APPENDIX "A": The Evolution in SBS Understanding

1. The Original Hypothesis

In 1962 a Dr. Henry Kempe wrote a very influential article identifying characteristics of "battered" children. *The Battered-Child Syndrome,* 181 J. AM.MED. ASS'N 17. He listed several physical injuries that, particularly when more than one was present, were suspicious for child abuse. Most were fairly common sense – broken bones in babies, soft tissue swelling, bruises. Also on his list was subdural hematoma -- a pooling of blood between the brain itself and the protective dura layer, which Dr. Kempe identified as often a trauma-induced injury.

In 1971, Dr. A. Norman Guthkelch, who was the first pediatric neurosurgeon in England, wrote an article that questioned why infants who presented with subdural hematoma and who he suspected had been abused, nevertheless did not have any sign of trauma to their heads. Guthkelch, *Infantile Subdural Haematoma and its Relationship to Whiplash Injuries*, 2 BRIT.MED. J. 430 (1971). He cited a biomechanical study by a Dr. Ommaya that Dr. Guthkelch described as recording "two well-documented cases of subdural haematoma, in both of which the subject sustained a whiplash injury to the neck as a result of an automobile accident, the head itself not being [impacted] at all." (*Id.* at 430). He also discussed two patients of his that had subdural hematomas yet no sign of head trauma -- in one the mother said she had shaken her infant when he was having a coughing fit and she feared he was choking; in the other, the infant had grip marks and the mother said that she "might have" shaken him when he cried at night. (*Id*. at 431). From the Ommaya study and his two case reports, he hypothesized that infants could

sustain whiplash-type injuries, including subdural hematoma, from being violently shaken.

In 1972 and 1974, a prominent American pediatric radiologist and textbook author named John Caffey published two articles, respectively entitled: *On the Theory and Practice of Shaking Infants: Its Potential Residual Effects of Permanent Brain Damage and Mental Retardation*, 124 AMER. J. DIS. CHILD. 161 (1972), and *The Whiplash Shaken Infant Syndrome: Manual Shaking by the Extremities With Whiplash-Induced Intracranial and Intraocular Bleedings, Linked With Permanent Brain Damage and Mental Retardation*, 54 PEDIATRICS 396 (1974). In the first article, Dr. Caffey collected 27 instances of what he deemed "convincing" examples of children who had suffered brain injury as a result of shaking. In the second article, Dr. Caffey cited his previous data and the same Ommaya study that Guthkelch cited for the proposition that shaking infants could cause subdural hemorrhage. In addition to causing subdural hemorrhage, he speculated that shaking damaged capillaries within the retina, which explained why retinal hemorrhages often were seen in children he thought to have been shaken. Although he admitted that his data set was "meager" and "manifestly incomplete," he broadly concluded that the evidence "indicates that manual whiplash shaking of infants is a common primary type of trauma in the so-called battered infant syndromes. It appears to be the major cause in these infants who suffer from subdural hematomas and intraocular bleedings." 54 PEDIATRICS at 402.

Dr. Caffey ended his article by calling for a "nationwide educational campaign" that he said could be summarized by the following stanza:

> Guard well your baby's precious head,
> Shake, jerk and slap it never,
> Lest you bruise his brain and twist his mind,
> Or whiplash him dead forever.

Id. at 403.

2. SBS Rapidly Becomes A Well-Accepted Medical Diagnosis

Notwithstanding that Dr. Caffey reached his conclusions on an evidence base that even he acknowledged was meager, but propelled by a nationwide campaign highlighting the dangers of shaking infants, the SBS diagnosis rapidly gained acceptance in medical circles. *See* Uscinski, *Shaken Baby Syndrome: An Odyssey*, 46 NEUROL.MED. CHIR. 57 (2006) ("Nonetheless, the mechanism of shaking and the so named syndrome gained immediate acceptance and enormously widespread popularity, with no real investigation or even question as to its scientific validity."); Immwinkelried, *Shaken Baby Syndrome: A Genuine Battle of the Scientific (and Non-Scientific) Experts*, 46 CRIM. BULL. 1, (Jan.-Feb. 2010) ("In a relatively short time after Caffey's enunciation of the theory, the theory became widely accepted in both medical and legal circles."). SBS was not always defined consistently in the literature -- for example, it often was applied in cases where there was evidence of impact to the head as well as in cases where there was not. But the general theory was as expressed at Havard's trial -- i.e., shaking caused the brain to move within the skull, which, in turn, caused bridging veins overlying the brain to rupture and tear, which, in turn, caused blood to form within the subdural area between the brain and the overlying protective dura. Consistent with Dr. Caffey's hypothesis, the same

acceleration-deceleration mechanism was assumed to cause capillaries within the retina to shear and hemorrhage.

By the early 1990s, SBS -- a diagnosis that an infant who presented with subdural hemorrhage, retinal hemorrhages and no "adequate" explanation for such allegedly traumatic injuries presumptively had been violently shaken or slammed – was an entrenched diagnosis within the medical community. *See* Turkheimer, *The Next Innocence Project: Shaken Baby Syndrome and the Criminal Courts*, 87 WASH. U.L. REV. 1, 3-4 (2009). Because SBS, by its very definition, is a diagnosis of violent shaking, it basically also is a diagnosis of child abuse. Consequently, if the baby died, an SBS diagnosis is, in essence, "a medical diagnosis of murder." Turkheimer, 87 WASH. U.L. REV. 1, 5.

As the SBS diagnosis became more and more entrenched, SBS-based prosecutions and child protective services proceedings became common. By 2000, a National Center for Shaking Baby Syndrome led by a board of prominent physicians had been established to host conferences, distribute educational literature, train law enforcement officers, and support prosecutors in SBS cases. *See* Turkheimer, 87 WASH. U.L. REV. 1, 29. Manuals were published to guide prosecutors in SBS cases, citing Holmgren, *Prosecuting the Shaken Infant Case* in THE SHAKEN BABY SYNDROME: A MULTIDISCIPLINARY APPROACH 307 (2001) (providing prosecutors with ideas for physician testimony such as: the "expert can testify that the forces the child experiences [from shaking] are the equivalent of a 50-60 m.p.h. unrestrained motor vehicle accident,

or a fall from 3-4 stories on a hard surface").[1] Thousands have been convicted. Turkheimer, 87 WASH. U.L. REV. 1, 9-10.

3. SBS Reaches Peak Acceptance, Then Slowly Starts to Unravel

Over the last decade, opposition to SBS has grown from a trickle to a virtual avalanche. The summary below provides a snapshot of this development:

2001

"The shaking hypothesis . . . was seemingly accepted as settled science in 2001 in two documents: a position paper from the National Association of Medical Examiners and an updated position statement from the American Academy of Pediatrics (AAP)." Lloyd, et al., *Biomechanical Evaluation of Head Kinematics During Infant Shaking Versus Pediatric Activities of Daily Living*, 2 J. FORENSIC BIOMECHANICS 1 (2011). The AAP position statement endorsed SBS and suggested that child abuse be presumed whenever a child presented younger than 1 year with intracranial injury and retinal hemorrhages. The paper from the National Association of Medical Examiners (NAME) also endorsed SBS as a reliable diagnosis.

Without dissent, numerous court decisions around the country at this point in time recognized SBS as a valid scientific theory upon which convictions could be sustained. *See, e.g., State v. Sayles*, 662 N.W.2d 1 (Iowa 2003) (both prosecution and defense medical experts agreed baby died from SBS; defense merely challenged timing); IND. CODE § 16-41-40-2 (providing for the admissibility of SBS testimony). In the 1980s and

[1] Testimony that is strikingly similar to that provided by Dr. Hayne at Havard's trial. Tr. at 557.

1990s, dozens of articles presuming the existence, validity and reliability of the SBS diagnosis filled the medical literature.

While SBS acceptance was at its zenith in 2001, hindsight reveals that the foundations for subsequent challenges to the SBS dogma were published that same year, though they were unquestionably outside of the mainstream. These were fringe opinions that were not widely accepted.

In 2001, Dr. Jennian Geddes, a British neuropathologist, published two papers after studying the brains and eyes of infants who allegedly were the victims of non-accidental head injury, including shaking. In one of the papers, she observed that the subdural hemorrhage and brain findings in infants who died of natural causes appeared to be virtually indistinguishable from the findings in cases of allegedly abused children. *Neuropathology of Inflicted Head Injury in Children I*, 124 BRAIN 1290. In the other, she noted that, although it was assumed in SBS cases that a particular kind of shearing brain injury occurred that was, by definition, traumatic, she found no such evidence of such shearing injury in studying the brains of babies thought to have been SBS victims. She concluded that the beliefs that shaking directly caused the triad (subdural hemorrhage, retinal hemorrhage and edema) "require fresh examination." *Neuropathology of Inflicted Head Injury in Children II*, 124 BRAIN 1299.

At the time, Geddes' work was vilified as unreliable by the child abuse protection community. *See* Block, *Letter to the Editor*, 113 Pediatrics 432 (Feb. 1, 2004) (criticizing Geddes' work and her "totally unfounded opinions not supported by published data other

than her own"); Lucey, *Editor Reply* (Feb. 1, 2004) (referring to Geddes' related articles as "junk science").

Also in 2001, John Plunkett, a forensic pathologist in Minnesota, published *Fatal Pediatric Head Injuries Caused By Short-Distance Falls*, 22 AM. J. FORENSIC MED. PATH. 1. In that article, Dr. Plunkett addressed common courtroom testimony that the triad could not be caused by falls unless the falls were from greater than 10 feet. Based on case data from the Consumer Product Safety Commission, he described multiple witnessed short falls that resulted in some or all of the triad injuries, including a **videotaped** fatal fall of a 23 month-old toddler from a plastic gym set (28 inches high) in the carpet-covered garage of her home. The child cried and talked after the fall, but soon vomited, became stuporous, and eventually died. The hospital findings included the SBS symptoms of subdural hemorrhage, retinal hemorrhage and cerebral edema -- all from a 28-inch fall.

2002

In 2002, Dr. Ayub Ommaya and heavyweight co-authors in the field of biomechanics published a lengthy article titled *Biomechanics and Neuropathology of Adult and Paediatric Head Injury*, 16 BRIT. J. NEUROSURG. 220.

Biomechanical engineers, unlike most medical doctors, study the exertion of forces on the human body and the body's tolerances to such forces. In their article, Dr. Ommaya and his co-authors explained that Dr. Ommaya's earlier whiplash study, the one that Guthkelch and Caffey cited in their seminal papers on SBS, had involved not infants, but adult rhesus monkeys. The monkeys had not been shaken, but instead had been

strapped in collision carts and impacted at various speeds from the rear in an effort to gauge human thresholds to whiplash injury in car accidents. (*Id.* at 221-22). They further explained that the Ommaya study actually shown that subdural hemorrhage was caused far more easily by impact to the head than by whiplash and they suggested that the study had been misinterpreted by Guthkelch and Caffey in citing to it as scientific support for SBS. (*Id*.)

With respect to their views on SBS itself, they reasoned that they would expect to see soft tissue injury to the neck as well as spinal injury in any case of shaking sufficient to cause subdural and retinal hemorrhage. (*Id*. at 222). On the subject of retinal hemorrhages, they were directly critical of SBS theory, stating that the "hypothesis" of "retinal hemorrhage caused by orbital shaking has not been tested experimentally" and the "levels of force required for retinal bleeding by shaking to damage the eye directly is biomechanically improbable." (*Id*. at 233).

2003

In about 1999, the medical community embraced a movement to ensure that medical practice was based on the best available medical and scientific evidence, as opposed to overreliance on anecdote and historical practice. This movement was known as the Evidence-Based Medicine (EBM) movement, and it developed repeatable criteria to gauge the evidentiary basis for medical practices and opinions, with Level I being the highest/most reliable evidence and Level IV the lowest/least reliable.

In a 2003 article, Dr. Mark Donohoe classified the medical and scientific SBS literature through 1998 against EBM standards. His conclusions were startling. Although

there were 55 published articles on SBS, none exceeded Level III-2 by the end of 1998, "which means that there was inadequate scientific evidence to come to a firm conclusion on most aspects of causation, diagnosis, treatment, or any other matter pertaining to SBS." *Evidence-Based Medicine and Shaken Baby Syndrome Part I: Literature Review, 1966-1998*, 24 AM. J. FORENSIC MED. PATH. 239, 241 (2003). Dr. Donohoe concluded that "there was an urgent need for properly controlled, prospective trials into SBS, using a variety of controls. Without published and replicated studies of that type, the commonly held opinion that the finding of SDH and RH in an infant was strong evidence of SBS was unsustainable, at least from the medical literature." (*Id*.).

2004

Over time, as more literature confirmed cases of retinal hemorrhages in a wide variety of circumstances where no abuse had occurred, SBS advocates increasingly began to claim that, although retinal hemorrhages may be found in circumstances unrelated to abuse, certain types of ocular or retinal hemorrhage were virtually always diagnostic for abuse. In 2004, however, Dr. Patrick Lantz published a case report finding perimacular retinal folds, retinal and optic sheath hemorrhage -- findings that previously had been considered diagnostic of SBS/abuse -- in a child hurt when a television tipped over and hit him on the head. Lantz, et al., *Evidence Based Case Report: Perimacular Retinal Folds from Childhood Head Trauma*, 328 BR.MED. J. 754. Although the article involved a single case, Dr. Lantz reviewed the existing literature that claimed such ocular findings were diagnostic of SBS and concluded that the literature suffered from the same systemic deficiencies noted by Dr. Donohoe with respect to SBS in general.

In a Letter to the Editor of the journal Pediatrics written the same year, Dr. Lantz stated that the "vested dogma" that the trauma of shaking causes retinal hemorrhages "is a faith-based assumption, not a scientific fact." Lantz, *Junk Science and Glass Houses*, 114 PEDIATRICS 330 (2004).

2005

As noted, in 2002 Dr. Ommaya and his co-authors had suggested that it was improbable that one could shake an infant hard enough to cause intracranial injuries without also causing significant neck and spinal injuries. In 2005, Dr. Faris Bandak, a biomechanical engineer, published a study after investigating that exact hypothesis. Dr. Bandak's study confirmed that the levels of force required to shake a healthy infant hard enough to produce subdural injury would in fact exceed the tolerance of the infant neck, causing near or total neck failure. *Shaken Baby Syndrome: A Biomechanics Analysis of Injury Mechanisms*, 151 FORENSIC SCI. INT. 71, (2005) ("Head acceleration and velocity levels commonly reported for SBS generate forces that are far too great for the infant neck to withstand without injury."). His article thus seriously called into question the assumption that shaking alone could cause the triad of injuries associated with SBS, at least without significant neck or spinal injury. This was a critical study, because such neck and spinal findings are conspicuously absent in SBS cases, including the case of Chloe Britt.

As these evidence-based contributions to the medical and scientific literature began to build, SBS advocates dismissed them as failing to acknowledge the literature establishing that a multitude of caretakers over the years had confessed to causing the

child's injuries through violent shaking. Perpetrator confessions, the SBS advocates contended, proved the validity of the diagnosis. But when Dr. Jan Leetsma, a neuropathologist at the Children's Memorial Hospital at Northwestern University closely examined the so-called SBS confession literature, he found that in the vast majority of the "confession" cases there was clear evidence of impact injury to the head -- i.e., the child's injuries likely had not been caused by shaking at all or, at least, were likely partially attributable to an impact. He found that the confession literature only recorded 11 "pure" shaking cases and several of those were questionable because no details were given about the degree of shaking, for how long, or about the circumstances surrounding the confession. For example in some of the cases where the caretaker admitted shaking the infant, it turns out the "admission" was of bouncing the baby during play or attempts to revive the baby when it was found unconscious.[2] Leestma, *Case Analysis of Brain Injured, Admittedly Shaken Infants*: *54 Cases*, 26 AM. J. FORENSIC MED. PATH. 199 (2005) (App. Tab 50). Dr. Leestma concluded that "confessions" did not provide an adequate basis to establish the reliability of the SBS diagnosis.

2006

In 2006, the National Association of Medical Examiners officially withdrew its 2001 position paper on SBS. At its annual meeting, presentations were made with titles such as *"Where's the Shaking?: Dragons, Elves, the Shaken Baby Syndrome and Other Mythical Entities"* and *"The Use of the Triad of Scant Subdural Hemorrhage, Brain*

[2] In Havard's case, the State repeatedly draws emphasis to a similar "confession," when Jeffrey stated under police questioning that he "shook her, but not hard" after she fell and struck the toilet. Havard Interview Transcript at pp. 5-6, 12.

Swelling, and Retinal Hemorrhages to Diagnose Non-Accidental Injury Is Not Scientifically Valid."

In a follow-up to his article the year before on confessions, Dr. Leestma lamented that the medical community's acceptance of SBS theory had resulted in a lack of studies into other potential causes of the SBS triad of findings:

> It should be apparent that from virtually every perspective many flaws exist in the theory that shaking is causative. No case studies have ever been undertaken to probe even a partial list of possible confounding variables/phenomena, such as the presence of intracranial cysts or fluid collections, hydrocephalus, congenital and inherited diseases, infection, coagulation disorders and venous thrombosis . . . or recent or remote head trauma. Until and unless these and probably many more factors are evaluated, it is inappropriate to select one mechanism only and ignore the rest of the potential causes.

Leestma, *"Shaken Baby Syndrome": Do Confessions by Alleged Perpetrators Validate the Concept*, 11 J. AM. PHYS. AND SURGEONS 14, 15-16 (2006).

2007

Echoing Dr. Leestma's call for greater consideration and investigation into other conditions that would mimic the SBS findings, Dr. Patrick Barnes compiled and published a lengthy paper that included a five-page summary of known non-traumatic causes that mimicked SBS. Barnes, et al., *Imaging of the Central Nervous System in Suspected or Alleged Nonaccidental Injury, Including the Mimics*, 18 TOP MAG RESON IMAGING 53.

2008

Despite these advances in the medical and scientific literature that served to undermine SBS theory, SBS prosecutions continued seemingly unabated, with at most

passing recognition that the SBS theory had become at all controversial. An abrupt change came in 2008.

In Ontario, Canada, there had been several documented, publicized instances of mistakes, wrongful accusations and even wrongful convictions in childhood death cases in Ontario, with a particular focus on cases involving the Hospital for Sick Children, in Toronto. This led the Ontario government to establish The Inquiry Into Pediatric Forensic Pathology in Ontario. Ontario Court of Appeals Justice Stephen Goudge was appointed as its Commissioner. Commissioner Goudge held hearings and gathered evidence for more than a year before issuing his several hundred page Report on October 1, 2008. Goudge, INQUIRY INTO PEDIATRIC FORENSIC PATHOLOGY IN ONTARIO – REPORT Volume 3 – Policy and Recommendations [3](2008).

The Goudge Report observed that "one of the deepest controversies surrounding pediatric forensic pathology concerns shaken baby syndrome." (*Id*. at 527). The Report noted the "evolution in forensic pathology in this area" had progressed such that **"the predominant view is no longer that the triad on its own is diagnostic of SBS. Instead, the issue is fraught with controversy."** (*Id.* at 528 (emphasis added)). The Report went on to conclude that "our systemic examination has identified this particular area of forensic pathology as one where change has raised the real possibility of past error." (*Id.* at 531). Commissioner Goudge called for a review of SBS convictions from 1986-2006 because **"[t]he significant evolution in pediatric forensic pathology relating to shaken**

[3] This is a four volume document. In order to avoid unnecessarily bulking up the record, Havard is only including the volume pertinent to the issue stated. If the Court desires the entire document, it can be made a part of the record.

baby syndrome" and "the concern that, in light of the change in knowledge, there may have been convictions that should now be seen as miscarriages of justice." (*Id.* at 533) (emphasis added)). Ontario undertook that review.

Also in 2008, the Wisconsin Court of Appeals granted post-conviction relief to a woman who had been convicted in 1996 of murdering an infant in her care. *Wisconsin v. Edmunds*, 746 N.W.2d 590 (Wis. Ct. App. 2008). The court did so because "a significant and legitimate debate in the medical community has developed in the past ten years over whether infants can be fatally injured through shaking alone . . . and whether other causes may mimic the symptoms traditionally viewed as indicating shaken baby or shaken impact syndrome." *Id*. at 596. The *Edmunds* case is discussed further in Havard's original Motion and herein.

2009

The Committee on Child Abuse and Neglect of the American Academy of Pediatrics has long been dominated by staunch SBS advocates. In 2009, the Committee nevertheless felt compelled to update its 2001 policy statement, reasoning that "advances in the understanding of the mechanisms and clinical spectrum of injury associated with abusive head trauma compel us to modify our terminology to keep pace with our understanding of pathologic mechanisms." Christian, et al. *Abusive Head Trauma in Infants and Children, Committee on Child Abuse and Neglect, News From the Field* (June 2009). The Committee continued to insist that the confession literature supported shaking as a mechanism of injury, but nevertheless recommended that physicians use the

term "abusive head trauma" (AHT) rather than Shaken Baby Syndrome, a tacit admission that the SBS diagnosis and mechanism of shaking had become highly controversial.

2010

By 2010, a debate was raging about SBS, yet there was growing consensus that: (1) brain swelling previously thought attributable to neurons sheared from shaking actually was the result of hypoxia (lack of oxygen to the brain)[4] from whatever cause and (2) there are many non-traumatic causes of subdural hemorrhage. But SBS (now "AHT") advocates insisted that retinal hemorrhages are a reliable marker of child abuse, particularly if they were multi-layered, extended out to the ora serrata and/or were accompanied by optic nerve sheath hemorrhage. The retinal hemorrhage hypothesis was severely undermined in February 2010.

Unlike most medical examiner's offices, the Dallas Medical Examiner's Office routinely removed eyes from corpses for evaluation by consulting ophthalmologic pathologists. In order to assess the hypothesis that certain eye findings were associated with child abuse and SBS, the office studied the eyes and records in cases involving deceased children. On February 24, 2010, Dr. Evan Matshes reported on the study. He explained that "[f]or many years, the dogma of pediatric forensic pathology was 'retinal and optic nerve sheath hemorrhages are pathognomonic of abusive head injury,' including shaken baby syndrome. Growing controversy surrounding the existence of SBS led to questioning of that dogma." *Retinal and Optic Nerve Sheath Hemorrhages Are Not*

[4] In Havard's case, Chloe Britt was oxygen-deprived for a significant amount (approximately 45 minutes to 1 hour) of time between when her mother discovered her blue and not breathing and when she was successfully intubated at the hospital.

Pathognomonic of Abusive Head Injury, AMERICAN ACADEMY OF FORENSIC SCIENCES (Feb. 24, 2010). The study revealed that retinal hemorrhages are commonly found in natural and accidental deaths, as well as homicides, and identified a statistically significant relationship between retinal and optic nerve sheath hemorrhage and the restoring of a perfusing cardiac rhythm following advanced life support and cerebral edema, regardless of etiology. In other words, where there is hypoxia, increased intracranial pressure and prolonged resuscitation efforts, retinal hemorrhages of all kinds follow; such hemorrhages are not diagnostic of nor caused directly by shaking. The study concluded that eye evaluations are of "limited value" in child death investigations. (*Id*.).

In 2010, Rubin Miller, a biomechanical engineer, and Marvin Miller, a pediatrician and geneticist, published an article that noted that male babies were diagnosed as victims of SBS and traumatically inflicted brain injury much more frequently than females. *Overrepresentation of Males in Traumatic Brain Injury of Infancy and in Infants with Macrocephaly: Further Evidence that Questions the Existence of the Shaken Baby Syndrome*, 31 AM. J. FORENSIC MED. PATH. 165 (App. Tab 53). The authors also noted that by a very similar margin male babies more frequently suffered subdural hemorrhage from non-SBS causes. The authors strongly criticized the evidentiary basis for SBS and explained why male babies can be expected to suffer intracranial bleeding from non-traumatic causes. They recommended that less focus be given to trying to support the failed SBS construct.

2011

Dr. Waney Squier is a neuropathologist and lecturer at Oxford. In a 2011 article she reviewed the status of the SBS science. Squier, *The "Shaken Baby" Syndrome: Pathology and Mechanisms*, ACTA NEUR. 1 (Sept. 24, 2011). Many of her findings bear directly on this case:

SBS Is Not Proven By Either Confessions or Witnessed Shakings

The SBS literature contains only three published reports of witnessed shakings. All three infants were already collapsed before the shaking event. (*Id*. at 2). Despite clear evidence in the literature that confessions are not reliable basis for validating SBS, SBS advocates, as the State in this case, nonetheless continue to rely heavily on such "confessions" as "proof" of the shaking hypothesis. (*Id*. at 3).

· ***Shaking Does Not Generate Enough Force to Cause Intracranial Injury***

Biomechanical tests done over the course of nearly two decades have confirmed that the forces generated by shaking are: (1) insufficient to cause whiplash intracranial injury and (2) less than those the head endures from an impact after a short fall Accordingly, "shaking is no longer a credible mechanism" for the SBS findings. (*Id*. at 2-3).

· ***There Are Many Non-SBS Causes of SBS Symptoms***

The differential diagnosis of a baby presenting with the SBS triad is now "wide." It includes alternative explanations that "are often overlooked," particularly cortical vein and/or sinus thrombosis (CVT). (*Id*. at 3, 15-17, 19). CVT often presents with symptoms such as "lethargy, poor feeding, vomiting or seizures." (*Id*. at 17).

Similarly, physicians often fail to diagnose early non-traumatic subdural bleeding (from whatever cause) because the symptoms are "non-specific," such as vomiting, irritability, progressive enlargement of the head and, "ultimately, a seizure." (*Id*. at 10).

· ***Retinal Hemorrhages Are Not A Reliable Marker of SBS***

"An important and almost invariably overlooked part of the clinical history in babies presenting with the triad is a prolonged period of hypoxia, often 30 min or more between the baby being found collapsed and arriving in hospital and receiving advanced resuscitation. . . . Prolonged hypoxia and resuscitation have been shown to be significantly associated with retinal hemorrhages and may also explain the [brain injury] in babies with the triad." (*Id*. at 9). In Havard's case, Chloe Britt had a period between 45 minutes to one hour of hypoxia and received prolonged advanced resuscitation, including multiple CPR efforts from her mother and multiple attempts at intubation by emergency room medical providers.

All aspects of intraocular hemorrhage have been shown to occur without shaking. Natural diseases greatly outnumber inflicted injury in association with retinal hemorrhages in infants under 1 year of age. (*Id*. at 12). Studies confirm that physicians check for retinal hemorrhages far more often when they suspect child abuse than when they do not. (*Id*. at 11-12).

Importantly, the literature and studies that Dr. Squier cited in support of these propositions all were published after Jeffrey Havard was accused of homicide and after his trial.

4. Even for Most SBS Advocates, the Approach Has Changed

The preceding sections document the dramatic change in understanding about SBS. That debate has had a particular, very practical consequence that merits highlighting against the backdrop of Chloe Britt's death and Havard's related conviction and death sentence.

Even among most steadfast SBS believers, there has been a move away from SBS as a "rule-in" diagnosis – if you find the triad, it is SBS unless proven otherwise -- to a "rule out" diagnosis -- it is SBS only if all other potential causes are thoroughly explored and can be ruled out. In 2002, however, the "rule-in" approach clearly ruled. Thus, consistent with the practice then, medical providers and Dr. Hayne did not extensively pour over Chloe's medical records, did not involve a neuropathologist or an ophthalmologist, and did not make any meaningful effort to determine whether Chloe's past medical history might give a clue as to symptoms that were assumed to be related to SBS. There is no evidence they were provided with or even considered Havard's description of the accidental short fall onto a hard surface. The record demonstrates that they saw retinal and subdural hemorrhage and reached a firm conclusion of SBS without considering any other alternatives. In his post-mortem evaluation, Dr. Hayne did the same.