id.* at 72. As a result, a patient experiencing an anterior spinal artery infarction would exhibit problems with motor function, temperature, pain, and gross touch sensations, but would *not* experience any changes to dorsal column functions such as proprioception, vibratory sense, and fine touch perception. *Id.* Dr. Zamvil admitted that he could not definitively conclude whether Mr. I.J. retained dorsal column function because the clinical testing for these functions was either not performed or was done but not recorded. *Id*. at 72–73, 88. Instead, Dr. Zamvil relied on MRI findings indicating posterior cord involvement to exclude a spinal cord infarction diagnosis. *Id.* at 86.

Similarly, Dr. Zamvil acknowledged that Mr. I.J. was diagnosed with a "longitudinally extensive myelopathy"—a condition that he agreed is more often the result of a vascular myopathy (such as ischemic stroke) than inflammatory myopathies. Tr. at 148–49 (citing Barreras at 15). Further still, Barreras found that twenty percent of study participants were initially misdiagnosed with TM and were later found to have vascular abnormalities. Tr. at 145–46; Barreras at 15.

Dr. Zamvil did, however, stress that *other* record evidence generally supported TM as the more likely diagnosis. MRI results were consistent with TM, and treating physicians overall seemed to embrace the TM diagnosis. Tr. at 53–54. Additionally, Mr. I.J. experienced some improvement following treatment with Solumedrol, IVIG, and plasmapheresis—common

[14] The term "dorsal" refers to the back of or a position that is more towards the back surface than some other object of reference. Dorsal, *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=14794&searchterm=dorsal (last visited Nov. 23, 2020).

[15] The term "anterior" refers to the front of or more forward position of an organ. Anterior, *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=3163&searchterm=anterior (last visited on Nov. 23, 2020).

treatments for neuroinflammatory conditions[16]—though Dr. Zamvil was unable to discern the extent of that improvement. Tr. at 54. Dr. Zamvil also emphasized that in acute TM, both gray and white matter may be involved, and thus the involvement of gray matter does not preclude a TM diagnosis, further reducing the significance of MRI findings suggesting lesion involvement as encompassing both. *Id.* at 74.

Dr. Zamvil next opined on the issue of causation. He testified to two potential mechanisms by which the Tdap vaccine could theoretically cause TM: molecular mimicry and innate immune activation through adjuvant activity. Tr. at 92, 101; Zamvil Rep. at 9–12. Dr. Zamvil explained that while not all vaccines can cause TM, vaccines containing the tetanus toxoid, such as Tdap, contain protein sequences that share structural homology with those of myelin-targeting autoantigens, and have been the subject of epidemiological studies seeking to identify relationships between vaccination and neurological conditions. Tr. at 92, 112–13 (citing R. Baxter et al., *Acute Demyelinating Events Following Vaccines: A Case Centered Analysis*, 63 Clinical Infectious Diseases 1456, 1456 (2016), filed as Ex. 16 Ref. 12 on Sept. 11, 2017 (ECF No. 32-3) ("Baxter")); Zamvil Rep. at 9.

In the presence of sufficient homology, T cells and antibodies may (due to similarity between vaccine components and myelin proteins) engage in cross-reactivity against central nervous system myelin. Tr. at 92; Zamvil Rep. at 11. To ascertain if such homology existed, Dr. Zamvil conducted his own BLAST search[17] in which he reviewed the National Institutes of Health's protein sequence database, comparing protein sequences contained within the Tdap vaccine with those commonly found in human myelin. Tr. at 92; Zamvil Rep. at 10–11. He found that there was significant sequential homology between these sequences, supporting the possibility of molecular mimicry as the pathogenic impetus. Zamvil Rep. at 11. However, though he described how molecular mimicry can lead to the development of other conditions such as experimental

[16] Solumedrol is an anti-inflammatory synthetic glucocorticoid. *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=89219 (last visited Dec. 14, 2020). Plasmapheresis is a procedure in which plasma is removed from blood and is then transfused back into the body with added donor components such as frozen plasma or albumin. *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=39455&searchterm=plasmapheresis (last visited Dec. 14, 2020). IVIG therapy is used to treat immune system disorders. During an IVIG treatment, immunoglobulin (a combination of antibody proteins) is injected into the body to help the immune system fight off infections. *See Primary Immunodeficiency*: *Treatment*, Mayo Clinic, https://www mayoclinic.org/diseases-conditions/primary-immunodeficiency/diagnosis-treatment/drc-20376910 (last visited Dec. 14, 2020).

[17] Basic Local Alignment Search Tool ("BLAST") is a medical/scientific internet resource that assists researchers in finding regions of similarity between biological sequences of amino acids. The program compares nucleotide or protein sequences to sequence databases and calculates the statistical significance. BLAST, U.S. National Library of Medicine, https://blast ncbi nlm nih.gov/Blast.cgi (last visited Nov. 19, 2020). Research undertaken to identify such homology has been previously described as an "in silica" study—meaning that the research is conducted via a desktop or personal computer, and access to scientific databases, to identify the comparable amino acid sequences that is referenced to establish homology. *See, e.g.*, *Blackburn v. Sec. of Health & Hum. Servs.*, No. 10-410V, 2015 WL 425935, at *10 (Fed. Cl. Spec. Mstr. Jan. 9, 2015). This kind of research is clearly case-oriented, and is not equivalent to lab or clinical research that an expert might perform and/or rely upon for an opinion.

autoimmune encephalomyelitis and narcolepsy, Dr. Zamvil admitted that he could not identify any studies concluding that Tdap can cause TM via this proposed mechanism. Tr. at 97, 136–37, 139, 152.

To further bulwark his proposed causal theory, Dr. Zamvil offered a study in which the incidence of TM and ADEM (a different neurologic disease with a likely autoimmune etiology or mechanism) following vaccination was studied. Tr. at 113–16; Zamvil Rep. at 7 (citing Baxter at 1456). Baxter found that after nearly 64 million vaccine doses, only seven cases of TM and eight cases of ADEM were reported within 5 to 28 days post-vaccination. Baxter at 1456. While a relationship between vaccination and the development of TM could not be established, Baxter concluded that there was a statistically significant association between the Tdap vaccine and the subsequent development of ADEM. *Id.* at 1460. Dr. Zamvil opined that the causal relationship between Tdap and ADEM would be parallel to the expected relationship between Tdap and TM—Baxter's express finding pertaining to TM to the contrary. Tr. at 116.

Dr. Zamvil also relied on a series of case reports documenting instances of TM following vaccination. Tr. at 119–121; Zamvil Rep. at 7 (citing N. Agmon-Levin et al., *Transverse Myelitis and Vaccines: A Multi-Analysis*, 18 Lupus 1198, 1198–1204 (2009), filed as Ex. 16 Ref. 9 on Sept. 11, 2017 (ECF No. 31-10) ("Agmon-Levin")). Agmon-Levin highlighted forty-three case reports of TM following vaccination. Agmon-Levin at 1199. Of these, only four involved TM after receiving either the diphtheria-tetanus-pertussis vaccine or the diphtheria-tetanus vaccine. *Id.* Agmon-Levin also found that seventy-three percent of TM cases were reported within one month of vaccination, consistent with the timeframe Ms. I.J. experienced. *Id.*

Another case report cited by Dr. Zamvil documented acute transverse myelitis in a seven-month-old child following receipt of the DTaP vaccine (a slightly different formulation of the same vaccine that is administered to children). R.M.S. Riel-Romero, *Acute Transverse Myelitis in a 7-Month-Old Boy After Diphtheria-Tetanus-Pertussis Immunization*, 44 Spinal Cord 688, 688–91 (2006), filed as Ex. 16 Ref. 11 on Sept. 11, 2017 (ECF No. 32-2) ("Riel-Romero"). Though the treating physicians discussed in Riel-Romero noted several documented instances of TM following receipt of the Tdap or other diphtheria-tetanus containing vaccine, they found that the temporal association was not sufficient to establish a causal association and noted the possibility of mere coincidence. Riel-Romero at 690. In relying on case reports generally, Dr. Zamvil acknowledged the inherent limitations of such evidence, accepting that they could at bottom only show a temporal relationship between vaccination and injury rather than provide scientifically-reliable causal proof. Tr. at 120.

Regarding the timeframe in which Mr. I.J. experienced the onset of his condition, Dr. Zamvil opined that an autoimmune reaction would be expected to occur two to three weeks following vaccination. Tr. at 98–100. Mr. I.J.'s symptoms began seventeen days after receipt of the Tdap vaccine. *Id.* at 98. Thus, Dr. Zamvil concluded that the onset of Mr. I.J.'s condition was consistent with an autoimmune reaction to his Tdap vaccination. *Id.*

Dr. Zamvil also testified to the role adjuvants, such as alum, have in promoting pro-inflammatory responses. Tr. at 101. He explained that such a pro-inflammatory response may exacerbate autoimmune responses already initiated through cross-reactivity. *Id.*; S. Eisenbarth, *Crucial Role for the Nalp3 Inflammasome in the Immunostimulatory Properties of Aluminum Adjuvants*, 453 Nature 1122, 1122–25 (2008), filed as Ex. 16 Ref. 29 on Sept. 11, 2017 (ECF No. 33-10) ("Eisenbarth"). This theory proposes that the alum adjuvant stimulates proinflammatory cytokine production via the Nalp3 innate immune response system. Eisenbarth at 1122. The proinflammatory cytokines such as interleukin-1β and interleukin-18 that are produced are associated with various aspects of adaptive immunity and antibody production. *Id.* at 1125.

Lastly, Dr. Zamvil addressed whether the onset of Mr. I.J.'s symptoms seventeen days post-vaccination was medically appropriate. He explained that the Tdap vaccine Mr. I.J. received was a booster, and thus would have initiated a faster, amnestic response. Tr. at 98–100. Thus, cellular and immune responses within one or two weeks would be expected. *Id.* He did not, however, reconcile this proposed timeline (7-14 days) with Mr. I.J.'s onset *seventeen* days post-vaccination.[18]

2. Dr. Alyssa Watanabe

Dr. Watanabe, a neuroradiologist, provided testimony at the hearing and offered three expert reports. Tr. at 161–225; Report, filed as Ex. 21 on Jan. 4, 2019 (ECF No. 52-1) ("Watanabe Rep."); Supplemental Report, filed as Ex. 63 on Oct. 10, 2019 (ECF No. 85-1) ("Watanabe Supp. Rep."); Supplemental Report, filed as Ex. 89 on April 24, 2020 (ECF No. 111-1) ("Third Watanabe Rep."). Dr. Watanabe opined that Mr. I.J. more likely than not suffered from TM as a result of his Tdap vaccination. Watanabe Rep. at 22.

Dr. Watanabe received her bachelor's degree (biological sciences) from Stanford University before receiving her medical degree from the University of California, San Francisco. Curriculum Vitae of Dr. Watanabe, filed as Ex. 27 on Jan. 8, 2019 (ECF No. 53-1) ("Watanabe CV"). She completed an internship in internal medicine at Huntington Memorial Hospital before completing her residency in diagnostic radiology at the University of California, Los Angeles. *Id.* at 1. Dr. Watanabe then completed several fellowships in neuroradiology and interventional neuroradiology at the University of Washington and the University of Southern California, though she elected to withdraw from her final fellowship in order to pursue a position in private practice. *Id.*; Tr. at 203. She is board certified in radiology and has additional certifications in neuroradiology. Watanabe CV at 1. Dr. Watanabe has held several positions as an instructor and clinician in the fields of radiology and neuro imaging, although her most recent educational and clinical activity at the University of Southern California has been in a volunteer capacity. *Id.* at 2;

[18] In his report, Dr. Zamvil again relied on a comparison to ADEM (a neurological condition that he agrees is diagnostically distinguishable from TM), noting that it can occur within the proposed seventeen-day timeframe proposed by Petitioner. Zamvil Rep. at 13.

Tr. at 200–02.[19] She has also published numerous articles regarding radiology. Watanabe CV at 4–11.

Dr. Watanabe began by discussing angiography and the results of the August 8, 2013 angiogram Mr. J. underwent during his initial hospitalization. Tr. at 171. As she explained, the process of angiography includes rapidly injecting contrast dye during a CT scan in order to visualize the patient's arteries. *Id.* Though some of the literature offered by Petitioner questioned the efficacy and reliability of angiography in diagnosing ischemic events such as infarction, Dr. Watanabe opined that such tools could still be helpful when the clinical picture is unclear. *Id.* at 216–18; M. Vargas et al., *Spinal Cord Ischemia: Practical Imaging Tips, Pearls, and Pitfalls*, 36 Am. J. Neuroradiology 825, 828 (2015), filed as Ex. 24 on Jan. 4, 2019 (ECF No. 52-4). Mr. J. underwent a CT angiogram on August 8, 2013, and according to Dr. Watanabe, its results did not reveal any vascular abnormalities. Tr. at 171–72; Watanabe Rep.at 6–7. These findings thus eliminated some of the most common etiologies of spinal cord infarction from consideration. Tr. at 171–72.

Dr. Watanabe next addressed the MRI imaging results that were obtained throughout the three-week period of Mr. I.J.'s hospitalization. Tr. at 173. The first MRI image to be addressed was obtained on August 8, 2013. *Id.*; Watanabe Rep. at 7–8; Ex. 8D, filed Jan. 4, 2019 (ECF No. 50-4). In Dr. Watanabe's view, it revealed "a very long segment of abnormal signal enhancement throughout his cervical and going down into the thoracic cord," which was initially interpreted to be compatible with a diagnosis of TM. *Id.* at 173. Dr. Watanabe agreed with this interpretation, though she acknowledged that these results were also compatible with other disease processes such as stroke and polio. *Id.* at 173, 175. She also agreed that there was no evidence of enhancement in this initial MRI (which would have suggested the presence of an active inflammatory process). *Id.* at 209, 218. She later noted, however, that up to forty percent of patients experiencing TM will have no MRI findings with initial enhancement, diminishing the significance of its absence. *Id.* at 211; Watanabe Supp. Rep. at 2 (citing G. Scotti & S. Gerevini, *Diagnosis and Differential Diagnosis of Acute Transverse Myelopathy. The Role of Neuroradiological Investigations and Review of the Literature*, 22 Neurological Sci. Supp. 69, 69–73 (2001), filed as Ex. 64 on Oct. 10, 2019 (ECF No. 85-2).

The second MRI images reviewed by Dr. Watanabe were obtained on August 17, 2013. *Id.* at 177; Ex. 9B, filed Jan. 4, 2019 (ECF No. 50-7). These follow-up images revealed Gadolinium enhancement—consistent with an inflammatory process and a breakdown of the blood-brain-

[19] Dr. Watanabe's credibility was somewhat diminished during cross examination, when she revealed that she is not a listed faculty member on the University of Southern California Medical School's website despite identifying herself as a USC "Clinical Instructor" on her CV. Tr. at 201; Watanabe CV at 2. She also admitted that the work she does there is done primarily on a "volunteer" basis—a detail that was not included in either her CV or her direct testimony. Tr. at 201; Watanabe CV at 2. While these admissions somewhat undermined the probative value of Dr. Watanabe's testimony, I do not find that they established a firm basis for questioning the honesty or accuracy of her testimony or opinions, which (except for the points she attempted to make about causation) largely stemmed from her professional radiologic expertise.

barrier—that had not been present in the initial August 8th MRI. Tr. at 177–78, 193. Dr. Watanabe explained this absence from the initial MRI study as the likely result of the MRI being conducted so close in time to the onset of the disease process. *Id.* at 178. She also noted that the abnormal signal was limited to the posterior portion of the spinal cord—opposite from the location of the anterior spinal artery.[20] *Id.* at 178–79. In her view, an anterior spinal artery infarction would not affect the posterior segment of the spinal cord. *Id.* In addition, TM often features signal abnormalities distributed *throughout* both the anterior and posterior segments of the cord, in a pattern of two round bright spots known as "owl eyes" or "snake eyes," though similar features may be present after a spinal cord infarction. *Id.* at 179–80, 194–95. This abnormality establishes damage to the anterior horn cells. *Id.* at 194. In 2016, three years after the initial onset of his symptoms, follow-up MRI imaging continued to reveal this pattern of damage in Mr. I.J.'s spinal cord, further supporting TM over infarction. *Id.*; Ex. J, filed Sept. 17, 2019 (ECF No. 78-1).

The MRI imaging studies overall also revealed holocord involvement and mild diffusion restriction. Tr. at 182–84, 190; Ex. 9F at 2. As Dr. Watanabe explained, holocord involvement means that both the gray and white matter of the spinal cord are affected. Tr. at 182–83. She opined that this pattern of involvement is typical of TM. *Id.* at 181, 183–84. She also explained that diffusion restriction is a process in which the diffusion of water between cell membranes of tissue in the body becomes impaired. *Id.* at 190. Although diffusion restriction is associated with TM, it can also be seen in other conditions such as tumors, and abscesses, and she further explained that it is "one of the most distinctive findings that one would expect for a stroke." *Id.* at 190, 219; Y. Kim et al., *The Role of Diffusion-Weighted MRI in Differentiation of Ideopathic Acute Transverse Myelitis and Acute Spinal Cord Infarction*, 65 J. Kor. Soc'y Radiology 101, 101–08 (2011), filed as Ex. 25 on Jan. 4, 2019 (ECF No. 52-5).

Because mild restriction diffusion was noted in Petitioner's August 17th MRI, a spinal angiogram was ordered and was performed on August 21, 2013. Tr. at 184, 189. That angiogram, Dr. Watanabe concluded, provided no evidence of vessel cutoff,[21] with the anterior spinal artery appearing to her to be intact. *Id.* at 185. Though she acknowledged treater documentation of a "cutoff," Dr. Watanabe attributed this misinterpretation to how the results of the angiogram were communicated by the treating radiologist. *Id.* at 224. Thus, notes regarding a cutoff do not support a diagnosis of spinal cord infarction, but they likely mislead treaters to that conclusion. *Id.* at 189.

Dr. Watanabe also noted that there was no evidence of a blood clot at the time the angiogram was performed, but she acknowledged the possibility that a previously existing clot

[20] Dr. Watanabe acknowledged, however, that dorsal column involvement was not documented by any of Mr. I.J.'s treating physicians, but she nonetheless maintained that her review of the MRI images revealed posterior cord involvement. *Id.* at 222–23.

[21] Dr. Watanabe used the term "cutoff" to describe an occlusion within the anterior spinal artery—something that she did not see in Mr. I.J.'s spinal angiogram. Tr. at 186–87. If an occlusion is present, the dye that is injected into the artery will abruptly stop, or "cutoff," within the vessel. *Id.* at 187.

(that could have precipitated Petitioner's symptoms) had dissolved. Tr. at 188. The absence of a clear cutoff or blood clot within the anterior spinal artery was further proof to Dr. Watanabe that a spinal cord infarction was an unlikely explanation for the radiological findings. *Id.* She did observe a narrowing of the anterior spinal artery in the angiogram, but attributed it to inflammation of the cord. *Id.* at 192. This opinion was supported by evidence of patchy enhancement—a finding consistent with inflammation—on the August 17th MRI. *Id.* at 193.

Based predominantly on the August 17th MRI imaging, Dr. Watanabe concluded that Mr. I.J. more likely than not experienced TM rather than a spinal cord infarction. Tr. at 197. Her overall impression was that the subsequent imaging did not evidence an embolism or thrombotic event. *Id.* She admitted, however that the Working Group diagnostic criteria requires that all inclusionary criteria are met while all exclusionary criteria are eliminated before a TM diagnosis can be accepted. *Id.* at 208 (citing Working Group at 500). She similarly acknowledged that Mr. I.J. did *not* strictly meet these criteria, given the absence of pleocytosis and the lack of enhancement on his initial MRI—though she argued that the MRI performed nine[22] days after the onset of his symptoms did show evidence of the required enhancement. Tr. at 209–10. To substantiate her position in light of these criteria (and Mr. I.J.'s clinical picture), Dr. Watanabe opined that clinical judgment is not bound by rigid restrictions set forth on paper. Tr. at 210. This argument was undercut by the medical record itself, however, because treating physicians did not unequivocally conclude that Mr. I.J. suffered from TM. *See, e.g.*, Ex. 2 at 7 (listing discharge diagnoses as tetraplegia, spinal cord infarction, and thrombophilia).

On rebuttal, Dr. Watanabe explained her process for reviewing MRI images, including a description of the computer program and monitors that allowed her to review the images obtained during Mr. I.J.'s initial hospitalization. Tr. at 390–91. Utilizing such technology, Dr. Watanabe observed that the majority of slides showed *posterior* cord involvement—contrary to the contentions of Respondent's expert. *Id.* at 316–18, 391–92. She again reiterated that posterior cord involvement is not consistent with the "well defined geographic distribution" seen in anterior spinal artery infarcts. *Id.* at 393. Dr. Watanabe also noted that the initial MRI performed on Mr. I.J. on August 8, 2013 (approximately eight hours after onset) was conducted with diffusion-weighted imaging ("DWI")[23], though she acknowledged that this was unusual, and she was unable to explain why DWI had been performed. *Id.* at 394, 396. According to Dr. Watanabe, that August 8th study did *not* show diffusion restriction—a characteristic that both she and Respondent's expert agreed would have been present if Mr. I.J. had in fact suffered a spinal cord infarction. *Id.* at

[22] Dr. Watanabe did concede that the Working Group diagnostic criteria require that repeat imaging studies, such as an MRI, be repeated 2-7 days following onset, and that Mr. I.J.'s second MRI was performed outside of this recommended timeframe. Tr. at 210.

[23] The DWI technique uses water movement within the body to create a diagnostic image. *See* M. Thurnher & R. Bammer, *Diffusion-Weighted MR Imaging (DWI) in Spinal Cord Ischemia*, 48 Neuroradiology 795, 799 (2006), filed as Ex. 70 on Oct. 10, 2019 (ECF No. 86-4).

394–96. These observations bulwarked Dr. Watanabe's opinion that Mr. I.J. more likely than not had experienced TM rather than a spinal cord infarction.

Dr. Watanabe's reports and testimony also touched in part on whether the Tdap vaccine can cause TM, and she offered some additional case reports to support the contention. *See, e.g.*, Tr. at 214–15, 221 (citing N. Gregg et al., *Tdap Vaccination and Acute Demyelinating Events*, 88 Neurology 1, 1–6 (2017), filed as Ex. 66 on Oct. 10, 2019 (ECF No. 85-4) ("Gregg")). However, such opinions greatly exceeded her professional expertise or knowledge, and since Dr. Zamvil was by contrast well qualified to offer testimony and opinions on these matters, I have not given the opinions she offered on this aspect of Petitioner's case much, if any, weight.

3. Dr. Mark Levin

Dr. Levin, a hematologist, provided testimony and submitted a single expert report. Tr. at 231–90; Report, filed as Ex. 39 on Aug. 22, 2019 (ECF No. 68-1) ("Levin Rep."). Following a review of the medical record and the reports filed by Drs. Zamvil, Watanabe, and Alexander, Dr. Levin concluded that Mr. I.J.'s overall hematologic condition was insufficient to support a diagnosis of spinal cord infarction. Levin Rep. at 5; Tr. at 236.

Dr. Levin received his bachelor's degree from Yeshiva University, followed by a medical degree from SUNY – Downstate Medical College. Dr. Levin Curriculum Vitae, filed as Ex. 62 on Sept. 26, 2019 (ECF No. 81-1) ("Levin CV"). He subsequently obtained his master's in business administration from Herriott-Watt University in Scotland. *Id.* at 1. After obtaining his medical degree, Dr. Levin completed his internship and residency in internal medicine at New York Downtown Hospital and Hahnemann University Medical Center. *Id.* He also completed post-doctoral training in hematology and oncology at the Long Island Jewish Hillside Hospital Medical Center. *Id.* Dr. Levin is board certified in internal medicine and oncology. *Id.* While he has previously held board certification in hematology, he has not sought recertification since 2000. *Id.*; Tr. at 232, 258. Throughout his career, Dr. Levin has served as an associate professor of medicine at several academic institutions in addition to his role as an attending clinician. Levin CV at 2. On average, Dr. Levin sees approximately 400 patients a year, and has experience in evaluating patients for stroke, though he indicated that such evaluations only happened "on occasion." Tr. at 234. Beyond his clinical duties, Dr. Levin has also published numerous journal articles and abstracts on topics within the fields of oncology and hematology. Levin CV at 6–11.

The first hematologic factor addressed by Dr. Levin was Mr. I.J.'s family history of venous thromboembolism ("VTE"), and whether it was significant in this case for diagnostic purposes. Tr. at 237–39, 263; Levin Rep. at 2–3. Dr. Levin opined that a family history of VTE alone was an insufficient basis for concluding that Mr. I.J. had an increased prothrombotic risk. Tr. at 237–38; Levin Rep. at 2. He explained that genetic risk alone is quite low—Mr. I.J.'s records did not contain any evidence for genetic risk beyond the family history notation—and environmental factors may play a large role in the development of VTE. Tr. at 237–39; Levin Rep.

at 2–3 (citing F. Couturaud et al., *Factors that Predict Thrombosis in Relatives of Patients with Venous Thromboembolism*, 124 Blood 2124, 2129 (2014), filed as Ex. 40 on Aug. 22, 2019 (ECF No. 68-2)). In addition, Dr. Levin noted that he lacked background evidence regarding the circumstances and context in which Mr. I.J.'s relatives experienced VTE, making it impossible for him to determine whether Mr. I.J. was at an increased risk for a prothrombotic condition. Levin Rep. at 3. He also clarified that in his view Mr. I.J. did not suffer from VTE or a deep vein thrombosis ("DVT"), adding that a venous clot such as VTE or DVT is "essentially the same phenomenon" as an arterial clot such as what could be seen in an anterior spinal artery infarction. Tr. at 264–45.

Dr. Levin next addressed clotting risk and its relationship to Factor VIII levels (given the findings of elevated Factor VIII levels for Mr. I.J. Tr. at 239. As he explained, Factor VIII is one of several hematologic requirements for blood clotting. *Id.* at 239–40. Factor VIII levels average at about 100—and if too low can result in hemophilia, or the inability to clot. *Id.* at 240. By contrast, when Factor VIII levels are too high, dangerous excessive clotting can occur. *Id.*

Mr. I.J. presented with an elevated Factor VIII level of 196, consistent with the risk factors associated with greater clotting like thrombosis or infarction. *Id.*; Ex. 2 at 166. While treating physicians found this clinically significant, Dr. Levin attributed this elevation to Petitioner's alleged TM (and hence consistent with the diagnosis favored in Petitioner's overall claim). As he noted, inflammation—such as that seen within the spinal cord of a patient suffering from TM—commonly leads to a secondary increase in Factor VIII. Tr. at 240–42, 282; Levin Rep. at 4. This explanation thus relies on the assumption that spinal cord inflammation would have systemic effects, but Dr. Levin did not provide any medical literature to support this supposition, and he conceded that elevated Factor VIII levels can also occur after an infarction (and hence be evidence of a propensity for the circumstances leading to infarction). Tr. at 283–84, 288–90.

The next risk factor addressed by Dr. Levin was that of obesity. Tr. at 243–44; Levin Rep. at 3. At the time of his hospital admission, Mr. I.J. had a body mass index ("BMI")[24] of 32.[25] Ex. 2 at 942. Dr. Levin explained that while a BMI over 30 meets the clinical requirement for obesity, Mr. I.J. just barely met that criterion, and this (coupled with his relatively young age) would reduce the significance of this finding. Tr. at 243–44. Thus, it was Dr. Levin's opinion that Petitioner's at worst mild obesity did not make it any more likely that he suffered from a spinal cord infarction despite acknowledging that obesity is typically associated with an increased risk of

[24] An individual's BMI is a measure of body fat that gives an indication of nutritional status. Body Mass Index, *Dorland's Medical Dictionary Online*, https://www.dorlandsonline.com/dorland/definition?id=82333 (last visited Nov. 23, 2020).

[25] In his report, Dr. Zamvil noted that Mr. I.J.'s BMI at the time of admission was 31.6. Zamvil Rep. at 3. The medical record indicates, however, that Mr. I.J.'s BMI on August 8, 2013 was actually 32. Ex. 2 at 942. The distinction between the two numbers is not large enough to give it great evidentiary significance.

stroke. *Id.* at 244, 276–78.

Dr. Levin also discussed the role marijuana use[26] may have played in Mr. I.J.'s clinical presentation. Tr. at 244–45; Levin Rep. at 3. He acknowledged that marijuana is a risk factor for a number of cardiovascular problems, but he did not find it to be significant for an increased prothrombotic risk. *Id.* at 244. His review of the relevant literature revealed only one report that described two cases of marijuana-induced VTE—a condition Mr. I.J. did not suffer from. *Id.* at 244; D. Salhan et al., *Cannabis-Induced VTE: Is it a Safe Recreational Drug?*, 150 Chest Supp. 909A, 909A (2016), filed as Ex. 41 on Aug. 22, 2019 (ECF No. 68-3) ("Salhan"). Dr. Levin acknowledged, however, that Salhan cited marijuana consumption as a risk factor for ischemic stroke. Tr. at 275–76. He concluded nonetheless that marijuana consumption did not increase the likelihood that Mr. I.J. had experienced a spinal cord infarction. *Id.* at 244–45.

Finally, Dr. Levin compared incidence rates between TM and spinal cord infarction, finding that while both conditions are relatively rare, TM is more common, occurring in 3 per 100,000 person-years,[27] while primary and secondary spinal cord infarction occurs at a rate of 1.5 and 1.6 per 100,000 person-years respectively.[28] Tr. at 242; Levin Rep. at 3–4; A. Qureshi et al., *A Population-Based Study of the Incidence of Acute Spinal Cord Infarction*, 9 J. Vascular Interventional Neurology 44, 44 (2017), filed as Ex. 43 on Aug. 22, 2019 (ECF No. 68-5); T. West et al, *Acute Transverse Myelitis: Demyelinating Inflammatory, and Infectious Myelopathies*, 32 Seminars Neurology 97, 97 (2012), filed as Ex. 44 on Aug. 22, 2019 (ECF No. 68-6). This, he seemed to suggest, further made it more likely that Mr. I.J.'s injury was TM (although opining on statistical/epidemiologic issues like illness risk exceeded Dr. Levin's expert qualifications).

C. *Respondent's Expert - Dr. David Alexander*

Dr. Alexander, a neurologist, acted as Respondent's sole expert, providing testimony at the entitlement hearing in addition to preparing three reports. Tr. at 291–389; Report, filed as Ex. A on Feb. 28, 2018 (ECF No. 41-1) ("Alexander Rep."); Supplemental Report, filed as Ex. N on Sept. 20, 2019 (ECF No. 79-1) ("Alexander Supp. Rep."); Supplemental Report, filed as Ex. O on Jan. 2, 2020 (ECF No. 107-1) ("Third Alexander Rep."). Dr. Alexander opined that Mr. I.J.

[26] Medical records from Mr. I.J.'s initial admission note marijuana use in his social history. Ex. 2 at 38, 64, 79, 312.

[27] The person years metric identifies the actual amount of time—in years—that an individual is at risk. *See* L. Alexander et al., *Calculating Person-Time*, ERIC Notebook – University of Chapel Hill Department of Epidemiology, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiSwcb1_c3tAhUlxVkKHtAhUlxVkKHWlmCsoQFj&url=https%3A%2F%2Fsph.unc.edu%2Ffiles%2F2015%2F07%2Fnciph_ERIC4.pdf&usu=AOvVaw0KRjpRECJsQZt-9DhcmkuQ (last visited Dec. 14, 2020).

[28] At hearing, Dr. Levin represented that TM occurs at a rate of three percent while spinal cord infarction occurs at a rate of 0.6 percent. Tr. at 242. This statement was likely made in error. Dr. Levin's report, however, is consistent with the literature, and accurately reflects that secondary spinal cord infarction occurred in 0.0016 percent of study participants, while TM occurred in 0.003 percent of study participants. Levin Rep. at 3–4.

more likely than not experienced an anterior spinal artery infarction, as opposed to TM, and that his condition was caused by factors other than the Tdap vaccine. Tr. at 299.

Dr. Alexander received his bachelor's degree (neuroscience) from Amherst College before obtaining his medical degree from the University of Minnesota Medical School. Updated Dr. Alexander Curriculum Vitae at 1, filed as Ex. Q on Jan. 2, 2020 (ECF No. 107-3) ("Alexander CV"). He then completed an internship in internal medicine at Boston University Medical Center followed by a residency in neurology at Columbia Presbyterian Medical Center's Neurological Institute of New York. *Id.*; Tr. at 292. Dr. Alexander is board certified in neurology with subspecialties and certifications in vascular neurology, neurorehabilitation, and spinal cord medicine. Alexander CV at 2. He has held several academic positions at the University of California, Los Angeles Medical School's department of neurology, and he has held the position of full-professor there since 2008. *Id.* at 2–3; Tr. at 292.

Dr. Alexander presently serves as the medical director and vice chief of staff for the California Rehabilitation Institute—an in-patient facility that is primarily focused on neurological rehabilitation. Alexander CV at 3; Tr. at 293. Throughout his career, Dr. Alexander has treated between twenty and fifty patients with TM, but has treated thousands of patients who suffered from a stroke. Tr. at 294. In addition to his clinical and academic duties, Dr. Alexander has published several articles on subjects within the field of neurology and neurorehabilitation, though he primarily focuses on his clinical practice and academic responsibilities rather than research. Alexander CV at 11–14; Tr. at 295–96.

Dr. Alexander began by reviewing relevant definitions and the TM diagnostic criteria set forth in the TM Working Group paper. Tr. at 302–05. TM describes general spinal cord inflammation, and can be secondary to other conditions such as NMO, MS, and/or Lupus. *Id.* at 301–02. If a pre-existing causal infection cannot be identified, then the TM is deemed idiopathic. *Id.* He emphasized that, overall, "it is pretty easy to be wrong about [TM]," and agreed that Barreras found that up to fifty percent of TM diagnoses are wrong, with a large number of those misdiagnosed patients actually suffered from a vascular abnormalities. *Id.* at 341–42 (citing Barreras at 15).

Dr. Alexander largely echoed the testimony of Dr. Zamvil regarding the proper criteria for a TM diagnosis (as embraced by the TM Working Group), but differed drastically in how to understand or apply those criteria. In particular, while Dr. Zamvil advocated for their flexible application, Dr. Alexander proposed they be utilized in a more stringent manner. *See* Tr. at 300, 302–05, 375. He also took issue with Dr. Zamvil's testimony regarding gray matter involvement. *Id.* at 304. According to Dr. Alexander, TM primarily targets white matter, and will not typically affect gray matter. *Id.* at 304.

Next, Dr. Alexander explained the process of diagnosing spinal cord infarction (in connection with his overall contention that the record best supports that as the proper diagnosis

over TM). Tr. at 305–06. Spinal cord infarction—which accounts for only one percent of all strokes—is characterized by sudden onset of bilateral signs and symptoms. *Id.* at 305, 313. These symptoms may develop over the course of hours, but timely administration of treatment can reverse ischemic damage. *Id.* at 329.

Dr. Alexander also focused on the extent of gray matter involvement, which he explained tends to be more extensive following a spinal cord infarction, because it is more sensitive to ischemia. Tr. at 305. Gray matter involvement in the anterior horn cell area following a spinal cord infarction may manifest as snake or owl eyes sign on MRI imaging studies. *Id.* at 309–10; Alexander Rep. at 8. He also disputed the efficacy of angiography in diagnosing spinal cord infarction, noting that although it is an imaging test commonly used to diagnose vascular problems (such as arteriovenous malformations or arteriovenous dural fistulas), it is rarely used for purposes of diagnosing a suspected spinal cord infarction. Tr. at 312, 366. The usefulness of angiography is further reduced by the fact that clots are often resorbed, broken down, or embolized before an angiogram can be performed. *Id.* Dr. Alexander estimated that approximately seventy-five percent of all spinal cord infarctions have no identified etiology, and he thus did not find it unusual that Mr. I.J.'s treating physicians did not propose an etiology for his suspected infarction—though some documentation was made in the record regarding his procoagulant state. *Id.* at 313–14, 336–37.

MRI imaging in a patient who has suffered a spinal cord infarction is typically negative for enhancement, but DWI—what he deems the "gold standard" measure for stroke assessment—may be positive within fifteen minutes of ischemic changes. Tr. at 307–08, 323, 379–80. DWI positivity, however, will fade within a couple of days. *Id.* at 379–80. He also allowed that DWI positivity can be seen in some instances of TM, though he disputed the probative value of case studies documenting this phenomenon. *Id.* at 383–84 (citing Kim at 103). Similarly, the presence of "watershed" abnormalities, which reflect and are attributable to reduced circulation and diminished vascular supply, are also consistent with spinal cord infarction. *Id.* at 310–11. But Dr. Alexander also noted that CSF and dorsal column function are not typically affected in the event of an anterior spinal artery infarction. *Id.* at 305–06.

Another point of dispute raised by Dr. Alexander was Petitioner's experts' use of the term "holocord" to describe transverse involvement of the spinal cord. Tr. at 308; Alexander Rep. at 8. In his view, "holocord" more accurately defines longitudinal involvement of the spinal cord, beginning at the cervicomedullary junction in the neck and extending all the way down to the conus, or tail, of the spinal cord. Tr. at 308; Alexander Rep. at 8. Dr. Alexander's review of the record did not reveal evidence of the extensive longitudinal involvement contemplated by his proposed definition. Tr. at 308.

Based on his review of the medical record, Dr. Alexander concluded that Mr. I.J. more likely than not suffered an acute spinal cord infarction in the cervical region. Tr. at 314. This determination began with the discharge diagnosis, in which treating physicians who had attended

to Petitioner throughout his illness documented tetraplegia, spinal cord infarction, and thrombophilia, but shied away from TM in the final differential. *Id.* at 314, 340; Ex. 2 at 4, 7. He further bulwarked his conclusion by referring to the results of Mr. I.J.'s MRI studies. Dr. Alexander noted that the "long linear white streak down . . . the more anterior portion of the cord" seen in the MRI conducted on August 8, 2013, was consistent with the "typical pencil-shaped lesion that you see in spinal cord infarction," along with evidence of ventral cord preservation. Tr. at 300–01, 316 (citing Ex. 87 at 2). More specifically, Dr. Alexander opined that in cases of TM, one would expect to see "more involvement of the cord" (evidenced by enhancement) rather than a discreet stripe or contained anterior horn involvement. Tr. at 318.

Though the MRI images obtained on August 17, 2013 showed some evidence of dorsal column involvement, Dr. Alexander noted that this finding had only been emphasized during Dr. Watanabe's hearing testimony. Tr. at 321. But even if accurate, Dr. Alexander considered this finding to be not particularly noteworthy, because the anterior horn cells of the central gray matter remained the area of greatest involvement. *Id.* at 321–22, 361–63. Similarly, the patchy enhancement seen in the second MRI, though admittedly a potential sign of TM-related inflammation, can also evidence spinal cord infarction in thirty to forty percent of cases. *Id.* at 324, 382–83. Ultimately, while he did not dispute the finding of dorsal cord involvement, Dr. Alexander concluded that the overall presentation was more consistent with a spinal cord infarction. *Id.* at 379.

Dr. Alexander also raised the possibility that the "enhancement" documented in the second August 2013 MRI (but not seen in the first) may not actually have reflected enhancement attributable to cord inflammation, but rather a phenomenon known as "luxury perfusion," whereby blood flow is increased to an area previously affected by an infarction. Tr. at 324–25. Additionally, Dr. Alexander opined that the DWI positivity seen in the second MRI was further evidence of an acute spinal cord infarction, given the importance of that finding in diagnosing infarction generally. *Id.* at 323. He did acknowledge, however, that if viewing the August 17, 2013 MRI in isolation, it could support a diagnosis of TM (although he still maintained the overall record leaned against that conclusion). *Id.* at 322, 325. He furthered this contention by noting that the MRI study conducted on November 15, 2016—three years after the onset of Mr. I.J.'s condition—evidenced a "primarily ventral change" (which he interpreted as a pencil-shaped lesion in the anterior horn) and an owl's eyes abnormality, both of which he argued supported a diagnosis of spinal cord infarction. *Id.* at 323–24.

Besides the above, Dr. Alexander disputed Dr. Watanabe's findings regarding the watershed abnormality seen on the August 17, 2013 MRI. Tr. at 325–26. Whereas Dr. Watanabe interpreted the abnormality to extend beyond the area of expected involvement following an anterior spinal artery infarction, Dr. Alexander expressed the opinion that the longitudinal position of the abnormality, plus its posterior cord involvement, were more consistent with an acute spinal cord infarction, and the extent of these abnormalities actually evidenced the central area of maximum infarction and ischemia. *Id.* at 196, 311–12, 325–26.

Dr. Alexander also deemed the August 21, 2013 spinal angiogram as supportive of his theory. Tr. at 333; Ex. 2 at 451–52. The attenuation, filling defect, and segmental narrowing of the anterior spinal artery that Dr. Watanabe agreed it revealed were consistent with a thrombotic event such as an ischemic stroke. Tr. at 333–34. Even though a clot was not visible in the angiogram, he explained that clots often dissolve, leaving behind residual arteriole narrowing. *Id.* at 334–35. Dr. Alexander also addressed the "cutoff" discussed by Dr. Watanabe. *Id.* at 333. After reviewing the angiogram report, he highlighted the note regarding an abrupt attenuation and filling defect at the C6 level. *Id.* at 334; Ex. 2 at 452. He admitted, however, that the term "cutoff" was not used in the record. Tr. at 367. Nonetheless, he concluded that a vessel abnormality existed, and he agreed with the radiological interpretation noting "discontinuity" within the vessel. *Id.* at 368. And even if Dr. Watanabe was correct that Mr. I.J. had not experienced a cutoff of the vessel, treating physicians on the stroke team still believed Mr. I.J. suffered an infarction. *Id.* at 334. Further still, Dr. Alexander emphasized that strokes do not require complete vessel occlusion, and the same treatment would likely be rendered regardless. *Id.* at 334, 369–70.

Ultimately, after applying the TM Working Group diagnostic criteria, Dr. Alexander concluded that a diagnosis of TM was not supported by the medical record. Tr. at 317. The initial August 2013 MRI study did not reveal enhancement, and neither the MRI nor CSF studies[29] produced evidence of inflammation that would occur in the presence of a central nervous system demyelinating event. *Id.* at 317–18, 331. Additionally, the total area of cord involvement was fairly limited, and was confined to the anterior horn cells thus preserving posterior column functions—though the total area of involvement was sufficient to cause the neurological symptoms Mr. I.J. experienced. *Id.* at 318, 335–36. Dr. Alexander found such limited cord involvement to be more consistent with a spinal cord infarction than TM. *Id.* at 316.

The thrombophilia studies—and more specifically the finding of elevated Factor VIII levels—also supported Dr. Alexander's proposed diagnosis. Though Dr. Zamvil attributed this finding to the inflammatory processes specific to TM, Dr. Alexander argued that the limited amount of tissue involved in TM is not enough to provoke systemic inflammation. Tr. at 343. Dr. Alexander's argument was further substantiated by the lack of evidence showing either local or systemic inflammation. *Id.* at 343–44. Regardless of whether Mr. I.J. suffered from TM or spinal cord infarction, Dr. Alexander believed that he would have exhibited elevated Factor VIII levels given the overall nature of his physical condition. *Id.* at 344.

Dr. Alexander further distinguished the competing diagnoses based on the timeframe in which Mr. I.J. experienced the initial onset of his symptoms. He opined that a sudden onset and rapid deterioration like that experienced by Mr. I.J. when he was boarding the bus and reaching for his wallet was indicative of an apoplectic event such as vascular infarction, and not consistent

[29] Dr. Alexander did allow for the possibility that immediate steroid treatment could mask pleocytosis, but he did not believe this point was applicable because his understanding was that Mr. I.J. did not receive steroid treatment until *after* the CSF study was completed. Tr. at 358.

with how an inflammatory myelitis, such as TM, would present. *Id.* at 306–07, 319, 326–31, 372. Dr. Alexander also articulated that if Mr. I.J. had been suffering from TM, and the inflammatory process had started two weeks post-vaccination as proposed by Petitioner, then the acute nature of his symptoms onset was made even less likely. *Id.* at 327, 372. But Dr. Alexander also pointed out that treaters characterized the onset of Mr. I.J.'s condition as "apoplectic," thus undermining Petitioner's proposed timeline of events. *Id.* at 373.

Further, the stepwise, stuttering progression of Mr. I.J.'s symptoms was consistent with collateral circulation following the initial onset of a spinal cord infarction. *Id.* at 329–30. This is due to the body's attempt to compensate and avoid ischemic damage by increasing blood flow to the spinal cord. *Id.* This process, however, is not sustainable, and the failure of this system results in ischemic damage to the cord. *Id.* at 330. Dr. Alexander also explained that back pain like that experienced by Mr. I.J. at the initial onset of his symptoms is typical of a spinal cord infarction, but not of TM. *Id.* at 319, 327. On cross examination, however, Dr. Alexander did admit that the overall timeline of symptom progression did fit the accepted temporal period for onset of TM (between four hours and twenty-one days), and that treaters seemed to recognize, consistent with Petitioner's testimony, that Mr. I.J. had experienced progressive symptoms over the course of six to eight hours. *Id.* at 375–76. He maintained, however, that patients suffering from a spinal cord infarction could also reach nadir within the same timeframe. *Id.* at 342.

Dr. Alexander next addressed how the treatments Mr. I.J. received factor into determining a proper diagnosis. While Dr. Zamvil emphasized the role of treatments Mr. I.J. received and his subsequent improvement in forming his opinions, Dr. Alexander disputed the diagnostic significance of these points. Tr. at 338–39. He noted that the improvements Mr. I.J. experienced were mostly sensory in nature, and he opined that those improvements could have been spontaneous. *Id.* He further explained that steroid treatment is non-specific and is not necessarily indicated when TM is suspected. *Id.* Similarly, Dr. Alexander argued that the IVIG treatment Mr. I.J. received is also non-specific and has not been demonstrated to be an effective treatment for TM—though it is widely administered to TM patients and Mr. I.J. was noted as having "marked improvement" following IVIG treatment. *Id.* at 352–56. He did ultimately admit that Mr. I.J.'s improvement subsequent to his IVIG treatment could evidence an inflammatory condition. *Id.* at 352–55, 357.

After the entitlement hearing, Dr. Alexander submitted a second supplemental report addressing Dr. Watanabe's interpretation of the DWI MRI obtained on August 8, 2013, as well as her conclusion (based on a comprehensive review of all relevant images) that the MRI performed on August 13, 2013 demonstrated dorsal/posterior cord involvement—a conclusion he notes did not appear in any of Dr. Watanabe's pre-hearing reports. *See generally* Third Alexander Rep.

In this report, Dr. Alexander took issue with Dr. Watanabe's interpretation of the DWI MRI obtained on August 8, 2013. Third Alexander Rep. at 1–2. Whereas Dr. Watanabe concluded that the images were negative for indicia of a spinal cord infarction, Dr. Alexander noted that the

DWI revealed increased signal intensity in the anterior portion of the spinal cord—the same area that demonstrated signal intensity in the T2 weighted MRI—consistent with an acute ischemic stroke. *Id.* at 2. He noted, however, that the quality of the images was not typical for diagnostic purposes, and there was no accompanying radiologic report for these images within the medical record. *Id.* He nonetheless concluded that the DWI MRI obtained just a few hours after Mr. I.J. first began experiencing symptoms was most consistent with a spinal cord infarction. *Id.*

Dr. Alexander did agree with Dr. Watanabe's conclusion that Mr. I.J.'s August 17th MRI showed posterior/dorsal spinal cord involvement. Third Alexander Rep. at 5. But unlike Dr. Watanabe, Dr. Alexander attributed these findings to a spinal cord infarction rather than TM. *Id.* at 6–7. As he explained, posterior cord involvement is not uncommon in patients who have experienced an anterior spinal artery infarction because both the anterior and posterior spinal arteries are fed by the radiculomedullary artery. *Id.* at 3–5. In support of this contention, Dr. Alexander cited several items of literature, including a study in which more than half of all participants who experienced an anterior spinal artery infarction exhibited posterior cord involvement. *Id*. at 4 (citing C. Masson et al., *Spinal Cord Infarction: Clinical and Magnetic Resonance Imaging Findings and Short Term Outcome*, 75 J. Neurology Neurosurgery Psychiatry 1431, 1434 (2004), filed as Ex. D on Aug. 2, 2019 (ECF No. 67-2)); *see also* J. Novy et al., *Spinal Cord Ischemia: Clinical and Imaging Patterns, Pathogenesis, and Outcome in 27 Patients*, 63 Archives Neurology 1113, 1117 (2006), filed as Ex. F on Aug. 2, 2019 (ECF No. 67-4); S. Weidauer et al., *Spinal Cord Ischemia: Aetiology, Clinical Syndromes and Imaging Features*, 57 Neuroradiology 241, 244 (2015), filed as Ex. H on Aug. 2, 2019 (ECF No. 67-6) ("Weidauer").

Thus, Dr. Alexander maintained that a clot in the radiculomedullary artery can result in ischemic changes to both the anterior and posterior spinal cord. Third Alexander Rep. at 5–6 (citing Weidauer at 244). Dr. Alexander supported his proposed interpretation by noting that the signal distribution within the posterior column was limited to the area surrounding the left posterior spinal artery and did not cross the cord midline as would be expected in TM. Third Alexander Rep. at 7. Lastly, he noted that these findings would not have appeared on the initial MRI obtained just hours after the onset of Mr. I.J.'s symptoms because ischemic changes to the tissue would have developed over time and only after secondary blood supplies to the cord were exhausted. *Id.* at 7–8.

III. Procedural History

This matter commenced with the filing of the Petition on July 21, 2016. Over the following months, Petitioner filed medical records in support of her claim. Respondent thereafter filed a Rule 4(c) Report on April 24, 2017, asserting that compensation was not appropriate in this case. Respondent's Report, filed April 14, 2017 (ECF No. 29). Petitioner subsequently filed expert reports from Drs. Zamvil, Watanabe, and Levin along with supporting literature between the summer of 2017 and fall 2019. Respondent filed a responsive report by Dr. Alexander on February 28, 2018, along with literature in opposition to Petitioner's position. The parties filed their

respective pre-hearing briefs over the summer of 2019, and a two-day entitlement hearing took place on October 22-23, 2019. The parties elected to file post-hearing briefs, doing so on April 24, 2020. Petitioner's Brief (ECF No. 112) ("Petitioner's Post-Hearing Br."); Respondent's Brief (ECF No. 113). The matter is now fully ripe for resolution.

IV. Applicable Legal Standards

A. *Petitioner's Overall Burden in Vaccine Program Cases*

To receive compensation in the Vaccine Program, a petitioner must prove either: (1) that he suffered a "Table Injury"—i.e., an injury falling within the Vaccine Injury Table—corresponding to one of the vaccinations in question within a statutorily prescribed period of time or, in the alternative, (2) that his illnesses were actually caused by a vaccine (a "Non-Table Injury"). *See* Sections 13(a)(1)(A), 11(c)(1), and 14(a), as amended by 42 C.F.R. § 100.3; § 11(c)(1)(C)(ii)(I); *see also Moberly v. Sec'y of Health & Hum. Servs.*, 592 F.3d 1315, 1321 (Fed. Cir. 2010); *Capizzano v. Sec'y of Health & Hum. Servs.*, 440 F.3d 1317, 1320 (Fed. Cir. 2006).[30] In this case, Petitioner does not assert a Table claim.

For both Table and Non-Table claims, Vaccine Program petitioners bear a "preponderance of the evidence" burden of proof. Section 13(1)(a). That is, a petitioner must offer evidence that leads the "trier of fact to believe that the existence of a fact is more probable than its nonexistence before [he] may find in favor of the party who has the burden to persuade the judge of the fact's existence." *Moberly*, 592 F.3d at 1322 n.2; *see also Snowbank Enter. v. United States*, 6 Cl. Ct. 476, 486 (1984) (mere conjecture or speculation is insufficient under a preponderance standard). Proof of medical certainty is not required. *Bunting v. Sec'y of Health & Hum. Servs.*, 931 F.2d 867, 873 (Fed. Cir. 1991). In particular, a petitioner must demonstrate 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)); *Pafford v. Sec'y of Health & Hum. Servs*., 451 F.3d 1352, 1355 (Fed. Cir. 2006). A petitioner may not receive a Vaccine Program award based solely on his assertions; rather, the petition must be supported by either medical records or by the opinion of a competent physician. Section 13(a)(1).

In attempting to establish entitlement to a Vaccine Program award of compensation for a Non-Table claim, a petitioner must satisfy all three of the elements established by the Federal Circuit in *Althen v. Sec'y of Health & Hum. Servs.*, 418 F.3d 1274, 1278 (2005): "(1) a medical theory causally connecting the vaccination and the injury; (2) a logical sequence of cause and

[30] Decisions of special masters (some of which I reference in this ruling) constitute persuasive but not binding authority. *Hanlon v. Sec'y of Health & Hum. Servs.*, 40 Fed. Cl. 625, 630 (1998). By contrast, Federal Circuit rulings concerning legal issues are binding on special masters. *Guillory v. Sec'y of Health & Hum. Servs.*, 59 Fed. Cl. 121, 124 (2003), *aff'd* 104 F. Appx. 712 (Fed. Cir. 2004); *see also Spooner v. Sec'y of Health & Hum. Servs.*, No. 13-159V, 2014 WL 504728, at *7 n.12 (Fed. Cl. Spec. Mstr. Jan. 16, 2014).

effect showing that the vaccination was the reason for the injury; and (3) a showing of proximate temporal relationship between vaccination and injury."

Each of the *Althen* prongs requires a different showing. Under *Althen* prong one, petitioners 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 (citations omitted). To satisfy this prong, a petitioner's theory must be based on a "sound and reliable medical or scientific explanation." *Knudsen v. Sec'y of Health & Hum. Servs.*, 35 F.3d 543, 548 (Fed. Cir. 1994). Such a theory must only be "legally probable, not medically or scientifically certain." *Id.* at 549.

Petitioners may satisfy the first *Althen* prong without resort to medical literature, epidemiological studies, demonstration of a specific mechanism, or a generally accepted medical theory. *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). 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 through the lens of the laboratorian, but instead from the vantage point of the Vaccine Act's preponderant evidence standard." *Id.* at 1380. Accordingly, special masters must take care not to increase the burden placed on petitioners in offering a scientific theory linking vaccine to injury.

In discussing the evidentiary standard applicable to the first *Althen* prong, the Federal Circuit has consistently rejected the contention that it can be satisfied merely by establishing the proposed causal theory's scientific or medical *plausibility*. *See Boatmon v. Sec'y of Health & Hum. Servs.*, 941 F.3d 1351, 1359 (Fed. Cir. 2019); *see also LaLonde v. Sec'y of Health & Hum. Servs.*, 746 F.3d 1334, 1339 (Fed. Cir. 2014) ("[h]owever, in the past we have made clear that simply identifying a 'plausible' theory of causation is insufficient for a petitioner to meet her burden of proof." (citing *Moberly*, 592 F.3d at 1322)). Petitioners otherwise always have the ultimate burden of establishing their *overall* Vaccine Act claim with preponderant evidence, regardless of what evidentiary level of evidence on the "can cause" prong is required. *W.C. v. Sec'y of Health & Hum. Servs.*, 704 F.3d 1352, 1356 (Fed. Cir. 2013) (citations omitted); *Tarsell v. United States*, 133 Fed. Cl. 782, 793 (2017) (noting that *Moberly* "addresses the petitioner's overall burden of proving causation-in-fact under the Vaccine Act" by a preponderance standard).

The second *Althen* prong requires proof of a logical sequence of cause and effect, usually supported by facts derived from a petitioner's medical records. *Althen*, 418 F.3d at 1278; *Andreu*, 569 F.3d at 1375–77; *Capizzano*, 440 F.3d at 1326; *Grant v. Sec'y of Health & Hum. Servs.*, 956 F.2d 1144, 1148 (Fed. Cir. 1992). In establishing that a vaccine "did cause" injury, the opinions and views of the injured party's treating physicians are entitled to some weight. *Andreu*, 569 F.3d at 1367; *Capizzano*, 440 F.3d at 1326 ("medical records and medical opinion testimony are favored in vaccine cases, as treating physicians are likely to be in the best position to determine whether a

'logical sequence of cause and effect show[s] that the vaccination was the reason for the injury'") (quoting *Althen*, 418 F.3d at 1280). Medical records are generally viewed as particularly trustworthy evidence, since they are created contemporaneously with the treatment of the patient. *Cucuras v. Sec'y of Health & Hum. Servs.*, 993 F.2d 1525, 1528 (Fed. Cir. 1993).

Medical records and statements of a treating physician, however, do not *per se* bind the special master to adopt the conclusions of such an individual, even if they must be considered and carefully evaluated. Section 13(b)(1) (providing that "[a]ny such diagnosis, conclusion, judgment, test result, report, or summary shall not be binding on the special master or court"); *Snyder v. Sec'y of Health & Hum. Servs*., 88 Fed. Cl. 706, 746 n.67 (2009) ("there is nothing . . . that mandates that the testimony of a treating physician is sacrosanct—that it must be accepted in its entirety and cannot be rebutted"). As with expert testimony offered to establish a theory of causation, the opinions or diagnoses of treating physicians are only as trustworthy as the reasonableness of their suppositions or bases. The views of treating physicians should be weighed against other, contrary evidence also present in the record—including conflicting opinions among such individuals. *Hibbard v. Sec'y of Health & Hum. Servs.*, 100 Fed. Cl. 742, 749 (2011) (not arbitrary or capricious for special master to weigh competing treating physicians' conclusions against each other), *aff'd*, 698 F.3d 1355 (Fed. Cir. 2012); *Veryzer v. Sec'y of Dept. of Health & Hum. Servs.*, No. 06-522V, 2011 WL 1935813, at *17 (Fed. Cl. Spec. Mstr. Apr. 29, 2011), *mot. for review denied*, 100 Fed. Cl. 344, 356 (2011), *aff'd without opinion*, 475 F. Appx. 765 (Fed. Cir. 2012).

The third *Althen* prong requires establishing a "proximate temporal relationship" between the vaccination and the injury alleged. *Althen*, 418 F.3d at 1281. That term has been equated to the phrase "medically-acceptable temporal relationship." *Id.* A petitioner must offer "preponderant proof that the onset of symptoms occurred within a timeframe which, given the medical understanding of the disorder's etiology, it is medically acceptable to infer causation." *de Bazan v. Sec'y of Health & Hum. Servs.*, 539 F.3d 1347, 1352 (Fed. Cir. 2008). The explanation for what is a medically acceptable timeframe must align with the theory of how the relevant vaccine can cause an injury (*Althen* prong one's requirement). *Id.* at 1352; *Shapiro v. Sec'y of Health & Hum. Servs.*, 101 Fed. Cl. 532, 542 (2011), *recons. denied after remand*, 105 Fed. Cl. 353 (2012), *aff'd mem.*, 503 F. Appx. 952 (Fed. Cir. 2013); *Koehn v. Sec'y of Health & Hum. Servs.*, No. 11-355V, 2013 WL 3214877 (Fed. Cl. Spec. Mstr. May 30, 2013), *mot. for rev. denied* (Fed. Cl. Dec. 3, 2013), *aff'd*, 773 F.3d 1239 (Fed. Cir. 2014).

B. *Legal Standards Governing Factual Determinations*

The process for making determinations in Vaccine Program cases regarding factual issues begins with consideration of the medical records. Section 11(c)(2). The special master is required to consider "all [] relevant medical and scientific evidence contained in the record," including "any diagnosis, conclusion, medical judgment, or autopsy or coroner's report which is contained in the record regarding the nature, causation, and aggravation of the petitioner's illness, disability, injury,

condition, or death," as well as the "results of any diagnostic or evaluative test which are contained in the record and the summaries and conclusions." Section 13(b)(1)(A). The special master is then required to weigh the evidence presented, including contemporaneous medical records and testimony. *See Burns v. Sec'y of Health & Hum. Servs*., 3 F.3d 415, 417 (Fed. Cir. 1993) (it is within the special master's discretion to determine whether to afford greater weight to contemporaneous medical records than to other evidence, such as oral testimony surrounding the events in question that was given at a later date, provided that such determination is evidenced by a rational determination).

Medical records that are created contemporaneously with the events they describe are presumed to be accurate and "complete" (i.e., presenting all relevant information on a patient's health problems). *Cucuras*, 993 F.2d at 1528; *Doe/70 v. Sec'y of Health & Hum. Servs.*, 95 Fed. Cl. 598, 608 (2010) ("[g]iven the inconsistencies between petitioner's testimony and his contemporaneous medical records, the special master's decision to rely on petitioner's medical records was rational and consistent with applicable law"), *aff'd sub nom. Rickett v. Sec'y of Health & Hum. Servs*., 468 F. Appx. 952 (Fed. Cir. 2011) (non-precedential opinion). This presumption is based on the linked propositions that (i) sick people visit medical professionals; (ii) sick people honestly report their health problems to those professionals; and (iii) medical professionals record what they are told or observe when examining their patients in as accurate a manner as possible, so that they are aware of enough relevant facts to make appropriate treatment decisions. *Sanchez v. Sec'y of Health & Hum. Servs.*, No. 11-685V, 2013 WL 1880825, at *2 (Fed. Cl. Spec. Mstr. Apr. 10, 2013); *Cucuras v. Sec'y of Health & Hum. Servs.*, 26 Cl. Ct. 537, 543 (1992), *aff'd*, 993 F.2d at 1525 (Fed. Cir. 1993) ("[i]t strains reason to conclude that petitioners would fail to accurately report the onset of their daughter's symptoms").

Accordingly, if the medical records are clear, consistent, and complete, then they should be afforded substantial weight. *Lowrie v. Sec'y of Health & Hum. Servs.*, No. 03-1585V, 2005 WL 6117475, at *20 (Fed. Cl. Spec. Mstr. Dec. 12, 2005). Indeed, contemporaneous medical records are generally found to be deserving of greater evidentiary weight than oral testimony—especially where such testimony conflicts with the record evidence. *Cucuras*, 993 F.2d at 1528; *see also Murphy v. Sec'y of Dep't of Health & Hum. Servs.*, 23 Cl. Ct. 726, 733 (1991) (citing *United States v. United States Gypsum Co.*, 333 U.S. 364, 396 (1947) ("[i]t has generally been held that oral testimony which is in conflict with contemporaneous documents is entitled to little evidentiary weight.")).

There are, however, situations in which compelling oral testimony may be more persuasive than written records, such as where records are deemed to be incomplete or inaccurate. *Campbell v. Sec'y of Health & Hum. Servs*., 69 Fed. Cl. 775, 779 (2006) ("like any norm based upon common sense and experience, this rule should not be treated as an absolute and must yield where the factual predicates for its application are weak or lacking"); *Lowrie*, 2005 WL 6117475, at *19 ("'[w]ritten

records which are, themselves, inconsistent, should be accorded less deference than those which are internally consistent'") (quoting *Murphy*, 23 Cl. Ct. at 733)). Ultimately, a determination regarding a witness's credibility is needed when determining the weight that such testimony should be afforded. *Andreu*, 569 F.3d at 1379; *Bradley v. Sec'y of Health & Hum. Servs*., 991 F.2d 1570, 1575 (Fed. Cir. 1993).

When witness testimony is offered to overcome the presumption of accuracy afforded to contemporaneous medical records, such testimony must be "consistent, clear, cogent, and compelling." *Sanchez*, 2013 WL 1880825, at *3 (citing *Blutstein v. Sec'y of Health & Hum. Servs*., No. 90-2808V, 1998 WL 408611, at *5 (Fed. Cl. Spec. Mstr. June 30, 1998)). In determining the accuracy and completeness of medical records, the Court of Federal Claims has listed four possible explanations for inconsistencies between contemporaneously created medical records and later testimony: (1) a person's failure to recount to the medical professional everything that happened during the relevant time period; (2) the medical professional's failure to document everything reported to her or him; (3) a person's faulty recollection of the events when presenting testimony; or (4) a person's purposeful recounting of symptoms that did not exist. *Lalonde v. Sec'y of Health & Hum. Servs*., 110 Fed. Cl. 184, 203-04 (2013), *aff'd*, 746 F.3d 1334 (Fed. Cir. 2014). In making a determination regarding whether to afford greater weight to contemporaneous medical records or other evidence, such as testimony at hearing, there must be evidence that this decision was the result of a rational determination. *Burns*, 3 F.3d at 417.

C. *Analysis of Expert Testimony*

Establishing a sound and reliable medical theory often requires a petitioner to present expert testimony in support of his claim. *Lampe v. Sec'y of Health & Hum. Servs*., 219 F.3d 1357, 1361 (Fed. Cir. 2000). Vaccine Program expert testimony is usually evaluated according to the factors for analyzing scientific reliability set forth in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 594–96 (1993). *See Cedillo v. Sec'y of Health & Hum. Servs.*, 617 F.3d 1328, 1339 (Fed. Cir. 2010) (citing *Terran v. Sec'y of Health & Hum. Servs.*, 195 F.3d 1302, 1316 (Fed. Cir. 1999)). "The *Daubert* factors for analyzing the reliability of testimony are: (1) whether a theory or technique can be (and has been) tested; (2) whether the theory or technique has been subjected to peer review and publication; (3) whether there is a known or potential rate of error and whether there are standards for controlling the error; and (4) whether the theory or technique enjoys general acceptance within a relevant scientific community." *Terran*, 195 F.3d at 1316 n.2 (citing *Daubert*, 509 U.S. at 592–95).

The *Daubert* factors play a slightly different role in Vaccine Program cases than they do when applied in other federal judicial fora (such as the district courts). *Daubert* factors are usually employed by judges (in the performance of their evidentiary gatekeeper roles) to exclude evidence that is unreliable and/or could confuse a jury. In Vaccine Program cases, by contrast, these factors are used in the *weighing* of the reliability of scientific evidence proffered. *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"). The flexible use of the *Daubert* factors to evaluate the persuasiveness and reliability of expert testimony has routinely been upheld. *See, e.g.*, *Snyder*, 88 Fed. Cl. at 742–45. In this matter (as in numerous other Vaccine Program cases), *Daubert* has not been employed at the threshold, to determine what evidence should be admitted, but instead to determine whether expert testimony offered is reliable and/or persuasive.

Respondent frequently offers one or more experts in order to rebut a petitioner's case. 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*, 219 F.3d at 1362). 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. 136, 146 (1997)); *see also Isaac v. Sec'y of Health & Hum. Servs*., No. 08-601V, 2012 WL 3609993, at *17 (Fed. Cl. Spec. Mstr. July 30, 2012), *mot. for rev. denied*, 108 Fed. Cl. 743 (2013), *aff'd*, 540 F. Appx. 999 (Fed. Cir. 2013) (citing *Cedillo*, 617 F.3d at 1339). 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").

Expert opinions based on unsupported facts may be given relatively little weight. *See Dobrydnev v. Sec'y of Health & Hum. Servs.*, 556 F. Appx. 976, 992–93 (Fed. Cir. 2014) ("[a] doctor's conclusion is only as good as the facts upon which it is based") (citing *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209, 242 (1993) ("[w]hen an expert assumes facts that are not supported by a preponderance of the evidence, a finder of fact may properly reject the expert's opinion")). Expert opinions that fail to address or are at odds with contemporaneous medical records may therefore be less persuasive than those which correspond to such records. *See Gerami v. Sec'y of Health & Hum. Servs.*, No. 12-442V, 2013 WL 5998109, at *4 (Fed. Cl. Spec. Mstr. Oct. 11, 2013), *aff'd*, 127 Fed. Cl. 299 (2014).

D. *Consideration of Medical Literature*

Both parties filed medical and scientific literature in this case, but not every filed item factors into the outcome of this decision. While I have reviewed all the medical literature submitted in this case, I discuss only those articles that are most relevant to my determination and/or are

central to Petitioner's case—just as I have not exhaustively discussed every individual medical record filed. *Moriarty v. Sec'y of Health & Hum. Servs.*, 844 F.3d 1322, 1328 (Fed. Cir. 2016) ("[w]e generally presume that a special master considered the relevant record evidence even though he does not explicitly reference such evidence in his decision") (citation omitted); *see also Paterek v. Sec'y of Health & Hum. Servs.,* 527 F. Appx. 875, 884 (Fed. Cir. 2013) ("[f]inding certain information not relevant does not lead to—and likely undermines—the conclusion that it was not considered").

E. *Consideration of Comparable Special Master Decisions*

In reaching a decision in this case, I have considered other decisions issued by special masters (including my own) involving similar injuries, vaccines, or circumstances. I also reference some of those cases in this Decision, in an effort to establish common themes, as well as demonstrate how prior determinations impact my thinking on the present case.

There is no error in doing so. It is certainly correct that prior decisions from different cases do not *control* the outcome herein.[31] *Boatmon v. Sec'y of Health & Hum. Servs.,* 941 F.3d 1351, 1358–59 (Fed. Cir. 2019); *Hanlon v. Sec'y of Health & Hum. Servs.*, 40 Fed. Cl. 625, 630 (1998). Thus, the fact that another special master reasonably determined elsewhere, on the basis of facts not in evidence in this case, that preponderant evidence supported the conclusion that vaccine X caused petitioner's injury Y does not compel me to reach the same conclusion in *this* case. Different actions present different background medical histories, different experts, and different items of medical literature, and therefore can reasonably result in contrary determinations.

However, it is *equally* the case that special masters reasonably draw upon their experience in resolving Vaccine Act claims. *Doe v. Sec'y of Health & Hum. Servs.,* 76 Fed. Cl. 328, 338–39 (2007) ("[o]ne reason that proceedings are more expeditious in the hands of special masters is that the special masters have the *expertise and experience to know the type of information that is most probative of a claim*") (emphasis added). They would therefore be remiss in ignoring prior cases presenting similar theories or factual circumstances, along with the reasoning employed in reaching such decisions. This is especially so given that special masters not only routinely hear from the same experts in comparable cases but are also repeatedly offered the *same* items of medical literature regarding certain common causation theories. It defies reason and logic to obligate special masters to "reinvent the wheel", so to speak, in each new case before them, paying no heed at all to how their colleagues past and present have addressed similar causation theories or fact patterns. It is for this reason that prior decisions can have high persuasive value—and why

[31] By contrast, Federal Circuit rulings concerning legal issues are binding on special masters. *Guillory v. Sec'y of Health & Hum. Servs.*, 59 Fed. Cl. 121, 124 (2003), *aff'd* 104 F. Appx. 712 (Fed. Cir. 2004); *see also Spooner v. Sec'y of Health & Hum. Servs.*, No. 13-159V, 2014 WL 504728, at *7 n.12 (Fed. Cl. Spec. Mstr. Jan. 16, 2014). Special masters are also bound within a specific case by determinations made by judges of the Court of Federal Claims after a motion for review is resolved.

special masters often explain how a new determination relates to such past decisions.[32] Even if the Federal Circuit does not *require* special masters to distinguish other relevant cases (*Boatmon,* 941 F.3d at 1358), it is still *wise* to do so.

ANALYSIS

I. Petitioner Has Established TM as His Likely Injury

In many Vaccine Program claims, prior to applying the *Althen* analytic framework it is proper first to determine the nature of the petitioner's injury, especially if the claimant's causal theory is dependent on the establishment of a specific injury. *Broekelschen*, 618 F.3d at 1345; *LaPierre v. Sec'y of Health & Hum. Servs.*, No. 17-227V, 2019 WL 6490730, at *16–17 (Fed. Cl. Spec. Mstr. Oct. 18, 2019). That is the case here, since the parties strenuously dispute the proper diagnosis—TM or spinal cord infarction—and since Petitioner's causation theory wholly assumes that the former is the correct one. Petitioner has *not* alleged that a spinal cord infarction could be vaccine-caused, so a determination that this best characterized his injury would be fatal to his claim.

Resolving this question is difficult. Both sides offered credible, reliably-bulwarked points for their respective positions, supported in turn by fair and persuasive expert testimony. In addition, the medical record is ultimately equivocal on the matter. Unquestionably Mr. I.J.'s initial treaters included both TM and infarction in their preliminary diagnostic differentials, noting the testing and imaging results that supported both. Although by the time of Petitioner's discharge it could reasonably be concluded that treaters were leaning against TM as a final diagnosis, the record is ambiguous enough on the subject to leave more than a little room for doubt, and Mr. I.J.'s post-hospitalization record offers no clarification of the matter. Dr. Watanabe's reading of the MRIs in this case also provided perspectives on the nature of Petitioner's injury that were not fully rebutted by Respondent (even after being provided the opportunity post-trial to do so).

The parties seemed to agree that the TM Working Group criteria were a good general yardstick for evaluating if TM was present in this case—and it appears that not all were met fully. Yet Petitioner successfully established *either* that certain of the criteria (for example, proof of inflammation) had not completely been eliminated, or more generally that a TM diagnosis should not be held to the literal standard set by the criteria. Tr. at 77–78, 80–83. And it is not my function as special master to propose a "correct" diagnosis. Rather, my task is to weigh whether the

[32] Consideration of prior determinations is a two-way street that does not only inure to the benefit of one party. Thus, I would likely take into account the numerous decisions finding no association between vaccination and autism when confronted with a new claim asserting autism as an injury and have informed such claimants early in the life of their case that the claim was not viable for just that reason. But I would *also* deem a non-Table claim asserting GBS after receipt of the flu vaccine as not requiring extensive proof on *Althen* prong one "can cause" matters, for the simple reason that the Program has repeatedly litigated the issue in favor of petitioners.

evidence preponderantly supports one conclusion over another—an analysis that leaves ample room for doubt to remain in either direction, regardless of the final determination.

Petitioner did persuasively establish that he experienced sensory, motor, and autonomic dysfunction consistent with TM. Tr. at 77. Similarly, he presented evidence that established the bilateral nature of his symptoms despite the initial unilateral presentation. *Id.* at 78. Petitioner's position was further bulwarked by the absence of connective tissue disease, infectious disease, abnormal void flows, and spinal radiation. *Id.* at 83–84. Other etiologies, such as optic neuritis and MS were also eliminated as potential causes for Mr. J.'s condition. *Id.* at 84. The progression of Petitioner's symptoms over the course of approximately eight or nine hours satisfied the Working Group's proposed diagnostic criteria and further distinguished Petitioner's course from that which is typical of spinal cord infarction. *Id.* at 57, 63, 83. And there is treater support for his proposed diagnosis, and (unlike in other cases) a review of the medical record beyond his initial onset does not suggest, based on the accumulation of additional information over time, that treaters later abandoned TM as an explanation. On the other hand, Respondent's expert Dr. Alexander provided a number of reasonable points for why an infarction was more likely.

Overall, this issue is close, with the evidence largely in equipoise. The experts were equally credible, making some points that were unrebutted while ceding others. Under such circumstances, persuasive Vaccine Program caselaw counsels me to decide the matter in the Petitioner's favor. *See Purtill v. Sec'y of Health & Hum. Servs.*, No. 18-832V, 2019 WL 7212162, at *6 (Fed. Cl. Spec. Mstr. Nov. 12, 2019) (citing *Roberts v. Sec'y of Health & Hum. Servs.*, No. 09-427V, 2013 WL 5314698 (Fed. Cl. Spec. Mstr. Aug. 29, 2013)). I do so here, and thus find that preponderant evidence has been offered to establish that Petitioner more likely than not suffered from TM.

II. Petitioner Has Not Demonstrated that the Tdap Vaccine "Can Cause" TM

A. *Relevant Case Law Regarding Vaccine Causality of TM*

Claims alleging acute, nerve-demyelinating conditions like TM following vaccination are common in the Vaccine Program. While some petitioners have obtained damages based on a successful showing that TM was caused by the Tdap vaccine, most such cases have been resolved through stipulations and proffers, leaving very few reasoned decisions addressing the issue of causation—and even those that exist are not particularly recent. *See, e.g.*, *Raymo v. Sec'y of Health & Hum. Servs.*, 11-654V, 2014 WL 1092274 (Fed. Cl. Spec. Mstr. Feb. 24, 2014) (petitioner established entitlement to compensation for a claim alleging TM following receipt of the HPV, Hepatitis A, meningococcal, and Tdap vaccines); *Roberts*, 2013 WL 5314698 (petitioner was entitled to compensation for a claim alleging TM following receipt of the Tdap vaccine); *Helman v. Sec'y of Health & Hum. Servs.*, No. 10-813V, 2012 WL 1607142 (Fed. Cl. Spec. Mstr. Apr. 5,

2012) (petitioner was entitled to compensation for a claim alleging TM and NMO following receipt of the Tdap vaccine).[33]

By contrast, several more recent, well-reasoned decisions have found that petitioners failed in their effort to establish that the flu vaccine "can cause" TM, as required by the first *Althen* prong. *See Pearson v. Sec'y of Health & Hum. Servs.,* No. 16-09V, 2019 WL 3852633, at *13–14 (Fed. Cl. Spec. Mstr. July 31, 2019); *Forrest v. Sec'y of Health & Hum. Servs.,* No. 14-1046V, 2019 WL 925485 (Fed. Cl. Spec. Mstr. Jan. 28, 2019). Although such determinations are somewhat less on point given the different vaccine at issue, they cast light on deficiencies in the reasoning that led prior special masters to conclude that the Tdap vaccine could be causal of the same injury (and also the theories offered in this particular case).

In *Pearson,* for example, an adult petitioner alleged that his receipt of the flu vaccine in October 2012 precipitated TM, with onset within three months (although it took treaters considerably longer to arrive at the diagnosis, which was not wholly supported by the record). *Pearson,* 2019 WL 3852633, at *3–4. The *Pearson* petitioner made many arguments parallel to those advanced in this case, e.g., that TM has an autoimmune-driven pathogenesis with molecular mimicry as its mechanism. *Id.* at *6. Molecular mimicry was also relied upon in the Tdap-TM cases mentioned above. *See Roberts,* 2013 WL 5314698, at *6; *Helman*, 2012 WL 1607142, at *3. And the *Pearson* Petitioner relied specifically on Agmon-Levin's review of post-vaccine TM cases to support his causation showing. *Pearson,* 2019 WL 3852633*,* at *7. In reaction, Respondent's expert pointed out that Agmon-Levin in totality identified only *two* instances of TM post-flu vaccine, and then only after a review of more than 35 years of literature to cull possible examples—thus implicitly demonstrating how little evidence existed for an association. *Id.* at *9. The special master denied compensation, observing (among other things) the low probative value of case reports generally, as well as the error in overreliance on Agmon-Levin, given the facial limitations of its findings. *Id.* at *14.

Forrest also featured an adult petitioner arguing that the flu vaccine caused TM, albeit with a far shorter onset timeframe (within a day or more of vaccination). *Forrest,* 2019 WL 925495, at *1. But there (as here) the petitioner also proposed molecular mimicry as the mechanism. *Id.* at

[33] I issued a decision approximately two years ago denying entitlement for a claim alleging TM following receipt of the DTaP vaccine (among others) in an infant child who experienced onset between thirty and thirty-six hours after vaccination. *Palattao v. Sec'y of Health & Hum. Servs.*, No. 13-591V, 2019 WL 989380 (Fed. Cl. Spec. Mstr. Feb. 4, 2019). The DTaP vaccine is the variant of the Tdap administered to infants and children. Notably, however, the petitioners in *Palattao* expressly *rejected* the theory of molecular mimicry espoused in this case, and instead relied solely on an aberrant proinflammatory cytokine response as the vaccine-instigated disease driver. *Id.* at *8. I found that the onset had occurred too close in time to the vaccination, and that the petitioners had failed to "demonstrate that cytokine upregulation in the periphery attributable to a vaccine can *also* trigger TM." *Id.* at *36 (emphasis in original). Thus, because of the difference in causation theory and overall circumstances, I find *Pallattao* to be less useful as a guide to resolution of this matter.

*3. In addition, Respondent (not Petitioner, as in this case) offered Baxter to *undermine* Petitioner's causation theory, highlighting that the very large-scale study saw no increased incidence of TM after administration of the flu vaccine—parallel to the same finding Baxter reached with respect to the Tdap vaccine (a finding Dr. Zamvil acknowledged at trial of this matter). *Id.* at *5. Although the special master's denial of entitlement in *Forrest* turned partially on some matters not relevant herein (in particular, the short onset timeframe and its inconsistency with the causal theory), the decision took special note of Baxter, observing the extent to which the study undermined the claimant's case (while acknowledging the "general rule" that petitioners are not required to submit affirmative epidemiologic evidence as part of their *prima facie* case). *Id.* at *5.

As I have already stated in my overview of the applicable legal standards to this case, none of these prior decisions control the outcome herein. However, they do provide guidance in evaluating the strength of the evidence offered by Petitioner herein in attempting to show that TM can be vaccine-caused—and the evidentiary weakness of certain items relied upon to do so.

B. *Petitioner's Althen One Showing was Insufficient*

Petitioner's showing for the first *Althen* prong was only credibly supported by the testimony and report of Dr. Zamvil (since neither Drs. Watanabe or Levin possessed the necessary training or background to offer a reliable opinion on the "can cause"/causation prong). Unquestionably, Petitioner has offered a variety of evidence in addition to Dr. Zamvil's report to support this prong. And, as noted above, there are reasoned decisions from the Program's past that support Petitioner's case. I nevertheless find (based on consideration of Dr. Zamvil's report, testimony, the filed literature, and other, more recent decisions) that it has not been preponderantly established that the Tdap vaccine can cause TM—and this determination, unlike my resolution of the disputed injury question, is not close at all.

As a threshold matter, I note that Petitioner has mischaracterized the evidentiary standard that is applied to the first *Althen* prong. *See generally* Petitioner's Post-Hearing Br. at 46. Thus, Petitioner incorrectly maintains that "reliable scientific evidence" is *not* required to meet his preponderant burden—although perhaps in so asserting he confuses the fact that no particular *class* of evidence (i.e. medical literature; research studies; expert reports; peer-reviewed articles; etc.) need be offered with the overall obligation of Program petitioners to offer a *reliable* theory, regardless of what specific items of evidence are gathered to support it. *Knudsen*, 35 F.3d at 548. If certain individual components of evidence critical to a theory's success are not themselves reliable, that finding reasonably impacts the overall theory's evidentiary preponderance. Petitioner also erroneously suggests a theory's mere plausibility is enough to meet the preponderant standard—a contention that the Federal Circuit clearly rejected in the recent *Boatmon* decision.

Boatmon, 941 F.3d at 1359.[34] Petitioner thus fashions evidentiary standards for evaluating his claim that are far easier to meet than the actual preponderant standard governing the claim.

Beyond this, the primary elements of Petitioner's theory have several deficiencies. First, scientific evidence not previously available when the TM/Tdap cases I mention above (and which Petitioner references favorably) were decided six or more years ago does not support a causal association between the Tdap vaccine and the development of TM. *Compare* Baxter (epidemiologic study published in 2017) *with Raymo*, 2014 WL 1092274, at *19 ("[t]here are no epidemiologic studies . . . linking or refuting a link between [TM] and vaccination"). Baxter is a large-scale, comprehensive epidemiological study aimed at examining the risk of demyelinating event following vaccination generally, and evaluated instances of the occurrence of two acute demyelinating diseases (TM and ADEM) within a field of nearly 64 million vaccinations (including almost *six million* Tdap recipients) derived from data maintained by the Vaccine Safety Datalink. Baxter at 1456–57. Only *seven* cases of TM were reported between 5-28 days post-vaccination—the very timeframe applicable herein. *Id.* at 1456–57. Baxter concluded that there was no reliably-demonstrated association between vaccination and the subsequent development of TM. *Id.* at 1456, 1461 ("[i]n conclusion, TM and ADEM are rarely, if ever, associated with vaccines").

Although it is unquestionably the case that Vaccine Program litigants are not *required* to offer epidemiological evidence to prevail, special masters may take note of its existence and consider it when determining if a claimant has met his burden of proof. *See Palattao*, 2019 WL 989380, at *37 (citing *D'Toile v. Sec'y of Health & Hum. Servs.*, 726 F App'x 809, 811–12 (Fed. Cir. 2018)). While I cannot state whether pre-Baxter decisions more favorable to Petitioner's theory, like *Raymo* or *Roberts,* would have been decided differently had the article existed when they were issued, *I can* take Baxter into account in this unquestionably later case—and find that it greatly damages Petitioner's causation theory.

Ironically, in this case Baxter was offered *by the Petitioner* as an exhibit to Dr. Zamvil's report—making it difficult for Petitioner to argue herein (as many petitioners do when attempting to rebut damaging epidemiologic proof) that my consideration of it amounts to "requiring" Petitioner to have found positive epidemiologic evidence to prevail. Indeed, Dr. Zamvil expressly relied on the Baxter article to support an association between TM and receipt of the Tdap vaccine.

[34] Petitioner also maintains that special masters need not "apply gatekeeping standards of reliability pursuant to *Daubert*," citing *Boatmon* for this proposition as well. Petitioner's Post-Hearing Brief at 46, *citing Boatmon*, 941 F.3d at 1359. This is correct—but only in the narrow sense that it would not be legal error if a special master fails to apply those standards. As I have already noted above, however, there is ample Federal Circuit support (cited even in *Boatmon*) for *embracing and applying* the *Daubert* standards in Vaccine Act cases, for purposes of evaluating the reliability of scientific and medical evidence (and thus what weight to give it). In the Program (unlike a federal district court), *Daubert* does not function to limit what evidence is considered by a special master—but it does provide a way to assess the trustworthiness of medical and scientific evidence, and hence the *weight* to give such evidence. I consistently follow *Daubert* in this manner when I decide Vaccine Act cases—and it is my conclusion that *I would not be performing my function adequately if I did not do so.*

Tr. at 113–16; Zamvil Rep. at 7. But his assertions regarding its findings essentially ignored what is so glaringly unfavorable about them. Thus, Dr. Zamvil attempted to redirect attention to the fact that Baxter's authors *did* find a slightly increased risk of ADEM following vaccination. Baxter at 1456 (noting eight reported cases of ADEM within 5-28 days of receiving the Tdap vaccine); Tr. at 116. *But ADEM is not the claimed injury* (and Petitioner could not establish it on the present record even if he so alleged). TM is the relevant injury—and therefore the findings in Baxter specific to TM cannot simply be ignored.

Second, the applicability of prior decisions like *Raymo*, *Roberts*, and *Helman*—all of which rely on literature similar to that offered herein, or more broadly involve theories parallel with Petitioner's theory of autoimmunity attributable to molecular mimicry—is limited by other specific aspects of their respective holdings, or diminished by more recent determinations involving the same causal theories producing TM. *See Forrest*, 2019 WL 925495, at *3 (citing *Caves v. Sec'y of Health & Hum. Servs.*, 100 Fed. Cl. 119, 135 (2011), *aff'd without opinion*, 463 F. App'x 932 (Fed. Cir. 2012)). In *Raymo*, for example, the petitioners prevailed based on a theory that the tetanus toxoid component of the Tdap vaccine can cause TM via molecular mimicry and bystander activation of IL-6—a proinflammatory cytokine which is associated with the development of TM. *Raymo*, 2014 WL 1092274, at *18, 20. The special master noted, however, that although molecular mimicry was an accepted medical/scientific explanation for many autoimmune diseases, in acute TM "homology has not been demonstrated between any suspected precipitating agent and the spinal cord nerve sheaths or axons." *Id.* at *20. The special master thus based her liability determination on the finding that the theory of bystander activation—a mechanism *not* proposed by Petitioner's experts in this case—was also a reasonable causal explanation under the circumstances. *Id.* at *20; *see also* Dr. Zamvil Rep. at 9.

The petitioners in *Roberts* similarly relied on the theory of molecular mimicry to explain how the Tdap vaccine could cause TM. *Roberts*, 2013 WL 5314698, at *6. The special master deciding that case acknowledged that petitioners' theory was supported by an expert opinion, but included no further analysis to explain *why* the theory was persuasive. *Id.* And in *Helman*, only two sentences of the special master's analysis in total are dedicated at all to the first *Althen* prong. *Helman*, 2012 WL 1607142, at *3. The special master concluded therein that the petitioner had met his burden merely by *providing* expert testimony referencing causal mechanisms such as molecular mimicry in addition to substantiating literature, though the special master did not explain what literature was provided. *Id.* No analysis explained how the Tdap vaccine can cause TM, thus greatly limiting the persuasive quality of such a determination. By contrast, and despite the fact that the decisions do not involve Tdap, more recent determinations like *Forrest* and *Pearson* constitute far more reliable guidance. These decisions in particular note the comparative weakness of case study-oriented literature like Agmon-Levin, especially when weighed against the value of Baxter.

Finally, and with the above as framework, I do not conclude that Petitioner's specific showing on the association between Tdap vaccine and TM was itself and on its own terms reliable

or robust enough to preponderantly establish the first *Althen* prong.[35] Thus, Dr. Zamvil relied on molecular mimicry—a generally accepted scientific explanation for many autoimmune diseases, to be sure, but one that cannot simply be invoked in *every* Vaccine Act claim to support causation. *Forrest*, 2019 WL 925495, at *3 (citing *Caves*, 100 Fed. Cl. at 135). Rather, petitioners must demonstrate (where they raise molecular mimicry as a possible mechanism) that it *likely does link* the vaccine in question to the relevant injury. *See Yalacki v. Sec'y of Health & Hum. Servs.*, No. 14-278V, 2019 WL 1061429, at *34 (Fed. Cl. Spec. Mstr. Jan. 31, 2019), *mot. for review den'd*, 146 Fed. Cl. 80 (2019). No such showing was made in this matter. Moreover, merely demonstrating some homology between vaccine components and relevant self-structures based on computer database searches does not carry the day. *See Pek v. Sec'y of Health & Hum. Servs.*, No. 16-736V, 2020 WL 1062959, at *16 (Fed. Cl. Spec. Mstr. Jan. 31, 2020) (citing *Blackburn*, 2015 WL 425935, at *7 n.14)).

Dr. Zamvil's assertions about the role the vaccine's alum adjuvant could play in activation of an aberrant innate response were even less reliable or persuasive. This argument relies mostly on what is known as a general matter about the performance of adjuvants in promoting an immune response—a noncontroversial assertion as far as it goes. But he has not shown, nor offered evidence in addition to his testimony, that reliably suggests or establishes that vaccines containing an aluminum adjuvant can, independent of anything else, cause a *pathologic* response not otherwise shown to be vaccine-attributable. I have previously criticized similar arguments in other cases, where petitioners try to convert what is known about a functioning immune process into something pathologic. *See, e.g.*, *Olson v. Sec'y of Health & Hum. Servs.*, No. 13-439V, 2017 WL 3624085, at *20–21 (Fed. Cl. Spec. Mstr. July 14, 2017), *mot. for review den'd,* 135 Fed. Cl. 670 (2017), *aff'd*, 758 Fed. App'x 919 (2018). The argument is no better structured or advanced in this case.

Petitioner also offered a few case reports, either collated in Agmon-Levin or contained in independent items of literature, to bulwark his causal showing. But these too also were ultimately of limited probative value—and not just for the reason that case reports generally are not given significant weight when deciding Program cases, since they do not establish causation *per se*. *See Knorr v. Sec'y of Health & Hum. Servs.*, No. 15-1169V, 2018 WL 6991548, at *30 (Fed. Cl. Spec. Mstr. Dec. 7, 2018) (citing *W.C. v. Sec'y of Health & Hum. Servs.*, No. 07-456V, 2011 WL 4537887, at *13 (Fed. Cl. Spec. Mstr. Feb. 22, 2011), *aff'd*, 704 F.3d 1352 (Fed. Cir. 2013)). Riel-

[35] Petitioner has argued that Respondent's expert, Dr. Alexander did not himself rebut Dr. Zamvil's theory, taking specific issue with Dr. Alexander's invocation of an Institute of Medicine report that purports to find no evidence associating TM with tetanus toxoid-containing vaccines like Tdap. Petitioner's Post-Hearing Br. at 49–50; Ex. A Ref. 1. My finding on the first *Althen* prong, however, is derived from a determination that *Petitioner's* showing was *itself* not preponderant—and that showing included especially damaging evidence like Baxter. I thus do not devote time herein to weighing the competing strengths and weaknesses of each side's expert contributions on this prong. Petitioners must *themselves* meet their preponderant burden, no matter the relative strength of Respondent's counter-efforts—and this was not a case where a robust showing by the Petitioner merited consideration of Respondent's success in rebutting it.

Romero, for example, not only involved a young child rather than adult like Mr. I.J. but also acknowledged that its observation of an association could simply be coincidental. Riel-Romero at 690. Agmon-Levin provided only four instances of association, and the weight this piece of literature should receive overall has reasonably been questioned. *Pearson*, 2019 WL 3852633, at *14. Other articles similarly offered limited numbers of case study instances. *See, e.g.*, Gregg at 1 (describing two case reports of TM post-vaccination); F.S. Pidcock et al., *Acute Transverse Myelitis in Childhood*, 68 Neurology 1474, 1476, 1479 (2007), filed as Ex. 55 on Sept. 13, 2019 (ECF No. 74-6) ("Pidcock") (documenting thirteen instances of TM post-vaccination). But both Pidcock and Gregg emphasize that the documented reports of post-vaccination TM could be coincidental, and neither article claims to establish a *causal* relationship between vaccination and the subsequent development of TM. Gregg at 4 (noting a possible association, but not distinguishing between temporal and causal association types); Pidcock at 1479. These case reports overall had some evidentiary value, and I have taken them into account (as my analysis should demonstrate). But they are not enough to meet the preponderant burden, especially given the far more comprehensive, contrary evidence provided by Baxter.[36]

All in all, the theory that the Tdap vaccine could cause TM was reasonably advanced in this case, as the theory has found some success in the past—but it was not preponderantly supported *herein* by *sufficient* reliable evidence, whatever the form, to find the first *Althen* prong was met.

III. Althen Prongs Two and Three

Petitioner's claim cannot succeed, given his failure to meet at least one of the three *Althen* prongs. *See Deshler v. Sec'y of Health & Hum. Servs.*, No. 16-1070V, 2020 WL 4593162, at *21 (Fed. Cl. Spec. Mstr. July 1, 2020) (citing *W.C.*, 704 F.3d at 1356)). However, for purposes of completion of my overall analysis, I will also discuss his success in meeting the other two.

Regarding the second, "did cause" prong, I find an absence of evidence that would allow me to conclude that the Tdap vaccine likely produced Petitioner's TM. Here, the inability to satisfy certain of the TM Working Group criteria (acknowledged expressly by Dr. Zamvil), while not fatal to Petitioner's diagnosis contentions, was much more harmful to this *Althen* prong showing. Thus, not only is there little evidence that Petitioner had experienced something amiss in the two week post-vaccination period, but there was hardly any testing evidence (whether from serologic sampling or MRI imaging) that would establish the existence of inflammation—a telltale sign confirming the presence of the autoimmune process that Petitioner's causation theory proposes

[36] The fact that TM specifically, or vaccine injuries generally, are rare occurrences also is no defense to the insufficient preponderant evidence offered in this case on causation. As a general matter, the Program is premised on the policy consideration that vaccination is safe for the majority of individuals, but that in order to encourage use of vaccines compensation for injuries should be permitted under specific defined circumstances. The Act thus inherently accepts that vaccine injuries are *uncommon*—but their rarity is not a shield protecting petitioners from their evidentiary obligations. Were it otherwise, claimants could prevail merely by pointing to their own individual "case study."

would have been instigated by the Tdap vaccine. The aspect of Dr. Zamvil's opinion relying on the pro-inflammatory characteristics of the alum adjuvant especially required some record confirmation of excessive or unusual inflammation post-vaccination—evidence not found in this record. There was also no evidence of any autoantibodies that might arguably be associated with the asserted TM cross-reaction. And no treaters ever proposed that Petitioner's injury, however defined, was likely caused by his prior Tdap vaccine. At most, the record reveals instances in which treaters assumed Petitioner had received a *different* vaccine (Hepatitis B) that they believed could be associated with TM—but in some of these instances went on to opine that vaccine causation was less likely than infarction given the diagnostic study results. *See, e.g.*, Ex. 2 at 8, 61, 92, 230–31, 245–47. There is thus insufficient support in the record for the conclusion that the Tdap vaccine could have caused Petitioner's TM.

I additionally observe that the medical record suggests the existence of a pre-onset intercurrent respiratory infection. Ex. 2 at 8. It is recognized that infection can be the instigating cause of TM—and the presence of such an infection has in other cases been held to possibly explain various demyelinating conditions. *See, e.g.*, *Deshler,* 2020 WL 4593162, at *18 (two-thirds of GBS cases follow an antecedent infection); *Palattao*, 2019 WL 989380, at *38 (evidence that infant had upper respiratory infection prior to onset of TM undercut vaccine causality). The evidence to support this alternative explanation is not itself particularly robust (certainly no infectious agent was identified in testing), and I do not propose that it establishes a stronger explanatory case than what Petitioner offered, or that (had the burden shifted to Respondent) it was preponderantly established as an alternative cause. But it *is* additional evidence that was not fully explained or distinguished by Petitioner, and thus it also undermined somewhat Petitioner's claim. *See Deshler,* 2020 WL 4593162, at *22.

By contrast, I find the record and evidence offered in this matter *does* support the conclusion that Petitioner's TM occurred in a medically acceptable timeframe, consistent with his causation theory. As noted above, Petitioner asserts that his symptoms began just over two weeks after his receipt of the Tdap vaccine—a timeframe which has consistently been deemed medically appropriate in cases involving demyelinating conditions, including TM, following vaccination. *See, e.g.*, *Raymo*, 2014 WL 1092274, at *23 (onset of TM three to four days after receipt of the Tdap vaccine); *Schmidt v. Sec'y of Health & Hum. Servs.*, No. 07-020V, 2009 WL 5196169, at *14 (Fed. Cl. Spec. Mstr. Dec. 17, 2009) (onset of TM one month after receiving the flu vaccine falls within a medically acceptable timeframe). The onset timeframe was also consistent with Dr. Zamvil's persuasive testimony about the time it would take for a molecular mimicry-driven process to manifest neurologic harm. But because Petitioner's causation theory in this case was not sufficiently supported with preponderant evidence, the consistency of the onset timing in this case with Petitioner's theory does not aid Petitioner.

CONCLUSION

Mr. I.J. was an engaging and highly sympathetic witness, and he plainly brought this case in the good-faith belief that the Tdap vaccine he had received might be related to his subsequent and sudden debilitating symptoms. He deserves praise for his aplomb in handling the deficits his condition has imposed on him. Petitioner unquestionably has marshalled credible support for his claim. And although it remains uncertain what his actual diagnosis should be, he has carried his burden (albeit in a close case) of establishing that he more likely than not experienced TM.

But the Vaccine Act permits me to award compensation to a petitioner alleging a "non-Table Injury" only if he can show by medical records or competent medical opinion that the injury could be, or was, vaccine-caused. And on these matters, the evidence is far less close, as even some of the proof Petitioner himself offered undercuts his *Althen* prong one showing. Thus, there is insufficient evidence to support an award of compensation, leaving me no choice but to hereby **DENY** this claim.

In the absence of a motion for review filed pursuant to RCFC Appendix B, the clerk of the court **SHALL ENTER JUDGMENT** in accordance with the terms of this decision.[37]

IT IS SO ORDERED.

/s/ Brian H. Corcoran
Brian H. Corcoran
Chief Special Master

[37] Pursuant to Vaccine Rule 11(a), the parties may expedite entry of judgment if (jointly or separately) they file notices renouncing their right to seek review.