THE HONORABLE JAMES W

Date of Hearing: June 1, 2022 @ 9:00 a.m.

IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON, LEWIS COUNTY

SCOTT HAMILTON, as guardian ad litem for Z.H., Plaintiffs, vs. LINDA AMONDSON-MULLER, Personal Representative of the ESTATE of LAURA HAMILTON, Defendants.	NO. 20-2-00543-21 DECLARATION OF SUSAN MACHLER IN SUPPORT OF PLAINTIFF'S MOTIONS *IN LIMINE*

SUSAN MACHLER, under penalty of perjury under the laws of the State of Washington, makes the following declarations:

1. My name is Susan Machler, and I am competent to testify to matters contained herein. I am one of the attorneys of record in the above-entitled case.

2. Attached hereto as Exhibit 1 is a true and correct copy of an email from defense counsel dated April 29, 2022.

3. Attached hereto as Exhibit 2 is a true and correct copy of the deposition transcript of Linda Amondson-Muller.

4. Attached hereto as Exhibit 3 are true and correct excerpts from the deposition transcript of Dr. Michael Freeman.

OSBORN MACHLER
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5. Attached hereto as Exhibit 4 is the amicus brief filed by David Heller.

6. Attached hereto as Exhibit 5 are true and correct excerpts from the deposition transcript of Edith Gurewitsch Allen, M.D.

7. Attached hereto as Exhibit 6 are true and correct excerpts from the deposition transcript of Robert Allen, Ph.D.

8. Attached hereto as Exhibit 7 are true and correct excerpts from the deposition transcript of Robert DeMott, M.D.

Dated this 19th day of May, 2022, at Seattle, Washington.

Susan Machler

OSBORN MACHLER
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CERTIFICATE OF SERVICE

The undersigned hereby certifies under penalty of perjury under the laws of the State of Washington that I caused the foregoing to serve upon the following in the manner indicated below:

Attorneys for Defendant:

Donna Moniz
925 4th Ave, Ste. 2300
Seattle, WA 98104

☐ Via Electronic Filing
☐ Via Legal Messenger
☐ Via U.S. Mail
☒ Via E-Mail: monizd@jgkmw.com; vasquezb@jgkmw.com; randp@jgkmw.com; sproulj@jgkmw.com
☐ Via Fax:

Dated this 20th day of June, 2022 at Seattle, Washington.

Jenine Michaelis

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EXHIBIT 1

Susan Machler

From: Donna Moniz <monizd@JGKMW.com>
Sent: Friday, April 29, 2022 10:54 AM
To: Austin Neff; Jenine Michaelis; Pierce Rand; Jennifer Sproul; Monica Welch
Cc: Susan Machler; Sim Osborn
Subject: RE: Hamilton v. Hamilton personal representative deposition

Austin,

Your position is disingenuous. As you know, act of God is a know legal defense. It was clarified in our answer and in discovery responses to specify the natural forces of labor. This is what has been discussed by most of the experts for both sides and was affirmed as a legitimate medical and legal theory in the LM v Hamilton case. Laura Hamilton was a devout Christian. However, religious questions to our expert or the personal representative are not appropriate. I urge you to reconsider the scope of questioning in order to avoid having to recess the deposition to get the court's ruling on this or other matters.

Donna

From: Austin Neff <ANeff@osbornmachler.com>
Sent: Tuesday, April 26, 2022 11:04 AM
To: Donna Moniz <monizd@JGKMW.com>; Jenine Michaelis <jmichaelis@osbornmachler.com>; Pierce Rand <randp@JGKMW.com>; Jennifer Sproul <sproulj@JGKMW.com>; Monica Welch <WelchM@JGKMW.com>
Cc: Susan Machler <Smachler@osbornmachler.com>; Sim Osborn <sosborn@osbornmachler.com>
Subject: RE: Hamilton v. Hamilton personal representative deposition

Donna,

"Act of God" is not commonly understood to mean caused by a natural force. That is an esoteric definition learned in law school or while working for insurance companies. The Estate either knew or should have known the meaning and significance the invocation of God's name would mean to a jury in Lewis County, a community of faith. Ms. Amondson-Muller is the personal representative for the Estate of Laura Hamilton. We intend to ask her about her decision to assert this affirmative defense and the basis therefore.

We also intend to ask Ms. Amondson-Muller if it is her understanding that recovery in this case is limited to funds available under the applicable insurance policy. Other than that, do not intend to ask questions about the assets or value of Laura Hamilton's estate.

Again, since the defense is raising this issue, it is incumbent upon the defense to articulate their concerns. Plaintiffs have now addressed concerns regarding elicitation of privileged testimony, the act of God defense, and questions about the assets of the estate. You are not entitled to advanced notice regarding the topics of a discovery deposition; however, plaintiffs are more than willing to address any additional concerns you can articulate. We object to your attempted reservation of the right to recess the deposition given the fact you seem unable or unwilling to articulate any additional concerns.

Austin Neff | Attorney
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EXHIBIT 2

SUPERIOR COURT OF WASHINGTON, LEWIS COUNTY

SCOTT HAMILTON, as guardian ad litem for Z.H., Plaintiff, vs. LINDA AMONDSON-MULLER, Personal Representative of the Estate of Laura Hamilton, Defendant.	) 20-2-00543-21

REMOTE DEPOSITION UPON ORAL EXAMINATION OF

LINDA AMONDSON-MULLER

11:00 a.m.

MAY 2, 2022

SEATTLE, WASHINGTON

(Via Zoom)

REPORTED BY: ELEANOR J. MITCHELL, RPR, CCR 3006

A P P E A R A N C E S

FOR THE PLAINTIFF:

(Appearing Remotely)

AUSTIN J. NEFF
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FOR THE DEFENDANT:

(Appearing Remotely)

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ALSO PRESENT: NONE

I N D E X

SEATTLE, WASHINGTON; MAY 2, 2022

11:00 a.m.

--oOo--

(Deposition Exhibits 1, 2, and 3 were marked for identification.)

(Proceedings began at 11:00 a.m.)

LINDA AMONDSON-MULLER,

sworn as a witness by the Certified Court Reporter, appearing remotely, testified as follows:

EXAMINATION

BY MR. NEFF:

Q. Good morning, Ms. Amondson-Muller.

A. Good morning.

Q. We just met, but I'm Austin Neff. I represent the Hamiltons, the plaintiffs in this case. You just talked with Eleanor about some of the rules of a deposition, but I'm going to touch on them one more time.

The number one rule is just let the other person finish speaking before you start speaking. So when I'm asking a question, please do your best to let me finish that question before you provide an answer.

If you're providing an answer, I'll try my best to let you finish your answer before I ask another question. Okay?

A. Yes.

Q. And you have to answer audibly, right? Because Eleanor is taking everything down. So in conversation, sometimes we shake our heads or, you know, we make a facial expression, and that's our way of answering a question. That doesn't work in a deposition because everything is being transcribed.

And so we need you to speak up with your answer. Okay?

A. Yes.

Q. And this should be a pretty short deposition. I don't have too many questions for you. But if, at any time, you need a break, you can just say so, and we can -- we're more than happy to take five or ten minutes.

If there are any questions that are unclear to you, just, you know, stop. You can say, Austin, I don't understand the question. Can you rephrase it? I'm happy to do that. No one's trying to trick you or anything like that.

But if you do answer a question, I'm going to assume that you understood it. Okay?

A. Yes.
Q. So can you start by stating your full name for the record?
A. Linda C. Amondson-Muller.
Q. And do you currently live in Lewis County?
A. I do not. I live in Phoenix, Arizona.
Q. When was the last time you lived in Lewis County?
A. August of 2020.
Q. And how long had you lived in Lewis County prior to August of 2020?
A. Approximately 68 years.
Q. So did you move down to Arizona to retire there --
A. I did.
Q. -- I'm guessing?
A. I did.
Q. That's a good choice.
A. It's been good so far.
Q. Are you currently married?
A. I am not.
Q. Have you been previously married?
A. Yes, I have.
Q. And how long were you married for?
A. My first marriage, I was married for 13 years.

My second marriage, I was married for four months.

Q. And do you have any children?

A. I have one child, a daughter who is now 42.

Q. And was your daughter born in a hospital or in a home birth?

A. I do not know the answer to that. I'm going to assume she was born at home. She's adopted from Korea.

Q. Oh, interesting. Okay. Have you made any notes about this case?

MS. MONIZ: Okay. Notes? So Ms. Amondson-Muller is our client. Any notes she would make in the course of litigation, and they would be privileged.

MR. NEFF: So is it attorney-client privilege you're asserting or work product?

MS. MONIZ: Yes.

MR. NEFF: Both?

MS. MONIZ: Yes.

MR. NEFF: Okay.

Q. (BY MR. NEFF.) So, Ms. Amondson-Muller, you don't have to tell me the substance of your notes, but I'd like to know if, indeed, you have made notes without telling me what they were about.

MS. MONIZ: So you may answer yes or no,

if you made notes about this case.

A. Yes, I did. With clarification --

MS. MONIZ: No. Don't say any more.

THE WITNESS: Okay.

MS. MONIZ: Just yes or no.

Q. (BY MR. NEFF.) And I'm going to ask you one more question. Donna may not like this one: Were your notes made for you or were they made for your attorney?

MS. MONIZ: Well, I don't -- I'm going to object to the form of that question, and we may need to go off the record on this one.

Why don't you just move along, Mr. Neff.

MR. NEFF: So are you instructing her not to answer?

MS. MONIZ: Yes. For the moment, yes.

MR. NEFF: Okay.

Q. (BY MR. NEFF.) So, Ms. Amondson-Muller, I want to talk to you now about your relationship with Laura Hamilton. Okay?

A. Okay.

Q. How long did you know Laura Hamilton before she passed away?

A. Approximately 45 years.

Q. And how did you and Laura Hamilton meet?

A. We met in about 1976 at LPN school at

Centralia College in Centralia, Washington.

Q. And were you two fast friends, or did it take a while for a friendship to develop? How did that happen?

A. No, we were fast friends. We had many things in common. There was -- we had a foursome in our group for studying and getting through nursing school.

Q. Okay. And are you a nurse, or have you ever been a nurse?

A. I was an LPN for 25 years or so, and I was an RN for about 20 years.

Q. Did you ever observe Laura Hamilton provide care to a patient?

A. Yes.

Q. And how many times did you observe her providing care to a patient?

A. Maybe 20 times in the early years, many years ago. We work in the opposite end of the spectrum, as far as humans go.

Q. So can you explain that a little bit for me? I'm not sure what you mean by that.

A. Well, she was a midwife and worked in OB, and I worked at the -- with the elderly and population in hospital.

Q. Got it. And have you ever worked with

pregnant women in your career?

A. For a short time, in the beginning of my career and with my clinical studies at nursing school.

Q. What did you do when you were working with pregnant women during that short time in the beginning of your career?

A. Well, most of that had to do with clinical -- the learning process in the nursing program. That's observation, maybe assisting them, in general. But as a student, you don't take responsibilities for those clients.

Q. So it sounded like you also mentioned working with them early in your career. Is that what you just testified about, or is there additional work you've done versus what you did as a student?

A. Maybe a year or so. When you work in a small hospital such as in Centralia Washington, you learn many different aspects of nursing, and you float around to different areas in the hospital that nurses would work. So I would say that, in general.

Q. Did you ever deliver babies or assist with delivering babies while working as a nurse?

A. I can't ever say that I was an assistant in the delivering babies. I probably floated on the floor, took care of mothers, that kind of thing, maybe

worked in the nursery.

That's been like 45 years ago, so it's been a long time. And I know things have changed. So...

Q. Have you ever personally delivered a baby?

A. I have not.

Q. Okay. So I want to take a step back. The times when you observed Laura Hamilton providing care to patients, how and why would that happen?

A. Maybe I would have come to her house -- a scenario: Came to her house to visit, and she may have been delivering a baby.

Q. So you remember a few times when that happened, when you came to her house and she was delivering a baby?

A. Yes.

Q. Did you ever actually observe Laura Hamilton deliver a baby?

A. Yes. In all honesty, yes.

Q. And approximately how many times do you think you were in the room when Laura Hamilton delivered a baby?

A. Boy, this would have been back in the early years. Maybe 50. We also did an internship in the West Indies and worked together several times. But I -- I really -- at this point, I can't really remember

an actual number, *per se*.

Q. So in addition to observing Laura Hamilton deliver a baby, had you ever assisted Laura Hamilton in delivering a baby?

A. Not in 45 years. I guess I'm unclear about what you mean by assisting.

Q. So I mean, if you're in the room observing, you're not assisting. But if you're helping her in any way, I'd consider that to be assisting.

So have you ever helped Laura Hamilton deliver a baby?

A. I'm going to say no to that. She was in charge of the delivery, and she delivered the baby.

Q. Did she ever ask you for help to deliver a baby at any time?

A. No, because she -- she knew that that was not my responsibility. I also have a license to protect.

Q. What was that last part? You have a license to what?

A. Protect. Meaning, I'm -- I work as an LPN out in the community, at that time.

Q. And would that have been a problem for protection of your license if you were delivering babies with Laura Hamilton?

A. No. I --

MS. MONIZ: Object to the form.

You may answer that.

THE WITNESS: I can?

MS. MONIZ: Yes.

A. I don't believe so. But I also feel that sometimes -- I feel my responsibility was -- as a nurse was not always assisting other people.

Does that make sense?

Q. (BY MR. NEFF.) Not really, if I'm being honest. Can you clarify that a little bit?

A. I worked in a different field than she did. And I felt like it was my responsibility to do what I need to do for myself, for Linda.

Q. Okay. Have you personally ever received any sort of midwifery care from Laura Hamilton?

A. I don't believe so.

Q. How many babies did Laura Hamilton deliver in her career as a midwife?

A. I'm aware of approximately 4,000.

Q. And how -- what's the basis for that number? How do you know that it was 4,000?

A. Well, because Laura was pretty meticulous about her records, and she started that when she got out of midwifery school. And she was just very meticulous about that type of recordkeeping. It was

really important to her.

Q. And have you seen these records of Laura Hamilton's since she passed away?

A. No.

Q. When was the last time you saw these records?

A. Maybe 20 years ago. Maybe 25 years ago. Maybe 30. I don't really have a clear answer for that.

I just -- it wasn't my place to look at her records. I never did verify anything that she told me. We were friends, and I -- I do know that she kept a count in her head how many babies she had delivered.

Q. Okay. But it sounds like you haven't seen a record of that number --

A. I haven't.

Q. -- for at least the past...

THE REPORTER: Could you repeat the last part of your question, Mr. Neff?

Q. (BY MR. NEFF.) It sounds like you haven't seen a record with a number for at least the past 20 years?

MS. MONIZ: Slow down and think. Let's make sure the question's finished. Go ahead.

A. That's correct.

Q. (BY MR. NEFF.) What do you know about Laura Hamilton's midwifery education?

A. I know she went to Seattle Midwifery School, and she graduated from there. And she had a license as a midwife, a licensed midwife license.

I know that she participated in education with other midwives. I do not know exactly all of her midwifery credentials or anything much more than that.

Q. Do you know whether Laura Hamilton was ever educated in how to respond to a shoulder dystocia?

A. I don't really know that, personally. Most -- most of her education, I believe, happened, you know, in the beginning when I was going -- educating myself in a different direction.

Remember, "in the beginning" was 40 to 45 years ago.

Q. I know it's a long time ago.

A. Yeah.

Q. Do you know if Laura Hamilton was ever trained on how to respond to a shoulder dystocia?

A. I don't really know that. I can assume because of her education, and I know her -- her education was pretty intense and direct with both deliveries that are, quote, normal and also deliveries that are not so normal, so to speak.

Just because of its midwifery school, but I don't really know personally what she learned during

that time.

Q. The next question is going to be -- could be a little tough, but I have to ask it: What is your understanding as to the cause of Laura Hamilton's death?

A. I believe she had multiple strokes at the end of her life.

Q. And did you ever speak with Laura Hamilton about this lawsuit before she passed away?

A. I did not.

Q. Did you ever speak with Laura Hamilton about the lawsuit *Myhre v. Hamilton* before she passed away?

MS. MONIZ: I'm going to object to the form.

Are you asking her for some discussion shortly before the death or at any time?

MR. NEFF: I'm asking if she ever spoke with Laura Hamilton about the lawsuit *Myhre v. Hamilton*.

MS. MONIZ: Ever at any time, including when it happened?

MR. NEFF: Well, yes. I'm asking if there was ever any conversation about that lawsuit.

A. Yes. I did.

Q. (BY MR. NEFF.) And what were -- what was that

conversation about?

A. I -- you know, I really can't recall the exact substance of that conversation. I'm just -- I'm trying to think in my mind.

I really don't have a substance for that conversation. I do know when it happened or I -- I knew at the time when it happened, and I attended the trial in Lewis County during that time.

Q. What do you know about that case?

A. In all fairness, I know that there was a child born with an arm that doesn't fully function. And I -- and I do know the results of the trial.

Q. Approximately how much money did Laura Hamilton make per year from her midwifery business? Do you know that?

A. Well, that's a variation. From the time she started, she had four or five clients per month. And towards -- not -- maybe a few years before she passed away, she had 20 clients a month at -- on some months, which was a great income.

I do not know her exact income, *per se*. I -- I really can say I don't know the answer to that.

Q. When you say Laura Hamilton had 20 clients per month towards the end, was that 20 deliveries per month? Or what was involved with that?

MS. MONIZ: Object to the form. Misstates the evidence.

Go ahead and answer.

A. I don't know that that was 20 deliveries a month, but she had 20 clients, up to that, which was a full load of OB gals.

But not all of those -- some of those would be sent out. Some of those moved. For whatever reason, she didn't deliver all those babies.

Q. (BY MR. NEFF.) Do you know how often Laura Hamilton would refer one of her clients to a hospital?

A. I do not know that.

Q. Do you know how much money Laura Hamilton made in 2014 from her midwifery business?

A. Boy, I do not know the answer to that.

Q. So without telling me anything that Ms. Moniz or the attorneys from her law firm told you, how did you become the personal representative of Laura Hamilton's estate?

A. Well, first of all, I'm not a legal person, but Laura and I were friends. And she had a will, and in the will she designated me the person to take care of and downsize her business should she pass away when she still had a business.

And so that's how it started. Her son

Taylor -- okay.

MS. MONIZ: You're finished with your answer. Let's just stop.

MR. NEFF: No, I -- sorry. I'm going to ask that you let her finish her answers. I think -- I don't think you should be cutting her off when she's answering a question.

MS. MONIZ: You can ask another question if you want to follow up. But we're - that is getting way beyond the subject of this lawsuit.

MR. NEFF: Well, you still need to let the witness answer a question. I -- I don't believe it's proper for you to cut her off and stop her in the middle of an answer.

Q. (BY MR. NEFF.) So what's your understanding of the basis for this lawsuit against Laura Hamilton's estate?

A. You know, I've not really seen the complaint. So I don't really know.

Q. I want to take one step back. I'm a little bit of ahead of myself.

You mentioned that Laura Hamilton appointed you in her will to downsize her business. What do you mean by that?

A. Well, there's records. There's -- she had an

office. She had many clients. And she had done some of that, but that's how I got involved. I have had my own business for many years, and she felt like I would know how to do that.

Q. And what's your business, if you don't mind me asking?

A. Actually, I was a nurse delegator in the state of Washington for about 15 years, and then I also owned four adult family homes in the Lewis County area. And I had many employees and many clients.

Q. What's a "nurse delegator"?

A. A nurse delegator in the state of Washington is one who accepts a client as their own and delegates to somebody who is in good standing with the state who is a caregiver to do nursing tasks.

Q. And did you, in fact, downsize Laura Hamilton's business?

A. By the time she passed, most of her business was already downsized as far as clients go. And so I didn't have to do a lot of the money part of it, mostly the protection of records and incidental things that she might have.

MS. MONIZ: We're getting some feedback here. I don't know what the problem is. But maybe one of these phones isn't muted.

Oh, now we can't hear you, Austin.

MR. NEFF: Well, that doesn't work. Can we try to press on, and if it's a problem, I can get rid of my phone and join the computer audio.

MS. MONIZ: Sure.

Just be sure you hear everything.

THE WITNESS: Okay.

Q. (BY MR. NEFF.) So, Ms. Amondson-Muller, do you know why Laura Hamilton's business was, for the most part, already downsized at the time she passed away?

A. I believe because she was ill. And also, at the time of her death, I don't believe she had a license to practice midwifery.

Q. And so do you still have access to her patient records?

A. I do.

Q. Have you reviewed the records from -- of this case, of Zachary and Seng Hamilton's records?

A. I have not.

Q. Will you be testifying at trial in this case?

A. I don't believe so.

MS. MONIZ: Yes, she will.

THE WITNESS: Oh.

MS. MONIZ: Sorry, Austin. I shouldn't

answer for her. But...

A. Yes. Yes.

MR. NEFF: We want the right answer. That's more important than who's answering the question.

Q. (BY MR. NEFF.) Do you know what you'll be testifying about at trial?

A. I think I will be testifying about my friendship with Laura and who she was as a person, as a midwife.

Q. Have you ever met Seng Hamilton?

A. I have not.

Q. Have you ever met Scott Hamilton?

A. Possibly as a teenager during the high school years. But other than that, I would not know him at this time if I saw him on the street.

Q. If you had met him as a teenager during your high school years, how would that have taken place?

A. Well, Lewis County is a small arena of people, and it would have been during a school event or something similar to that. That would have been -- that would have been the only reason for me to have met him.

I think in high school he was a basketball player, but I could be wrong about that. And I was

involved in some -- some activities -- our schools were back and forth. So that would have been the only way that I would have ever met him.

Q. Were you and Scott Hamilton in high school at the same time?

A. You know, I can't really answer that. But I think we were about the same age. But maybe I -- there are -- I will tell you this: There are three Scott Hamiltons in the Lewis County area. So...

Q. We've heard about another one. Apparently he's a real estate guy.

A. Um-hmm. Um-hmm.

Q. Have you ever met Zachary Hamilton?

A. I have not.

Q. So I want to take a minute now and go through some of the exhibits with you. I'm going to share my screen here.

Can you see my screen, Ms. Amondson-Muller?

A. Yes, I can.

Q. So this has been marked as Exhibit 1 to your deposition. It is the -- it's your responses to the Plaintiff's First Set of Interrogatories and Request For Production.

Does this document look familiar to you?

A. Yes.

Q. Okay. So I'm going to scroll to the bottom here. And we have a line -- oh.

So we have a line for your signature, but your signature is not on this document. Does that look right to you?

A. Are you asking me if that's my name? Yes. I do not see my signature on there, but I do believe I signed it.

Q. Okay. So I'm going to switch now to Exhibit No. 2 to your deposition. This is your signature page.

Does this document look familiar?

A. Yes.

Q. And is this your signature right here?

A. I do believe I signed that. And I do believe I did it on the computer with a finger, blah, blah, blah. So it's a variation of my signature, yes.

Q. When you signed this document, what was your understanding as to what you were signing?

A. Well, could you clarify what you -- would you just clarify that question for me?

Q. When you signed this document, what did you think you were signing?

MS. MONIZ: I'm going to object to the form of the question. It seems to be confusing.

Q. (BY MR. NEFF.) Is there something I can do to

clarify the question, Ms. Amondson-Muller?

A. Well, I guess that I thought I was signing what -- what this case was about.

Q. Let me ask you this: Did you understand that your signature on this page was going to be incorporated into Exhibit 1, the Defendant's Responses to the Plaintiff's First Interrogatories and Request For Production, the document we just looked at before this one?

A. Well, at some point I knew that probably somebody was going to be looking at it to see what I had signed.

Q. Okay. So I'm going to go back to this first exhibit right here. And this is the first document we looked at.

Did you understand that by signing that signature page we just looked at, you were signing this document?

A. Well, yes.

Q. Okay. So I want --

A. Because this --

Q. Go ahead.

A. Because this document is 20-some pages long, correct?

Q. 26 pages long, it looks like?

A. Okay.

Q. So I want to scroll up here. This is Interrogatory No. 11. And the question was [as read]: At the time of the decedent's death and for each of the three calendar years preceding the decedent's death, please list the following: The decedent's net worth; the nature and value of the decedent's assets; and the nature and extent of the decedent's liabilities or debts.

And your answer was [as read]: Objection. This request is not reasonably calculated to lead to discovery of admissible evidence. Plaintiff is proceeding solely under RCW 11.40.060, which expressly states that the amount of recovery cannot exceed the amount of the insurance under decedent's liability policy. Further objection as this request is unduly burdensome.

Did I read that right, Ms. Amondson-Muller?

A. I believe you did.

Q. Now, I want to skip down to Interrogatory No. 14. The question was [as read]: Was decedent covered by any applicable policy of liability insurance that would apply to the incident that forms the basis of this lawsuit? If so, please state, (a) the name and address of the insurer; (b) the dollar limits of any

applicable policy; (c) name of the insured; (d) the type of coverage, in parentheses, primary, excess, umbrella; and (e) whether any reservation of rights have been asserted.

The answer was yes [as read]: (a) the Joint Underwriting Association; (b) 1 million; (c) Laura Hamilton; (d) primary; and (e) no.

Did I read that right?

A. I believe you did.

Q. So is it your understanding that plaintiff's potential recovery in this case is limited to the funds available under the insurance policy held by Laura Hamilton at the time she provided care to Seng and Zachary Hamilton?

A. Yes, I believe that to be true.

Q. And according to your understanding, is any money or property belonging to Laura Hamilton's estate at risk due to this lawsuit?

MS. MONIZ: Objection. Calls for a legal conclusion.

If you are able to, you may answer.

A. I do know she had insurance at the time of this incident. And I do know, in the state of Washington, that there is some recovery possible by the plaintiff.

Q. (BY MR. NEFF.) And is it your understanding that that recovery is limited to that insurance and the plaintiffs can't get Laura Hamilton's estate or any of her money?

A. I --

MS. MONIZ: Objection. Calls for a legal conclusion.

But you may answer, if you know.

A. I do not know the answer to that.

Q. (BY MR. NEFF.) So you're not sure whether -- if plaintiffs win this lawsuit, you're not sure whether or not they'll be able to recover money or property belonging to Laura Hamilton's estate?

A. I -- I'm sorry. I don't know the answer to that.

Q. Okay. I want to introduce Exhibit 3. This is the defendant's answer.

So, Ms. Amondson-Muller, are you aware -- I'm going to scroll down here to the affirmative defenses section. Are you aware that you've asserted an affirmative defense that Zachary's four-level brachial plexus avulsion injury was caused by act of God?

MS. MONIZ: Object to the form.

You may answer whether you're aware or not.

A. Would you ask me the question again.

Q. (BY MR. NEFF.) Are you aware that you've asserted the affirmative defense that Zachary's four-level brachial plexus avulsion injury was caused by an act of God?

MS. MONIZ: Object to the form.

A. Yes.

Q. (BY MR. NEFF.) What's the factual basis for assertion of that affirmative defense?

A. Well, personally, I think that act of God and the natural forces of labor, as I -- as I read this, are one and the same. And so I guess that's the act-of-God part because of the natural forces of labor.

Q. Have you had any communications with God about Zachary's injuries?

MS. MONIZ: Object to the form of the question. It's rude, it's unacceptable, and it violates your obligations, Mr. Neff, as an officer of the court.

You may answer.

MR. NEFF: Well, we disagree on that.

A. I have not personally talked to God about it, no.

Q. (BY MR. NEFF.) Are you a religious person?

A. Do my religious beliefs need to be brought out into this case? I'm not really very comfortable with

that. I can tell you I'm not a very religious person.

Q. Do you belong to a religious denomination?

A. I'm a Christian.

Q. When was the last time you attended church?

A. About three months ago.

Q. And do you have an active relationship with God?

MS. MONIZ: I'm going to object again. This line of questioning is completely inappropriate and is going far beyond the -- the bounds of CR 11. And if you're going to persist, we're going to take a recess and bring a motion.

MR. NEFF: I have one more question.

Q. (BY MR. NEFF.) You can answer the previous question, Ms. Amondson-Muller.

MS. MONIZ: You may answer if you're comfortable. That's up to you.

A. I'm not really comfortable answering that.

MR. NEFF: Okay. So are you instructing her not to answer, Donna?

MS. MONIZ: The witness is making her choice based on a totally inappropriate and completely irrelevant question not reasonably calculated to lead to any admissible evidence in this case and harassment of the witness. She's made her choice.

Are you done asking questions? Or do you have something else appropriate to ask?

MR. NEFF: Well, Donna, we've been over this. We disagree whether or not this is relevant. We believe it's clearly relevant based on your decision to assert this affirmative defense. I have one more question.

MS. MONIZ: Mr. Neff, you persist in omitting the key facts that follow that phrase, "the natural forces of labor," which is what we've been discussing in this whole case, including all your experts as well as ours. And so --

MR. NEFF: And yet --

MS. MONIZ: -- this whole business is completely inappropriate.

MS. NEFF: Donna, the defendants made --

MS. MONIZ: Do you have proper questions for Ms. Amondson-Muller?

MR. NEFF: The defendants made the choice to frame this defense as an act of God in their answer by asserting that affirmative defense. That is a door you have opened, and we believe that this -- any of these questions are now relevant.

We can take it up with the court at a later date, and you're free to bring a motion. But please

let me ask my question. I only have one more --

MS. MONIZ: But you go far beyond what's appropriate.

MR. NEFF: I am aware that, in your mind, that is the case.

Q. (BY MR. NEFF.) Last question, Ms. Amondson-Muller: Do you believe that God would act upon a baby like Zachary and cause him a permanent injury?

MS. MONIZ: Object -- same objection as previously made.

You may answer.

A. Again, I don't feel comfortable with the terms that -- with what you're asking me.

Q. (BY MR. NEFF.) Okay. But -- so you're unable to answer that last question?

A. Correct.

Q. All right. I think that's it. I'd like a moment to confer with co-counsel, but I think that is everything.

MS. MONIZ: I may have some follow-up questions. So let's take a 10-minute break. Why don't you take this document down and we'll resume, or potentially resume, in a few minutes.

MR. NEFF: Okay.

(Recess taken.)

Q. (BY MR. NEFF.) Ms. Amondson-Muller, what do you think an "act of God" is?

MS. MONIZ: Same objections.

Q. (BY MR. NEFF.) You can answer, Ms. Amondson-Muller.

A. Pertaining to this case, the act of God is the natural force of labor.

Q. (BY MR. NEFF.) And it looks like you're looking down. Are you reading something while you're giving that answer?

A. No. Actually, I'm not.

Q. What about aside from this case? What is your understanding of the term "act of God," generally?

A. I have used that term loosely as a nurse when we don't have a definite answer, when it's not something concrete that maybe the medical profession knows about.

And the example would be: Sometimes, people look like they're going to live and they die. Sometimes, people die when they should have lived, and we don't have a clear-cut answer. And many times, as a nurse, I have said and others have said, Well, it's an act of God. It's somewhere in between.

That's why I refer to, in this case, they are

one and the same, the natural forces of labor and act of God.

Q. Okay.

A. It's something natural that happens. So go ahead.

Q. So it sounds like you've used that term as a nurse independent from any legal case you've been involved with?

A. That's correct. I truly haven't been involved in very many legal cases. So...

Q. Do you plan to testify that Laura Hamilton was a good midwife at trial?

A. Yes, I believe so.

Q. And do you plan to testify about that at trial?

MS. MONIZ: She's not going to be asked that question at trial.

Q. (BY MR. NEFF.) You can answer the question, Ms. Amondson-Muller.

MS. MONIZ: You may answer.

A. Would you ask the question again?

Q. (BY MR. NEFF.) Do you plan to testify at trial that Laura Hamilton was a good midwife?

MS. MONIZ: I'm going to object to the form. I said she wasn't going to testify about that.

That's not an issue in the case. The issue is whether she acted within the standard of care in this case.

You may answer.

A. Well, I believe that Laura Hamilton is a good midwife.

Q. (BY MR. NEFF.) And do you plan to make that part of your testimony at trial?

MS. MONIZ: Same objection. It's not up to her what her testimony is about. It's what she's asked and what are the issues in the case.

MR. NEFF: Only Ms. Amondson-Muller can control what she says on the witness stand, Donna.

MS. MONIZ: Yeah. Same objection.

You may answer.

A. We're back to: Now what's the question? I've not done this before, so repeat it one more time.

Q. (BY MR. NEFF.) Sure. Do you plan to testify at trial that Laura Hamilton was a good midwife?

MS. MONIZ: Same objections.

A. I believe Laura Hamilton was a good midwife.

Q. (BY MR. NEFF.) And I know what you believe. But my question is: Do you plan to testify about that at trial?

MS. MONIZ: Same objections.

A. If I were asked that question, I would say

yes, she was a good midwife.

Q. (BY MR. NEFF.) Do you plan to testify that Laura Hamilton provided safe care to patients in the past, before she became involved with Seng Hamilton and Zachary Hamilton?

MS. MONIZ: Same objections.

You may answer, if you're able to.

A. I have never seen anything to the contrary of that.

Q. (BY MR. NEFF.) And do you plan to testify about that at trial?

MS. MONIZ: Same objections.

A. To be truthful with you, I don't know exactly if I will be asked that question or not.

Q. (BY MR. NEFF.) Do you plan to testify that Laura Hamilton successfully delivered babies in the past, before becoming involved with Seng and Zachary Hamilton?

MS. MONIZ: Same objections.

A. I'm going to say yes to that.

Q. (BY MR. NEFF.) Do you plan to testify that Laura Hamilton never had an issue providing care to patients prior to providing care to Seng and Zachary Hamilton?

MS. MONIZ: Object to the form and all the

prior objections reasserted.

A. I'm not sure that I...

I'm not sure I can comfortably answer that.

Q. (BY MR. NEFF.) You can't comfortably answer whether or not you plan to testify about that?

MS. MONIZ: Object to the form. It's not up to this witness. Same objections. Also, way beyond the scope.

A. I don't know, at this point, exactly what I'm going to be asked at trial, so I don't really know how to answer the question. I've not been in this position before.

So are you going to ask me all these questions that we've -- that I've answered? I guess I'm confused about what I'm going to do in the future.

Q. (BY MR. NEFF.) I'm just asking whether you have plans to testify about this at trial.

MS. MONIZ: Object to the form of the question and reassert the multiple previous objections.

A. I am not an expert witness on every delivery that Laura's had. And so I don't feel comfortable still answering the question.

Q. (BY MR. NEFF.) All right. Well, we can end it there, I guess. Those are all my questions.

MS. MONIZ: I have a few follow-up

questions.

EXAMINATION

BY MS. MONIZ:

Q. Ms. Amondson-Muller, when you were referring to times many years ago, decades ago when you would be present at a birth that Laura did, what -- what was your role exactly?

A. Well, I would put myself -- I was not there as a nurse assisting Laura. I was there and I may have been a helper. I may have cleaned up afterwards. I may have talked to the person who was delivering.

But I wasn't really asked to be there. And I just want to clarify the assistant part of it: I was not her assistant. I was there at the birth but not there to work.

Q. And is there any particular reason you were not acting as Laura's assistant for an out-of-hospital birth?

A. Well, there was a couple of reasons. And one of them, I was also employed by Providence Hospital in the Lewis County area. And Laura's deliveries in the community and her position in the community was a very political issue. And I was threatened by Providence that they would fire me or they could easily let me go just being her friend.

And so when I stated about my license, that's what I was referring to. And so I was very careful not to always cross the line when I worked as a nurse versus being friends with Laura.

Q. Okay. Now, you mentioned that Laura kept detailed records of how many births she did.

A. Yes.

Q. Do you have any records as part of your help in closing up Laura's practice that would show that information?

A. Well, I do have some records that I personally have not gone through because she divided them up into years and -- and the deliveries that she would have documented for that year.

Do I know -- have I looked at those documentation [verbatim]? I have not. And she's also -- she told me that she had delivered approximately 4,000 births.

Q. At some point, did Laura close her practice?

A. Well, I believe, in her way, yes, she had started to close her practice. She was going to retire. She was not delivering. She had just a couple of babies in December that she needed to deliver.

And I believe the last delivery was around December 30th or 31st of '19. I think that's correct.

Q. 2019?

A. 2019.

Q. And so shortly before her death, had Laura retired?

A. I believe so.

Q. And prior to her final illness, had she had health problems?

A. She had many health problems.

Q. And about how long were those going on?

A. I think probably fairly close to about 18 months to two years she just did not feel well.

Q. Okay. Those are all my questions.

MR. NEFF: I don't think I have any more.

(Deposition concluded at 12:20 p.m.)

(Signature reserved.)

* * * * *

CORRECTION & SIGNATURE PAGE

RE: SCOTT HAMILTON vs. LINDA AMONDSON-MULLER
LEWIS COUNTY; 20-2-00543-21
LINDA AMONDSON-MULLER; TAKEN MAY 2, 2022
REPORTED BY: ELEANOR MITCHELL, CCR, RPR

I, LINDA AMONDSON-MULLER, have read the within transcript taken May 2, 2022, and the same is true and accurate except for any changes and/or corrections, if any, as follows:

PAGE/LINE	CORRECTION	REASON

Signed at _____, Washington,

on this date: _____.

_____

LINDA AMONDSON-MULLER

REPORTER'S CERTIFICATE

I, ELEANOR J. MITCHELL, the undersigned Certified Court Reporter, pursuant to RCW 5.28.010 authorized to administer oaths and affirmations in and for the State of Washington, do hereby certify that the sworn testimony and/or proceedings, a transcript of which is attached, was given before me at the time and place stated therein; that any and/or all witness(es) were duly sworn to testify to the truth; that the sworn testimony and/or proceedings were by me stenographically recorded and transcribed under my supervision, to the best of my ability; that the foregoing transcript contains a full, true, and accurate record of all the sworn testimony and/or proceedings given and occurring at the time and place stated in the transcript; that a review of which was requested; that I am in no way related to any party to the matter, nor to any counsel, nor do I have any financial interest in the event of the cause.

WITNESS MY HAND and DIGITAL SIGNATURE this 6th day of May 2022.

Eleanor Mitchell

ELEANOR J. MITCHELL, RPR
Washington Certified Court Reporter, CCR 3006

EXHIBIT 3

02:12:27 **Q. Do you know what the Supreme Court decided?**

02:12:35 A. No. I mean, I might have at one time, but

02:12:37 I certainly don't recall it.

02:12:42 **Q. Do you have an estimate of how many times**

02:12:44 **you have testified in a case opposite to Dr. Allan**

02:12:49 **Tencer?**

02:12:51 A. Well, I've certainly been retained more

02:12:54 than I've testified. I've probably testified over

02:12:56 the years -- and it's been some years -- oh, 15 to

02:13:05 20 cases, and I've probably had over 50 over the

02:13:08 years, or more than that maybe, including a case in

02:13:16 which I testified for the defense at trial and

02:13:21 Dr. Tencer was a plaintiff's expert, of all things.

02:13:24 **Q. Is that pretty unusual?**

02:13:27 A. I already told you what my percentage

02:13:29 breakdown is for testimony, so it would be certainly

02:13:32 less frequent.

02:13:34 **Q. Did you actually write this brief or was it**

02:13:37 **written by Mr. Osborn with your signature?**

02:13:42 A. That sort of action doesn't exist in my

02:13:44 practice. I don't let other people write down what

02:13:48 my thoughts are.

02:13:55 **Q. Let's scroll down to the first full page of**

02:14:00 **text on this one.**

02:14:07 **Actually, before we get to that, David**

Or at least I was.

Q. Have you ever been a party to a lawsuit?

A. Sure.

Q. How many?

A. I don't know. A couple.

Q. Okay. Have you ever been a party to any lawsuit in which you were the plaintiff?

A. Probably a couple.

Q. And what were those in regard to?

A. I think it was business litigation primarily, and then there was a lawsuit from 30-odd years ago when I was a practicing chiropractor. It was like an unlawful trade practices thing that was dismissed and thrown out of court because it was clearly concocted.

Q. Well, let's take this one at a time. The couple of lawsuits where you were the plaintiff regarding business, who did you sue?

A. Oh, plaintiff. I'm sorry. I was thinking defendant. So the question about the second one, which was from 30-odd years ago, I was the defendant. And that case was thrown out of court.

I'm not sure if I've been a plaintiff in any cases. I'm not sure. There's been business litigation on, like, values of companies and that

02:27:17 kind of thing that I can recall. And I can't
02:27:19 remember if I was plaintiff or defendant in them.
02:27:22 **Q. What companies did they involve?**
02:27:27 A. They were medical imaging companies.
02:27:30 **Q. Do you remember the names of any of them?**
02:27:33 A. No.
02:27:42 **Q. You don't remember the names?**
02:27:44 A. No, not really. They were a couple of
02:27:49 decades ago.
02:27:50 **Q. What county did they take place in?**
02:27:53 A. No recollection.
02:27:55 **Q. A couple of decades ago where were you**
02:27:58 **living?**
02:28:00 A. I think I was living in Oregon.
02:28:02 **Q. What part of Oregon?**
02:28:04 A. Salem.
02:28:05 THE COURT REPORTER: Counsel, just give me a
02:28:05 minute. I just have to plug in. My battery is
02:28:05 dying. I don't need a break. Just give me 30
02:28:05 seconds.
02:28:05 MS. MONIZ: Sure.
02:28:04 THE WITNESS: I do. It's a good time for me to
02:28:19 take a break.
02:28:20 MS. MONIZ: All right. Let's take five minutes.
02:28:24 THE VIDEOGRAPHER: The time is 2:28 P.M. We're

02:28:26 off the record.

02:34:16 (Recess.)

02:34:26 THE VIDEOGRAPHER: The time is 2:34 P.M. We're back on the record.

02:34:31 **Q. BY MS. MONIZ: So just so I understand, your best memory as you sit here today is that you've been sued a couple of times over business matters, but you cannot remember the names of the companies involved or the location of the suit. Is that right?**

02:34:52 A. Not specifically, no.

02:34:54 **Q. Can you recall generally?**

02:34:57 A. No, outside of the fact that they were in Oregon.

02:35:07 **Q. There was also a trade practice lawsuit. That was over the Toftness device that was allegedly used by you and your father and was not approved?**

02:35:21 A. Well, if you have it the lawsuit that was thrown out of court. I can't tell you what all the allegations were or the nonsense that went on with it. Certainly it's not anything I ever had anything to do with it.

02:35:34 **Q. Did that case go to trial?**

02:35:36 A. Yes. And the verdict from the bench was overturned and the case was dismissed with

prejudice.

Q. So this was a judge trial, and the judge found against you and your father but the Court of Appeals reversed?

A. That's correct.

Q. Any other lawsuits that you were involved in either as a plaintiff or defendant?

A. I told you everything I can remember that comes to mind.

Q. In these half a dozen or so amicus briefs that you filed, did somebody pay you to write any of them?

A. I don't have any recollection of the circumstances of them so --

Q. Did you pay a lawyer to file them on your behalf?

A. I doubt it.

Q. But you don't remember?

A. I would seriously doubt it.

Q. What would your motivation be to file half a dozen amicus briefs?

A. You mean like why six and not five and why not seven? I mean, I just don't understand the question.

Q. Why file amicus briefs?

02:36:50 A. I assume because somebody asked me to.
02:36:57 **Q. But you don't remember if you were paid?**
02:37:01 A. I don't have any recollection of the
02:37:03 circumstances of them.
02:37:12 **Q. Have we generally reviewed the opinions you**
02:37:15 **plan to express in this case?**
02:37:16 A. I think we have.
02:37:18 **Q. Okay. Let's pull up a couple more**
02:37:24 **exhibits. And let's get the letter from Western**
02:37:36 **States Chiropractic College. We'll mark this I**
02:37:44 **think Exhibit 9.**
02:37:57 (Whereupon Exhibit 9 was marked for
02:37:57 identification by the Court Reporter.)
02:37:57 **Q. BY MS. MONIZ: Do you recognize this**
02:37:57 **letter?**
02:37:59 A. People have shown it to me. I don't have
02:37:59 any recollection from it that goes back to the date
02:37:59 that it was supposedly sent or was supposedly made.
02:38:03 My understanding is the school doesn't have a record
02:38:05 of it either.
02:38:08 **Q. Dr. Freeman, you have been asked about this**
02:38:11 **letter before, both in court and in depositions. Do**
02:38:15 **you deny that this letter at some point back in the**
02:38:19 **'80s was addressed to you?**
02:38:22 A. No. Exactly what I just said. I have no

recollection of this letter. I don't have any record of it. I don't have a recollection of what I got at the time. It's almost 40 years old. That's my answer.

Q. But you do agree that you were suspended from chiropractic school for claiming to do treatment on patients that you did not actually treat. Correct?

A. I think it was exams maybe. Maybe it was treatment. I don't recall. But yeah, I certainly was suspended from that school. It was a terrible school.

Q. All right. Let's take that one down.

And then I think there's at least one other exhibit I want to look at. And that would be -- actually, I think Mr. Rand was going to put up another one, the rebuttal article. So we can take that down. And would you go ahead and send that, Pierce. We'll mark that Exhibit 10.

(Whereupon Exhibit 10 was marked for identification by the Court Reporter.)

MS. MONIZ: All right. Let's go off the record for a minute.

THE VIDEOGRAPHER: The time is 2:40 P.M. We're off the record.

EXHIBIT 4

No. 95173-0

IN THE SUPREME COURT OF THE STATE OF WASHINGTON

L.M., a minor, by and through his Guardian ad Litem
WILLIAM L.E. DUSSAULT,

Plaintiffs/Petitioners,

vs.

LAURA HAMILTON, individually and her marital community; LAURA HAMILTON LICENSED MIDWIFE, a Washington business,

Defendants/Respondents.

AMICUS CURIAE BRIEF OF DR. MICHAEL D. FREEMAN

David S. Heller
WSBA No. 12669
860 SW 143rd Street
Seattle, WA 98166
(206) 243-7300

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I. IDENTITY & INTEREST OF AMICUS CURIAE

Dr. Michael D. Freeman, MedDr, PhD, MPH, FAAFS is, among other things, a doctor of medicine and an epidemiologist, an associate professor of forensic medicine at Maastricht University Faculty of Health, Medicine, and Life Science, an affiliate professor at Oregon Health & Science University School of Medicine, and a US Fulbright Fellow. A copy of his CV is attached as Appendix A. Briefly, Dr. Freeman practices in the fields of forensic medicine and forensic epidemiology and has published approximately 190 peer-reviewed scientific papers, abstracts, book chapters, and books upon topics that include injury causation and injury biomechanics, including one of the largest ever published studies of the causes of brachial plexus birth injuries.

Dr. Freeman has an interest in preventing the misuse and misapplication of science, and of biomechanical testimony in particular, in our trial courts. Dr. Freeman, through the undersigned counsel, is filing contemporaneously with this brief a motion for leave to file an amicus curiae brief in this matter, pursuant to RAP 10.1(e), 10.6(a) and (b).

II. STATEMENT OF THE CASE & INTRODUCTION

The facts are set forth in the Court of Appeals opinion herein, and in the briefs of the parties. It apparently is undisputed that defendant midwife Hamilton delivered LM and that LM has a permanent injury to

all five nerves of his brachial plexus, including avulsions (nerves torn away from the bone). Testimony of Dr. Howard Mandel, MD, 10/21/15 RP 66, ll. 15-25.

An injury may have more than one proximate cause. If the defendant's negligence was a proximate cause of the injury, the defendant is liable for the harm even though other contributing causes may also have existed. WPI 15.04; *Brashear v. Puget Sound Power & Light Co., Inc.*, 100 Wn.2d 204, 667 P.2d 78 (1983). The legal liability issue in this case therefore is whether one of the proximate causes of LM's brachial plexus avulsions and other injuries was negligence by the defendant.

The defense claimed that LM's mother herself caused LM's injuries by pushing during labor – the so-called "Natural Forces of Labor" defense. In support of that defense, defendant called as a witness biomechanical engineer Prof. Allan Tencer. 10/27/15 RP 4-39.

III. ISSUE PRESENTED

Should a biomechanical engineer's opinion about the cause of an injury be admitted into evidence where he did not follow generally accepted methodologies in arriving at that opinion, where the opinion is contrary to established medical literature, and where the opinion itself is not generally accepted in the relevant scientific community?

IV. ARGUMENT

A. Professor Tencer's opinion that natural forces of labor could cause LM's injuries was not reached by methodology which is generally

accepted in the relevant scientific community, and his opinion should not have been admitted under the *Frye*[1] test.

I. Frye applies to this case and mandates exclusion of Prof. Tencer's opinions unless he used generally accepted methodology to reach those opinions.

The application of *Frye* to issues of medical causation was addressed by this Court in *Anderson v. Akzo Nobel Coatings, Inc.*, 172 Wn.2d 593, 603, 260 P.3d 857 (2011):

> The primary goal [under *Frye*] is to determine "whether the evidence offered is based on established scientific methodology." Both the scientific theory underlying the evidence and the technique or methodology used to implement it must be generally accepted in the scientific community for evidence to be admissible under *Frye*. [citations omitted, emphasis added].

Anderson recognized, at 611, a distinction between the method used to reach the witness's opinion, which must pass the *Frye* test, and the witness's opinion itself, which in some cases need not pass *Frye*. But neither Prof. Tencer's methodology in reaching his opinion, nor his opinion itself, passes *Frye*, and *Anderson* therefore does not support admitting his testimony.

Even if *Anderson* does at first blush appear to support admission of Prof. Tencer's testimony, it is in fact distinguishable on several grounds pertaining to Prof. Tencer's credentials and to the relationship between his opinions and the relevant scientific literature.

---

[1] *Frye v. United States*, 54 App. D.C. 46, 293 F. 1013 (1923).

In *Anderson*, plaintiff alleged brain damage due to exposure to toxic solvents. The medical literature reported that brain damage could be caused by these solvents, but was silent about whether these solvents could cause plaintiff's particular type of brain damage. This Court nevertheless permitted a medical doctor to testify that these solvents had caused plaintiff's damage.

The proffered testimony in *Anderson* came from a medical doctor, Dr. Sohail Khattak, and not from an engineer such as Prof. Tencer. *Anderson*, at 598.[2] Dr. Khattak testified to a reasonable degree of medical certainty. These facts distinguish *Anderson* from the instant case.

Dr. Khattak also undertook the necessary differential diagnosis, considering and excluding other plausible causes of plaintiff's brain damage as unlikely. *Anderson* at 610. Differential diagnosis and the consideration of other plausible causes is part of the generally accepted methodology of determining medical causation. Dr. Khattak acknowledged that the type of injury plaintiff had was found in 1 in 2,500 babies who had no known exposure to toxic solvents. Obviously, some cause other than toxic exposure was a possible cause of that plaintiff's injury, but

[2]We are aware that this Court held in *Frausto v. Yakima HMA, LLC*, 188 Wn.2d 227, 229, 393 P.3d 776 (2017) that a non-doctor, an ARNP, could testify to the causation of an injury. But ARNPs are independently licensed health care practitioners who are legislatively empowered to diagnose injuries, pursuant to RCW 18.79.050. Prof. Tencer has no such credentials or license.

was so rare that it was not a probable cause. Prof. Tencer did not offer this kind of analysis.

In *Anderson* the medical literature was silent on the issue of whether plaintiff's type of injury was caused by toxic solvents. Society, and the law, cannot wait forever for science to answer a specific question that it might never get around to addressing. So as a matter of sound public policy, the Court might permit medical doctors to fill in the gaps, with a professional opinion based upon education, training and experience. But this policy consideration does not apply in the instant case, because Prof. Tencer is not a doctor, and, as will be explained below, because the medical literature is not silent on the cause of brachial plexus avulsion. As will be discussed *infra* at pp. 18-20, the literature contradicts Prof. Tencer's claim that maternal labor alone can cause such injuries.

2. In science, the words "hypothesis" and "theory" mean different things and cannot be used interchangeably.

In the discussion which follows, it is important to note the distinction science makes between a hypothesis and a theory. These words are terms of art, and their meanings are not identical to their common dictionary meanings. *See, e.g.*, Federal Judicial Center, REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 50-51 (3d. ed. 2011).

A hypothesis is at best an educated guess, which has been proposed so that it can be properly tested through experiment to determine

whether it is correct or incorrect. Without testing, a hypothesis is no better than speculation, and it is not science. On the other hand, a theory is a principle or a set of principles which may have started out as a hypothesis but which has been thoroughly tested. For example, one of the most thoroughly tested and validated, and therefore one of the most universally accepted sets of principles in all of physics, is Albert Einstein's Special Theory of Relativity. *Id.*

> *3. Epidemiology[3] and differential diagnosis, not engineering calculations, are the appropriate scientific mechanism for determining the cause of a specific type of injury or illness. Cause is always assessed by examining the likely contribution of a suspected cause versus plausible competing causes; it is never determined merely by demonstrating that a particular competing cause is theoretically possible or plausible.*

The generally accepted way to determine the cause of an injury is to form a hypothesis about the cause, observe the manifold plausible causes in the real world, and study them to confirm or refute the hypothesis. This study is called epidemiology.

How science test a hypothesis about the cause of a type of injury? We obviously cannot perform injury-risking experiments upon laboring mothers and their babies. So part of the generally accepted procedure is

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[3]Epidemiology is "the science concerned with the study of the factors determining and influencing the frequency and distribution of disease, injury, and other health-related events..." ENCYCLOPEDIA AND DICTIONARY OF MEDICINE, NURSING, & ALLIED HEALTH (7th ed.) 2003. The use of epidemiological methods as a correct way of determining the cause of a medical condition was tacitly acknowledged in *Anderson v. Akzo Nobel Coatings, Inc., supra*, at 603-04, 611-12 (2011).

to use epidemiological studies to identify factors associated with an increased or decreased risk of injury.

An early example illustrates the point. Dr. Ignác Semmelweis was a 19th-century Hungarian obstetrician. He became one of the pioneers of epidemiology when, in 1847, he published a book entitled ETIOLOGY, CONCEPT, AND PROPHYLAXIS OF CHILDBED FEVER.[4] Semmelweis observed that women who delivered in hospital wards where they were attended by medical doctors developed childbed fever at eight times the rate of women who delivered in wards attended by midwives.

Semmelweis' search for causation focused on behavioral differences between obstetricians and midwives. It was common for obstetricians to spend their early mornings performing autopsies upon the corpses of women who had died in childbirth; then the doctors made their rounds in the wards. Midwives, being viewed in those days as "mere women", were not permitted to participate in autopsies. Semmelweis hypothesized that somehow the doctors were carrying illness from the dead, autopsied women to the living patients.

He conducted a proper scientific study. He formulated a hypothesis, that certain healthcare providers were causing illness, based upon the observed difference in infection rates between doctors and

[4]Childbed fever is a type of potentially fatal post-partum infection which in Semmelweis' time was the single most common cause of maternal death.

midwives. He further hypothesized that the different infection rates could be explained by the difference in how the two groups spent their mornings.

He then confirmed his hypotheses through an experiment. He recorded the rate of childbed fever in the wards, then implemented a new protocol, then recorded the new rate of childbed fever. Semmelweis' new protocol was simple: he ordered the doctors under his supervision to wash their hands after autopsies and before examining patients.[5] The results were dramatic. The rate of childbed fever fell from 18% to 3%.

Some of Semmelweis' contemporaries accepted his findings, and many lives were saved. But others did not want to acknowledge that they might be harming their patients, so they loudly rejected Semmelweis' discovery. They refused to wash their hands. They attributed the death rate differential to "divine providence"[6], or they claimed that the mothers fell ill for "hysterical" reasons when male doctors examined them.[7] Of course, Semmelweis' work ultimately was vindicated when later scientists developed modern germ and hygiene theory.

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[5]Semmelweis lived in the time before the development of modern germ theory.

[6]"I prefer to believe that childbed fever is brought about by the will of Providence, which I understand, than that it is caused by an unknown contagion, which I don't." Dr. Charles D. Meigs, *On the nature, signs, and treatment of childbed fevers* 104 (1854).

[7]Medical doctors in the 1800's believed that a person who experienced emotional distress could develop a life-threatening condition called "brain fever." Supposed symptoms included a high temperature, weakness leading to being bedridden, and temporary insanity. *See, e.g.*, Dr. A. C. Doyle, *The Naval Treaty* (1893)

The work of Dr. Semmelweis provides an analogy to brachial plexus injury, because of his correct use of epidemiology and because he studied the increased risk of injuries depending upon the profession of the practitioner attending the delivery. The medical literature establishes that:

1. Shoulder dystocia "occurs when the anterior shoulder of the fetus becomes lodged behind the superior symphysis pubis, preventing further delivery." MCGRAW-HILL CONCISE DICTIONARY OF MODERN MEDICINE (2002) (emphasis added).

2. Shoulder dystocias attended by a midwife, nurse, corpsman, or osteopath are at 3.1 to 4.9 times increased risk of neonatal brachial plexus injury, versus dystocias attended by an MD-OB. Lynne V. McFarland, PhC, et al, *Erb/Duchenne's Palsy: A Consequence of Fetal Macrosomia and Method of Delivery*, 68 OBSTETRICS & GYNECOLOGY 786 (1986).[8]

Similar to what Semmelweis recognized so long ago, a plausible hypothesis for the higher rate of brachial plexus injury to babies delivered by certain types of healthcare providers is that those types of health care providers can cause, or contribute to causing, brachial plexus injury.

An example of the generally accepted methodology for determining medical causation among competing plausible causes, and of the role of differential diagnosis therein, was described in *Etherton v. Owners Insurance Co.*, 829 F.3d 1209, 1218-19, 1223 (10th Cir. 2016). This process requires, among other steps, that one consider other potential causes of an injury or illness. The *Etherton* court approved this method in

[8]Erb/Duchenne's Palsy is a type of brachial plexus injury. Fetal macrosomia is medical jargon for "large baby". A copy of Dr. McFarland's paper is attached as Appendix B.

light of *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993) and *Daubert*'s progeny.[9]

4. Prof. Tencer failed to follow generally accepted scientific procedures by using a hypothesized, unproven cause of injury as if it were an accepted, proven, most probable cause.

Prof. Tencer hypothesizes that natural forces of labor caused LM's brachial plexus injuries, including avulsions. But a hypothesis is not a tested theory, and it cannot be treated as anything other than speculation unless it has been tested and proved.

Prof. Tencer developed his hypothesis about the cause of LM's injury via abductive reasoning. Abductive reasoning is reasoning based upon limited observation, and it can be used to generate a possible explanatory hypothesis. It was perhaps most famously used by the fictional detective Sherlock Holmes, who observed characteristics about a person and then hypothesized about that person's profession or life story.[10]

In the real world of science and medicine, hypotheses always require proof before being accepted. Abductive reasoning is suitable for developing a hypothesis about a plausible cause for an injury. But it is not suitable for testing or confirming that hypothesis. It cannot be used to

[9]Of course, in matters of scientific evidence, Washington has followed *Frye*, not *Daubert*, though the outcome of the two analyses frequently is the same. *See, e.g., Reese v. Stroh*, 128 Wn.2d 300, 907 P.2d 282 (1995).

[10]Holmes called it "deductive reasoning" but this was largely a misnomer.

quantify whether that hypothetical cause is a substantial factor, or the most probable factor, or not a factor at all, in causing the injury.

As explained at p. 6, *supra*, the correct, generally accepted procedure is to identify the multiple factors which could cause or contribute to causing the injury. As verified by the medical literature, it is generally accepted that there is more than one factor which may contribute to causing brachial plexus injury. The literature documents that the risk of brachial plexus injury is increased for delivering practitioners in certain professions. *See*, McFarland, cited *supra*, at p. 9. Other established risk factors include the use of forceps in delivery (injury 4.6 times more likely to occur), and the use of vacuum extraction in delivery (injury 2.3 times more likely to occur); both of these activities involve the practitioner exerting traction (pulling) on the baby.[11]

Once a set of risk factors for a type of injury is established, it is generally accepted that the next step is to weigh those factors against one another. Statistics, probability, and/or differential diagnosis are used to determine the most probable cause or causes of an injury. In order to show, as Prof. Tencer claimed or implied, that the cause of a brachial plexus injury was maternal labor, it would be scientifically necessary to rule out other likely causes, or at least to establish that other causes were less likely

[11] *See, e.g.*, Michael D. Freeman, et al, *A multistate population-based analysis of linked maternal and neonatal discharge records to identify risk factors for neonatal brachial plexus injury*, 136 INT. J. GYNECOL. OBSTET. 331-36 (2017) (attached in Appendix C).

than maternal labor. Prof. Tencer did neither, nor did he show that it had been done by others. When a witness fails to follow proper methodology in coming to a conclusion, the conclusion is unreliable. *Lakey v. Puget Sound Energy, Inc.*, 176 Wn.2d 909, 920, 296 P.3d 860 (2013).

In fact, the existing scientific/epidemiological data regarding brachial plexus injuries makes it extremely unlikely that LM's injury could have been caused by maternal labor alone. All vaginal births involve forces of maternal labor, yet most vaginal births do not result in brachial plexus injuries, let alone brachial plexus avulsion. All vaginal births which involve shoulder dystocia also involve maternal labor, yet all vaginal births involving shoulder dystocia do not result in brachial plexus injuries, let alone brachial plexus avulsion. Obviously, something more than merely giving birth must cause or contribute to causing brachial plexus avulsion. The above data regarding practitioners, forceps, and vacuum extraction identify some of those potential contributing causes.

It is not simply Prof Tencer's hypothesis which is not generally accepted. The use of a hypothesis generated in this way and left untested also is not generally accepted. And the use of an untested hypothesis which contradicts the published medical literature is not generally accepted.

A hypothesis with no or insufficient real world evidence to support it is speculation, not science. One might just as well hypothesize

that LM's brachial plexus injury was caused because at the time of his birth, the Moon was in its Seventh House. Anyone can proffer a hypothesis that appears to exonerate a civil defendant, but when there is no or insufficient scientific evidence to support it, and where that hypothesis is contradicted by the applicable literature, then the hypothesis is not generally accepted and should be inadmissible under *Frye*.

The established view in the medical world is that practitioner traction (pulling) is the most likely cause of a brachial plexus avulsion. In science, the burden of proof rests upon the person claiming that the established view is wrong. Unless that burden of proof is someday met through proper methods, Prof. Tencer's causation hypothesis will never achieve general acceptance. To date, it has not.

5. Prof. Tencer's methodologies and opinions in this case are scientifically flawed because they use "average" information in a manner that is not generally accepted in the scientific community.

Prof. Tencer attempted to solve his lack of specific information about the forces involved in LM's delivery by using "averages". 10/27/15 RP 15-16. An average is calculated by adding up and dividing a certain characteristic of different people or things, not one of whom may actually be "average".[12]

[12]If a certain type of house costs $140,000 when located in Omak and $750,000 when located in Seattle, one could say that the average cost for this type of house is $445,000. But that "average" figure tells us nothing useful about what a home costs in Omak or in Seattle.

Prof. Tencer's "average" numbers are themselves suspect. They were based in part upon an article, CP 2375; 10/27/15 RP 11, 26, which contained "calculations" obtained by assuming: an imaginary uterus and a baby's body, both perfect ellipsoids; an imaginary baby's head that was a perfect sphere; and a contact area between the imaginary mother's symphysis pubis and the baby that was a perfect trapezoid. CP 3200. Using these questionable numbers, Prof. Tencer speculated that "average" natural forces of labor can cause the rupture and avulsion of a baby's brachial plexus. 10/27/15 RP 22, ll. 6-9.

Applying "average" data to a specific event such as the injuries to LM is not a generally accepted method of determining the forces involved in that event. Applying "average" data to a specific injury also is not a generally accepted method of determining the cause of that injury. Different midwives will pull on a baby with different amounts of force. Some women are in labor for 2 hours and some for 2 days, a fact consistent with the common-sense recognition that the sizes and shapes of women and their birth canals, the sizes and shapes of babies, and the "pushing ability" of women in labor, all vary widely. There is no way to know where LM's mother or LM or defendant midwife fell within any alleged "average range".[13] Such testimony is inadmissible under *Frye*.

[13]As far as we can discern, the record does not show that the defense made any effort to measure how much force defendant exerted upon a baby during delivery. They did not,

This testimony also suffered from the same scientific flaws that often undermine biomechanical testimony in personal injury cases. It is reminiscent of Prof. Tencer's testimony in car crash cases, where he "imported 'average person' studies ... to speculate what the transfer of energy might have been in this case...." *Gilmore v. Jefferson County Public Transportation Benefit Area*, 190 Wn.2d 483, 506, 415 P.3d 212 (2018)(Yu, J., concurring).

In a motor vehicle crash, one can at least look up the size, weight, and structural composition of the motor vehicle(s) in question. Even so, it remains extremely difficult to determine the forces that a particular person involved in a particular crash experienced, especially where individual characteristics of the person, such as height, weight, head positioning, etc. cannot be determined with accuracy. *See, e.g., Stedman v. Cooper*, 172 Wn. App. 9, 19-21, 292 P.3d 764 (2012), and cases cited therein. How much more difficult would it be to accurately calculate the forces acting upon a specific baby, particularly where, as here, no actual measurements of LM or his mother were made?

For these reasons, and others, it is inappropriate and misleading to use "average person" studies to speculate either about how much force might have been applied to LM by his mother pushing, or by the

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for example, have defendant pull on some force-measuring apparatus in a manner similar to how she pulls on babies, or to how she pulled on LM.

defendant midwife pulling. It violates ER 702. *See, Gilmore, supra,* at 504-06 (Yu, J., concurring).

Furthermore, testimony that does not tell the jury about the effect of a particular event upon a particular person is speculative and irrelevant. *State v. Lewis*, 141 Wn. App. 367, 389, 166 P.3d 786 (2007). "Scientific evidence that does not help the trier of fact resolve any issue of fact is irrelevant and does not meet the requirements of ER 702." *State v. Greene*, 139 Wn.2d 64, 73, 984 P.2d 1024 (1999).

6. By offering speculative testimony about possible causes of injury, Prof. Tencer violated generally accepted scientific principles for determining the cause of an injury.

As discussed above, *supra* at pp. 10-11, proper scientific procedure requires that plausible causes or contributing causes of an injury be considered and ruled in or ruled out. Prof. Tencer did not do this. Even if his engineering calculations had been done correctly, and even if his hypothesis that maternal labor could contribute to causing brachial plexus avulsion were correct, his methodology still failed the *Frye* test. Ignoring obvious contributing causes in favor of a speculative, unlikely cause is contrary to generally accepted scientific methods of determining the cause of an injury or illness. The resulting opinion should be inadmissible under *Frye.*

Even if Prof. Tencer had found one possible cause, it was improper to ignore all the others, especially the most probable – practitioner traction. Even if it were possible for maternal labor to have contributed to causing LM's injuries, that would in no way preclude other contributing causes, including negligence by the defendant midwife.

For this reason, witnesses who offer an opinion on medical causation must testify in terms of probability, not mere possibility. *Miller v. Staton*, 58 Wn.2d 879, 885-86, 365 P.2d 333 (1961). Testimony about "other possible causes" of a plaintiff's injury is speculative and inadmissible. *Washington Irrigation & Development Company v. Sherman*, 106 Wn.2d 685, 724 P.2d 997 (1986). It was not helpful to the jury in deciding whether defendant's negligence was a proximate cause of LM's injury.

Colley v. Peacehealth, 177 Wn. App. 717, 312 P.3d 989 (2013) might be interpreted as permitting a defense witness to testify about speculative "other possible causes" in a medical malpractice case. But *Colley* should be distinguished and limited to its unusual facts. First, the defense witnesses in *Colley* were medical doctors, not engineers. Second, plaintiffs in *Colley* were arguing something close to a res ipsa loquitur case – they claimed there was no explanation for the plaintiff's brain damage other than oxygen deprivation, and that oxygen deprivation proved medical malpractice had occurred. *Colley*, at 729. The court therefore allowed

the defense to offer medical testimony about other possible causes of the plaintiff's brain damage, to respond to plaintiff's assertion that the existence of his brain damage alone was proof of malpractice.

Here, plaintiff was not solely relying upon a theory that his injuries were proof of malpractice. Plaintiff offered expert medical testimony, based upon review of the actual video of LM's delivery, that this particular defendant midwife pulled excessively upon LM after LM developed shoulder dystocia, and that her pulling was a proximate cause of LM's brachial plexus avulsion. CP 1640; Testimony of Dr. Howard Mandel, MD, 10/21/15 RP 70. Because plaintiff's experts did not rely upon the fact of injury alone to prove malpractice, no *Colley*-based exception to the usual rule excluding "possible" causes should apply.[14]

B. **Prof. Tencer's hypothesis that the force of maternal labor acting alone can cause brachial plexus avulsion is not generally accepted in the relevant scientific community.**

As explained above, Prof. Tencer did not follow generally accepted methodologies to reach his opinion. Moreover, his opinion itself, that brachial plexus injury can be caused by maternal labor alone, is not generally accepted.

Dr. Freeman has not been able to find any reliable reports in the published, peer-reviewed medical literature, of a baby who suffered

[14]In some cases, the injury alone is evidence of malpractice. In others, it is not. If the trial court perceived a risk in a particular case that jurors might wrongly infer malpractice from injury alone, it could be addressed through jury instructions such as WPI 105.07.

permanent brachial plexus injury – much less a brachial plexus avulsion – in the absence of pulling or external traction instituted by the delivering practitioner. *See also*, Testimony of Dr. Howard Mandel, MD, 10/21/15 RP 69, ll. 2-5 (no literature ever showed avulsion caused by natural forces). In short, there is no observational, real world evidence that an avulsion has ever occurred without external traction, *i.e.*, pulling by the practitioner.

Some papers may exist which hypothesize that maternal labor could be the sole cause of a permanent avulsion injury to a baby's brachial plexus. That does not mean there is a general acceptance that this can happen. *See, e.g.*, Testimony of Dr. Stephen Glass, MD, 10/22/15 RP 116, ll. 2-3 (one report deemed unreliable because case was in litigation when written); RP 118-19, ll. 2-4 (no data to support claim that forces of labor cause most if not all brachial plexus injuries).

Controversial or speculative papers are and sometimes should be published, so that the scientific community can debate, verify, or refute them. This is part of how science advances. But controversial and speculative papers do not acquire general acceptance unless their hypotheses have been tested and validated.

The above-cited sources demonstrate that the established medical literature contradicts Prof. Tencer's testimony. When this fact is combined with the scientific flaws in Prof. Tencer's methods and testimony, and with

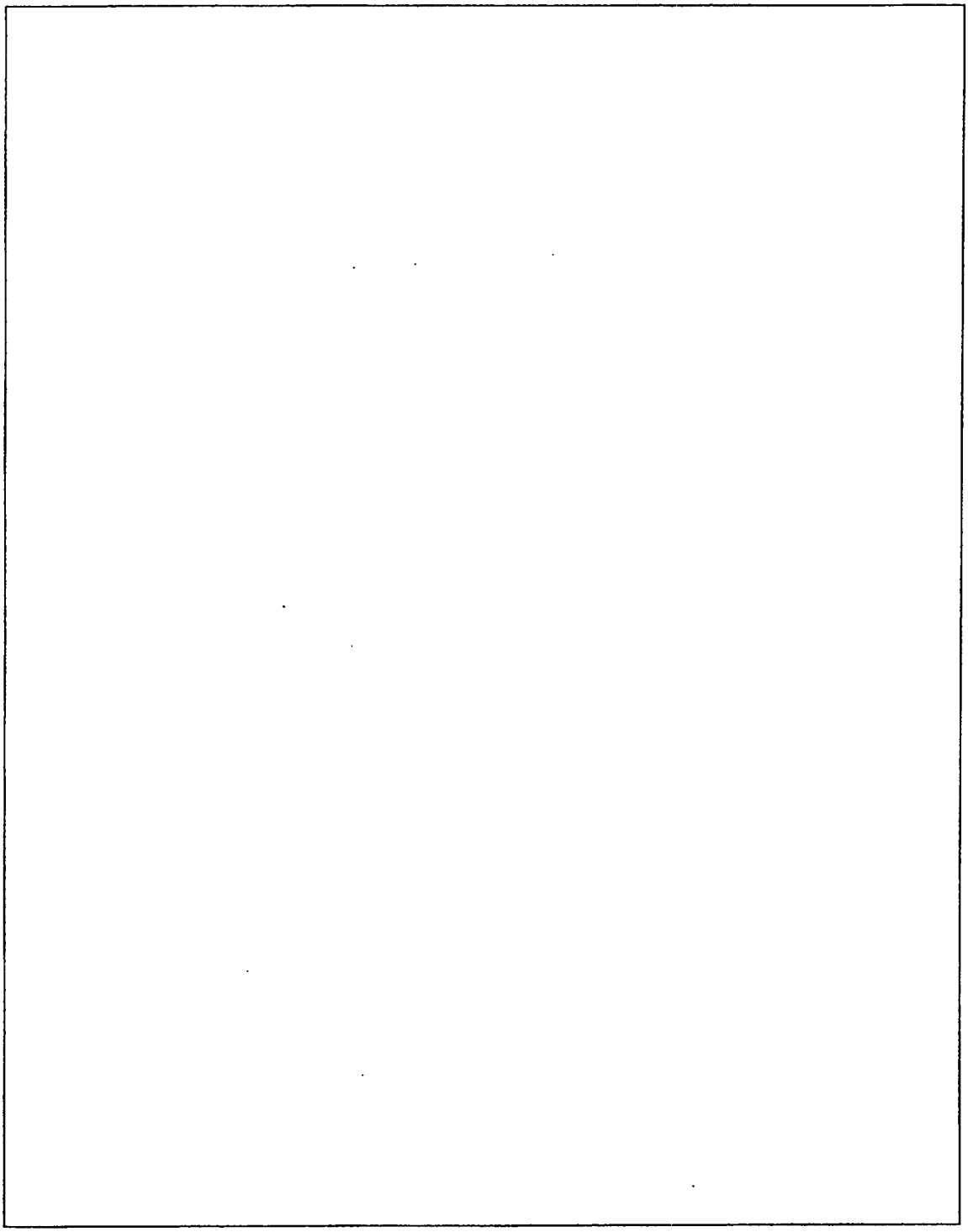
the extreme rarity or perhaps even non-existence of any known case where a baby suffered a permanent brachial plexus avulsion injury through maternal pushing alone, we can state confidently that it is not generally accepted in the scientific/medical community that maternal forces of labor acting alone could cause the injuries suffered by LM.

V. CONCLUSION

Prof. Tencer failed to follow generally accepted methods of developing and testing his hypothesis of the cause of injury. He failed to validate his hypothesis. He failed to consider and rule out other causes of injury. His hypothesis itself is not generally accepted, and in fact is contradicted by respected medical authority. For all these reasons, his opinions should have been excluded.

DATED this 12th day of October, 2018

David S. Heller, WSBA #12669
On behalf of Dr. Michael D. Freeman



HELLER LAW FIRM, PLLC APPENDIX A

CURRICULUM VITAE

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FELLOWSHIPS
Fulbright Specialist Roster
Bureau of Educational and Cultural Affairs and.World Learning,
United States Department of State, 2017-2020 tenure

Postdoctoral Fellowship
Forensic Pathology
Section of Forensic Medicine, Department of Community Medicine and Rehabilitation, Umeå University, Umeå, Sweden 2014-2015

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Associate Professor of Forensic Medicine – 2015-2018
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Affiliate Professor of Epidemiology – 2010 to 2015
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EDITORIAL ACTIVITIES

Co-Editor in Chief:
Journal of Whiplash-Related Disorders 1999-2006
Associate Editor:
OA Epidemiology, 2014-present
J of Forensic Biomechanics, 2010-present
The Spine Journal 2007-present
PM&R, official scientific journal of the American Academy of Physical Medicine and Rehabilitation, 2008-present
Scandinavian Journal of Forensic Medicine, 2012-present
Editorial Board Member:
The Spine Journal 2004-present
International Research Journal of Medicine and Medical Sciences
Egyptian Journal of Forensic Sciences 2010-present
Journal of Case Reports Practice 2014-present
Austin Journal of Public Health & Epidemiology 2014-2016
Edorium Journal of Public Health 2014-present
Editorial Committee Member:
Spineline 2004-2009
Peer reviewer:
BMC Public Health
BMC Research Notes
Annals of Epidemiology (outstanding reviewer status 2015)
Orthopedics
Spine
The Spine Journal
Lancet
Mayo Clinic Proceedings
Annals of Biomechanical Engineering

Journal of the American Board of Family Medicine
Journal of Forensic and Legal Medicine
Acta Neurologica Scandanavica
Medical Science Monitor
Pain Research & Management
Journal of Back and Musculoskeletal Rehabilitation
American Society for Testing and Materials (ASTM)
Biosecurity & Bioterrorism
Annals of Medical and Health Sciences Research
Neurorehabilitation and Neural Repair
International Research Journal of Medicine and Medical Sciences
Jurimetrics
Law, Probability, and Risk
International Journal of Molecular Sciences
Journal of Rehabilitation Medicine
Arthritis
BMC Pediatrics
Journal of Back and Musculoskeletal Rehabilitation
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Principles of Forensic Medicine and Forensic Epidemiology
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PHPM 503 Thesis Advising
Department of Public Health and Preventive Medicine
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PHPM 507 Injury and Trauma Epidemiology
Department of Public Health and Preventive Medicine
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Portland, Oregon 1999 – 2005

Forensic Epidemiology and Bioterrorism
Charles County Department of Public Health
College of Southern Maryland, Waldorf, Maryland 2014

ACTIVITIES and HONORS

Faculty, course designer and keynote speaker, "*When Science Meets Law: Forensic Epidemiology in Medicolegal Practice.*" Summer school course, Radboud Medical Center, Nijmegen, Netherlands, August 13-17, 2018.

Fulbright fellowship, US Department of State, *Forensic Epidemiology in Forensic Medicine*, March 1-15, Maastricht, Netherlands.

Keynote speaker, Gran Sesión de Epidemiología Forense. November 18, 2016 Universidad Libre, Seccional Cali, Colombia.

Vice Chair, American Academy of Forensic Sciences Standards Board Medicolegal Death Investigation Consensus Body – 2016-present
Member, American Academy of Forensic Sciences Standards Board Medicolegal Death Investigation Consensus Body – 2016-present
Affiliate Medical Examiner, Allegheny County, Pennsylvania, 2014-present
Member, Scientific Advisory Board, International Conference on Forensic Inference and Statistics. August 2014, Leiden, The Netherlands
Reviewer, National Aeronautical Space Administration (NASA) 2011
Past president, International Cellular Medicine Society, 2009 to 2012
Founding member, International Cellular Medicine Society, 2009
Member, Research Planning Committee, North American Spine Society 2007-2009
Member, Complementary Medicine Committee, North American Spine Society 2007-2009
Special Deputy Sheriff (Forensics), Vehicular Homicide Investigator, Clackamas County, Oregon, 2007-2009
Member, Crash Reconstruction and Forensic Technology (CRAFT) multidisciplinary law enforcement fatal crash investigation team, Clackamas County, Oregon, 2002-2013
Consultant Forensic Trauma Epidemiologist to the Medical Examiner Division of the Oregon Department of State Police – Occupant Kinematics, 1999-2006
Deputy Medical Examiner, Marion County, Oregon. 2000-2005
Moderator, Engineering sciences section, American Academy of Forensic Sciences 62nd Annual Meeting, Seattle, WA 2010
Co-Chair, International Whiplash Trauma Congress V, Lund, Sweden. 2011
Co-Chair, International Whiplash Trauma Congress IV, Miami, FL. October 2007.
Co-Chair, International Whiplash Trauma Congress III, Portland, OR. June 2006.
Co-Chair, International Whiplash Trauma Congress II, Breckenridge, CO. February 2005.
Co-Chair, International Whiplash Trauma Congress I, Denver, CO. October, 2003
Co-Chair, Forensic Section, International Traffic Medicine Association. Budapest, Hungary. September, 2003
Member, Blue Ribbon Panel Congressional Task Force on roller coaster-induced brain injury. Funded by a grant from the National Institute of Child Health and Human Development 2002-2003
President, Spinal Injury Foundation. Denver, CO 2002-2009
Member, Marion-Polk County C.R.A.S.H. Team - Occupant Kinematics Consultant 1999-2004
Scientific Chair, North American Whiplash Trauma Congress. Victoria, British Columbia 1999

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American Academy of Forensic Sciences, Pathology/ Biology section
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Crash Data Retrieval Technician I & II
Certification in basic and advanced crash reconstruction - Northwestern University
Diplomate, American Academy of Pain Management
Member, American College of Epidemiology
Member, Association for the Advancement of Automotive Medicine
Member, Sigma Xi Scientific Honor Society
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Fellow, International College of Chiropractic
Inactive member, North American Spine Society
Past member, Forensic Accident Reconstructionists of Oregon

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2015 National Science Foundation Industry/University Cooperative Research Centers Program, NSF 13-594 Planning Grant: I/UCRC for Advanced Research in Forensic Science, National Center for Research on Forensic Epidemiology. Principal Investigator.

2011-2013 World Health Organization – research grant for Rwandan study of relationship between genocide and suicide and homicide victimization and offending. $50,000. Project No: AFRWA 1005685, Award No: 53975.

2010-2015 Centers for Disease Control (Administered by National University of Rwanda and OHSU) SPH/CDC $200,000 over 4 years.

2002-2003 National Institute of Child Health and Human Development – Blue Ribbon Task Force on Roller Coaster Associated Brain Injury. $75,000.

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18. **Freeman MD,** Uhrenholt L. Self-defense or attempted murder? A combined ballistic and traffic crash reconstruction of a Texas shooting. *Scand J Forens Med* (2012;18(1):51.

19. **Freeman MD.** Applied forensic epidemiology: the evaluation of individual causation in wrongful death cases using relative risk. *Scand J Forens Med* (2012;18(1):25.

20. Uhrenholt L, Webb A, Pedersen M, Christensen HW, **Freeman MD.** Does whiplash trauma result in somatic injury. *Scand J Forens Med* (2012;18(1):121

21. **Freeman M,** Uhrenholt L. Rollover collisions; the effect of restraint use on skull vault fractures. 2011. Poster session presented at Årsmøde i Dansk Selskab for Retsmedicin og Dansk Selskab for Ulykkes- og Skadeforebyggelse [The Danish Traffic Medicine Society of the Danish Society for Forensic Medicine] November 3-5, 2011] Grenå, Denmark.

22. Uhrenholt L, **Freeman M,** Jurik AG, Jensen LL, Gregersen MEG, Boel LWT et al. Evidence of somatic injury in rear-impact collisions - esophagus injuries. 2011. Poster session presented at Årsmøde i Dansk Selskab for Retsmedicin og Dansk Selskab for Ulykkes- og Skadeforebyggelse [The Danish Traffic Medicine Society of the Danish Society for Forensic Medicine] November 3-5, 2011] Grenå, Denmark.

23. Uhrenholt L, **Freeman M.** How microscopy can explain traffic crash-related cervical spine injury. 2011. Poster session presented at Årsmøde i Dansk Selskab for Retsmedicin og Dansk Selskab for Ulykkes- og Skadeforebyggelse [The Danish Traffic Medicine Society of the Danish Society for Forensic Medicine] November 3-5, 2011] Grenå, Denmark.

24. Nystrom NA, **Freeman MD.** "Trigger Point" Surgery for Soft Tissue Pain in Chronic Whiplash Syndrome. *J Rehab Medicine* 2011;Suppl 50:27.

25. **Freeman MD,** Kohles SS. Scientific and Legal Criteria for Evaluating Injury Causation Following Whiplash Trauma. *J Rehab Medicine* 2011;Suppl 50:20.

26. Rosa S, **Freeman MD,** Harshfield D. Restoration of Normal Cerebrospinal Fluid Flow in 2 Cases of Confirmed Cerebellar Tonsillar Ectopia with Long-Term Headaches, Following Use of The Atlas Orthogonal Instrumented Manipulation Technique. *J Rehab Medicine* 2011;Suppl 50:14.

27. **Freeman MD,** Centeno CJ. "Whiplash-Associated Disorders [WAD]" – the persisting lexicon of a failed venture. *J Rehab Medicine* 2011;Suppl 50:6-7

28. Kohles SS, **Freeman MD.** Mathematical Models Characterizing the Probability of Trigger Event, Ambient-Risk, and Coincidental Influences on Inductive and Abductive Conclusions of Specific Causation. *Annals of Epidemiology* 2010;20(9):713-4.

29. Centeno MD, **Freeman MD,** Schultz J, Cheever M, Faulkner S, Hanson R, Kohles S. Clinical Percutaneous Implantation of Autologous, Culture-Expanded MSCs into Peripheral Joints. *Orthopedic Research Society,* 2011 Annual Meeting in Long Beach, California, January 13-16.

30. Nystrom A, **Freeman MD**. Central sensitization is a reversible response to focal soft-tissue neck pain in chronic whiplash. *2010 American Academy of Orthopedic Surgeons Annual Meeting* March 9-13, 2010, New Orleans, LA.

31. **Freeman MD**. The Error Odds method of objectively assessing bioengineering based claims of causation; a Bayesian approach to test validity quantification (Special joint session of Jurisprudence and Engineering Sciences) *Proceedings of 62nd Annual Meeting of the American Academy of Forensic Sciences* Feb 2010, Seattle, Washington.

32. Nystrom A, **Freeman MD**. Central sensitization is an immediately reversible phenomenon in chronic pain after whiplash. A double blind, placebo controlled study. *XXVIII European Society for Regional Anaesthesia Annual Congress* Salzburg, Austria, September 9-12, 2009

33. **Freeman MD**, Rosa S, Harshfield D, Smith F, Bennett RM, Centeno CJ, Kornel E, Nystrom A, Heffez D, Kohles SS. A case-control study of cerebellar tonsillar ectopia and cervical spine trauma. *European Congress of Radiology,* March 4-8, 2010, Vienna, Austria.

34. Uhrenholt L, **Freeman MD**. The Role of Microscopic Post-Mortem Study in Explaining Traffic-Crash Related Neck Injury; A Review. *Proceedings of 62nd Annual Meeting of the American Academy of Forensic Sciences*. Feb 2010, Seattle, Washington.

35. **Freeman MD**, Uhrenholt L, Newgard C. The effect of restraint use on skull vault fractures in rollover crashes. *Proceedings of 62nd Annual Meeting of the American Academy of Forensic Sciences* Feb 2010, Seattle, Washington.

36. **Freeman MD**, Uhrenholt L, Newgard C. Head injuries in lower speed collinear collisions; an analysis of the National Automotive Sampling System database. *Proceedings of 62nd Annual Meeting of the American Academy of Forensic Sciences* Feb 2010, Seattle, Washington.

37. **Freeman MD**, Rosa S, Harshfield D, Smith F, Bennett RM, Centeno CJ, Kornel E, Nystrom A, Heffez D, Kohles SS. A case-control study of cerebellar tonsillar ectopia and cervical spine trauma. *XXI Congress of the International Academy of Legal Medicine* May 2009 Lisbon, Portugal

38. **Freeman MD**. The Error Odds assessment of accuracy for tests in forensic medicine; a simple application of Bayes' Law. *XXI Congress of the International Academy of Legal Medicine* May 2009 Lisbon, Portugal

39. Uhrenholt L, Schumacher B, **Freeman MD**. A cross-sectional study of road traffic fatalities and vehicular homicide investigation practices in Denmark for 2000-2004. *Proceedings of 61st Annual Meeting of the American Academy of Forensic Sciences*. Feb 2009, Denver, Colorado.

40. **Freeman MD**, Centeno CJ. Etiologic and demographic characteristics of traffic crash-related disc injuries. *Spine J* doi:10.1016/j.spinee.2008.06.373.

41. **Freeman MD**. Bayesian analysis of predictive characteristics in suicidal versus homicidal hanging deaths: A case study in forensic epidemiology. *Proceedings of 59th Annual Meeting*

of the American Academy of Forensic Sciences February 19-24, 2007, San Antonio, Texas 2007;13:304.

42. **Freeman MD.** Probability and pathological findings in suicide versus homicidal hanging deaths; a case study. *Proceedings of 16th Nordic Conference on Forensic Medicine* June 15-17, 2006, Turku, Finland 2006:15-6.

43. **Freeman MD.** Injury Pattern Analysis as a means of driver determination in a vehicular homicide investigation. *Proceedings of 16th Nordic Conference on Forensic Medicine* Turku, Finland June 15-17 2006:38-9.

44. **Freeman MD.** Injury Pattern Analysis in Fatal Traffic Crash Investigation. *Proceedings of 57th Annual Meeting of American Academy of Forensic Sciences* New Orleans, Louisiana. February 24, 2005.

45. **Freeman MD**, Croft AC, Centeno C. Fatal head injury cases in a rural Oregon county. *Proceedings of the 19th World Congress of the International Traffic Medicine Association* Budapest, Hungary, September 14-17, 2003.

46. Croft AC, Haneline MT, **Freeman MD.** Differential Occupant Kinematics and Forces Between Frontal and Rear Automobile Impacts at Low Speed: Evidence for a Differential Injury Risk, *International Research Council on the Biomechanics of Impact (IRCOBI)* Munich, Germany September 18-20, 2002:365-6.

47. Sparr L, **Freeman MD.** The Uses and Abuses of Psychiatric IMEs: An Ethical Dilemma? *American Psychiatric Association Annual Meeting* San Francisco, California May 2003.

48. Croft AC, Haneline MT, **Freeman MD.** Low speed frontal crashes and low speed rear crashes: is there a differential risk for injury? *Proceedings of the 46th Association for the Advancement of Automotive Medicine (AAAM) Annual Scientific Conference* Tempe, Arizona, September 29-October 2, 2002:79-91.

49. Croft AC, Lord S, **Freeman MD.** Whiplash Injury: Mechanisms of Injury, Pathophysiology, and Treatment *10th World Congress on Pain, International Association for the Study of Pain* San Diego, August 17-22, 2002:482.

50. **Freeman MD**, Centeno C, Croft AC, Nicodemus CN: Significant spinal injury resulting from low-level accelerations: a comparison with whiplash. *International Congress on Whiplash-Associated Disorders* Berne, Switzerland, March 9-10, 2001.

51. Croft AC, Haneline MT, **Freeman MD.** Differential occupant kinematics and head linear acceleration between frontal and rear automobile impacts at low speed: evidence for a differential injury risk. *International Congress on Whiplash-Associated Disorders* Berne, Switzerland, March 9-10, 2001.

52. Croft AC, Haneline MT, **Freeman MD.** Automobile crash reconstruction in low speed rear impact crashes utilizing a momentum, energy, and restitution (MER) method. *International Congress on Whiplash-Associated Disorders* Berne, Switzerland, March 9-10, 2001.

53. Centeno C, **Freeman MD**, Croft AC. A comparison of the functional profile of an international cohort of whiplash injured patients and non-patients: an internet study. *International Congress on Whiplash-Associated Disorders* Berne, Switzerland, March 9-10, 2001.

54. **Freeman MD**, Sapir D, Boutselis A, Gorup J, Tuckman G, Croft AC, Centeno C, Phillips A. Whiplash injury and occult vertebral fracture: a case series of bone SPECT imaging of patients with persisting spine pain following a motor vehicle crash. *Cervical Spine Research Society 29th Annual Meeting* Monterey, CA, Nov 29-Dec 1, 2001.

55. Johansson BH, **Freeman MD**. The prevalence of symptomatic cervical disc herniation in the Swedish population with asymptomatic degenerative disc disease (a cross-sectional study). *International Congress on Whiplash Associated Disorders* March, 2001. Berne, Switzerland.

56. **Freeman MD**, Centeno C, Croft AC, Nicodemus C. Significant spinal injuries resulting from low-level accelerations: a case series of roller coaster injuries. *Proceedings of Cervical Spine Research Society 28th Annual Meeting,* November 30-December 2, 2000:110-1.

57. Croft AC, **Freeman MD**. An evaluation of the neck injury criterion; recommendations for future consideration. *Association for the Advancement of Automotive Medicine,* San Antonio, TX October, 2000.

58. **Freeman MD**, Croft AC, Rossignol AM. The prevalence of whiplash-associated chronic cervical pain among a random sample of patients with chronic spine pain. *Proceedings of 27th Annual Cervical Spine Research Society Annual Meeting.* Seattle, WA December 13-15, 1999.

59. **Freeman MD**, Croft AC, Rossignol AM. Late whiplash risk factor analysis of a random sample of patients with chronic spine pain. *World Whiplash Associated Disorders Congress,* February 8-10, 1999, Vancouver, British Columbia

Scientific Commentary/Editorials/Letters

1. Uhrenholt L, Webb A, **Freeman MD**. Letter to the Editor regarding "Do X-ray-occult fractures play a role in chronic pain following a whiplash injury?" *Eur Spine J* DOI 10.1007/s00586-014-3362-3.

2. **Freeman MD**. Clinical Practice Guidelines versus Systematic Reviews; which serves as the best basis for evidence based spine medicine? Invited commentary. *Spine J* 2010 Jun;10(6):512-3.

3. **Freeman MD**, Centeno CJ, Katz E. MR imaging of whiplash injury in the upper cervical spine; controversy or confounding? *Spine J* 2009 Sep;9(9):789-90. Epub 2009 Jun 17

4. Centeno CJ, **Freeman M**. Re: Are smooth pursuit eye movements altered in chronic whiplash-associated disorders? A cross-sectional study. *Clin Rehabil* 2008 Apr;22(4):377-8.

5. Centeno CJ, **Freeman MD**. Editorial Submission on Kongsted, A., et al., Are smooth pursuit eye movements altered in chronic whiplash associated disorders? A cross-sectional study. *Clin Rehabil* 2007;21(11):1038-49.

6. **Freeman MD.** Crash Test Dummy? *New Scientist* June 23, 2007:22-3.

7. **Freeman MD**, Centeno CJ, Merskey H, Teasell R, Rossignol AM. Greater injury leads to more treatment for whiplash: no surprises here. *Arch Int Med* 2006;166(11):1238-9.

8. Centeno C, **Freeman MD.** Alberta rodeo riders do not develop late whiplash. *J Rheumatol* 2007 Feb;34(2):451-2.

9. **Freeman MD**, Centeno C. Alar, Transverse and Apical Ligament Strain due to Head-Turned Rear Impact. *Spine* 2006;31(17):2030.

10. **Freeman MD.** Cervical disc herniation following motor vehicle crash trauma. Invited commentary. *Spine J* 2005 Nov-Dec;5(6):644.

11. **Freeman MD**, Centeno C. Whiplash and Peer Review *JWRD* 2003;2(2):1-3.

12. **Freeman MD**, Centeno C. Whiplash and Secondary Gain *JWRD* 2003;2(1):1-4.

13. **Freeman MD**, Centeno C. "Placebo" Collisions and Whiplash *JWRD* 2002;1(2):1-8.

14. **Freeman MD.** Biomechanics of minor automobile accidents. *J South Orthop Assoc* 2001 Summer;10(2):95-6.

15. **Freeman MD.** Are demolition derby drivers a valid proxy for the population at risk for whiplash injury? *Arch Neurol* 2001 Apr;58(4):680-1.

16. **Freeman MD**, Rossignol AM. Effect of eliminating compensation for pain and suffering on the outcome of insurance claims. *NEJM* 2000 Oct 12;343 (15):1118-9.

17. **Freeman MD.** Letter to the editor. *Cranio* 1999;17(3):160-1.

18. Croft AC, **Freeman MD.** Commentary on "Pain after whiplash: a prospective controlled inception cohort study." *The Back Letter* 1999;14(4):43-5.

19. **Freeman MD**, Croft AC. Late Whiplash Syndrome, 3rd reply. *Lancet* 1996 Jul 13;348(9020):125.

SCIENTIFIC PRESENTATIONS

1. Freeman MD. Causation analysis in medical negligence. Radboud Summer School. Radboud Medical Center, August 14, 2017: Nijmegen, Netherlands.

2. Freeman MD. Injury causation analysis. Radboud Summer School. Radboud Medical Center, August 14, 2017: Nijmegen, Netherlands.

3. Freeman MD. Criminal applications of Forensic Epidemiology. Radboud Summer School. Radboud Medical Center, August 14, 2017: Nijmegen, Netherlands.

4. Freeman MD. Introduction to Forensic Epidemiology. Radboud Summer School. Radboud Medical Center, August 13, 2017: Nijmegen, Netherlands.

5. Freeman MD. Ballistic analysis of an attempted murder using a porcine model. *Proceedings of 70th Annual Meeting of the American Academy of Forensic Sciences* 2018 Feb 19-23: Seattle, WA.

6. Freeman MD. Evidence-based practice in Forensic Medicine; Principles of Forensic Epidemiology. Radboud Medical Center, October 9, 2017: Nijmegen, Netherlands.

7. Freeman MD. Incidence and risk factors for neonatal falls US Hospitals, 2003-2012. *Health Science Research,* Doernbecher Childrens' Hospital, Oregon Health & Science University, March 13, 2017, Portland, Oregon.

8. Freeman MD. Incidence and risk factors for neonatal falls US Hospitals, 2003-2012. *Research in Progress,* Department of Internal Medicine, Oregon Health & Science University School of Medicine, January 31, 2017, Portland, Oregon.

9. Freeman MD. Evidence-based practice in Forensic Medicine. Invited presentation to the Dutch National Forensic Institute (NFI). December 6, 2016 Maastricht University, Maastricht, Netherlands.

10. Freeman MD. Forensic Epidemiology: Principals & Practice Part 2: Investigation of specific causation. Gran Sesión de Epidemiología Forense. November 18, 2016 Universidad Libre, Cali, Colombia.

11. Freeman MD. Forensic Epidemiology: Principals & Practice Part 1: Investigation of specific causation. Gran Sesión de Epidemiología Forense. November 18, 2016 Universidad Libre, Cali, Colombia.

12. Freeman MD. Fatal crash investigation. World Reconstruction Exposition (WREX 2016). May 2-6, 2016. Orlando, Florida.

13. Freeman MD. Trends in police use-of-force related hospitalizations; an analysis of Nationwide Inpatient Sample data for 1998-2012. *Research in Progress,* Department of Internal Medicine, Oregon Health & Science University School of Medicine, November 10, 2015, Portland, Oregon.

14. Freeman MD. Concussion risk associated with head impact; an analysis of pooled data from helmeted sports. *12th Annual Conference of the North American Brain Injury Society,* April 29-May 1, 2015 San Antonio, Texas

15. Freeman MD. The role of risk in assessing cause in forensic investigation of injury and death. *American Medical Response biennial EMS training.* April 17, 2015, Mt. Hood, Oregon.

16. Freeman MD. Development of a pediatric fatal head trauma registry. *Research in Progress,* Department of Internal Medicine, Oregon Health & Science University School of Medicine, April 7, 2015, Portland, Oregon.

17. Freeman MD. Fatal crash investigation: methods and case presentations. Washington County CART Team training lecture. Tualatin Police Department, Tualatin, Oregon. March 4, 2015.

18. Freeman MD. An analysis of the causal relationship between maternal/ prenatal cocaine

use and stillbirth: results of a national hospital database study. *67th Annual Meeting of the American Academy of Forensic Sciences* 2015 Feb 16-21: Orlando, FL

19. Freeman MD. Biomechanical, Mechanical, and Epidemiologic Characteristics of Low Speed Rear Impact Collisions. *67th Annual Meeting of the American Academy of Forensic Sciences* 2015 Feb 16-21: Orlando, FL.

20. Freeman MD. Sexual abuse in the Boy Scouts: a preliminary analysis of Boy Scout ineligible volunteer files from 1945 to 2004. *Research in Progress,* Department of Sociology, Portland State University. December 18, 2014.

21. Freeman MD. Understanding chronic pain after whiplash trauma. *Lund University Hospital, Department of Rehabilitation Medicine.* December 11, 2014, Lund, Sweden.

22. Freeman MD. Forensic Applications of Epidemiology in Criminal and Civil Settings. *Richard Doll Building, Nuffield College, Oxford University.* December 10, 2014, Oxford, UK.

23. Freeman MD. The Efficacy of tPA in Preventing Long Term Poor Outcome After Ischemic Stroke: A Reanalysis of NINDS Data. *Research in Progress,* Department of Internal Medicine, Oregon Health & Science University School of Medicine, November 25, 2014, Portland, Oregon.

24. Freeman MD. Forensic Epidemiology and Bioterrorism. Full day course for public health and law enforcement. A joint training for public health, law enforcement, and emergency services. Sponsored by Charles County Department of Public Health and funded through a grant from the Centers for Disease Control and Prevention, Public Health Preparedness Cooperative Agreement. College of Southern Maryland. June 10, 2014. Waldorf, Maryland.

25. Freeman MD. Maternal cocaine exposure and still-birth risk. *Research in Progress,* Department of Internal Medicine, Oregon Health & Science University School of Medicine, May 20, 2014, Portland, Oregon.

26. Freeman MD. Forensic Applications of Epidemiology in Civil and Criminal Litigation. *9th International Conference on Forensic Inference and Statistics* August 19-22, 2014

27. Freeman MD. Investigation of a disputed mechanism of diffuse axonal injury following a low speed frontal crash. *65th Annual Meeting of the American Academy of Forensic Sciences,* Feb 21, 2014, Seattle, Washington.

28. Freeman MD. Public defense of dissertation for Doctor of Medicine degree, "The role of forensic epidemiology in evidence based forensic medical practice." *Section of Forensic Medicine, Department of Community Medicine and Rehabilitation, Faculty of Medicine, Umeå University.* November 6, 2013, Umeå, Sweden.

29. Freeman MD. Case studies in applied forensic epidemiology. Invited lecture, *University of Maastricht, Department of Complex Genetics and Epidemiology,* Maastricht, The Netherlands. October 31, 2013.

30. Freeman MD. The relationship between Chiari malformation, trauma, and chronic pain. *Karolinska Institute,* September 27, 2012, Stockholm, Sweden.

31. Freeman MD. Serious head and neck injury as a predictor of occupant position in fatal rollover crashes. *18th Nordic Conference on Forensic Medicine,* June 13-16, 2012 Aarhus Denmark.

32. Freeman M. Self-defense or attempted murder? A combined ballistic and traffic crash reconstruction of a Texas shooting. *18th Nordic Conference on Forensic Medicine*, June 13-16, 2012 Aarhus Denmark.

33. Freeman MD. Applied forensic epidemiology: the evaluation of individual causation in wrongful death cases using relative risk. *18th Nordic Conference on Forensic Medicine*, June 13-16, 2012 Aarhus Denmark.

34. Freeman MD. Forensic Epidemiologic Investigation of Traffic Crash-Related Homicide. *Årsmøde i Dansk Selskab for Retsmedicin og Dansk Selskab for Ulykkes- og Skadeforebyggelse* [The Danish Traffic Medicine Society of the Danish Society for Forensic Medicine] November 3-5, 2011] Grenå, Denmark.

35. Freeman MD. Traffic Crash Injuries 1960 to the present; how far we've come. Keynote address, *Årsmøde i Dansk Selskab for Retsmedicin og Dansk Selskab for Ulykkes- og Skadeforebyggelse* [The Danish Traffic Medicine Society of the Danish Society for Forensic Medicine] November 3-5, 2011] Grenå, Denmark.

36. Freeman MD. Is there a place for forensic biomechanics in evaluation of Probability of Causation? *8th International Conference on Forensic Inference and Statistics (ICFIS)*, July 19-21, 2011; University of Washington, Seattle, Washington.

37. Freeman MD. Case studies in forensic epidemiology. *8th International Conference on Forensic Inference and Statistics (ICFIS)*, July 19-21, 2011; University of Washington, Seattle, Washington.

38. Freeman MD. The Error Odds method of objectively assessing bioengineering based claims of causation; a Bayesian approach to test validity quantification. Invited lecture; joint session of Jurisprudence and Engineering Sciences. *62nd Annual Meeting of the American Academy of Forensic Sciences* Feb 25, 2010, Seattle, Washington.

39. Freeman MD, Uhrenholt L, Newgard C. The effect of restraint use on skull vault fractures in rollover crashes. Engineering Sciences section, *62nd Annual Meeting of the American Academy of Forensic Sciences* Feb 26, 2010 Seattle, Washington.

40. Freeman MD, Uhrenholt L, Newgard C. Head injuries in lower speed collinear collisions; an analysis of the National Automotive Sampling System database. Engineering Sciences section, *62nd Annual Meeting of the American Academy of Forensic Sciences* Feb 26, 2010 Seattle, Washington.

41. Freeman MD. The Error Odds assessment of accuracy for tests in forensic medicine; a simple application of Bayes' Law. Invited presentation; *XXI Congress of the International Academy of Legal Medicine* May 2009, Lisbon, Portugal

42. Freeman MD. Forensic Epidemiology and Traumatic Brain Injury. Invited presentation; *VII World Congress on Brain Injury, International Brain Injury Association* April 2008 Lisbon, Portugal.

43. Freeman MD, Hand M. Bayesian analysis of predictive characteristics in suicidal versus homicidal hanging deaths: A case study in forensic epidemiology. *59th Annual Meeting of the American Academy of Forensic Sciences* February 19-24, 2007, San Antonio, Texas.

44. Freeman MD. Probability and pathologic findings in suicidal versus homicidal hanging deaths; a case study *16th Nordic Conference on Forensic Medicine* June 15, 2006, Turku, Finland.

45. Freeman MD. Injury Pattern Analysis as a means of driver determination in a vehicular homicide investigation *16th Nordic Conference on Forensic Medicine* June 16, 2006, Turku, Finland.

46. Freeman MD. Probability and pathologic findings in suicidal versus homicidal hangings; a case study. Grand Rounds *Institute of Forensic Medicine, Aarhus University, Aarhus, Denmark.* October 27, 2005.

47. Freeman MD. Road Traffic Crashes- mechanisms, injuries and analysis. Invited lecture (Keynote address) *Danish Society for Automotive Medicine* Aarhus, Denmark. October 27, 2005.

48. Freeman MD. The Defense Medical Evaluation: Issues, Ethics and Pitfalls. *2nd Annual International Whiplash Trauma Congress* Breckenridge, Colorado. February 26, 2005.

49. Freeman MD. Injury Pattern Analysis in Fatal Traffic Crash Investigation *American Academy of Forensic Sciences' 57th Annual Meeting* New Orleans, Louisiana. February 24, 2005.

50. Freeman MD. Independent Medical Evaluations and secondary gain. Grand Rounds, *Department of Psychiatry, Oregon Health & Science University School of Medicine* November 2, 2004.

51. Freeman MD. The epidemiology of crash-related trauma. Invited lecture. Grand Rounds *Peace Health Hospital* Longview, Washington. March 30, 2004.

52. Freeman MD. Injury pattern analysis: the practical application to the investigation of crash related death. Grand Rounds Department of Pathology, *Oregon Health Sciences University* Portland, Oregon. January 21, 2004.

53. Freeman MD. Literature critique, Whiplash Updates. Invited lecture. *British Columbia Chiropractic Association* Vancouver, British Columbia, Canada. October 23, 2003.

54. Freeman MD. Catastrophic crash cases and probability. Invited lecture. *Paris American Legal Institute* Florence, Italy. September 22, 2003.

55. Freeman MD. Injury pattern analysis as a means of driver identification in a vehicular homicide; a case study. *International Traffic Medicine Association Annual Meeting.* Budapest, Hungary. September 17, 2003.

56. Freeman MD. Fatal head injury crashes in a rural Oregon county, 1990-1999. *International Traffic Medicine Association Annual Meeting.* Budapest, Hungary. September 16, 2003.

57. Freeman MD. Crash reconstruction and forensic science. Invited lecture. *CRASH 2003* Spine Research Institute of San Diego. San Diego, California. August 22, 2003.

58. Freeman MD, Sparr L. The uses and abuses of psychiatric IMEs: an ethical dilemma. *American Psychiatric Association Annual Meeting.* San Francisco, California. May 21, 2003.

59. Freeman MD. Crash-related trauma. Invited lecture. THRI Neuroscience meeting. *Texas Back Institute* St. Mary's Hospital. Plano, Texas. February 28, 2003.

60. Freeman MD. Whiplash injury and occult spinal fracture. *International Association for the Study of Pain* 10th World Congress on pain. San Diego, California. August 20, 2002.

61. Freeman MD. Crash Reconstruction and forensic science. *CRASH 2002* Spine Research Institute of San Diego. San Diego, California. August 8, 2002.

62. Freeman MD. Epidemiologic and medical aspects of whiplash injury. *Swedish Orthopedic Society* Stockholm, Sweden. May 17, 2002.

63. Freeman MD. Epidemiologic considerations of whiplash injuries. Invited lecture. *European Chiropractic Union Annual Congress* Oslo, Norway. May 9, 2002.

64. Freeman MD. The role of cervical manipulation in neck pain. Invited lecture. *Cervical Spine Research Society 29th Annual Meeting* Instructional Course, Monterey, CA, Nov 29-Dec 1, 2001

65. Freeman MD. Whiplash injury and occult vertebral fracture: a case series of bone SPECT imaging of patients with persisting spine pain following a motor vehicle crash. *Cervical Spine Research Society 29th Annual Meeting* Monterey, CA, Nov 29-Dec 1, 2001

66. Freeman MD. Interpreting the medical literature with a focus on bias and confounding/Minimal Damage Crash Reconstruction. Invited lecture. *CRASH 2001* Spine Research Institute of San Diego. San Diego, CA. August 2001.

67. Freeman MD. Injury Pattern Analysis and Forensic Trauma Epidemiology in vehicular homicide investigation. *Washington State Patrol* Lacy, WA, June 20, 2001

68. Freeman MD. Case studies in multidisciplinary spine care. *Chiropractic Association of Oregon* Portland OR, April 28, 2001

69. Freeman MD. Injury Pattern Analysis and Forensic Trauma Epidemiology in vehicular homicide investigation. *Washington State Patrol* Vancouver, WA, February 13, 2001

70. Freeman MD. The role of cervical manipulation in neck pain. Invited lecture. *Cervical Spine Research Society 28th Annual Meeting* Instructional Course. Charleston, South Carolina, December 1, 2000

71. Freeman MD. Significant spinal injuries resulting from low-level accelerations: a case series of roller coaster injuries. *Cervical Spine Research Society 28th Annual Meeting* Charleston, South Carolina, December 1, 2000

72. Freeman MD. Injury Pattern Analysis and Forensic Trauma Epidemiology in vehicular homicide investigation. *Medical Examiner Division, Oregon State Police.* Salem, OR. November 28, 2000

73. Freeman MD. Minimal damage motor vehicle crash reconstruction. Invited lecture. Spine Research Institute of San Diego. *CRASH 2000* Spine Research Institute of San Diego. San Diego CA. August 11-13, 2000

74. Freeman MD. Analysis of the whiplash literature with emphasis on research out of Quebec and Saskatchewan. *Saskatchewan Medical Group and Coalition Against No-Fault.* Saskatoon, Saskatchewan. September 2000.

75. Freeman MD. Forensic applications of crash reconstruction. Invited lecture. *CRASH 2000* Spine Research Institute of San Diego.. San Diego, CA. August 11, 2000.

76. Freeman MD. Injury Pattern Analysis and Forensic Trauma Epidemiology; practical application in the forensic setting. Washington County CART Team training lecture, on behalf of *Medical Examiner Division, Oregon State Police.* Lake Oswego, Oregon. July 13, 2000.

77. Freeman MD. The epidemiology of acute and chronic whiplash injury in the U.S. Invited lecture. *HWS-Distorsion (Schleudetrauma) & Leichte Traumatische, Hirnverletzung. Invaliditat und Berufliche Reintegration.* Basel, Switzerland. June 29-30, 2000.

78. Freeman MD. Whiplash injury risk factors. Invited lecture. *Whiplash 2000.* Bath, England. May 18, 2000.

79. Freeman MD. How many whiplash injuries could there be? Invited lecture. *Whiplash 2000* Bath, England. May 17, 2000.

80. Freeman MD. Whiplash injury and occupant kinematics; the results of human volunteer crash testing. Invited lecture. *Society for Road Traffic Injuries (LFT).* Oslo, Norway. April 3, 2000.

81. Freeman MD. Epidemiology of Whiplash Injuries. Invited lecture. *Swedish Orthopedic Society* Stockholm, Sweden. March 31, 2000.

82. Freeman MD. Methodologic pitfalls in epidemiological and clinical research, with examples from whiplash research. Invited lecture. *Arvetsinstitut (Institute for Musculoskeletal Medicine Research) Umeå University,* Umeå, Sweden. March 30, 2000.

83. Freeman MD. The prevalence of whiplash-associated chronic cervical pain among a random sample of patients with chronic spine pain. *Cervical Spine Research Society 27th Annual Meeting* Seattle, WA December 13-15, 1999.

84. Freeman MD. High speed videography of occupant movement during human volunteer crash testing; searching for an injury threshold. *North American Whiplash Trauma Congress* November 12, 1999.

85. Freeman MD. Scientific Chair Address. *North American Whiplash Trauma Congress* November 12, 1999.

86. The science of whiplash injuries: common mistakes in the reconstruction of low speed crashes. Invited lecture. *Forensic Accident Reconstructionists of Oregon* Eugene, Oregon, April 1, 1999.

87. Freeman MD. Late whiplash risk factor analysis of a random sample of patients with chronic spine pain. *Whiplash Associated Disorders World Congress* Vancouver, B.C. February 9, 1999.

88. Freeman MD. The epidemiology of whiplash injuries; critiquing the literature. Grand rounds, *Department of Public Health and Preventive Medicine, Oregon Health Sciences University* Portland, Oregon. December 17, 1998.

89. Freeman MD. The scientific appraisal of motor vehicle crash-related injuries. Invited lecture. *Managing the Cost of Auto Injuries.* Orlando, FL. December 8, 1998.

90. Freeman MD. Risk factors for chronic pain following acute whiplash injury. Invited lecture. *Managing the Cost of Auto Injuries* Orlando, FL. December 7, 1998.

91. Freeman MD. The epidemiology of whiplash injuries. Current Issues in Public Health, *Department of Public Health and Preventive Medicine, Oregon Health Sciences University* Portland, Oregon. October 7, 1998

92. Freeman MD. The epidemiology of whiplash - is there a reliable threshold for whiplash injury? Invited lecture. *HWS-Distortion (Schleudetrauma) & Leichte Traumatische Medico-Legal Congress.* Basel, Switzerland, June 26, 1998.

93. Freeman MD. The Epidemiology of Late Whiplash. Invited lecture. *HWS-Distortion (Schleudetrauma) & Leichte Traumatische Medico-Legal Congress.* Basel, Switzerland, June 25, 1998.

94. Freeman MD. Methodologic error in the whiplash literature. Invited lecture. *Whiplash '96* Brussels, Belgium, November 15-16, 1996

95. Freeman MD. Conservative therapy for spinal disorders *St. Francis Hospital*, San Francisco, CA. September 1994

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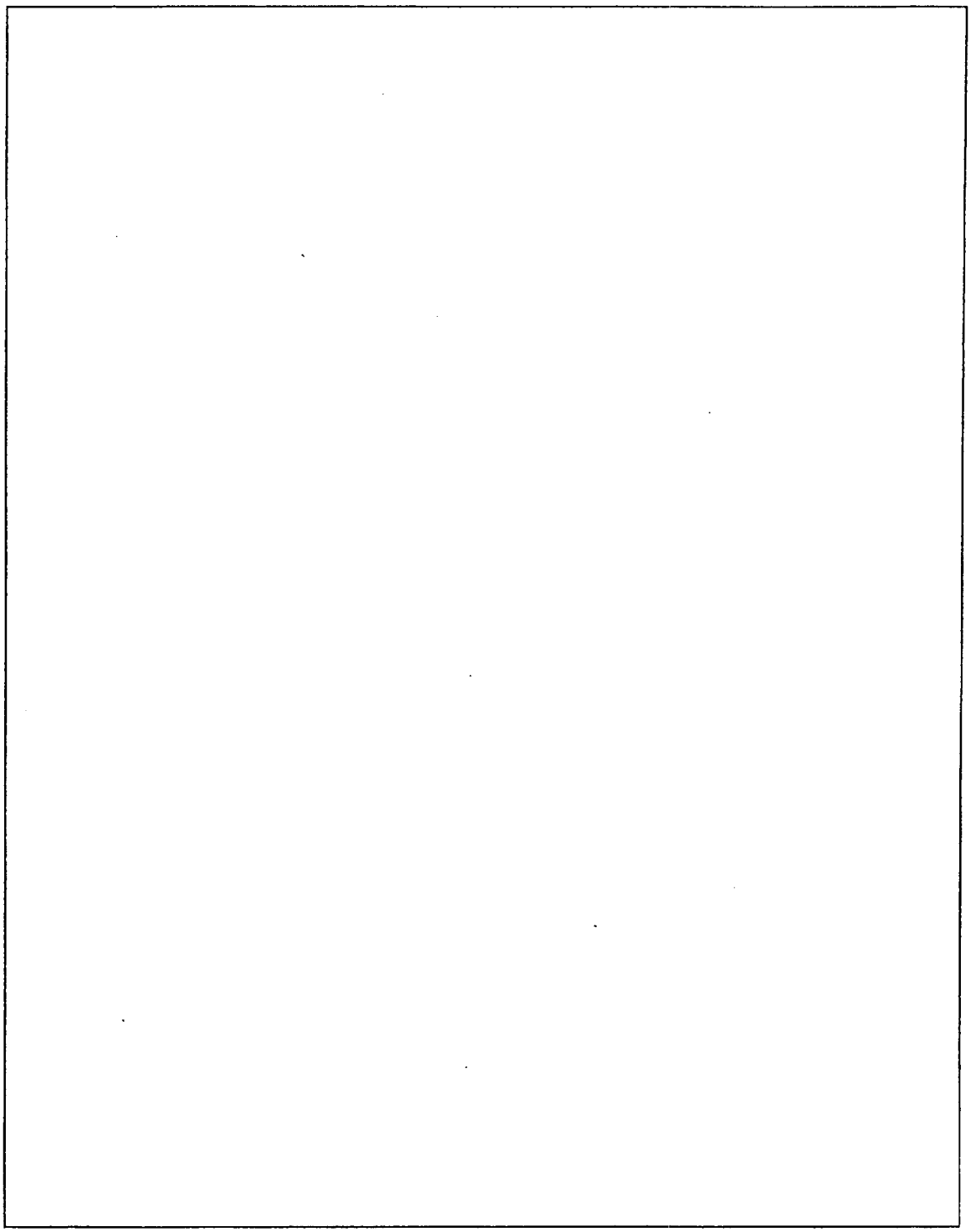

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APPENDIX **B**

Erb/Duchenne's Palsy: A Consequence of Fetal Macrosomia and Method of Delivery

LYNNE V. McFARLAND, PhC, MAUREEN RASKIN, MS, JANET R. DALING, PhD, AND THOMAS J. BENEDETTI, MD

Methods of delivery, maternal and neonatal characteristics were examined to determine their role in the occurrence of Erb/Duchenne's palsy. Data from 210,947 Washington state birth certificates from 1980 through 1982 were examined. The incidence was 50.2 cases of Erb's palsy per 100,000 live births. A case control study design was used to analyze 106 cases and 386 controls by both univariable and multivariable analysis. Birth weight was shown to be a significant risk factor regardless of which method of delivery was used. A high birth weight infant (4001–4500 g) had 2.5 times the risk of incurring an upper brachial plexus injury compared with normal size infants (2501–4000 g). The risk for infants greater than 4500 g increased another tenfold (OR = 21.0). When birth weight was controlled for in the analysis, midforceps (OR = 18.3), vacuum extraction (OR = 17.2), and low forceps (OR = 3.7) remained significantly associated with the Erb's palsy. Delivery by cesarean section was associated with a significant protective effect (OR = 0.5) compared with instrumental vaginal delivery. These data demonstrate a high risk for serious birth injury associated with instrumental midpelvic delivery. *(Obstet Gynecol 68:784, 1986)*

Injuries to the brachial plexus occur when there is a strong lateral traction on the head and neck or a downward traction on the shoulders, which causes adduction and internal rotation of the shoulder with pronation of the forearm. Damage may range from minimal to severe: from stretching of the nerve, to hemorrhage within the nerve, tearing of the nerve or root, or avulsion of the root with resulting cervical cord injury.[1] Differentiation of the types of injuries is based upon which cervical roots are involved. Erb/Duchenne's palsy is an upper brachial plexus injury involving cervical roots of C_5 to C_6. Associated unilateral paralysis of the diaphragm has also been reported.[2-4] Recent information suggests that about 70% of Erb's palsy patients recover by 3–13 months of age.[5,6] Klumpke's palsy, a lower brachial plexus type involving roots from C_7 to T_1, has a much poorer prognosis but is far less common than Erb's.[1]

Due to the low incidence of brachial plexus injuries, there has been a paucity of accurate data concerning true incidence as well as prognosis. The best estimates place the incidence between 35 and 57 per 100,000 live births, but such information is at least ten years old.[6,7] The authors felt there was a need for a population-based study to delineate those factors associated with upper brachial plexus injuries. The specific objectives of this study were 1) to identify which methods of delivery are associated with an increased risk of Erb's palsy while controlling for other variables, 2) to quantitate the risk associated with each of the methods, and 3) to examine birth weight as both an independent risk factor and a modifying variable.

Methods

A case-control design was used to examine data from 210,947 Washington state birth certificates from 1980 through 1982. All cases of Erb's palsy as coded on the birth certificates were identified. To assure the accuracy of the computer data to be used, patients' birth certificates were examined and compared with that coded on the computer tapes. Based on power considerations, a case-control ratio of 1:3 was used. Controls were randomly selected from those certificates where Erb's palsy was not indicated. Univariable and multivariable analyses were performed on the data obtained. Linked birth and infant death certificates provided data on mortality of Erb's palsy infants. Cause of death was listed by ICD codes.

Analysis of cesarean section was performed by pooling both primary and repeat cesarean sections. Be-

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cause use of high forceps is a rare clinical event and only two categories of forceps use ("low" or "other") are present on the Washington birth certificates, "other" forceps was assumed to mean midforceps and, for purposes of presentation, was indicated as such. In addition to birth weight and method of delivery, the distributions among cases and controls for a number of other potentially significant factors were also examined. These variables included: attendant at birth, labor complications, neonatal sex, and maternal factors of age, race, parity, and diabetes status.

Data were analyzed by two methods. For the univariable analysis, a separate odds ratio and 95% Taylor series confidence interval were calculated for each variable. Odds ratios were significant at $P \leq .05$ when confidence intervals did not include one. Birth weight was classified as low (2500 g or less), normal (2501–4000 g), high (4001–4500 g), or very high (over 4500 g). The baseline comparisons used in calculating the crude odds ratios for the exposures were as follows: methods of delivery: unassisted vaginal delivery; attendant at birth: MD; number of prior pregnancies: none; maternal age: 20–35 years old; birth weight: normal (2501–4000 g); race: white; and neonatal sex: female. This method gave risk estimates for each of the exposures, but not independent of one another.

To account for collinearity of variables, adjust for simultaneous exposures, and reveal any interaction between these exposures, logistic regression was performed using the logistic regression program GLIM (General Linear Interactive Modeling, Royal Statistical Society, London, 1977). Due to the association of high and very high birth weight with Erb's palsy, birth weight was controlled for in the logistic model. Seven patients and 12 control subjects had more than one method of delivery listed (eg, other forceps and low forceps, other forceps and cesarean section, other forceps and vacuum extraction, or low forceps and vacuum extraction). In eight instances where induced labor was indicated, no method of delivery was identified. This resulted in the exclusion of eight subjects from analysis of method of delivery. Regression variables were fitted by a nested hierarchy approach. Coefficients (βs) of these regression variables were tested for significance using differences of log likelihood statistics interpreted as χ^2 as described by Breslow and Day.[8] Such coefficients can be interpreted as odds ratios (e^{β}), adjusted for other variables in the model. Ninety-five percent confidence intervals were calculated from the coefficients as $e^{\beta \pm 1.96\ (se\beta)}$. An omnibus test to assess goodness-of-fit of the final model was performed.

Table 1. Frequency Distribution of Selected Variables for Erb's Palsy Patients and Control Subjects

Variables	Erb's palsy	Controls
Method of delivery*		
Spontaneous	47 (42.3)	271 (69.1)
Cesarean section	4 (3.6)	46 (11.7)
Vacuum extraction	9 (8.1)	5 (1.2)
Low forceps	32 (28.8)	55 (14.0)
Midforceps	14 (12.6)	5 (1.2)
Total documented methods	106	382
Complications		
Asphyxia	6 (5.7)	2 (0.5)
Prolonged labor	5 (4.7)	16 (4.1)
Induced labor	4 (3.8)	8 (2.1)
Breech presentation	5 (4.5)	10 (2.5)
Attendant at birth†		
MD	93 (88.6)	361 (94.0)
Osteopath	6 (5.7)	8 (2.1)
Other non-MD	6 (5.7)	15 (3.9)
Maternal factors		
Diabetes	3 (2.8)	0
Age		
< 20 yr	27 (25.5)	64 (16.6)
> 35 yr	3 (2.8)	12 (3.1)
Race		
Black	9 (8.5)	13 (3.4)
White	90 (84.9)	341 (88.3)
Other	7 (6.6)	32 (8.3)
No. of prior pregnancies‡		
None	39 (37.9)	126 (32.6)
1–2	45 (43.7)	193 (50.0)
> 2	19 (18.4)	67 (17.4)
Neonatal factors		
Birth weight†		
Low (≤ 2500 g)	2 (1.9)	9 (2.3)
Normal (2501-4000 g)	52 (49.5)	320 (82.9)
High (4001–4500 g)	17 (16.2)	45 (11.6)
Very high (Over 4500 g)	33 (31.4)	12 (3.1)
Sex		
Male	61 (57.5)	197 (51.0)
Low Apgar score (≤ 7)§		
One minute	67 (65.7)	78 (20.3)
Five minutes	27 (26.5)	12 (3.1)

Number in parentheses denotes relative frequency.
* May be more than one category.
† One missing value (cases).
‡ Three missing values (cases).
§ Four missing values (cases).

Results

Among the 210,947 Washington state births from 1980 through 1982, 106 cases of Erb's palsy were clearly documented (an incidence of 50.2 cases per 100,000 live births).

The characteristics of case and control groups are shown in Table 1. Of interest are the appreciable differences between patients and control subjects for asphyxia, birth weight, low Apgar score, attendant at birth, and several methods of delivery.

Table 2. Crude Odds Ratios for Erb's Palsy

Variables	Odds ratio	95% Confidence intervals
Complications		
Asphyxia	11.6	(2.8, 47.8)
Prolonged labor	1.1	(0.4, 3.2)
Induced labor	1.8	(0.5, 6.3)
Maternal factors		
Age		
< 20 yr	1.6	(1.0, 2.8)
> 35 yr	1.0	(0.3, 3.6)
Race		
Nonwhite	1.4	(0.7, 2.5)
Parity		
1–2	0.8	(0.5, 1.2)
> 2	0.9	(0.6, 1.4)
Diabetes	∞	(0.8, ∞)*
Neonatal factors		
Sex		
Male	1.3	(0.8, 2.0)
Low Apgar score		
One minute	7.5	(4.6, 12.1)
Five minutes	11.2	(5.4, 23.0)

* Insufficient numbers to calculate OR. Confidence interval calculated by Fisher exact test.

Birth complications significantly associated with Erb's palsy included asphyxia (OR = 11.6), and low one- and five-minute Apgar scores (OR = 7.5 and OR = 11.2, respectively), as shown in Table 2. No significant association was seen between Erb's palsy and induced labor or with the maternal factors of race or parity. A trend towards significance was shown by a slightly elevated odds ratio (OR = 1.6) for maternal age under 20, but there was no association with maternal age over 35 years. Although there were slightly more male infants born with Erb's (OR = 1.3), the increase was not significant.

The results from logistic regression analysis are shown in Tables 3 and 4 and were similar to those obtained by univariable analysis. Neonatal birth weight remained the strongest predictor of Erb's palsy with an odds ratio of 2.4 for high birth weight (4001–4500 g) and OR = 21.0 for infants with a birth weight over 4500 g. Adjusting for birth weight allowed the determination of other factors, which may predict increased risk of Erb's palsy independent of birth weight. When compared with mechanically assisted deliveries (forceps or vacuum), significantly reduced risks were seen with cesarean section (OR = 0.1, 95% CI=0.02, 0.3) and unassisted spontaneous vaginal deliveries (OR = 0.2, 95% CI = 0.1, 0.3).

While the risk of Erb's in breech presentations was reduced from a univariable odds ratio of 11.7 to an adjusted odds ratio of 5.6 when the effects of birth

Table 3. Logistic Regression Analysis of Variables Associated With Erb's Palsy*

Variables	Odds ratio*	95% Confidence intervals
Birth weight		
Normal (2501–4000g)	1.00	
Low (≤ 2500 g)	2.4	(0.5, 10.4)
High (4001–4500 g)	2.4	(1.2, 4.8)
Very high (> 4500 g)	21.0	(9.5, 46.6)
Attendant at birth		
MD	1.0	
Osteopath	4.9	(1.5, 16.3)
Other non-MD	3.1	(1.0, 9.8)
Complications		
Breech presentation	5.6	(1.4, 22.7)

* Each variable is adjusted for others listed in table.

weight and methods of delivery were controlled for, it nonetheless remained significantly elevated. Delivery by a non-MD (midwife, nurse, corpsman) showed an increased risk (OR = 3.1), which did not quite reach significance. On the other hand, delivery by an osteopath was associated with a significantly higher risk than delivery by an MD (OR = 4.9).

Specific methods of delivery were analyzed using unassisted spontaneous vaginal delivery as the baseline while controlling for birth weight and attendant at birth, as shown in Table 4. Use of low forceps was associated with increased risk (OR = 3.7). Use of midforceps and vacuum extraction resulted in even higher risk estimates (OR = 18.3 and OR = 17.2, respectively). Cesarean sections were protective for Erb's palsy (OR = 0.5). These results were not confounded by maternal age, parity, race, or neonatal sex. The risks associated with the methods of delivery were also not found to significantly vary across birth weight strata (no effect-modification). The inclusion of variables in Tables 3 and 4 (birth weight, attendant, methods of delivery, and breech presentation) in the logistic model was sufficient to predict the occurrence

Table 4. Logistic Regression Analysis of Methods of Delivery*

Method of delivery	Odds ratio	95% Confidence intervals
Unassisted vaginal	1.0	
Low forceps	3.7	(2.0, 7.0)
Midforceps	18.3	(5.7, 59.3)
Vacuum extraction	17.2	(5.1, 58.2)
Cesarean section	0.5	(0.1, 1.9)

* Controlled for birth weight, type of attendant, and breech presentation.

of Erb's palsy in our data (Omnibus test: $X_9^2 = 4.3$, $P > .80$).

Four of the 106 infants born with Erb's palsy died during the first year of life. The causes of death were identified by ICD codes as follows: 481 (pneumococcal pneumonia), 763.8 (other specified complications of labor and delivery), 769 (respiratory distress syndrome), and 798.0 (SIDS).

Discussion

Erb's palsy is usually a complication of shoulder dystocia, although it has been associated with complicated breech deliveries. Only four injured infants in this series were delivered in the breech position, one of which was an 830-g baby delivered by cesarean section. Therefore, the brachial plexus injuries in this study were nearly all the result of shoulder dystocia. A conservative estimate of the incidence of shoulder dystocia is 3 in 1000 vaginal births.[9] If that figure was used to estimate the total number of shoulder dystocia cases in the state during the time of our study, the rate of brachial plexus injury in those infants sustaining shoulder dystocia would be 1 in 6.

This study confirms the association of high birth weight with Erb palsy[6,8,10] and further refines the risks associated with fetal macrosomia and method of delivery. Use of logistic regression allowed for the assessment of birth weight as an independent variable as well as allowing for the calculation of other risk factors independent of birth weight. By this method we are able to show the highest risk occurs in infants weighing in excess of 4.5 kg (OR = 21.0). Further analysis of the data demonstrated the risk of brachial plexus injury to be 1 in 165 (33 of 5442) for any infant with birth weight over 4500 g. Data from all Washington state birth certificates showed an overall cesarean section rate of 25% in infants with extreme fetal macrosomia. Of these, 18% were primary cesarean sections, and 7% were repeat cesarean sections. If one eliminates the patients who had cesarean section from consideration of the population at risk, the incidence of brachial plexus injury increases to 1 in 124. Assuming that there is one brachial plexus injury for each six shoulder dystocia, the incidence of shoulder dystocia in infants weighing greater than 4.5 kg would be 1 in 20. This group accounted for 32% (33 of 104) of infants in this study suffering a brachial plexus injury. If a reliable method of predicting fetal weight becomes available in the near future, this group of infants would seem to be at such high risk for birth injury that cesarean delivery would seem justifiable on the basis of weight alone.

When one considers the risk to infants weighing between 4001 and 4500 g, the indication for primary cesarean section becomes less compelling. Seventeen infants in this group suffered brachial plexus injury. However, there were 23,523 infants delivered in this same period that were in this weight range, giving an incidence of 1 brachial plexus injury per 1383 births compared with an incidence of 1 in 3294 if the infant is less than 4000 g. Despite the increased risk of Erb's palsy associated with birth weight between 4001–4500 g (OR = 2.4), the high frequency (11.2%) of infants in this group does not justify a strategy of elective cesarean delivery on the basis of birth weight alone. Even if a reliable method of estimation of fetal weight is developed, a plan of cesarean delivery for infants over 4000 g would result in an excessive number of cesarean deliveries.

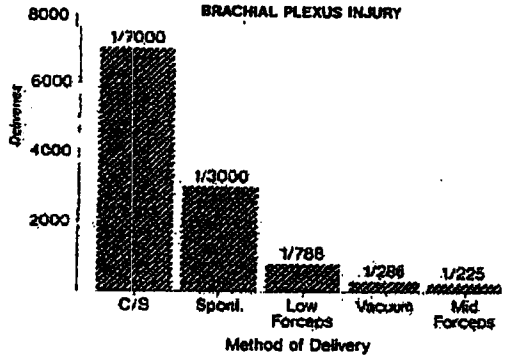

Figure 1. Incidence of Erb's palsy by method of delivery.

The highest risk factor that can be avoided with the present state of knowledge is the performance of midpelvic delivery. Midforceps delivery carried the highest risk for brachial plexus injury (OR = 18.3) even when corrected for birth weight. Figure 1 shows the incidence of Erb's associated with the different methods of delivery. Given the limitations of a study using birth certificates, we were not able to ascertain the reasons for the midforceps deliveries or the station from which they were performed. However, most clinicians have abandoned the use of forceps at 0 and +1 station and have limited midforceps procedures to station +2 and below. Furthermore, most clinicians do not list deliveries requiring minor degrees of rotation on the pelvic floor as midforceps procedures. It seems reasonable to infer from these data that midforceps procedures were those requiring significant amounts of rotation (over −90 degrees).

Vacuum extraction was also associated with a very high relative risk of Erb's palsy (OR = 17.2). Clinical information regarding vacuum extraction was not available. However, the usual practice is to use outlet forceps when the head is on the pelvic floor and

selection of other instruments when the criteria for low forceps are not satisfied. Many delivery attendants feel the use of the vacuum extractor offers advantages over use of forceps for both low and midpelvic deliveries. It has been reasoned that it is impossible to exert excessive traction with the vacuum extractor. According to this line of reasoning, when the traction forces exceed 30 pounds of pressure, the cup will separate from the head. In the absence of technical difficulties, this usually indicates the presence of cephalopelvic disproportion and cesarean delivery is indicated.

Unfortunately, the use of the vacuum extractor allows a delivery attendant with less technical skill and possibly less experience and judgement to attempt deliveries previously included in the midforceps category. Furthermore, the head with the vacuum extractor attached presents 8% less width than does the same fetal head during a forceps delivery. This fact may allow skilled technicians with the vacuum extractor to deliver very large infants without excessive force.

Our findings are consistent with the hypothesis that the vacuum extractor is being used instead of forceps for midpelvic deliveries. However, we cannot discount the possibility that these were low pelvic deliveries that benefited from the narrower diameter required to transverse the pelvis.

As expected, cesarean section offered a significant protective effect with regard to the development of brachial plexus injury in the infant. However, a finding that merits further explanation is the occurrence of brachial plexus injuries in four patients delivered by cesarean section. One infant presenting in the breech position weighed only 830 g. The three vertex presenting infants with Erb's palsy were not excessively large (2778, 3182, and 3997 g). In one instance fetal distress was listed as the reason for cesarean section delivery and in another case midforceps delivery was unsuccessful. From these data it would appear that brachial plexus injury may result from: 1) lateral traction during cesarean delivery, 2) antecedent events during deep engagement, and/or 3) attempted vaginal delivery.

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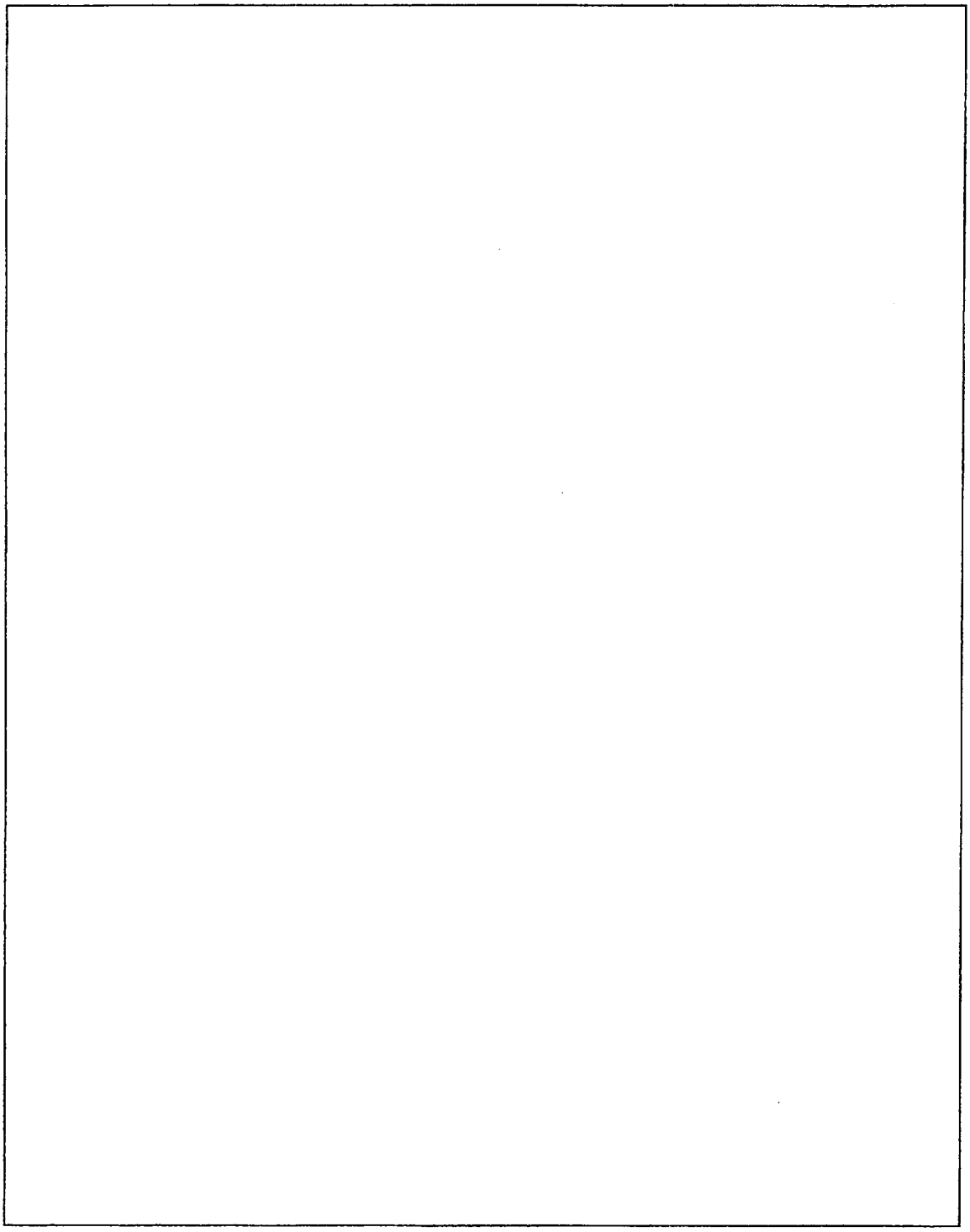

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APPENDIX C

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CLINICAL ARTICLE

Obstetrics

WILEY

A multistate population-based analysis of linked maternal and neonatal discharge records to identify risk factors for neonatal brachial plexus injury

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Abstract

Objective: To evaluate the interaction and contribution of maternal and fetal risk factors associated with neonatal brachial plexus injury (BPI).

Methods: In a case–control study, matched maternal and neonatal discharge records were accessed from US State Inpatient Databases for New Jersey (2010–2012), Michigan (2010–2011), and Hawaii (2010–2011). Univariate and multivariate logistic regressions were used to evaluate associations between risk factors and BPI. Area under the receiver operating characteristic curve was used to build predictive models, including two stratified models evaluating deliveries among obese and diabetic cohorts.

Results: Among 376 325 deliveries, BPI was diagnosed in 274 (0.1%). Significant BPI risk factors included maternal obesity (odds ratio [OR] 2.7, 95% confidence interval [CI] 1.7–4.4), maternal diabetes (OR 4.6, 95% CI 3.0–7.0), use of forceps (OR 4.6, 95% CI 2.3–9.0), and vacuum assistance (OR 2.3, 95% CI 1.7–3.3). After adjusting for shoulder dystocia and other predictive factors, cesarean reduced the risk of BPI by 88% (OR 0.1, 95% CI 0.07–0.2). When stratified by obesity and diabetes, the ORs for BPI increased significantly for macrosomia, forceps, and vacuum assistance.

Conclusion: The analysis confirms and quantifies more precisely the impact of risk factors for neonatal BPI, and provides a reliable basis for evidence-based clinical decision-making models.

KEYWORDS

Cesarean delivery, Maternal diabetes, Maternal obesity, Neonatal brachial plexus injury, Shoulder dystocia, State Inpatient Databases

1 | INTRODUCTION

Neonatal brachial plexus injury (BPI) results from excessive caudal traction at the fetal shoulder and spine that occurs during the second stage of labor, leading to a stretch or avulsion injury of the spinal nerves traveling from the cervical spine to the upper extremities.[1] The prevalence of BPI is approximately 1.5 per 1000 births and, although most injuries (approximately 70%) resolve within the first few months after birth, a substantial minority are permanent.[2]

The most common risk factor for BPI is shoulder dystocia, occurring in approximately 1.4% of all deliveries and 55% of BPI cases.[2] The risk of shoulder dystocia is highly correlated with fetal macrosomia and other conditions such as maternal diabetes and obesity.[3] Cesarean delivery is the most assured way to avoid BPI secondary to shoulder dystocia, and is recommended for macrosomic pregnancies complicated by diabetes.[4,5] The practice is not without controversy, however, and a commonly raised issue is the cost-to-benefit ratio of elective cesarean delivery for macrosomic pregnancy.[4–6] Another challenge is

that macrosomia is difficult to predict, leading to estimates that more than 1000 elective cesarean deliveries—costing $4–8 million—would be required to prevent one case of BPI.[4] By comparison, the lifetime costs for a case of BPI, excluding potential loss in productivity and earning capacity, is estimated at more than $1 million.[5] A more accurate model for predicting shoulder dystocia would substantially improve the number needed to treat (NNT) value of elective cesarean delivery as a means of preventing BPI, potentially improving prior estimates that were based on less precise models.

The aim of the present study was to examine risk factors associated with BPI via a unique inpatient database with linked neonatal and maternal records in order to provide a more accurate assessment of BPI risk factors in a large sample of hospital discharge data, and also evaluate whether a more precise predictive model of dystocia and BPI might more accurately define previously estimated NNT values for cesarean delivery.

2 | MATERIALS AND METHODS

The present case–control study was based on maternal and neonatal data from deliveries in three US states between January 1, 2010, and December 31, 2012, abstracted from the State Inpatient Databases (SID), maintained by the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality (HCUP). The SID is a de-identified database and as such, research based on SID data does not require informed consent or institutional board review.

The SID provides all inpatient discharge records for all hospitals across 46 states, and contains clinical and resource-use information found in a discharge abstract. Owing to privacy considerations, HCUP prohibits publishing details on cell sizes of 10 or smaller, and requires investigators to sign a data use agreement that governs the disclosure and use of these data.

Since 2010, New Jersey, Michigan, and Hawaii have provided a variable linking a mother's delivery record with her newborn's birth record, which provides a more comprehensive record of procedures performed during labor and other factors that may affect the newborn. For the present analysis, SID data for New Jersey (January 1, 2010, to December 31, 2012), Michigan (January 1, 2010, to December, 31, 2011), and Hawaii (January 1, 2010, to December 31, 2011) were queried for all births, with BPI as the outcome of interest. Predictive variables were based on previously published BPI risk or cofactors, including cesarean delivery, shoulder dystocia, breech presentation, macrosomia, multiple birth, maternal diabetes or obesity, induced labor, prolonged first and second stages of labor, forceps, vacuum extraction, manual assistance, and payer, as well as mother's ethnic origin (white vs non-white), age, and ZIP income quartile (a variable that estimates median household income quartile per patient's residential ZIP code). These factors were identified by International Classification of Diseases, Ninth Revision (ICD-9) codes (Table 1), or were defined by HCUP in the data.

All statistical analyses were performed with SAS version 9.4 (SAS Institute, Cary, NC, USA). To examine risk factors associated with BPI, crude odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for each of the potential categorical risk factors. A Satterthwaite t test (for unequal variance) was used to assess the relationship between the continuous variable maternal age by BPI status.

TABLE 1 ICD-9 codes used.

Variable definition	ICD-9 code
Brachial plexus palsy	767.6
Shoulder dystocia	660.4x
Breech	72.5x 763.0
Macrosomia	Birth weight >4500 g; 766.0
Multiple birth	V31.xx-V37.xx
Maternal diabetes	Comorbidity indicator, 250.xx; 648.0x; 775.0
Maternal obesity	Comorbidity indicator
Induced labor	73.4, 73.01, 73.9
Prolonged first stage	662.0x
Prolonged second stage	662.2x
Forceps	72.0, 72.1, 72.2x, 72.3x, 72.4, 72.6, 73.3, 763.2
Vacuum extraction	72.7, 72.71, 72.79, 763.3
Manual-assisted delivery	73.5x
Cesarean	74.0, 74.1, 74.2, 74.4, 74.99, 763.4

Abbreviation: ICD-9, International Classification of Diseases, Ninth Revision.

Three predictive models were constructed using multivariate adjusted logistic regression to identify independent predictors of BPI among those found significant in the univariate analysis. The first model included all the data; the second and third models were stratified for deliveries by mothers with obesity or diabetes, respectively. The models were built using stepwise selection with an inclusion criterion of P=0.20 to enter the model and an exclusion criterion of P=0.05 to exit. A parallel process was used to construct a model for predicting shoulder dystocia among vaginal deliveries. The predictive ability of each model was assessed by using the area under the receiver operating characteristic (ROC) curve.

The NNT for a cesarean delivery to prevent one case of BPI was calculated by the adjusted OR, which was adjusted for potential confounders.[7] In some cases, cell sizes were too small to publish, as per the HCUP data use agreement, and only the ORs are presented. Unless otherwise specified, statistical significance was at a P value of 0.05 or less.

3 | RESULTS

Among a total of 376 325 deliveries, BPI was diagnosed in 274 (0.1%) newborns. Shoulder dystocia was observed in 3749 cases, of which 138 (3.7%) were associated with a diagnosis of BPI (OR 104.7, 95% CI 82.4–132.9). Macrosomia (birth weight >4500 g) was present in 3487 neonates, of whom 29 (0.8%) were diagnosed with BPI

(OR 12.8, 95% CI 8.7–18.8). Use of forceps and vacuum extraction were associated with increased risk of injury (OR 6.2, 95% CI 3.3–11.7, and OR 4.5, 95% CI 3.3–6.1, respectively). Maternal diabetes and obesity, defined as a body mass index (BMI, calculated as weight in kilograms divided by the square of height in meters) of 30 or higher, were also significantly associated with BPI (OR 7.4, 95% CI 5.1–10.7, and OR 3.2, 95% CI 2.1–4.9, respectively). Mother's ethnic origin (white vs non-white) and cesarean delivery were associated with decreased risk of BPI. Maternal age was approximately 1 year lower for newborns with BPI than for those without. The complete data are presented in Table 2.

After univariate analysis, a stepwise logistic regression model was constructed for all deliveries. Shoulder dystocia remained the strongest risk factor for BPI (OR 56.7, 95% CI 43.6–73.8), along with the use of forceps and vacuum extraction (OR 4.6, 95% CI 2.31–9.1, and OR 2.3, 95% CI 1.7–3.3, respectively). Maternal obesity and diabetes remained significant risk factors (OR 2.7, 95% CI 1.7–4.4, and OR 4.6, 95% CI 3.0–7.0, respectively). The complete data are presented in Table 3.

Among obese women (n=10 428), there were 4105 vaginal deliveries and 6323 cesareans. In this cohort, there were 23 (0.2%) cases of BPI. The variables in the final model included cesarean delivery, forceps, vacuum extraction, shoulder dystocia, prolonged second stage of labor, macrosomia, maternal diabetes, and mother's ethnic origin. Due to a lack of fit, the variable "payer" was removed from the final model. The complete data are shown in Table 4. The ROC area predicting BPI in the maternal obesity cohort was 0.88, indicating good predictive ability. On the basis of this analysis, it is estimated that, among obese pregnancies, 198 cesarean procedures would be required to prevent one case of BPI.

TABLE 2 Crude associations between neonatal brachial plexus injury and risk factors.[a]

Risk factor	All live-born neonates (n=376 325)	Live-born neonates with BPI (n=274)	Odds ratio (95% confidence interval)
Induced labor	72 407 (19.2)	81 (29.6)	1.8 (1.4–2.3)
Forceps	[b]	[b]	6.2 (3.3–11.7)
Vacuum extraction	18 393 (4.9)	51 (18.6)	4.5 (3.3–6.1)
Breech	[b]	[b]	2.1 (0.3–15.0)
Manual	145 207 (38.6)	117 (42.7)	1.2 (0.9–1.5)
Cesarean	142 670 (37.9)	15 (5.5)	0.1 (0.06–0.2)
Dystocia	3749 (1.0)	138 (50.4)	104.7 (82.40–132.9)
Maternal diabetes	6617 (1.8)	32 (11.7)	7.4 (5.1–10.7)
Multiple pregnancy	[b]	[b]	0.4 (0.2–1.1)
Prolonged 1st stage	347 (0.1)	0	
Prolonged 2nd stage	[b]	[b]	7.4 (3.5–15.7)
Macrosomia	3487 (0.9)	29 (10.6)	12.8 (8.7–18.8)
Maternal obesity	10 428 (2.8)	23 (8.4)	3.2 (2.1–4.9)
White ethnic origin	179 505 (47.7)	95 (34.7)	0.6 (0.5–0.8)
Payer			
Private insurance	231 306 (61.5)	117 (42.7)	Ref.
Self-pay	16 730 (4.5)	22 (8.0)	2.6 (1.7–4.1)
Medicare/Medicaid	122 086 (32.4)	131 (47.8)	2.1 (1.7–2.7)
Other	[b]	[b]	1.3 (0.5–3.5)
ZIP income quartile			
1	59 038 (15.7)	63 (23.0)	2.0 (1.4–2.8)
2	70 062 (18.6)	60 (21.9)	1.6 (1.2–2.2)
3	87 267 (23.2)	66 (24.1)	1.4 (1.0–2.0)
4	156 697 (41.6)	84 (30.7)	Ref.
State			
Hawaii	31 359 (6.9)	19 (6.9)	0.9 (0.5–1.4)
Michigan	68 250 (22.3)	61 (22.3)	1.3 (1.0–1.7)
New Jersey	276 716 (70.8)	194 (70.8)	Ref.

[a]Values are given as number (percentage) unless indicated otherwise.

[b]Number too small for publication as per the Healthcare Cost and Utilization Project data use agreement.

TABLE 3 Adjusted odds ratios for neonatal brachial plexus injury among all deliveries.[a]

Risk factor	Odds ratio (95% confidence interval)
Cesarean	0.1 (0.1–0.2)
Forceps	4.6 (2.9–9.0)
Vacuum extraction	2.3 (1.7–3.3)
Breech	8.0 (1.1–57.6)
Manual	0.7 (0.5–0.9)
Dystocia	56.7 (43.6–73.8)
Prolonged 2nd stage	2.6 (1.1–6.1)
Macrosomia	4.7 (3.0–7.3)
Maternal obesity	2.7 (1.7–4.4)
Maternal diabetes	4.6 (3.0–7.0)
White ethnic origin	0.6 (0.4–0.7)
Payer	
Private insurance	Ref.
Self-pay	2.0 (1.2–3.3)
Medicare/Medicaid	1.8 (1.3–2.3)
Other	1.2 (0.4–3.2)
State	
Hawaii	0.5 (0.3–0.9)
Michigan	1.0 (0.7–1.3)
New Jersey	Ref.

[a]Stepwise selection criteria: entry, $P=0.2$; exit, $P=0.05$.

Among the mothers with diabetes (n=6617), there were 2265 vaginal deliveries and 4352 cesarean deliveries. In this cohort, there were 32 (0.5%) cases of BPI. Stepwise selection resulted in a logistic model that included cesarean delivery, forceps, vacuum extraction, shoulder dystocia, macrosomia, and maternal obesity. The adjusted ORs are shown in Table 5. Analysis of the area under the ROC curve indicated good predictive ability of the model (ROC area 0.91). On the basis of this analysis in the diabetic cohort, an estimated 92 cesarean procedures would prevent one case of BPI.

The above results demonstrate that, even after adjustment for significant confounders, shoulder dystocia remains the single greatest risk factor for BPI. Therefore, potential risk factors for shoulder dystocia were investigated among vaginal deliveries. Stepwise logistic regression analysis was performed on the cohort of vaginal deliveries, and the variables included in the final model are shown in Table 6. After adjustment, the three greatest risk factors for shoulder dystocia were macrosomia, maternal diabetes, and vacuum extraction.

4 | DISCUSSION

The present analysis confirms other investigators' findings regarding the increased risk of BPI among pregnant women with obesity or diabetes, and the significant protective effect that cesarean delivery provides against BPI. The data showed that, for mothers with diabetes, 92 cesarean deliveries would be required to prevent one case of BPI. When applied to obese mothers, an NNT of 198 cesarean deliveries would be needed to prevent one case of BPI.

TABLE 4 Adjusted odds ratios for neonatal brachial plexus injury among obese mothers.[a]

Risk factor	Odds ratio (95% confidence interval)
Cesarean delivery	0.04 (0.01–0.31)
Forceps	9.7 (1.5–62.2)
Vacuum extraction	6.5 (1.9–21.7)
Dystocia	40.5 (15.5–105.8)
Prolonged second stage	39.6 (3.4–457.4)
Macrosomia	10.3 (2.4–45.0)
Maternal diabetes	6.6 (2.4–17.9)
White ethnic origin	0.3 (0.1–0.9)

[a]Stepwise selection criteria: entry, $P=0.2$; exit, $P=0.05$.

The precise number of cesarean deliveries needed to prevent a permanent case of BPI is less clear. A review of the literature indicated that obstetrician-led studies demonstrate a BPI permanency rate of 10%–17%, whereas studies conducted by pediatric and orthopedic surgeons report a higher proportion of persisting injury, ranging from 27% to 58%.[8] The wide variation in the reported rate of BPI permanency is attributable to inconsistencies in study methods: only some studies provide comprehensive criteria for evaluating persistent BPI, and others do not include expert consultation or adequate follow-up times.[8,9]

A sensitivity analysis applying the upper and lower bounds of previous permanency rates (10%–58%) to the present data indicated that a range of 159–920 cesarean deliveries would be needed to prevent one permanent case of BPI among diabetic pregnancies. Thus, at minimum, the present study enables the previously published NNT range of 91–1494 for diabetic pregnancies to be narrowed.[4,8,10] The cesarean NNT for permanent BPI injury among obese pregnancies spans a wider range; applying the same permanent BPI rates as above resulted in a cesarean delivery NNT of 341–1980. It is likely that the narrower range of NNT values observed in the present study, relative to previous estimates, is a result of the large study population (approximately 380 000 births) accessed via the SID data.

On the basis of estimated average total Medicaid-related charges for maternal and newborn care of $9131 and $13 590 for vaginal and cesarean deliveries, respectively, the increased cost of preventive cesarean procedures would range from $709 000 to $4.1 million per case of BPI prevented among pregnant women with diabetes. Applying the same analysis to the NNT range associated with pregnant women with obesity, the increased cost of preventive cesarean deliveries would range from $1.5 million to $8.8 million per case of BPI prevented.[11]

Independent or sequential use of forceps and vacuum extractor greatly increases the risk of BPI. Moreover, neonates requiring cesarean delivery after failed instrument-assisted delivery are more likely to incur trauma than are those who receive an immediate cesarean.[12] Similar to previous reports,[10,13,14] the present study found that forceps

TABLE 5 Adjusted odds ratios for neonatal brachial plexus injury among mothers with diabetes.[a]

Risk factor	Odds ratio (95% confidence interval)
Cesarean delivery	0.13 (0.03–0.46)
Forceps	12.1 (1.3–111.2)
Vacuum extraction	3.8 (1.2–11.0)
Dystocia	41.3 (17.6–96.8)
Macrosomia	4.2 (1.5–11.5)
Maternal obesity	3.5 (1.4–8.3)

[a]Stepwise selection criteria: entry, P=0.2; exit, P=0.05.

TABLE 6 Adjusted odds ratios for shoulder dystocia.[a]

Risk factor	Odds ratio (95% confidence interval)
Induction	1.5 (1.4–1.6)
Vacuum extraction	2.4 (2.1–2.6)
Prolonged second stage	1.6 (1.1–2.4)
Macrosomia	9.5 (8.1–11.2)
Multiple pregnancy	0.05 (0.01–0.19)
Maternal obesity	1.7 (1.4–2.1)
Maternal diabetes	3.6 (3.0–4.3)
White	1.5 (1.4–1.6)
Payer	
Private insurance	Ref.
Self-pay	0.9 (0.8–1.1)
Medicare/medicaid	1.1 (1.00–1.2)
Other	1.4 (1.1–1.8)
ZIP income quartile	
1	1.07 (0.96–1.20)
2	1.2 (1.1–1.4)
3	1.2 (1.1–1.3)
4	Ref.

[a]Stepwise selection criteria: entry, P=0.2; exit, P=0.05.

and vacuum extraction increased the risk of BPI among both obese and diabetic pregnancies. Additionally, predictive modeling indicated that vacuum extraction, but not forceps, is an independent risk factor for shoulder dystocia. The reason for this finding is not completely clear; however, others have suggested that the direction of force applied to the fetal head with vacuum extraction could increase impaction of the anterior fetal shoulder against the maternal pubic symphysis.[13] Alternatively, vacuum extraction is more likely to be used for deliveries in which fetal size tends toward the upper range and which are thus more prone to dystocia.[13] The statistical modeling in the present analysis was adjusted for fetal size and other factors predictive of dystocia; thus, the increased risk of BPI with vacuum extraction is more probably representative of a real association, rather than the result of a confounded relationship.

The strength of the present analysis lies in use of the SID, an annual inpatient database encompassing approximately 90% of all hospital discharges per state. By comparison, the Kids' Inpatient Database (KID) is a stratified sample of pediatric discharges derived from each SID, and is only available every 3 years. Most critically, the KID contains coding data that are only related to diagnoses and procedures associated with the newborn's birth record, and lacks information from the mother's discharge record. By contrast, maternal and neonatal records in selected SID datasets are linked. The difference in the information contained in the two datasets is exemplified by use of the ICD-9 code for forceps or vacuum extractor, which is denoted on the mother's record as a procedure, but documented in the newborn's record as a diagnosis only if use of the instrument resulted in an injury. In a prior study using KID data, Foad et al.[15] reported that 0.08% and 0.2% of newborns underwent forceps or vacuum extraction, respectively. In the present study, the respective rates were 1.7% and 6.1%. Thus, the KID does not contain documentation regarding more than 95% of instrumented deliveries, resulting in a probable source of bias.

Another source of bias associated with coding differences between the KID and SID is the use of ICD-9 code 763.1 in the former database. Along with shoulder dystocia, this code includes a vague description of "other malpresentation, malposition, and disproportion during labor and delivery," and may explain the finding of Foad et al.[15] of 100.9 times increased odds of BPI when "shoulder dystocia" is present, as compared with the increased odds of 56.7 (95% CI 43.6-73.8) found in the present study using a maternal diagnostic code specific to shoulder dystocia (660.4x).[15] Overall, the inability to adjust for both maternal and neonatal risk factors biased Foad et al.'s[15] estimates of association, and explains why an identifiable risk factor for BPI was reported in only 46% of their KID BPI cases, whereas at least one dichotomous risk factor was observed in 78% of SID BPI cases in the present study.

The present study has some limitations. Extrapolating the results to the whole US population is potentially limited by the analysis of data from only New Jersey, Michigan, and Hawaii. The limited geographic scope of the data and small number of BPI cases (in comparison with the KID) could affect the accuracy of the estimates owing to the large variation in the data. For example, Foad et al.[15] reported shoulder dystocia in 17.7% of neonates with BPI, whereas this condition was observed in 50% of cases of BPI in the SID data. This difference is likely attributable to the discrepancy in how dystocia is coded; however, both frequencies are within the range reported in the literature (26%–85%).[16–19] Further limitations of the analysis were the lack of information regarding the severity and duration of BPI (i.e. stretch vs avulsion, temporary vs permanent injury), and the inability to comprehensively stratify characteristics such as fetal size and maternal BMI. Nevertheless, the SID provides a useful resource to investigate the role of both maternal and fetal factors on newborn injury outcomes.

As the prevalence of maternal obesity and gestational diabetes rises, obstetricians and midwives are increasingly challenged with high-risk pregnancies and the need to reduce the risk of negative outcomes for both the mother and newborn.[20,21] The findings of the present study of an increased risk of BPI for instrument-assisted deliveries

among obese and diabetic mothers suggests that extra caution should be taken in managing such deliveries.

AUTHOR CONTRIBUTIONS

MDF and WML conceived and designed the study, and performed statistical analysis. All authors acquired, analyzed, and interpreted the data. MDF and SMG drafted the manuscript, and all authors critically revised it. MDF and SMG provided administrative, technical, and material support.

CONFLICT OF INTEREST

MDF provides consultation in medicolegal matters, including cases of BPI allegedly associated with birth trauma. The authors have no other conflicts of interest.

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EXHIBIT 5

IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON

IN AND FOR THE COUNTY OF LEWIS

SCOTT HAMILTON, as guardian ad litem For Z.H., Plaintiffs, V. LINDA AMONDSON-MULLER, Personal Representative of the ESTATE of LAURA HAMILTON, Defendants.	No. 20-2-00543-21

Videotaped Videoconference Deposition of

EDITH GUREWITSCH ALLEN, M.D.

Thursday, January 13, 2022

REPORTED BY: Chase Frazier,
RMR, CRR, CRC, CA CRR, CCR 3434

JOB NUMBER 815278

16:08:46 A No. There were only -- she only made two
16:08:49 attempts. The first was diagnosing the shoulder
16:08:54 dystocia, and the second was in conjunction with
16:08:56 McRobert's.
16:09:03 **Q And you tried one maneuver, which was**
16:09:07 **delivering the posterior arm?**
16:09:10 A Yes.
16:09:10 **Q Now, tell us about the one delivery you had**
16:09:21 **that led to a permanent brachial plexus injury, first of**
16:09:32 **all, approximately when was that?**
16:09:33 A It was in 1999.
16:09:38 **Q And that was at Hopkins?**
16:09:40 A Yes.
16:09:40 **Q And describe for us what you remember about**
16:09:45 **that delivery?**
16:09:51 A We encountered -- I encountered a shoulder
16:09:53 dystocia -- it was a precipitous delivery. It was her
16:09:56 third baby. Baby came out in less than 20 minutes from
16:10:01 being fully dilated to the head delivering. Encountered
16:10:08 shoulder dystocia, called for McRobert's and suprapubic.
16:10:15 And then I did a -- attempted a Wood's screw, and
16:10:23 converted that to delivery with posterior arm. So the
16:10:26 whole thing took around -- somewhere between 90 seconds
16:10:30 and two minutes. And, again, it was a permanent injury
16:10:39 that did not require surgical intervention, only

16:10:46 physical therapy and injury confined to the upper
16:10:54 plexus.
16:11:01 **Q Did you consider the possibility in that**
16:11:05 **delivery that you did, that actually the maternal forces**
16:11:08 **of labor in a precipitous delivery had been the cause of**
16:11:12 **that permanent brachial plexus injury?**
16:11:17 A No.
16:11:19 **Q And why do you believe that was not the case?**
16:11:26 A Because basic physics. The brachial plexus is
16:11:32 aligned nearly perpendicularly with the vertebral
16:11:39 column, head and neck. A pushing force comes up through
16:11:47 the rump, the sacrum up through the vertebral column and
16:11:54 is not in any way -- it's a pushing force. It's not a
16:11:59 pulling force. Whereas these injuries were traction or
16:12:06 stretch-based injuries. And the pushing force of the
16:12:19 uterus and mom's pushing are not aligned with the
16:12:25 brachial plexus such that it can stretch it.
16:12:50 **Q Did you follow that child over any period of**
16:12:53 **time?**
16:13:01 A The last report I had was 2 years of age.
16:13:08 **Q Uh-huh. And how was the child doing at 2**
16:13:11 **years of age, which would have been about 2001?**
16:13:15 A As I mentioned, it was an upper plexus injury.
16:13:20 Baby was -- you know, they were doing physical therapy
16:13:26 to treat it.

17:53:21 **Q Yeah.**

17:53:21 A Because I meant when I said that a note in the
17:53:27 medical record is contemporaneous is more reliable and
17:53:30 carries more weight with me than testimony from years
17:53:34 later. That was the context in which I talked about
17:53:37 contemporaneous. So I wanted to make sure that it's
17:53:41 understood that when you're asking me is that considered
17:53:43 contemporaneous, even if it's a couple of hours, that
17:53:47 we're still -- or at least I understood that to be in
17:53:53 comparison to oral testimony given years later.

17:54:01 **Q So you would agree that a delivery record made**
17:54:09 **within a couple of hours of the birth is a**
17:54:14 **contemporaneous record when it's kept in a midwifery or**
17:54:20 **medical record; right?**

17:54:21 A Yes.

17:54:21 **Q All right. Let's go back to this, which I**
17:54:27 **think is Exhibit 8.**

17:54:30 **On the second paragraph, it says, "Dr. Allen**
17:54:32 **will also testify that the force used in this case was**
17:54:36 **not justified."**

17:54:40 **Is that your opinion?**

17:54:43 A Yes.

17:54:43 **Q And what is the basis of saying it was not**
17:54:46 **justified?**

17:54:48 A It's in the next sentence.

17:54:52 **Q That is the --**

17:54:53 A They've gone the length -- right. Go ahead.

17:54:56 **Q Well, why don't you go ahead.**

17:55:02 A Although the exact time that the shoulder dystocia lasted is unknown, the best estimates from the testimony and, again, the medical record, is that it was about five minutes in total time between when the head delivered and when the rest of the body delivered, and the baby was able to be revived with just a few puffs, which is actually -- I mean, in a hospital setting, we wouldn't do it mouth-to-mouth, we would do it with a bag. Bag and mask. But it's actually a very common thing that's required after even a normal birth, uncomplicated by shoulder dystocia. And this baby never had any kind of asphyxial damage. So it could not have been a protracted head-to-body interval, based on the circumstances of the delivery and the estimated time in the -- in the testimony as well.

So given that, you would have equal priority for trying to prevent injury while also trying to be expeditious. At about eight minutes, that's when you would start to see CNS damage, central nervous system damage, and your priority switches to prevention of brain damage and death.

And it would be justified under those

17:57:02 circumstances if you're trying to be gentle up until
17:57:04 that point and not increase your traction beyond what
17:57:10 you were -- what you would use in an unobstructed
17:57:15 delivery, which is what the standard of care requires,
17:57:17 than if it were necessary to use greater force in order
17:57:22 to deliver the baby and prevent brain damage and death,
17:57:27 it would be justified, which is why I said that you can
17:57:38 have permanent brachial plexus injuries caused by a
17:57:41 clinician where they still have met the standard of
17:57:43 care. And as I showed you a variety of cases that I've
17:57:52 declined on that basis for plaintiffs.

17:58:07 **Q So you're familiar with literature that gives**
17:58:09 **a range of four to eight minutes before brain damage**
17:58:17 **potentially occurs?**

17:58:18 A Yes.

17:58:20 **Q And you disagree with that literature?**

17:58:24 A No. I told you. About eight minutes is when
17:58:27 you would shift your priority.

17:58:32 **Q So eight minutes would have been at a time**
17:58:34 **when the brain damage was beginning to occur?**

17:58:39 A Correct.

17:58:39 **Q As far as we know prospectively; right?**

17:58:42 A Correct.

17:58:42 **Q And in this case, we have approximately a**
17:59:05 **four- to five-minute shoulder dystocia, based on your**

17:59:08 **review of the records?**

17:59:12 A So the records don't indicate that. The
17:59:15 records indicate the resuscitation needed after the
17:59:19 delivery. The testimony estimates the time. Several --
17:59:30 several people, including midwife Hamilton give about a
17:59:37 five-minute estimation.

17:59:46 **Q And by the fact that some resuscitation was**
17:59:50 **needed, that would be consistent with a five-minute**
17:59:55 **shoulder dystocia?**

17:59:58 A Yes. As I said, that level of resuscitation
18:00:00 is actually common, even in -- in unobstructed,
18:00:09 uncomplicated deliveries.

18:00:11 **Q And the resuscitation --**

18:00:12 A And babies often come out -- babies often come
18:00:14 out and don't take a breath right away, so you stimulate
18:00:17 them, and you might need to give them, you know, two
18:00:20 bags, two puffs to -- to get them to perk up. That's
18:00:30 actually the most common time that any child needs to be
18:00:37 resuscitated is immediately after birth. Any birth.

18:00:43 **Q And the resuscitation of Zachary was**
18:00:46 **appropriate; correct?**

18:00:49 A Yes.

18:00:49 **Q Do you have any criticisms of Laura Hamilton's**
18:00:53 **management of the pregnancy?**

18:01:01 A No. I -- my standard would be different than

EXHIBIT 6

IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON

IN AND FOR THE COUNTY OF LEWIS

SCOTT HAMILTON, as guardian ad litem for Z.H.,	)	
Plaintiffs,	)	NO. 20-2-00543-21
vs.	)	
LINDA AMONDSON-MULLER, Personal Representative of the ESTATE of LAURA HAMILTON,	)	
Defendants.	)	

REMOTE VIDEOTAPED DEPOSITION UPON ORAL EXAMINATION OF

ROBERT ALLEN, Ph.D.

April 5, 2022
11:32 a.m.
all parties appearing remotely
New York, New York

TAKEN AT THE INSTANCE OF THE DEFENDANT

REPORTED BY:
AMY J. BROWN, RMR, CRR, WA CCR NO. 2133, ID CCR NO. 700

JOB NUMBER 859959

research.

Q. And is that a full-time position?

A. Yes.

Q. And you said the position was assistant research professor?

A. Yes.

Q. And is your wife Dr. Edith Gurewitsch Allen, also a professor in that same department?

A. Yes.

Q. When did you and Dr. Edith Gurewitsch Allen get married?

A. 2010.

Q. Was that the second marriage for both of you?

A. Yes.

Q. And who is Niva Gurewitsch?

A. That's Dr. Gurewitsch's daughter.

Q. Does she have some role in your consulting business?

A. Yes. She's -- she's our -- she's my administrative assistant.

Q. Does she also work for your wife?

A. Yes.

Q. And are you and your wife both in the same consulting business?

A. I think she consults on other types of cases.

Q. Yeah. What I'm asking more of is the legal status of your consulting business. Are you working out of the same legal entity?

A. No.

Q. Okay. So when you do expert consulting, are you doing it, in essence, as a sole proprietor consultant?

A. Yes.

Q. Other than sharing the work, the benefit of Niva being the administrative assistant, do you have any other overlap between your consulting practice and your wife's?

A. No.

Q. And is Niva's position a full-time position?

A. I don't believe so.

Q. How is she paid?

A. She's paid on a -- she submits invoices to us and we pay her, and then she would get a 1099 at the end of the year.

Q. And so the 1099 that Niva gets, where does that come from?

A. It comes from myself and Dr. Gurewitsch.

Q. So two of you separately or two of you jointly?

A. Separately.

Q. So Niva would get two 1099s, one from you and

one from your wife?

A. Yes.

Q. And do you -- do you provide 1099s to anyone else besides Niva Gurewitsch?

A. No.

Q. Does Niva have any other employment or job responsibilities besides to you and your wife?

A. Not currently, no.

Q. When did you and Dr. Gurewitsch Allen first start working together?

A. We first started working together in 2004.

Q. And that was at Johns Hopkins?

A. Yes.

Q. And when did you and your wife leave Johns Hopkins?

A. 2018.

Q. Why did you leave?

A. There was an opportunity for my wife, and it was an opportunity for both of us to be closer to our families.

Q. You grew up in New York?

A. I did.

Q. Okay. In terms of your current assistant research professorship, what kind of activities do you do in that position?

EXHIBIT 7

SUPERIOR COURT OF WASHINGTON, LEWIS COUNTY

SCOTT HAMILTON, as guardian ad litem for Z.H., Plaintiff,	)
vs.	) 20-2-00543-21
LINDA AMONDSON-MULLER, Personal Representative of the ESTATE OF LAURA HAMILTON, Defendant.	)

VIDEOTAPED REMOTE DEPOSITION UPON ORAL EXAMINATION OF

ROBERT DeMOTT, M.D.

9:00 a.m.

APRIL 12, 2022

(Via Zoom)

REPORTED BY: ELEANOR J. MITCHELL, RPR, CCR 3006

to normal or gentle downward traction.

So the -- the statement is -- in Williams' textbook I believe it says normal, and in ACOG bulletins it says gentle. And so you should use the same amount of force that you would with a normal delivery.

Q. (BY MS. MACHLER.) And why -- what is -- why is that the standard of care?

A. Well, just that -- that normal pressures, it -- it makes sense that babies could tolerate that, and they have for millions of years. And the release maneuvers are required if that doesn't work, because increasing the traction might cause some other problems such as making the shoulder dystocia worse that you're trying to relieve.

So with our knowledge now that, if normal traction doesn't work that the release maneuvers lead to a higher degree of success, that is why it is the standard of care.

Q. Is -- is the -- is the use of gentle or normal traction -- is that the standard of care because the -- partially or wholly because a birth attendant can injure a baby by pulling on it?

A. Like I said before, theoretically it's possible that increased traction, especially in the

wrong direction, could lead to a brachial plexus deficit. Yes.

Q. Now, after all of the articles and all of the literature that you talked about, has ACOG or anyone else changed the standard of care?

A. Not that I'm aware of, no.

Q. So the standard of care still is gentle or normal traction?

A. Well, that's what every publication that I have read over the last 20 to 25 years on the subject has stated, and I have no reason to disagree with that.

Q. Okay. Now, in this case there was a shoulder dystocia. Would you agree with that?

A. Yes.

Q. And -- and Midwife Laura Hamilton, she testified that she attempted to deliver the posterior shoulder. Do you remember her testimony on that?

A. Yes. That was one of her maneuvers that she wrote about, yes.

Q. And -- but it's still your opinion that -- that -- that Zachary's injury was caused before that?

A. Yes. That posterior shoulder was in the hollow of the sacrum at that time. And, you know, you can't -- you can't reach the posterior shoulder when it's up -- impacted on the sacral promontory. It just