

Committee Report

CONSENT CALENDAR

February 12, 2019

HOUSE OF REPRESENTATIVES

REPORT OF COMMITTEE

**The Committee on Health, Human Services and Elderly
Affairs to which was referred HB 555-FN,**

**AN ACT relative to shaken baby syndrome. Having
considered the same, report the same with the following
resolution: RESOLVED, that it is INEXPEDIENT TO
LEGISLATE.**

Rep. Jeffrey Salloway

FOR THE COMMITTEE

COMMITTEE REPORT

Committee:	Health, Human Services and Elderly Affairs
Bill Number:	HB 555-FN
Title:	relative to shaken baby syndrome.
Date:	February 12, 2019
Consent Calendar:	CONSENT
Recommendation:	INEXPEDIENT TO LEGISLATE

STATEMENT OF INTENT

This bill requires that hospitals request new parents view a video on Shaken Baby Syndrome and co-sleeping and requires child-care providers to participate in training on Shaken Baby Syndrome. The committee voted that legislation was not needed, as all relevant hospitals already provide access to these materials, and child-care providers already receive this information as well.

Vote 19-1.

Rep. Jeffrey Salloway
FOR THE COMMITTEE

Original: House Clerk
Cc: Committee Bill File

CONSENT CALENDAR

Health, Human Services and Elderly Affairs

HB 555-FN, relative to shaken baby syndrome. **INEXPEDIENT TO LEGISLATE.**

Rep. Jeffrey Salloway for Health, Human Services and Elderly Affairs. This bill requires that hospitals request new parents view a video on Shaken Baby Syndrome and co-sleeping and requires child-care providers to participate in training on Shaken Baby Syndrome. The committee voted that legislation was not needed, as all relevant hospitals already provide access to these materials, and child-care providers already receive this information as well. **Vote 19-1.**

COMMITTEE REPORT

COMMITTEE: Health

BILL NUMBER: HB 555-FN

TITLE: relative to shaken baby syndrome

DATE: _____ CONSENT CALENDAR: YES NO

- OUGHT TO PASS
- OUGHT TO PASS W/ AMENDMENT
- INEXPEDIENT TO LEGISLATE
- INTERIM STUDY (Available only 2nd year of biennium)

Amendment No.

STATEMENT OF INTENT:

This Bill requires that hospitals ~~require~~ request new parents to view a video on shaken baby syndrome and required child care providers to participate in training on shaken baby syndrome. ~~The committee voted that legislation was not needed~~ as all relevant hospitals already ~~provide~~ provide access to these materials and child care providers already receive this information as well.

COMMITTEE VOTE: 20-1

RESPECTFULLY SUBMITTED,

- Copy to Committee Bill File
- Use Another Report for Minority Report

Rep. J.C. Falow
For the Committee

Voting Sheets

HOUSE COMMITTEE ON HEALTH, HUMAN SERVICES AND ELDERLY AFFAIRS

EXECUTIVE SESSION on HB 555-FN

BILL TITLE: relative to shaken baby syndrome.

DATE: February 12, 2019

LOB ROOM: 205

MOTIONS: INEXPEDIENT TO LEGISLATE

Moved by Rep. Salloway


Seconded by Rep. Fothergill

Vote: 19-1

CONSENT CALENDAR: YES

Statement of Intent: Refer to Committee Report

Respectfully submitted,


Rep Susan Ticehurst, Clerk

HOUSE COMMITTEE ON HEALTH, HUMAN SERVICES AND ELDERLY AFFAIRS

EXECUTIVE SESSION on HB 555-FN

BILL TITLE: relative to shaken baby syndrome.

DATE: 12-12-19

LOB ROOM: 205

MOTION: (Please check one box)

OTP ITL Retain (1st year) Adoption of
Amendment # _____
 Interim Study (2nd year) (if offered)

Moved by Rep. Salloway Seconded by Rep. Fothergill Vote: 19-1

MOTION: (Please check one box)

OTP OTP/A ITL Retain (1st year) Adoption of
Amendment # _____
 Interim Study (2nd year) (if offered)

Moved by Rep. _____ Seconded by Rep. _____ Vote: _____

MOTION: (Please check one box)

OTP OTP/A ITL Retain (1st year) Adoption of
Amendment # _____
 Interim Study (2nd year) (if offered)

Moved by Rep. _____ Seconded by Rep. _____ Vote: _____

MOTION: (Please check one box)

OTP OTP/A ITL Retain (1st year) Adoption of
Amendment # _____
 Interim Study (2nd year) (if offered)

Moved by Rep. _____ Seconded by Rep. _____ Vote: _____

CONSENT CALENDAR: YES NO

Minority Report? _____ Yes _____ No If yes, author, Rep: _____ Motion _____

Respectfully submitted: Susan Ticehurst
Rep Susan Ticehurst, Clerk



2019 SESSION

Health, Human Services and Elderly Affairs

Bill #: 555 Motion: ITL AM #: _____ Exec Session Date: 2-12-19

<u>Members</u>	<u>YEAS</u>	<u>Nays</u>	<u>NV</u>
Weber, Lucy M. Chairman	✓		
Campion, Polly Kent Vice Chairman	✓		
MacKay, James R.	✓		
Snow, Kendall A.			✓
Freitas, Mary C.	✓		
Ticehurst, Susan J. Clerk	✓		
Knirk, Jerry L.	✓		
Salloway, Jeffrey C.	✓		
Cannon, Gerri D.	✓		
Nutter-Upham, Frances E.	✓		
Osborne, Richard G.	✓		
Schapiro, Joe	✓		
Woods, Gary L.	✓		
McMahon, Charles E.	✓		
Nelson, Bill G.			✓
Guthrie, Joseph A.	✓		
Fothergill, John J.	✓		
Marsh, William M.	✓		
Pearson, Mark A.	✓		
Acton, Dennis F.	✓		
DeClercq, Edward	✓		

OFFICE OF THE HOUSE CLERK



1/14/2019 3:22:00 PM
Roll Call Committee Registers
Report

2019 SESSION

Health, Human Services and Elderly Affairs

Bill #: _____ Motion: _____ AM #: _____ Exec Session Date: _____

Stapleton, Walter A.

TOTAL VOTE:

			✓	
	19		1	

Hearing Minutes

HOUSE COMMITTEE ON HEALTH, HUMAN SERVICES AND ELDERLY AFFAIRS

PUBLIC HEARING ON HB 555-FN

BILL TITLE: relative to shaken baby syndrome.

DATE: January 22, 2019

LOB ROOM: 205 **Time Public Hearing Called to Order:** 11:00 AM

Time Adjourned: 11:49 AM

Committee Members: Reps. Weber, Campion, Ticehurst, MacKay, Snow, Knirk, Salloway, Cannon, Nutter-Upham, R. Osborne, Schapiro, Woods, McMahon, Nelson, Guthrie, Fothergill, Marsh, M. Pearson, Acton, DeClercq and Stapleton

Bill Sponsors:

Rep. Harb

Rep. DeSimone

TESTIMONY

* Use asterisk if written testimony and/or amendments are submitted.

* **1,2,3 Introduced by Sponsor: Rep. Harb –**

Currently there is no mandated program for abusive head trauma, also known as shaken baby syndrome. With education there may be a 34% drop in abusive head trauma. An educational video, produced by the National Institute for Shaken Baby Syndrome, is available for \$2.25, and has been updated. Federal regulations require child care workers to be trained in abusive head trauma. It has been suggested that the bill be expanded to include midwives. The proposed legislation impacts the scope of practice for physicians. Asking for a written refusal may decrease the number of people who hesitate to watch the video.

Mary Kusturin -

Supports the intent but is concerned with lines 9-12: having parents sign a form stating that they have viewed, or refused to view, the information. Concerned that this information could potentially be used to penalize parents. Would support the bill if amended.

4 Gwendolyn Gladstone, NH Pediatric Society

She is a retired pediatrician and specialist in child abuse evaluation. Supports the aims of the bill, which is to prevent abusive head trauma in NH, through the use of an evidence-based program. Hospitals have almost all already adopted this program voluntarily. This bill would help them to get funding for it. The cost of a fatal case of abusive head trauma is over \$5.5 million; cost of non-fatal is \$2.5 million. Children who are victims end up in the foster care system. Education regarding co-sleeping was included because when parents are taught how to deal with a crying baby, they learn that holding the baby in bed puts the child in danger of unsafe sleeping conditions

5 Paula Minnahan, NH Hospital Association -

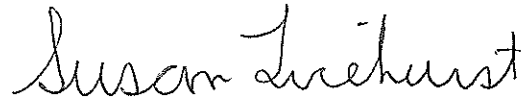
Supports the intent, but questions the necessity as all birthing hospitals currently practice what the bill calls for. Most hospitals use the same educational program, but some may choose to use different programs. Concerns about the form: unclear what would be done with the form and whether it would be required to be submitted to the Department of Health and Human Services. Unclear that a mandated state law would increase awareness since education is already occurring.

**Patricia Tilley, Department of Health and Human Services,
Director of Public Health Services -**

Supports the concept of the bill. Almost all hospitals use the video "Period of PURPLE Crying". One hospital uses other materials. DHHS does not provide grant funds but there are other sources. Supports education about SIDS or sleeping practices. Annually, in New Hampshire, there are a

handful of deaths from intentional trauma and more from unsafe sleep environments. Federal regulations require that child care providers who care for infants receive training in abusive head trauma prevention, but the bill would require those caring for older children to complete the training as well. It is unknown if the three freestanding birthing centers offer this education. Out of 12,000 New Hampshire births per year, about 200 births happen outside of the hospital. Using the term "birth attendant" would be more inclusive. Presumption is that the form would stay in the medical record.

Respectfully submitted,

A handwritten signature in cursive script that reads "Susan Ticehurst". The signature is written in black ink and is positioned above the typed name.

Rep. Susan Ticehurst, Clerk

House Committee on Health, Human Services & Elderly Affairs
Public Hearing on HB 555

Bill Title:	HB 555-FN, relative to shaken baby syndrome.		
Date:	1/22/19		
Room:	205	Time Public Hearing Called to Order:	11:00
		Time Adjourned:	11:49

Committee Members Present:

X	Shapiro	X	DeClerq
X	Cannon	X	Osborne
X	Stapleton	X	Acton
X	Nutter-Upham	X	Woods
X	Marsh	X	Pearson
X	Salloway	X	Knirk
X	Fothergill	X	Guthrie
	Freitas	X	Snow
X	MacKay	X	McMahon
X	Ticehurst	X	Campion
X	Weber		

Testimony

* Use asterisk if written testimony and/or amendments are submitted.

*	Attch #	Name	Testimony:
*	1,2,3	Introduced by Sponsor: Rep. Harb	Currently there is no mandated program for abusive head trauma, also known as shaken baby syndrome. With education there may be a 34% drop in abusive head trauma. An educational video, produced by the National Institute for Shaken Baby Syndrome, is available for \$2.25, and has been updated. Federal regulations require child care workers to be trained in abusive head trauma. It has been suggested that the bill be expanded to include midwives. The proposed legislation impacts the scope

			of practice for physicians. Asking for a written refusal may decrease the number of people who hesitate to watch the video.
dy		Mary Kusturin	Supports the intent, but is concerned with lines 9-12: having parents sign a form stating that they have viewed, or refused to view, the information. Concerned that this information could potentially be used to penalize parents. Would support the bill if amended.
#	4	Gwendolyn Gladstone, NH Pediatric Society	She is a retired pediatrician and specialist in child abuse evaluation. Supports the aims of the bill, which is to prevent abusive head trauma in NH, through the use of an evidence based program. Hospitals have almost all already adopted this program voluntarily. This bill would help them to get funding for it. The cost of a fatal case of abusive head trauma is over \$5.5 million; cost of non-fatal is \$2.5 million. Children who are victims end up in the foster care system. Education regarding co-sleeping was included because when parents are taught how to deal with a crying baby, they learn that holding the baby in bed puts the child in danger of unsafe sleeping conditions
#	5	Paula Minnahan, NH Hospital Association	Supports the intent but questions the necessity as all birthing hospitals currently practice what the bill calls for. Most hospitals use the same educational program but some may choose to use different programs. Concerns about the form: unclear what would be done with the form and whether it would be required to be submitted to the Department of Health and Human Services. Unclear that a mandated state law would increase awareness since education is already occurring.
dy		Patricia Tilley, Department of Health and Human Services, Director of Public	Supports the concept of the bill. Almost all hospitals use the video "Period of Purple Crying". One hospital uses other materials. DHHS does not provide grant

		Health Services	<p>funds but there are other sources. Supports education about SIDS or sleeping practices. Annually, in New Hampshire, there are a handful of deaths from intentional trauma and more from unsafe sleep environments. Federal regulations require that child care providers who care for infants receive training in abusive head trauma prevention but the bill would require those caring for older children to complete the training as well. It is unknown if the three freestanding birthing centers offer this education. Out of 12,000 New Hampshire births per year, about 200 births happen outside of the hospital. Using the term "birth attendant" would be more inclusive. Presumption is that the form would stay in the medical record.</p>
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Respectfully submitted,

Rep. Susan Ticehurst, Clerk

Testimony



Period of **PURPLE** Crying®

A New Way To Understand Your Baby's Crying

Hospitals sharing information with parents at birthing unit:

Androscoggin Valley Hospital – Berlin	Southern NH Medical Center - Nashua
Littleton Regional Healthcare	Portsmouth Regional Hospital
Memorial Hospital – North Conway	Wentworth Douglass Hospital - Dover
Lakes Region General Hospital – Laconia	Parkland Medical Center - Derry
Children's Hospital at Dartmouth-Hitchcock – Lebanon	Cheshire Medical Center - Keene
Alice Peck Day Hospital - Lebanon	
Concord Hospital	
Frisbie Memorial Hospital – Rochester	
Exeter Hospital	
Catholic Medical Center - Manchester	
NH Hospital for Children at Elliot – Manchester	
Monadnock Community Hospital – Peterborough	
St. Joseph Hospital - Nashua	

Family Resource Centers/Family Support Programs where parents can turn for support:

Child and Family Services (Nashua, Manchester, Concord, Littleton): 1-800-640-6486 ♥

Families First Health and Support Center (Portsmouth): 603-422-8208 ext 146 ♥

OUR Place (serving parents teens to 25) (Nashua and Manchester): 603-647-2244♥

Families Connections at Children Unlimited (North Conway): 603-447-6456 ♥

Family Resource Center Berlin/Gorham 603-456-5190 ext. 303 ♥

Family Resource Center of Central NH(Laconia) 603-524-1741 ♥

The Children's Place (Concord) 603-224-9920

Whole Village Family Resource Center (Plymouth) 603-536-3720

Good Beginnings of Sullivan County (Claremont) 603-542-1848

The River Center – A Family and Community Resource Center (Peterborough) 603-924-6800 ♥

The Upper Room – A Family Resource Center (Derry) 603-437-8477

Salem Family Resources – Success by 6 (Salem) 603- 898-5493

Family Education Collaborative YWCA – NH (Manchester) 603-625-5785

The Grapevine – Family and Community Resource Center (Antrim) 603-588-2620 ♥

Community Action Program Strafford County (Dover) 603-516-8130

Monadnock Family Services (Keene) 603-357-4400

HCS – Maternal and Child Health Program (Greater Keene area) 603-352-2253 ♥

The Greater Nashua Family Resource Center 603-883-0523

Easter Seals Child Development and Family Resource Center (Manchester) 603-666-5982

Family Connections Center at the Department of Corrections 603-271-2255

The Letters in **PURPLE** Stand for

P

PEAK OF CRYING

Your baby may cry more each week. The most at 2 months, then less at 3-5 months

U

UNEXPECTED

Crying can come and go and you don't know why

R

RESISTS SOOTHING

Your baby may not stop crying no matter what you try

P

PAIN-LIKE FACE

A crying baby may look like they are in pain, even when they are not

L

LONG LASTING

Crying can last as much as 5 hours a day, or more

E

EVENING

Your baby may cry more in the late afternoon and evening

Calming the Baby:

- ♥ Swaddle the baby in a soft blanket and hold her next to you.
- ♥ Give the baby a warm bath to relax him.
- ♥ Rock the baby in a swing or chair OR gently sway your body while holding the baby close.
- ♥ Take the baby for a walk in the stroller or a ride in the car.
- ♥ Let the baby have skin-to-skin contact with you such as holding her to your chest.
- ♥ Run some "white noise" like the vacuum cleaner, the hairdryer, or fan.
- ♥ Remember that sometimes it is normal for babies to cry even after you try all the calming techniques.

Calming Yourself:

- ♥ Take a break. If you've checked everything above and all is OK, put the baby safely in a crib, and take a few minutes for yourself in another room.
- ♥ Call a friend who will listen and be sympathetic.
- ♥ Ask a trusted friend or neighbor to watch your child while you take a short break or a brief nap. Always be careful about whom you leave your baby with.
- ♥ Call a parent support line like 1-800-4-A-CHILD or 1-877-4A- PARENT

It's normal for babies to cry sometimes, and it's certainly normal for parents to feel frustrated by the crying. You may have received a film and booklet at the hospital called the *Period of PURPLE Crying*® that talked about this. For more information about infant crying and soothing techniques, visit www.purplecrying.info.

If you think your baby may be sick, contact a doctor.

More hospitals and providers are added all the time. For an updated list contact NH Children's Trust 603-224-1279, info@nhchildrenstrust.org



NEVER SHAKE A BABY!

TAKING CARE OF A SMALL CHILD IS A BIG JOB

BABIES. Just the word suggests warm feelings, tender moments and innocent little people who depend on parents, grandparents, siblings and other caregivers to love and care for them. However, there is another side to caring for a baby or small child that isn't talked about much – the feelings of being frustrated, overwhelmed and alone.



HOW DOES IT HAPPEN?

Often frustrated parents or other persons responsible for a child's care feel that shaking a baby is a harmless way to make a child stop crying. Other times, children become victims when a parent or caretaker, not realizing how seriously this behavior can harm, throws a small child vigorously into the air, plays too rough or hits an infant too hard on the back.

These are normal feelings to have while taking care of a baby. After all, it is a big responsibility for anyone. Many times the stresses of day-to-day life – fatigue, family problems, financial strain and overworking – can make someone reach a breaking point, especially if a baby is fussy and crying for a long period of time. It happens to mothers, fathers, family members, day care providers, friends and even teenagers who are baby sitting for just a few hours a day. Unfortunately, babies and small children are the victims when feelings of frustration result in violent shaking to stop the child from crying.

The number one reason a baby is shaken is because of inconsolable crying. Almost 25 percent of all babies with Shaken Baby Syndrome die. It is estimated that 25 - 50 percent of parents and caretakers aren't aware of the effects of shaking a baby.

WHAT IS SHAKEN BABY SYNDROME?

When a baby is vigorously shaken, the head moves back and forth. This sudden whiplash motion can cause bleeding inside the head and increased pressure on the brain, causing the brain to pull apart and resulting in injury to the baby. This is known as Shaken Baby Syndrome. A baby's head and neck are susceptible to head trauma because his or her muscles are not fully developed and the brain tissue is exceptionally fragile. Head trauma is the leading cause of disability among abused infants and children.

Shaken Baby Syndrome occurs most frequently in infants younger than six months old, yet can occur up to the age of three. Often there are no obvious outward signs of inside injury, particularly in the head or behind the eyes. In reality, shaking a baby, if only for a few seconds, can injure the baby for life. These injuries can include brain swelling and damage; cerebral palsy; mental retardation; developmental delays; blindness; hearing loss; paralysis and death. When a child is shaken in anger and frustration, the force is multiplied five or 10 times more than it would be if the child had simply tripped and fallen.

WHAT CAN YOU DO TO PREVENT A TRAGEDY?

- ❖ Never shake or throw a baby around. However, gentle play with a baby will not cause these injuries.
- ❖ Always provide support for the baby's head and neck. Don't wiggle or bounce an infant's head.
- ❖ Educate parents, grandparents, caregivers, new parents, baby sitters, teenagers, siblings and licensed child care providers about the dangers of shaking a baby.
- ❖ Choose child care providers and baby sitters carefully. Know how they play with children, and how they will react when the children are upset.

If you or someone else shakes a baby, either accidentally or on purpose, call 911 or take the child to the emergency room immediately. Bleeding inside the brain can be treated. Immediate medical attention will save your baby many future problems . . . and possibly save the baby's life.

You CAN COPE!



Often times babies need attention. **BE PATIENT.** Remember taking care of a baby is a big job. It is all right to feel overwhelmed and frustrated with a crying child. It's not all right to shake a child to stop the crying. You may stop the crying, but also change the child's life (and yours) forever in just one moment of uncontrolled frustration. Here are some nonviolent ways to stop the crying and calm yourself . . .

- Place the baby in a safe place, like a crib, and leave the room for a few minutes
- Sit down, close your eyes and take 20 deep breaths
- Relax!
- Play music
- Ask a friend or relative to "take over" for a while
- Think about how much you love your baby and wouldn't want to do anything to hurt him/her
- Don't pick the baby up until you feel calm
- Make sure the baby is fed and dry
- Feed the baby slowly and burp often
- Gently rock or walk the baby
- Take the baby for a ride in the stroller or car
- Check for signs of discomfort such as diaper rash, teething or fever
- Call the doctor if you think the baby is sick
- After immunizations, be sure the baby is comfortable and given recommended medications
- Put the baby in a windup swing
- Make sure the clothing is not too tight or that fingers or toes are not bent
- Give the baby a pacifier
- Lay the baby tummy down across your lap and gently pat or rub his or her back
- Offer a noisy toy or rattle
- Hug and cuddle the baby gently
- Sing or talk to the baby.



**National Exchange
Club Foundation**



Preventing Child Abuse . . . Serving America

3050 Central Avenue Toledo, Ohio 43606

800/924-2643 Fax: 419/535-1989

www.preventchildabuse.com



The National Exchange Club Foundation is a nonprofit organization dedicated to developing, promoting and implementing programs that seek to eliminate child abuse, strengthen families and strengthen Exchange. The Foundation coordinates a nationwide network of child abuse prevention centers, each countering abuse through the parent aide program. It is the goal of the Foundation to educate as many parents, care givers, baby sitters and relatives as possible about Shaken Baby Syndrome.

To date the Foundation has helped more than 140,000 children and 100,000 families eliminate abuse from their lives and providing a safe and healthy home environment. If you would like more information, please contact the National Exchange Club Foundation, 800.924.2643.

Babies are fragile.



**Please don't shake a child.
Learn about shaken baby syndrome.**





Contents lists available at ScienceDirect

Child Abuse & Neglect

journal homepage: www.elsevier.com/locate/chiabuneg

Eight-year outcome of implementation of abusive head trauma prevention



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ARTICLE INFO

Keywords:

Abusive head trauma
Shaken baby syndrome
Prevention
Parental education
Crying
Shaking
Infant abuse

ABSTRACT

Low incidence rates and economic recession have hampered interpretation of educational prevention efforts to reduce abusive head trauma (AHT). Our objective was to determine whether the British Columbia experience implementing a province-wide prevention program reduced AHT hospitalization rates. A 3-dose primary, universal education program (the *Period of PURPLE Crying*) was implemented through maternal and public health units and assessed by retrospective-prospective surveillance. With parents of all newborn infants born between January 2009 and December 2016 ($n = 354,477$), nurses discussed crying and shaking while delivering a booklet and DVD during maternity admission (dose 1). Public health nurses reinforced Talking Points by telephone and/or home visits post-discharge (dose 2) and community education was instituted annually (dose 3). During admission, program delivery occurred for 90% of mothers. Fathers were present 74.4% of the time. By 2–4 months, 70.9% of mothers and 50.5% of fathers watched the DVD and/or read the booklet. AHT admissions decreased for < 12-month-olds from 10.6 (95% CI: 8.3–13.5) to 7.1 (95% CI: 4.8–10.5) or, for < 24-month-olds, from 6.7 (95% CI: 5.4–8.3) to 4.4 (95% CI: 3.1–6.2) cases per 100,000 person-years. Relative risk of admission was 0.67 (95% CI: 0.42–1.07, $P = 0.090$) and 0.65 (95% CI: 0.43–0.99, $P = 0.048$) respectively. We conclude that the intervention was associated with a 35% reduction in infant AHT admissions that was significant for < 24-month-olds. The results are encouraging that, despite a low initial incidence and economic recession, reductions in AHT may be achievable with a system-wide implementation of a comprehensive parental education prevention program.

* Corresponding author at: Evidence to Innovation, British Columbia Children's Hospital, 4480 Oak Street, F508, Vancouver, BC, V6H 3V4, Canada.

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1. Introduction

Abusive head trauma (AHT) [or shaken baby syndrome (SBS)] is a devastating form of infant abuse (Barr, 2012; Christian, Block, & Neglect, 2009) with significant mortality and morbidity (Duhaim, Christian, Moss, & Seidl, 1996; Keenan et al., 2003; Keenan, Hooper, Wetherington, Nocera, & Runyan, 2007; King, MacKay, & Sirnack, 2003), medical costs (Miller et al., 2017; Peterson et al., 2014), the destruction of families and society's failure to protect its most vulnerable citizens. Evaluation studies of the effectiveness of prevention efforts are mixed, and interpretation of these studies is challenging. Because crying is a significant trigger (Barr, Trent, & Cross, 2006; Barr, 2012; Lee, Barr, Catherine, & Wicks, 2007; Talvik, Alexander, & Talvik, 2008), prevention has targeted parents with education about crying and shaking. Randomized controlled trials (RCTs) of maternal education have demonstrated improved crying knowledge (Barr, Barr et al., 2009; Barr, Rivara et al., 2009; Bechtel et al., 2011; Fujiwara, Yamada et al., 2012), sharing of learned information with other caregivers (Barr, Barr et al., 2009; Barr, Rivara et al., 2009; Fujiwara, Yamada et al., 2012) and changed crying response behaviors (Barr, Barr et al., 2009; Fujiwara, Yamada et al., 2012). In observational studies, education of new mothers changed behaviors by reducing calls to a nurse advice line (Zolotor et al., 2015) and visits to emergency rooms for crying complaints (Barr, Rajabali, Aragon, Colbourne, & Brant, 2015). Economic influences may have confounded studies of the effectiveness of prevention through educating parents about crying and shaking. Early studies reported 47% and 78% reductions in AHT admissions pre- to post-implementation (Altman et al., 2011; Dias et al., 2005), but later studies reported an increase (Dias, Rottmund, & Cappos, 2017) or no reduction of cases (Zolotor et al., 2015). The later implementations coincided with the economic recession (December 2007–June 2009) associated elsewhere with substantial increases in AHT admissions (Berger et al., 2011; Huang et al., 2011; Klevens, Luo, Xu, Peterson, & Latzman, 2016; Wood et al., 2016; Xiang et al., 2013) that persisted post-recession (Wood et al., 2016), potentially confounding interpretation of the results.

This paper describes the eight-year outcome of AHT admissions in British Columbia (BC) following implementation of a primary, universal prevention program, the *Period of PURPLE Crying* (www.dontshake.org/purplecrying; National Center on Shaken Baby Syndrome [NCSBS], Farmington, UT). The intervention included three “doses:” education of parents of all newborns during maternity admission or home births; post-partum reinforcement of Talking Points by public health nurses (PHNs); and an annual public education campaign. The intervention had two aims: (1) improving understanding of early increased crying by parents, and (2) reducing AHT incidence. Aim 1 was evaluated by measuring visits for crying complaints to the BC Children's Hospital (BCCH) emergency previously reported (Barr et al., 2015). Aim 2 is being evaluated by retrospective-prospective surveillance of AHT hospital admissions.

Implementation began in January 2008. At that time, AHT incidence in the USA and Britain clustered around 30 per 100,000 person-years for < 12-month-olds (Barlow & Minns, 2000; Ellingson, Leventhal, & Weiss, 2008; Fujiwara, Barr, Brant, Rajabali, & Pike, 2012; Keenan et al., 2003). Subsequently, Fujiwara, Barr et al. (2012) and others in Canada (Bennett et al., 2011)—consistent with reports in New Zealand (Kelly & Farrant, 2008) and Britain (Hobbs, Childs, Wynne, Livingston, & Seal, 2005)—reported incidences around 15 per 100,000 person-years. In BC, there were an estimated 10 admissions per 100,000 person-years using the same data and methodology (unpublished). With that incidence, assuming a 14-year baseline and a birthrate of 45,000/year in BC, power to detect a 50% reduction as previously reported by Dias et al. (2005) required 9 years and detecting a statistically significant 30% reduction was not possible. Consequently, achieving statistically significant reductions with highly variable but low annual incidences approached infeasibility. Nevertheless, because of mixed and potentially confounded reports on prevention effectiveness, we elected to report our experience after 8 years of follow-up.

2. Patients and methods

2.1. Intervention

The *Period of PURPLE Crying* program development began in 2002. The strategic approach and materials centered on parental interest in their infants' normal development, especially crying, and the dangers of shaking when frustrated with crying. It utilized 40 years of empirical evidence supporting a developmental interpretation of early increased crying (Barr, 2000, 2012; Brazelton, 1962; St.James-Roberts et al., 1991) and clinical and epidemiological evidence that crying was the most common stimulus for AHT (Barr et al., 2006; Brewster, Nelson, & Hymel, 1998; Kempe, 1971; Lee et al., 2007; Reijneveld, van der Wal, Brugman, Sing, & Verloove-Vanhorick, 2004; Talvik et al., 2008). AHT was conceptualized as a failure of normal, common, iterative infant-caregiver interactions, rather than only of abnormal behavior, at-risk caregivers or their interaction (Barr, 2012; Jenny, 2008).

Dose 1 included scripted interactions between a maternity nurse (or midwife) and mother with father present if possible, protocolized use of the 10-page educational booklet where the nurses reviewed the booklet as the stimulus for the discussion, viewing an educational film on a DVD when possible, emphasis on key program messages (Talking Points: see Fig. 1), and providing the materials to the parents to take home with them. In 2012, another film (*Crying, Soothing and Coping*) was added to the DVD emphasizing parental coping when soothing failed. Unique to the *PURPLE* program, parents received their own booklet and DVD (available in 10 languages) to share with fathers and other caregivers, and review later when crying increases (Barr, 2000; Brazelton, 1962). Two features emphasized non-maternal caregivers. First, because fathers are the most common perpetrators (Barr, 2012; Starling, Holden, & Jenny, 1995), nurses were encouraged to teach with fathers present. Second, Talking Point #4 emphasized sharing information with anyone caring for the infant (e.g. grandparents, sitters).

In Dose 2, to assure consistent and accurate messaging from multiple sources (Willinger, Ko, Hoffman, Kessler, & Corwin, 2000), the Talking Points were reinforced within 2 weeks during routine post-natal telephone contact or, occasionally, during home visits

The *Period of PURPLE Crying* Program: Talking Points

FOR NURSES

I strongly recommend you read and watch these materials when you get home because it is very important information.

Let me go over some important points with you:

1. Infant crying is normal, especially in the first 4-5 months of life.
 - Remember, crying increases at about 2 weeks, peaks at 2-3 months, declines by 5 months.
 - Some babies cry as long as 5 hours a day or more, others cry for only 20 mins or less each day. This is still normal -- this early crying time is what we call the *Period of PURPLE Crying*.
2. If you are concerned, always have your doctor examine your baby. However, if your baby is growing, is not sick or has no fever or other symptoms, then they are very likely going through the *Period of PURPLE Crying*.
3. Some parents say they get so frustrated with the crying they could just shake the baby.
 - Remember, shaking is the most dangerous thing anyone can do to a baby.
 - Even mild shaking can cause brain damage and hard shaking can be deadly.
4. Make sure you tell others about the *Period of PURPLE Crying* and the dangers of shaking a baby.
 - Do not leave your baby with someone who gets frustrated easily.
 - Show everyone the booklet and DVD before they care for your baby.
 - Don't be embarrassed to tell them. It can save your baby's life.

Fig. 1. Talking Points delivered by maternity and public health nurses.

from PHNs. Other potential sources of contact for new parents in the postpartum period ("reinforcement" groups) were also trained, including pediatricians, family physicians, adoptive/foster parent support, crisis lines, Aboriginal support, Health-Link BC (phone-in service), pregnancy outreach, infant development and early childhood education staff. In contrast to the maternity and public health nurses, the role of these professionals was not to disseminate the program, but rather (1) to be aware of the existence and purpose of the program so that both parents and professionals were talking about the *Period of PURPLE Crying* program; and (2) to assure that parents received consistent messages about crying, its normality, its importance and the dangers of responding violently to it. Other than tracking the numbers of professionals trained, we did not track fidelity parameters on them.

Nurses in 49 maternity units (n = 2014) and 112 public health offices (n = 959) were trained by 2 full-time educators (January 2008–January 2009) that included 30-minute in-person sessions, on-line training, webinars, and certificates for successful completion. In each maternity, at least eighty percent of nurses were trained before implementation. Updates and new nurse training occurred annually. By December 2015, over 5400 maternity nurses and PHNs and 4800 reinforcement group practitioners had completed training.

Dose 3 (public education) began in 2010. The campaign was *CLICK for Babies* (www.CLICKforBabies.org), originally "PURPLE Caps." First developed in North Carolina, the campaign asked volunteers to knit purple caps for Prevent SBS BC. Over 4000 caps distributed to hospitals were provided as gifts to each newborn during November. Because of its success and cost effectiveness, the campaign was repeated annually.

The study was approved by the UBC Behavioural Research Ethics Board in 2007 and re-approved annually.

2.2. Participation rates

The program targeted parents of all newborn infants born between January 2009 and December 2016 (n = 354,477). Four tracking methods were utilized to estimate the percentage of newborn families receiving and using the program: (1) public health

(PH) evaluation forms; (2) public health nurse (PHN) surveys; (3) parent surveys; and (4) maternity nurse surveys (for father and other caregiver exposures).

PH evaluation forms (January 2009–September 2011) were used to track an estimated 79% of all parents targeted to receive the intervention. PH monitoring could not track 21% of parents that included First Nations births on reserve or in rural areas (followed separately by First Nations Health Authority nurses), home births (followed by midwives), self-paid and out-of-province births or those with significant language barriers. PH unit nurses called parents within two weeks of discharge and reviewed the Talking Points reinforcing the *PURPLE Crying* messages. If parents had been missed in maternity, the program was delivered by home visitor or by mail. By prior agreement, PH evaluation forms were discontinued in September 2011.

From October 2012–December 2016, participation rates were estimated with a randomized, stratified sample of PHN surveys (3 min; $n = 910$). From 2010, parent telephone surveys occurred in three waves of approximately two years each (2010–2011, 2012–2013, 2014–2016) of randomized, stratified samples of mothers of 2–4-month-old infants (5 min; total $n = 2572$).

Each survey (PHN or parent) asked whether parents received the program, how it was provided (maternity, midwife, public health, other) and, if received, had they reviewed the DVD and/or booklet. To reduce recall bias, the PHN survey requested nurses to answer the questions based on the last mother they contacted regarding the new baby follow-up. The PH evaluation also determined where parents reviewed the DVD and/or booklet (at home, hospital, or elsewhere). The parent surveys included five knowledge questions to insure receipt of program messages.

2.3. Fathers and other caregivers

Father and other caregiver exposures were tracked with randomized, stratified sample surveys of maternity nurses (3 min; $n = 841$; September 2009–November 2013). Two questions asked whether someone else (fathers, grandparents, “others”) was in the room during teaching. In the 2012 and 2014 parent surveys, mothers were asked whether fathers and other caregivers had watched the DVD and/or read the booklet. In 2010, 2012 and 2014 parent surveys, mothers were asked whether they had talked about crying and shaking with other caregivers.

2.4. Hospitalization rates

A retroactive review of all Child Protection Service (CPS) case charts (1995–2003) was undertaken in 2004 by two child abuse physicians (J.H. and M.C.) and re-reviewed in 2013 with the additional years 2004–2006 for definite cases only. Prospectively from January 2007, AHT admissions were tracked through two systems: the CPS and the Inflicted Head Injury Surveillance program. All serious child abuse assessments and child neurosurgery cases are referred to British Columbia Children's Hospital (BCCCH), the only pediatric hospital in BC. All CPS referrals with physical abuse as a primary or secondary referral and/or diagnosis were reviewed quarterly with a protocolized process by CPS (physicians and social workers) and investigation teams. To assure consistency in defining cases, throughout the years of prospective reviews this committee was chaired by one or other of the child abuse physicians who carried out the retrospective reviews. To define a case, reviewers followed the Canadian Pediatric Society and American Academy of Pediatrics recommendations that have remained the same throughout; namely, that AHT is a medical diagnosis made when an infant or child presents with physical injury to the head due to violent shaking, impact or a combination of the two, and may involve intracranial hemorrhage, retinal hemorrhage, brain injury, skull fracture and rib or long bone fractures. Cases did not have to have all of these but were required to have clear clinical documentation of intracranial pathology. Using an adaptation of certainty from Feldman et al. (Feldman, Bethel, Shugerman, Grady, & Ellenbogen, 2001), cases were classified as definite, probable, possible, unknown and definitely not. Independently, the Inflicted Head Injury Surveillance program actively monitored all neurosurgery cases biweekly. Cases were compared quarterly to assure no missed cases in the CPS reviews. With five child abuse and neglect teams in other hospitals throughout BC, teleconferences reviewed all physical abuse cases < 24-months-old. No missed AHT cases were discovered.

To calculate incidence per person-year annually, the estimated population by age (accounting for immigration and out-migration) produced by Statistics Canada 2017 (www.bcstats.gov.bc.ca/apps/PopulationEstimates.aspx) was used. Hospitalization rates per 100,000 person-years by date of birth were calculated for < 12 and < 24-month-olds through 2016. Follow-up for hospitalization was available only to 2017 so children born in 2016 had an average 1.5 years of follow-up to their second birthday. The person-years denominator was adjusted accordingly in corresponding rate calculations. Rates were first examined for serial correlation by applying the Durbin-Watson test to a linear regression model for the square root (variance stabilizing) transformation of rates. Poisson regression was then applied to model the change in rates by including an indicator term characterizing observations from 2009 forward. Analyses were calculated with R, version 3.3.3 (Team, 2017).

3. Results

3.1. Participation rates

By September 2011, 89,885 PH administration forms had been returned of which 82,992 were complete, for a return rate of 74.5% of registered births (82,992/111,351). Since an estimated 21% of registered births are not followed by public health, the completed forms provided responses for 94.3% (82,992/87,967) of registered births followed by public health. That parents received the materials was recorded for 91.2% (75,662/82,992), or at least 86.0% (75,662/87,967) of births followed by public health. Of

parents receiving materials, 83% received them during maternity, 7% from public health, 1% from “other;” for 9% this information was missing.

Through December 2016, PHNs reported that 89.8% of their patients confirmed receiving the materials. Of those, 93.1% received them from maternity, 3.1% from public health, 0.6% from midwives, and 3.2% from “others.”

On parent surveys, receiving materials was confirmed by 92.7% of participants consistently through the years (2010:93.8%; 2012:91.3%; 2014:93.0%). Of those, 83.2% received the materials in maternity, and this remained stable or increased slightly in later years (2010:82.7%; 2012:81.2%; 2014:85.0%).

3.2. Reading and viewing materials

On PH administration forms (through September 2011), 20.1% of mothers reported viewing the DVD (77.6% at home; 17.7% in hospital; 4.6% elsewhere) and 17.7% read the booklet (81.0% at home; 15.9% in hospital; 3.1% elsewhere). Combined, 23.3% watched the DVD and/or read the booklet. On PHN surveys (2012–2016), nurses reported that 24.8% of mothers viewed the DVD and 19.6% read the booklet; combined, 31.8% watched the DVD and/or read the booklet. The PHN surveys did not inquire about where the materials were watched or read.

By parent surveys at 2–4 months, 53.0% of mothers reported watching the DVD and 60.1% read the booklet. Combined, 70.9% watched the DVD and/or read the booklet. Watching/reading tended to increase over time (2010:67.9%; 2012:71.9%; 2014:72.1%).

3.3. Fathers and other caregivers

Maternity nurse surveys indicated someone other than mother was present during teaching 80.3% of the time, consisting of fathers (74.4%); grandparents (9.3%); and “others” (5.6%).

On the 2012 and 2014 parent surveys, 37.7% of fathers watched the DVD and 38.7% read the booklet; combined, 50.5% watched the DVD and/or read the booklet. In addition, 8.7% of other caregivers watched the DVD and 7.6% read the booklet; combined, 11.3% watched the DVD and/or read the booklet.

On the 2010, 2012 and 2014 surveys, 31.5% of mothers reported talking with other caregivers about crying and shaking.

3.4. Hospitalization rates

Estimated AHT admission rates per 100,000 person-years by date of birth pre- and post-implementation are illustrated in Fig. 2 A (< 12-month-olds) and B (< 24-month-olds) through 2016. The Table 1 shows estimated rates with confidence intervals, relative risk for admission post-implementation, and absolute risk reduction post-implementation. As anticipated (Bennett et al., 2011; Fujiwara, Barr et al., 2012), admission rates by CPS retrospective-prospective assessment for < 12-month-olds prior to implementation averaged 10.6 per 100,000 person-years. Following implementation, admission rates decreased for < 12-month-olds to 7.1 per 100,000 person-years, a reduction of 33% ($P = 0.090$). For < 24-month-olds, admission rates decreased from 6.7 to 4.4 per 100,000 person-years, a 35% reduction ($P = 0.048$). This represents an absolute annual reduction of 3.5 and 2.3 cases for < 12 and < 24-month-olds per 100,000 person-years respectively.

4. Discussion

The BC experience implementing a 3-dose primary, universal educational prevention program was associated with a 35% decrease in AHT admissions that was statistically significant for < 24-month-olds, and a similar though non-statistically significant 33% decrease for < 12-month-olds. Although less than the 47% and 75% reductions reported in New York (Altman et al., 2011; Dias et al., 2005), this is better than the more recently reported increase in Pennsylvania (Dias et al., 2017) or no change in North Carolina (Zolotor et al., 2015). Unfortunately, those implementations coincided with the Great Recession, itself associated with substantial increases in at least 11 other states or regions (Berger et al., 2011; Huang et al., 2011; Klevens et al., 2016; Wood et al., 2016; Xiang et al., 2013) that persisted post-recession (Wood et al., 2016) in some. Consequently, the North Carolina program may have prevented a rise despite no reduction in rates, although comparing rates from some states without systematic prevention programs did not show differences from North Carolina (Zolotor et al., 2015). In Canada, the recession also coincided with the implementation. Nevertheless, hospitalization rates declined in sharp contrast with neighboring Washington State that experienced a doubling of AHT admissions (Berger et al., 2011; Wood et al., 2016). The lower pre-implementation BC admission rate made it more challenging to achieve a statistically significant reduction. Also, there may have been less room for an educational intervention—compared to more intensive and/or targeted social support interventions (Olds, 2006; Sanders, Markie-Dadds, & Turner, 2012)—to achieve further reductions. Consequently, the BC experience provides a contrasting and encouraging finding for educational prevention efforts that differs from recent reports.

A number of program features may have contributed to the favorable results. First, all tracking systems indicated that approximately 90% of parents received the intervention. Second, participation remained high indicating no “fatigue” over time. Third, since materials were available in 10 languages, most participants received the education in their preferred language in the diversified population of BC. Fourth, PHNs provided materials to 7% of parents who would have been “missed” during the first two years. Fifth, parents receiving materials from the maternity nurse increased slightly between 2010 (82.7%) and 2014 (85.0%). Similarly, parents receiving materials from public health decreased to 3.1% from the earlier 7% rate. These indices imply that the program became

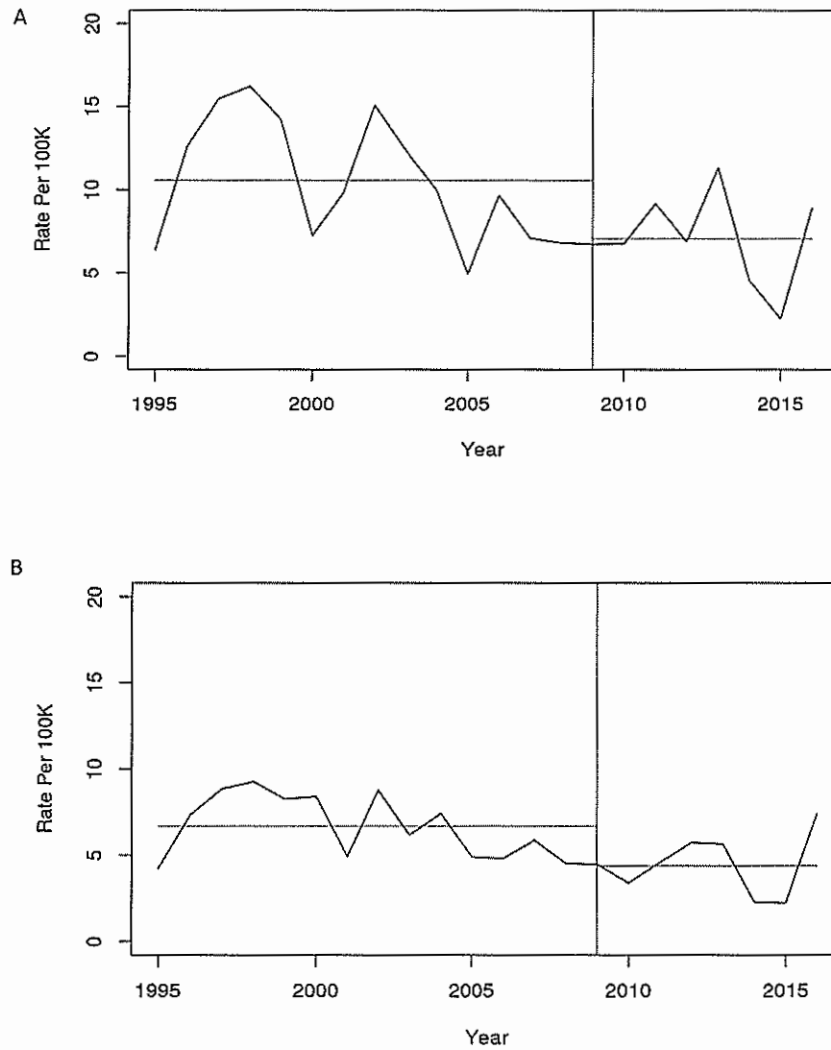


Fig. 2. AHT Hospital Admissions per 100,000 Person-Years by Date of Birth for (A) < 12-month-olds and (B) < 24-month-olds. Vertical lines represent January 2009 date of implementation. Horizontal lines represent mean rates pre- and post-implementation by date of birth.

Table 1
AHT Admission Rates and Comparative Risks (2009 and later versus Pre-2009).

	Age < 12 Months		Age < 24 Months	
	Admission Rate	95% C.I.	Rate	95% C.I.
Pre-2009	10.6	8.3 to 13.5	6.7	5.4 to 8.3
2009 and later	7.1	4.8 to 10.5	4.4	3.1 to 6.2
Comparative Risks post-2009				
	Relative Risk	95% C.I.	P-value	
Age < 12 months	0.67	0.42 to 1.07	0.090	
Age < 24 months	0.65	0.43 to 0.99	0.048	
	Absolute Risk Difference*	95% C.I.		
Age < 12 months	-3.5	-7.3 to -0.3		
Age < 24 months	-2.3	-4.5 to -0.2		

* per 100,000 person-years.

more “embedded” in maternity nurse practice.

Importantly, actual use of materials (viewing and/or reading) increased over time post-discharge, supporting the program principle that parents receive their own DVD and booklet to take home. PH administration forms and PHN surveys captured viewing/

reading rates within days after discharge. Those rates increased from 23% to 32% over 7 years. Of mothers who reviewed the materials early, about four-fifths reviewed them at home. Both the DVD and booklet were important, since roughly 50% reported reviewing each. More importantly, however, later parent surveys captured viewing/reading 2–4 months after discharge. These measures are particularly important for two reasons. First, they demonstrate use later in infancy when the normative increase in crying and likely caregiver frustration would have occurred (Barr, 2000, Barr, 2012; Brazelton, 1962; St. James-Roberts & Halil, 1991). Second, previous neonatal maternal education programs to prevent SIDS (sudden infant death syndrome) showed that approximately 20% of caregivers reported changing from the safer non-prone position they were taught at birth to the less safe prone position in the 2nd and 3rd months of life (Lesko et al., 1998; Willinger et al., 2000). In the current prevention program, reviews of the materials more than doubled to 71% of mothers by 2 to 4 months of life. Since not all parents were likely to be stressed by their infant's crying, these rates suggest that having the materials at home was supportive weeks later when faced with increased crying.

Two important program principles involved fathers and sharing information with other caregivers. All current studies cite related males as the most common perpetrators (Barr, 2012; Starling et al., 1995). For prevention purposes, there is no clear public health access to all fathers. Emphasizing the importance of having fathers present resulted in accessing a creditable 74% of fathers. Furthermore, providing the materials to take home was associated with approximately 50% of fathers having viewed and/or read the materials after discharge. Emphasizing sharing of information with other caregivers resulted in grandparents and "others" being present during maternity teaching 9% and 6% of the time respectively, materials being viewed and/or read by other caregivers 11% of the time, and verbal message transfer occurring in 31% of families. We do not know how often other caregivers are utilized but communicating crying and shaking messages appears to be enhanced with mothers as "teachers" of other caregivers.

Following the disappointing Pennsylvania (Dias et al., 2017) and North Carolina (Zolotor et al., 2015) results, Leventhal and colleagues (Leventhal, Asnes, & Bechtel, 2017) proposed five modifications to strengthen postpartum maternal education efforts: (1) receiving the education from "multiple, diverse sources;" (2) focusing parents on their own frustration and anger, rather than their infant's behavior; (3) combining prevention with other forms of parental support, such as paid parental leave (available in BC); (4) home visiting; and (5) actively including male caregivers. Wholly or partially, this *Period of PURPLE Crying* implementation included all five strategies.

Interpreting the AHT reduction as due to this program implementation must be treated with caution. Other unmeasured influences may have been contributory. AHT cases are relatively rare and highly variable year-to-year, only two reasons why a randomized, controlled trial would have been infeasible. Had the province been larger, a time series design with implementation delayed in different regions might have resulted in a more robust demonstration of time-dependent program effects. Interpretation is further limited by the unavailability of similar comparison data from adjacent provinces and states. However, a doubling of rates was documented in adjacent Washington State (Berger et al., 2011; Wood et al., 2016) as were significant increases in 7 states (Klevens et al., 2016) and 4 regions (Berger et al., 2011; Huang et al., 2011; Wood et al., 2016; Xiang et al., 2013). Canada-USA differences in health care systems could have contributed to the lower initial admission rate and/or the reduction following implementation. For example, Klevens et al. (2016) reported that the introduction of paid family leave in California prevented rises in AHT admissions associated with the recession, a program already in place in BC. The potential synergies between supportive family programs such as paid family leave and the *Period of PURPLE Crying* might have facilitated the latter's effectiveness. Finally, our study excluded fatal AHT cases not admitted to hospital resulting in a slight underestimate of overall incidence.

5. Conclusion

Our study found an association of the *Period of PURPLE Crying* program implementation province-wide in BC with a 35% decrease in AHT hospitalizations. This reduction occurred despite low pre-implementation rates and contrasted positively with reports of increasing rates or no changes following prevention implementations concurrent with the economic recession (Dias et al., 2017; Zolotor et al., 2015). This result converges with a reduction of 29.5% in emergency visits for crying complaints related to the same program (Barr et al., 2015), implying that the messages were received and effective in reducing parental concern about normal increased postnatal crying (Barr, 2012). A report of lifetime costs of AHT cases in the USA (Miller et al., 2017) estimated that, if existing prevention programs reduced AHT by as much as 2%, there would be a net saving to society and government. Because of the tragic individual, family and societal costs, consideration of parental education programs as a component of AHT prevention may be appropriate.

Declaration of interest

The National Center on Shaken Baby Syndrome (NCSBS) and RG Barr jointly registered the trademark for the *Period of PURPLE Crying*. Graham Consulting ULC consults and provides grants for child abuse prevention and child development programs. It owns the royalties that are a minor share of the net profits from the sale of the *Period of PURPLE Crying* program. RG Barr and M Barr sit as two members of the uncompensated Board of Directors. M Barr was the former Executive Director of the NCSBS, a 501(c)3 non-profit organization. Both are uncompensated members of the International Advisory Board of the NCSBS. The other authors have no conflict of interest or financial interests relevant to this article to disclose.

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Lifetime Cost of Abusive Head Trauma at Ages 0–4, USA

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Abstract This paper aims to estimate lifetime costs resulting from abusive head trauma (AHT) in the USA and the break-even effectiveness for prevention. A mathematical model incorporated data from Vital Statistics, the Healthcare Cost and Utilization Project Kids' Inpatient Database, and previous studies. Unit costs were derived from published sources. From society's perspective, discounted lifetime cost of an AHT averages \$5.7 million (95% CI \$3.2–9.2 million) for a death. It averages \$2.6 million (95% CI \$1.0–2.9 million) for a surviving AHT victim including \$224,500 for medical care and related direct costs (2010 USD). The estimated 4824 incident AHT cases in 2010 had an estimated lifetime cost of \$13.5 billion (95% CI \$5.5–16.2 billion) including \$257 million for medical care, \$552 million for special education, \$322 million for child protective services/criminal justice, \$2.0 billion for lost work, and \$10.3 billion for lost quality of life. Government sources paid an estimated \$1.3 billion. Out-of-pocket benefits of existing prevention programming would exceed its costs if it

prevents 2% of cases. When a child survives AHT, providers and caregivers can anticipate a lifetime of potentially costly and life-threatening care needs. Better effectiveness estimates are needed for both broad prevention messaging and intensive prevention targeting high-risk caregivers.

Keywords Child abuse · Shaken baby syndrome · Economic analysis · DALY · Breakeven

Introduction

The American Academy of Pediatrics defines abusive head trauma (AHT) as any injury intentionally inflicted on the head or brain of a young child (Christian et al. 2009). The term encompasses shaken baby syndrome and other forms of child abuse, with a cutoff age below 5 years recommended for case ascertainment (Parks et al. 2012). AHT is a devastating and potentially lethal form of child abuse that is a tragedy for the young child, the child's family, and society in general.

The costs of AHT are not only financial but include the destruction of families and the failure of society's obligation to protect those who are defenseless against abuse. Medical costs attributable to AHT in the 4 years following diagnosis average approximately \$48,000 per affected child (with all costs in this paper in 2010 dollars) (Peterson et al. 2014). The only comprehensive analysis of the costs of an AHT case comes from New Zealand. There, costs per AHT survivor averaged USD\$725,300 (as detailed in the online supplement) (Friedman et al. 2012). Across all forms of child maltreatment in the USA, average lifetime cost per maltreatment survivor is an estimated \$210,000, excluding quality of life and lost work costs (Fang et al. 2012). AHT is a particularly severe form of child physical abuse, which means that costs for AHT victims

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are likely to be even higher. However, no study has comprehensively estimated lifetime costs of AHT in the USA.

This study aimed to estimate the total lifetime costs of fatal AHT and of non-fatal AHT by severity—mild, moderate, and severe—including lost quality of life and lost work costs, as well as the share of costs paid by government sources. Drawing on previous prevention cost estimates, this study also provides insight into the effectiveness required for AHT prevention to break even.

The study provides lifetime costs per incident, which are the appropriate problem cost estimates for analyzing the economics of prevention. It follows quality guidelines for producing benefit-cost data in National Academies of Sciences, Engineering, and Medicine (2016), notably in its choice of method to place a dollar value on the disability-adjusted life year (DALY) burden resulting from the problem. It also complies with the Consolidated Health Economic Evaluation Reporting Standards (Husereau et al. 2013).

Methods

We used the Centers for Disease Control and Prevention's definition of AHT: an injury to the skull or intracranial contents of an infant or child under age 5 due to inflicted blunt impact or violent shaking (Parks et al. 2012). We compiled existing information from a variety of sources as inputs for a mathematical model to project lifetime cost of AHT. Table 1

reports model inputs and sources. The online supplement shows the formulas that combined the inputs. We report lifetime cost per case of mild, moderate, and severe AHT; the portion of costs paid by government sources; the cost of AHT per US live birth; and the effectiveness needed for AHT prevention to break even.

Incidence

We used published AHT case count estimates, including a distribution of non-fatal AHT by severity (Miller et al. 2014). Drawing on the expertise of an informal physician panel, the published study defined mild cases as ones with no long-term sequelae. It defined moderate cases as ones with no long-term effects except one and only one of (1) use of one anti-epileptic medication, (2) use of an arm brace or another assistive eating device and/or needing shoes with ankle-foot orthopedics, or (3) insertion of a brain shunt. Interview reports by caregivers or medical providers for a convenience sample of 120 severe AHT victims showed that 116 victims had retinal damage or took multiple anti-epileptic drugs. The study used those two markers to estimate which cases were severe in population-based administrative data sets, which we note means it may have misclassified a modest 3% of severe cases (4/120) as mild or moderate. Its AHT case counts came from 2009 Vital Statistics mortality data, 2009 Healthcare Cost and Utilization Project (HCUP) Kid's Inpatient Database (KID) admissions, and 2003–2011 Truven Health Marketscan®

Table 1 Incidence and cost model components and their sources

Component	Data source and details/computations
Incidence	
Deaths in hospital	261 deaths; 2009 HCUP KID (Miller et al. 2014)
Deaths not in hospital	73 deaths; 2009 Vital Statistics mortality (Miller et al. 2014)
Hospital admissions	2211 cases; 2009 HCUP KID (Miller et al. 2014)
Emergency department treated and released	1515 cases; admissions times ratio of 0.338 treated and released/0.494 cases admitted from Peterson et al. (2014)
Cases not promptly medically treated	764 cases; admissions times ratio of 0.168 treated and released/0.494 cases admitted from Peterson et al. (2014)
Unit costs	
Medical care cost for survivors	For data values, see Table 2
Medical care cost of fatalities	Peterson et al. (2014)
Special education	Original calculations using methods from Finkelstein et al. (2006)
Child protective, victim, adjudication, and sanctioning costs, mental health care costs of homicide, and perpetrator work losses while incarcerated	Chambers et al. (2003)
Work loss due to death and injury	Miller and Hendrie (2014) with sanctioning costs adjusted downward by 25% based on Augé and Mitchell (2012) and further adjusted to average earnings of parents of AHT victims computed from Niederkrotenthaler et al. (2013)
DALYs lost to non-fatal injury	Lawrence et al. (2000) and Blincoc et al. (2014), adjusted to average earnings of parents of AHT victims
Dollar value of a DALY net of work loss	Miller et al. (2014)
	Miller and Hendrie (2014), adjusted to average earnings of parents of AHT victims using income elasticity from Viscusi and Aldy (2003)

claims data from private insurers and Medicaid plans (Miller et al. 2014). The estimates assumed that each inpatient admission reported in HCUP KID represented a unique AHT victim. Miller et al. (2014) computed its estimates for non-admitted cases by multiplying the admission count times ratios computed from the distribution of place of treatment for 1209 AHT cases identified in longitudinal MarketScan data. For every AHT case admitted to the hospital, 0.894 cases were treated in the ED and released and 0.340 cases were not treated at hospitals within 2 days after initial diagnosis (which suggests that they were latent cases not diagnosed during the acute phase) (Peterson et al. 2014). So, only counting hospital admissions would have underestimated the rate of AHT. Table 1 provides details of these computations.

Except in sensitivity analysis, following Miller et al. (2014), we increased observed AHT incidence estimates to account for latent AHT survivors not treated at hospitals within 2 days of diagnosis (Peterson et al. 2014). We believe that by the time these survivors are correctly diagnosed in the medical system, their AHT is no longer in an acute phase that would benefit from inpatient care. Though such treatment circumstances may be surprising to clinicians familiar with AHT, this finding—and our corresponding increased estimate of AHT incidence—seems credible for several reasons. First, AHT is closed head trauma. It often is not visible to the untrained eye. Indeed, one study found that pediatric emergency physicians missed 31% of AHT diagnoses at first visit, sometimes failing even to consider TBI in their differential diagnosis (Jenny et al. 1999). Second, a shaken infant typically suffers a concussion-like brain injury that causes it to stop crying, creating a positive feedback cycle with the abuser rewarded by improved infant behavior (Barr 2012). Lack of external signs of injury may result in repeated shaking in more than half of AHT babies and a lengthy delay in seeking medical care (Adamsbaum et al. 2010). Third, in Wales, Copley and Sanders (2007) found that in 20% of AHT cases where police filed charges (9.4% of all cases), the charges included a charge of medical neglect for failing to get prompt medical attention for the child. Supplemental Table 2 shows that these latent cases account for 28% of total annual costs.

Survival and Mortality

We used published estimates of mortality impacts of AHT, with 7% almost immediately fatal (Miller et al. 2014). Those estimates assumed that 5% of severe AHT survivors died within the first 6 months following hospital discharge. Thereafter, for severe AHT survivors, the study applied a mortality rate based on traumatic brain injury (TBI) mortality data (Strauss et al. 1998) of 5% per year for the first 8 years (a cumulative standardized mortality rate [SMR] for children aged 1 to 8 that averages 44.7 times the normal rate without TBI from the 2009 US life table (Arias 2014)) and 4% per year

beyond 8 years following abuse (a SMR of 21.0 times the norm for individuals aged 9 to 45). The mortality data (Strauss et al. 1998) provided smaller SMRs of 1.7 times the norm following moderate TBI and 1.06 times the norm following mild TBI.

Costs and Disability-Adjusted Life Years

All costs and DALY losses beyond the first year following the abuse were converted to present values using a 3% discount rate (Neumann et al. 2016). Because the case counts are from 2010, for consistency, all costs are presented as 2010 US dollars, inflated using appropriate components of the Consumer Price Index and Employment Cost Index (Obama and Advisers 2014).

By place of treatment (inpatient, ED treated and released, physician's office or clinic for latent cases), we assessed AHT burden from a societal perspective in the following cost categories: medical, special education, child protective and criminal justice, and adult mental health services; perpetrator work loss if incarcerated; short-term work loss of caregivers; loss of earning capacity of the abused; and DALYs. Conceptually, DALYs capture the earning capacity loss. Using a widely accepted method (Blincoe et al. 2014), we stated that loss separately to let readers better understand the burden AHT places on victims. Separately stating the earning loss component does not imply that AHT changes net earnings in the US economy.

We applied average *medical* costs of \$47,952 (95% CI 40,219–55,685) in the first 4 years following non-fatal AHT based on a recent analysis of medical claim data among AHT victims (Peterson et al. 2014). Because moderately and severely injured AHT victims require lifelong prescription drugs, medical care, or medical devices, we assumed that their increased medical cost of \$1501 (95% CI \$350–\$2652) in the fourth year following the abuse would persist throughout the child's life. For mild cases, the pediatrician on our team estimated that increased cost only would persist through age 18. To estimate medical care cost for AHT fatalities, we multiplied reported medical cost estimates by place of death (untreated, in-hospital, etc.) by the number of AHT deaths by place of death reported in Vital Statistics data (Finkelstein et al. 2006). We computed medical costs per AHT fatality in ED and inpatient hospital settings by applying HCUP's cost-to-charge ratios (HCUP 2015) to charges for deceased AHT discharges in HCUP KID and selected state ED discharge data. We then applied diagnosis-specific multipliers that we derived from Truven Health MarketScan® data to add associated physician or professional fees, which were not included in HCUP financial data.

Special education costs came from 1999 to 2000 data (Chambers et al. 2003), inflated to 2010 dollars by multiplying these costs by the cost per pupil in US schools in 2010 divided

Table 2 Cases, costs per case, and disability-adjusted life years per case of abusive head trauma by severity, USA, 2010

Cases	Mild 1,365	Moderate 1,163	Severe 1,962	Non-fatal 4,490	Fatal 334
Medical care	50,500	72,695	48,374 ^a	55,319	26,497
Special education	92,573	146,000	130,500	122,984	
Child protective services	37,018	37,018	37,018	37,018	
Victim services	21	21	21	21	
Police	80	80	80	80	2,273
Criminal justice	2,589	2,589	2,589	2,589	430,277
Perpetrator work loss while incarcerated	400	400	400	400	74,539
Adult mental health services		5,112	10,735	6,015	10,735
Lost work	3,339	118,386	815,205	387,931	815,205
Disability-adjusted life years (\$)	689,808	792,206	3,530,746	1,957,861	4,377,575
Total	876,327	1,174,507	4,575,668	2,570,218	5,737,101
Disability-adjusted life years	4.7	5.4	24.1	13.3	29.9

In 2010 dollars, future costs converted to present value using a 3% discount rate

^a Costs are lower for severe cases because these children have very short life spans

by the cost in 1999 (National Center for Educational Statistics 2013). We applied estimated costs of \$34,280 annually for special education per child with severe AHT, \$28,219 annually per child with moderate AHT, and \$21,367 annually per child with mild AHT (Chambers et al. 2003). From these estimates, we subtracted the \$11,184 average cost of education per pupil in the USA (including pupils with disabilities) (National Center for Educational Statistics 2013).

Non-fatal AHT is legally chargeable as assault, while fatal AHT is chargeable as homicide. We used national average unit costs of *child protective, victim, police, adjudication, and sanctioning (prison or parole) services* from a previous study (Miller and Hendrie 2014). Data were not available to differentiate these costs by AHT severity.

We used published *mental health care costs* for family and friends of a homicide victim (Miller and Hendrie 2014). On average, homicide puts 2.1 people into mental health treatment (Cohen and Miller 1998). We assumed that, on average, severe AHT would impose the same mental health burden while moderate AHT would put one adult into treatment at a comparable level of service.

Work loss cost estimates included lost wages, fringe benefits, and the value of lost household work. To value work loss, we started from published estimates of lifetime work loss due to death or permanent disability and of work loss due to injury by diagnosis (Blincoe et al. 2014; Finkelstein et al. 2006; Lawrence et al. 2011; Lawrence et al. 2000). Less than 40% of severe AHT victims are expected to survive into adulthood. Their functional deficits, as reported in a recent survey (Miller et al. 2014), leave victims totally and permanently disabled, so their work loss is equivalent to that of a fatality. For moderate and mild AHT, we assumed that a caregiver at a female wage level would lose a day from work caring for a homebound or hospitalized child for each day that an adult suffering a

comparable injury would have been unable to work (Blincoe et al. 2014; Lawrence et al. 2000).

Rather than use average earnings in calculating wage losses of victims, their post-injury caregivers, and perpetrators, we tailored estimates. First, we estimated the average annual earnings of the parents of AHT victims. The estimate started from national estimates that in 2000–2009, the odds of AHT were 2.81 times higher for children on Medicaid/CHIP (95% CI 2.52–3.15) and 1.37 times higher for self-pay children (95% CI 1.05, 1.78) than for children covered by private insurance or other payers (Niederkröthenthaler et al. 2013). We used unadjusted odds ratios because adjusted ones (2.78 and 1.68, respectively) included a non-significant but collinear variable about residence in a zip code below median income. We combined a national count of children by source of health care coverage in 2010 (Bloom et al. 2011) and a national estimate of household income distribution by source of child health care coverage in 2010 (Coyer and Kenney 2013) to estimate household income in 2010 dollars. Household income averaged \$24,743 for children on Medicaid, \$49,200 for uninsured children, and \$71,725 for children with other coverage. This calculation assumed that (1) average income was at the midpoint of each income category and at 450% of Federal Poverty Level (FPL) for children in the 400%+ category and (2) uninsured children were spread proportionally across non-Medicaid children in the income categories up to 400% of FPL. Weighting income by coverage with number of children by coverage times odds of AHT by coverage yielded an estimate that household income of AHT victims averaged \$28,825 or 58.3% of national median household income (DeNavas-Walt et al. 2011). We assumed that estimate applied to individual income.

We assumed that in the absence of AHT, child income would have mirrored parental income. That is a lower bound

estimate because Mitnik and Grusky (2015), using longitudinal tax return data, estimate that only half of low-income children are locked in poverty. We assumed that income of post-injury caregivers and perpetrators will equal parental income. In reality, other people—e.g., friends, grandparents, babysitters, or foster parents—may fill these roles. We assumed the quantity/value of lost household work (15.5% of national median work loss for adults and 23.2% of lifetime earnings for young children) would not vary with income. That assumption is conservative since lower-income people are more likely than higher-income people to do household work themselves rather than hiring someone to do it.

We adjusted the costs of *perpetrator work loss if incarcerated* from a previous study (Miller and Hendrie 2014) to the parental earning level. We further reduced sanctioning-related costs downward by 25% from the average for homicide based on a study which reported that, controlling for felony class, sentences for child abuse deaths were 25% shorter than sentences for other homicides (Augé and Mitchell 2012).

DALYs, a standard measure of burden of disease, are computed by summing the discounted present value of life years lost by those who die prematurely plus years lived with disability by survivors (i.e., the portion of quality of life lost during those years) (Bourgeois et al. 2014; Murray et al. 2013). We applied published DALY estimates for AHT, as measured by the Health Utilities Index—Mark 2 (Drummond et al. 2007), based on a survey of AHT caregivers and pediatricians familiar with AHT ($n = 170$) (Miller et al. 2014). Our cost estimates started from a published dollar value of \$180,407 per DALY, which excludes associated work loss, and an average discounted present value of 29.85 life years lost per fatal AHT, which equates to a value of \$6.6 million (95% CI \$2.3–\$9.8 million) per child homicide inclusive of work loss (Blincoe et al. 2014; Cohen and Miller 2003; Miller and Hendrie 2014). We adjusted the value of a DALY to reflect the expected below-average lifetime income of AHT victims had they not been victimized. Specifically, we adjusted the estimates using an income elasticity of 0.47 from Viscusi and Aldy (2003), as recommended by Hammitt and Robinson (2011). Following guidelines from the Second Panel on Cost-Effectiveness in Health and Medicine (Neumann et al. 2016), we showed work and DALY losses separately.

To compute the present value of AHT costs per each US live birth, we used national distributions of age at AHT occurrence (Parks et al. 2012; Xiang et al. 2013). We used contemporaneous 2010 Vital Statistics data indicating 3,999,386 annual live births.

Standard Error of Estimates and Sensitivity Analysis

We used the Crystal Ball® add-in to Excel to simulate standard errors for the incidence and cost estimates (see

Supplemental Table 1, available online). Crystal Ball® used Monte Carlo simulation techniques to run 100,000 estimates of the costs, drawing on estimated statistical distributions for each incidence and cost factor as inputs. The software determined the 95% confidence interval from the distribution of the 100,000 estimates. Importantly, because uncertainty around best estimates of some costs was asymmetric, simulated 95% confidence intervals around those estimates are unbalanced.

Additional sensitivity analyses assessed how total costs varied with factors that required a non-probabilistic analytic choice: (1) at discount rates of 2 and 4% ($\pm 1\%$ from the reference case estimate of 3%) and of 7% (the rate the US Office of Management and Budget (1992) has prescribed for use in regulatory analyses for decades); (2) if the AHT severity distribution matched the distribution for all intentional brain injuries including AHT, assaults, and suicide acts for children aged 0–18 (Rivara et al. 2011) or matched the distribution in the survey by Miller et al. (2014); (3) if we used the 0.595 ratio of non-admitted to admitted hospital cases from the 2006–2009 HCUP Nationwide Emergency Department Database (which provides an undercount because some participating states did not code injury causes for patients who were treated and released) instead of the MarketScan-based rate of 0.684; (4) if annual medical costs for mild cases lasted only through age 4 (the age when the available data ended) or throughout the child's life span rather than the pediatrician's best estimate of age 18; and (5) if we income-adjusted published estimates of public willingness to pay to prevent a homicide of \$5.8 million (Kochi and Taylor 2011), \$13.0 million (Cohen et al. 2004), or \$15.0 million (Corso et al. 2011) rather than \$6.6 million.

Supplemental Estimates from a Government Perspective

Government typically pays special education, child protective services, and criminal justice costs. The 2009 KID data on expected payers (i.e., private insurance or public payers such as Medicare and Medicaid) for hospital inpatient care of AHT indicated that government sources paid 80% of associated medical costs. Foregone taxes average 14.5% of wage losses (work losses minus fringe benefits and household work) (Miller et al. 2011). We applied this rate of foregone taxes to the work loss costs estimated for caregivers and victims, as well as for perpetrators while incarcerated, to estimate the amount of lost tax revenue.

AHT Prevention Programs

AHT prevention programs have been evaluated in pre-post effectiveness trials (Barr, Barr et al. 2009; Barr, Rivara et al. 2009; Dias et al. 2005; Dias et al. 2017; Fujiwara et al. 2012; Keenan and Leventhal 2010; Zolotor et al. 2015). We

estimated the effectiveness required for these programs to break even by combining our cost estimates with existing data on program costs and effectiveness. Delivering one hospital-based program costs \$5 per family educated in 2010 dollars (Altman et al. 2011; Dias et al. 2005). Similarly, delivering the *Period of PURPLE Crying* program in a hospital maternity ward costs an estimated \$4 per family educated (Pointer 2011). The literature does not document any more intensive interventions that target shaking-related AHT. We used a \$5 cost per family to avoid understating the cost of prevention.

It is unclear if the existing programs are effective. Pooling binomial outcome data from two pre-post evaluations of a hospital-based AHT prevention program (Altman et al. 2011; Dias et al. 2005), hospital-admitted AHT cases per 100,000 babies declined from 25.9 to 13.6 (a 47.7% reduction, 95% CI 15.6–67.5) following the program. Rates changed minimally in neighboring states without the programs. Conversely, the AHT rates in North Carolina and Pennsylvania did not fall after large-scale program implementation (Shanahan et al. 2013; Zolotor et al. 2015; Dias et al. 2017), and an educational video shown in Utah had no effect (Keenan and Leventhal 2010). Given these mixed-to-negative results, we chose to compute the break-even effectiveness for a program but not to make a best effectiveness estimate and compute a benefit-cost ratio. That calculation excluded the savings in victim work loss and quality of life.

Results

In 2010, Miller et al. (2014) estimated AHT killed 334 abused children, with another 4490 injured including 1962 severe cases, 1163 moderate cases, and 1365 mild cases. From a

societal perspective, the discounted lifetime average cost of each AHT death and surviving AHT victim were \$5.7 million (95% CI \$3.2–9.2 million) and \$2.6 million (95% CI \$1.0–2.9 million), respectively (Table 2). Subtracting the cost of lost work and decreased quality of life, estimated out-of-pocket costs were \$544,000 per fatality (95% CI \$481,000–594,000) and \$224,000 per surviving AHT victim (95% CI \$187,000–262,000). Table 2 reports estimated lifetime costs by more detailed categories and AHT severity.

The collective lifetime cost of AHT that occurred in 2010 was an estimated \$13.5 billion (95% CI \$5.5–16.2 billion), including \$1.2 billion (95% CI \$0.9–1.4 billion) in medical and other out-of-pocket costs (consisting of \$257 million in medical costs, \$552 million in special education costs, and \$323 million in child protective services and criminal justice costs), \$2.0 billion in work losses (95% CI \$1.4–2.6 billion), and \$10.3 billion in lost quality of life (95% CI \$2.5–12.8 billion) (Table 3). Governments paid an estimated \$1.3 billion of the total cost (95% CI \$1.0–1.5 billion).

AHT costs an estimated \$3300 per live birth in the USA (95% CI \$1381–4045) including \$284 in out-of-pocket costs (95% CI \$238–356) (Table 4). This estimate is the present value at birth of expected lifetime AHT costs, accounting for the age distribution of abuse. Using a hospital-based prevention program that cost \$5 would yield a net out-of-pocket cost saving for society and for government if it prevented at least 1.8% (5/284) of AHT cases.

Sensitivity Analyses

As detailed in Table 5 and in the “Methods” section, sensitivity analyses examined how total costs and costs paid by governments changed under alternate analytic choices and

Table 3 Total costs and DALY burden due to abusive head trauma, USA, 2010

	Non-fatal	Fatal (within 30 days)	Total	95% CI for total	Percent
Medical care	248,382,000	8,850,000	257,232,000	201,642,000–313,576,000	1.9%
Special education	552,198,000	0	552,198,000	365,574,000–739,200,000	4.1%
Child protective services	166,211,000	0	166,211,000	135,889,000–196,569,000	1.2%
Victim services	94,000	0	94,000	75,500–113,000	0.0%
Police	359,000	759,000	1,118,000	932,000–1,305,000	0.0%
Criminal justice	11,625,000	143,713,000	155,338,000	132,084,000–178,582,000	1.2%
Perpetrator work loss	1,796,000	24,896,000	26,692,000	14,600,000–34,173,000	0.2%
Adult mental health services	27,007,000	3,585,000	30,592,000	23,632,000–37,557,000	0.2%
Lost work	1,741,810,000	272,278,000	2,014,088,000	1,423,036,000–2,605,910,000	15.0%
Disability-adjusted life years (\$)	8,790,796,000	1,462,110,000	10,252,906,000	2,457,687,000–12,840,720,000	76.2%
Total	11,540,278,000	1,916,192,000	13,456,470,000	5,523,934,000–16,978,924,000	100.0%
Disability-adjusted life years	59,953	9,972	69,925	50,376–92,167	
Cases	4,490	334	4,824	4,087–5,561	

In 2010 dollars, future costs converted to present value using a 3% discount rate

Table 4 Costs per live birth due to abusive head trauma and estimated savings per child from hospital-based prevention, USA, 2010

Cost category	Per birth (\$)
Medical care	63
Special education	135
Child protective services	41
Victim services	0.02
Police	0.27
Criminal justice	38
Perpetrator work loss	7
Adult mental health services	7
Lost work	492
Disability-adjusted life years	2504
Total	3287
Out-of-pocket costs	291
Costs paid by government	312
Quality-adjusted life years lost	.017

In 2010 dollars, present value computed at a 3% discount rate, accounting for distribution of age at abuse and timing of costs after abuse occurs

assumptions. Total cost estimates from the sensitivity analyses ranged from \$7.9 billion to \$32.1 billion, with costs paid by governments ranging from \$0.9 billion to \$1.5 billion. The largest uncertainty in the cost estimates related to the quality of life loss and its valuation. Since government pays none of the quality of life costs, total costs were more sensitive to analytic choices than were costs paid by governments.

Discussion

AHT is very debilitating. An estimated one in 14 cases will be fatal before hospital discharge, and more than half of severely

injured survivors will die before age 21. More than 40% of survivors are severely injured, with costs exceeding \$3 million each. Even a mild case results in an average estimated loss of 15.5% of the child's health-related quality of life and costs over a million dollars.

Decomposing our non-fatal AHT medical cost estimate, costs averaged \$34,750 per survivor in the first 3.5 years post-injury, similar to a New Zealand estimate of US\$35,300 based on 44 cases, but the New Zealand estimate excluded physician's office cost (Friedman et al. 2012). (The online supplement details the New Zealand costs and their conversion to US dollars.) Our estimated lifetime special education costs averaged \$123,000 per survivor, well above the New Zealand estimate of USD\$39,100. Conversely, our estimated \$39,700 per survivor in lifetime child protective and criminal justice services costs is well below the New Zealand estimate of USD\$70,200. Most importantly, the New Zealand expenditures of USD\$523,300 for adaptive equipment, home modifications, and attendant and home help care largely equate to unmet needs or unmeasured personal expenses in the US system.

This study's main limitation is its unavoidable reliance on published estimates from convenience samples, notably in the survey to determine DALY loss over time by AHT severity (Miller et al. 2014). Our cost estimates were informed by a previous AHT study that used MarketScan data, a large but non-representative sample of insurance claims (Peterson et al. 2014). It is unclear how well MarketScan identifies AHT cases. MarketScan identifies 1.46 live hospital inpatient discharges for AHT per case treated in the ED and released (or left against medical advice). By comparison, the HCUP National ED Sample identifies 1.68. A third limitation is the modest precision of our estimates of some small costs, notably costs related to perpetrators and adult mental health services. However, those costs represent less than 2% of total costs. We

Table 5 Sensitivity analysis showing the effects of assumptions and modeling choices on total costs of AHT and costs paid by government

Change in model	Total cost (billions) ^a	Costs paid by government (billions) ^a
Best model estimates	13.5	1.3
2% discount rate	15.0	1.5
4% discount rate	12.5	1.1
7% discount rate	11.0	0.9
Severity distribution for intentional brain injuries	7.9	1.1
Severity distribution from survey	17.8	1.4
Non-admitted cases from NEDS	9.1	0.9
Medical costs for mild cases only through age 4	13.4	1.3
Medical costs for mild cases throughout life span	13.5	1.3
Willingness to pay to prevent a homicide of \$5.8 million	12.8	1.3
Willingness to pay to prevent a homicide of \$13.0 million	27.9	1.3
Willingness to pay to prevent a homicide of \$15.0 million	32.1	1.3

^a2010 USD

also relied on non-representative survey data from a recent publication, although that study included comparisons with the national incidence datasets used here that suggest the survey captured data about AHT victims who were demographically similar to the overall population of AHT victims (Miller et al. 2014).

Despite limitations, this study provides the first well-founded US estimate of lifetime costs associated with AHT. Total annual costs of AHT are high, about one fifth of the total annual costs associated with the more prevalent problem of underage drinking (Miller et al. 2006). The nation has invested in underage drinking prevention in virtually every school (Ringwalt et al. 2011) and alcohol sales outlet.

If existing prevention programs reduced AHT by as little as 2%, they would yield a net out-of-pocket saving. Perhaps because evidence for the effectiveness of these programs is mixed, sizable numbers of hospitals and pediatricians have not yet adopted them (National Center on Shaken Baby Syndrome (n.d.)). In the absence of more definitive evaluation, this study's estimates provide limited guidance for future investment decisions. Better effectiveness estimates are needed for both broad prevention messaging and intensive prevention targeting high-risk caregivers. With only 1 in 825 live births resulting in AHT, mounting a well-controlled evaluation of intervention impact unavoidably will be difficult and expensive.

When a child survives AHT, providers and caregivers can anticipate a lifetime of potentially costly and life-threatening care needs. To our knowledge, this analysis provides the first comprehensive US estimates of the likely financial burden and its variation with AHT severity. Future research to refine the estimates might focus on (1) tracking impact on quality of life for a more representative sample of victims and (2) identifying and proactively tracking mild cases and latent ones that are not treated in hospital within 48 h of identification. Data about the number, circumstances, and outlook of the latent cases are especially tenuous.

Compliance with Ethical Standards

Funding The authors' work was supported in part by grants from the Annie E. Casey Foundation (TM, RS, BL, and MB) and a Canada Research Chair in Community Child Health Research (RGB). Neither funder was involved in decisions regarding design, analysis, or interpretation of study results. The findings and conclusions in this report are those of the authors and do not necessarily represent the official positions of the Centers for Disease Control and Prevention or of the funders.

Conflicts of Interest The National Center on Shaken Baby Syndrome (NCSBS) and RG Barr jointly registered the trademark for the Period of PURPLE Crying. Graham Consulting Ltd. consults and provides grants for child abuse prevention and child development programs. It owns the royalties that are a minor share of the net profits from the sale of the Period of PURPLE Crying program. RG Barr and M Barr sit as two members of its uncompensated Board of Directors. M Barr was the former Executive Director of the NCSBS, a 501(c)3 non-profit organization.

Both are uncompensated members of the International Advisory Board of the NCSBS. The other authors have no financial relationships or potential conflicts of interest relevant to this article to disclose.

Ethical Review All protocols and instruments for the broader study that included this paper were approved by Pacific Institute for Research and Evaluation's institutional review board. The study was performed in accordance with the approved protocol and with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments. Informed consent was obtained from all individual participants included in the study.

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January 22, 2019

Members of the House Committee on Health and Human Services,

Good morning. My name is Gwendolyn ("Wendy") Gladstone. I am a resident of Exeter and I am here this morning to speak in support of the objectives of House Bill 555.

I am a retired pediatrician. For 39 years I practiced in primary care and then as a specialist in the field of child abuse medicine. During those years I evaluated thousands of children who were referred because of concerns for possible abuse or neglect. I cared for many patients who had suffered brain injury from shaking and other kinds of abusive head trauma. To see a baby in an intensive care unit with devastating inflicted injuries, a baby who would otherwise be healthy and thriving, is a very upsetting experience even to someone who has seen it many times before. After discharge from the hospital, these infants often are seriously impaired for life. It is not uncommon for them to be unable to speak, walk, eat, see or hear. They are dependent on someone to care for them for the rest of their lives. And many end up in the foster care system because what happened, happened at the hands of a parent. Every case is a tragedy. One of the most upsetting things about these cases is that they are preventable. Now that I am retired from clinical practice, I am working, like Representative Harb, to help eliminate this and other forms of child maltreatment.

What the general public knows as "shaken baby syndrome" and we pediatricians call "abusive head trauma" should not happen. It almost always results from the overwhelming stress of caring for an infant that will not stop crying. Shaking a screaming baby is a common way that some frustrated adults deal with the situation. Other responses to the crying can include throwing, squeezing or hitting the infant. Often, the shaking stuns the infant by causing a kind of concussion. Because the infant becomes quiet, the adult thinks that shaking is an effective thing to do and repeats it. Research shows that shaking an infant is typically a repeated pattern that extends over time (Adamsbaum et al "Abusive Head Trauma: Judicial Admissions Highlight Violent and Repetitive Shaking," *Pediatrics* 126(3) (2010) 546-55) although in some cases a single violent incident can immediately and permanently damage a baby or even kill it.

Preventing this kind of injury involves teaching adults who care for children how to deal with the crying that is a normal part of infant development and that shaking an infant causes severe brain damage and death. One such program that has been shown to prevent abusive head trauma is "The Period of PURPLE Crying," developed at the National Center on Shaken Baby Syndrome. It is an educational program first delivered to parents at the time of their baby's birth and reinforced in the early weeks and months when the baby will start to increase the amount of time spent crying. A study published within the past month of this program's effect on outcomes for over 350,000 newborns over an 8 year period showed a 35% reduction in admissions for abusive head trauma in children under the age of 2. This is not perfect but it is a statistically significant result. (Barr et al "Eight Year Outcome of Implementation of Abusive Head Trauma Prevention," *Child Abuse and Neglect* 84 (2018) 106-114). We should be able to do better but we can at least do this.

When an infant is severely injured, it is likely to end up with a host of medical problems which may include intellectual impairment, blindness, deafness, seizures and leave the child dependent for life on others to provide even the most basic care. Aside from the tragedy that this represents, there is the issue of what that costs. The medical expenses and special education are costs borne by the family and society. A recent medical study of the cost of abusive head trauma in the US estimated that one fatal case costs \$5.7 million. A nonfatal case costs \$2.6 million. (Miller et al "Lifetime Cost of Abusive Head Trauma at Ages 0-4, USA," *Prevention Science* 19 (2018) 695-704). By comparison, the Period of PURPLE Crying materials needed to educate the parents of one newborn cost less than \$5. It is estimated that even if 2% of cases are prevented, a program with a low cost like that would pay for itself in the savings that would result.

Given the value of the Period of PURPLE Crying, almost all hospitals in the state with newborn services have voluntarily implemented the program. But it costs money and once a start-up grant runs out, hospitals are burdened with finding funds to assure that the program can continue. Maintaining the fidelity of the program in the hospital and once the babies go home takes time and resources too which is why having a coordinator for this prevention program is essential.

Sometimes parents who try to calm a crying baby without hurting it turn to methods that seem safe, like cuddling with the baby in bed until it is asleep, but this practice has its own dangers. Learning how to deal with a crying baby must include methods that don't raise the risk of suffocation or other forms of sudden infant death. So teaching about safe sleep for babies should be taught at the same time as abusive head trauma prevention.

In addition to speaking as an individual, I am also here today representing The New Hampshire Chapter of the American Academy of Pediatrics which supports the themes of child abuse prevention, education of parents, promotion of safe sleep for infants and financial support of these preventive efforts statewide.



HOUSE HEALTH, HUMAN SERVICES AND ELDERLY AFFAIRS COMMITTEE

January 22, 2019

HB 555 – Relative to Shaken Baby Syndrome

Testimony

Good morning, Madam Chair and members of the committee. My name is Paula Minnehan, VP, State Government Relations with the New Hampshire Hospital Association (NHHA), representing all 26 of the state’s community hospitals as well as all specialty hospitals.

The NHHA supports the intent behind HB 555. However, we do question whether the bill is necessary. Currently, all the birthing hospitals in New Hampshire provide the education contemplated in the bill before you. We do not believe mandating this practice is necessary. Hospitals have provided this important training voluntarily and will continue to do so as it is the evidence-based standard of practice in the field of pediatrics. Currently the program most commonly used by hospitals is called “Period of Purple Crying”.

However, what is not currently done by hospitals is the requirement to have parents sign a form stating that he/she has or refused to view and read the presentation and materials.

What is unclear and not explicit in the bill text is what is done with the forms. Will the hospitals be required to submit them to the department?

While we absolutely support the education of parents on Shaken Baby Syndrome, it is unclear that a mandate in state law would necessarily increase awareness since this educational training is already being provided voluntarily. There are many programs and practices that hospitals implement voluntarily which are in the best interest of patients. Allowing the hospitals to modify programs and implement best practices without overly burdensome regulations encourages innovation and high-quality institutions.

Thank you for the opportunity to provide our comments. I am happy to answer any questions.

Fiscal Notes

HB 555-FN- FISCAL NOTE
AS INTRODUCED

AN ACT relative to shaken baby syndrome.

FISCAL IMPACT: State County Local None

STATE:	Estimated Increase / (Decrease)			
	FY 2020	FY 2021	FY 2022	FY 2023
Appropriation	\$0	\$0	\$0	\$0
Revenue	\$0	\$0	\$0	\$0
Expenditures	\$34,300	\$68,860	\$69,130	\$69,400
<i>Funding Source:</i>	<input checked="" type="checkbox"/> General	<input type="checkbox"/> Education	<input type="checkbox"/> Highway	<input type="checkbox"/> Other

METHODOLOGY:

This bill requires hospitals to provide new parents with information on shaken baby syndrome, and requires day care providers to participate in training on shaken baby syndrome as part of the licensure process. Although the bill does not directly impose any requirements on the Department of Health and Human Services, it does state that informational and other materials supplied to parents by hospitals may be provided by the Department. The Department assumes that it will be responsible for providing said materials as well for training hospital personnel, and will do so as part of an amended contract with the Children's Hospital at Dartmouth Injury Prevention Center (IPC). Assuming 12,000 children born per year in the state, a \$5 per kit curriculum cost, and .10 full-time equivalent (FTE) employee through the contract with the IPC, the bill's cost estimate is as follows:

	FY 2020 (6 Months)	FY 2021	FY 2022	FY 2023
Salary (3% increase yearly)	\$ 2,850	\$ 5,870	\$ 6,050	\$ 6,230
Benefits (3% increase yearly)	\$ 1,450	\$ 2,990	\$ 3,080	\$ 3,170
Curriculum	\$ 30,000	\$ 60,000	\$ 60,000	\$ 60,000
Total:	\$ 34,300	\$ 68,860	\$ 69,130	\$ 69,400

The Department states that as information on shaken baby syndrome is currently supplied for free to child care providers, and because such training is already a federal requirement, the part of the bill that pertains to day care providers will have no fiscal impact.

AGENCIES CONTACTED:

Department of Health and Human Services

Bill as
Introduced

HB 555-FN - AS INTRODUCED

2019 SESSION

19-0455
01/05

HOUSE BILL

555-FN

AN ACT relative to shaken baby syndrome.

SPONSORS: Rep. Harb, Rock. 14; Rep. DeSimone, Rock. 14

COMMITTEE: Health, Human Services and Elderly Affairs

ANALYSIS

This bill requires hospitals to provide new parents with information on shaken baby syndrome. This bill also requires day care providers to participate in training for shaken baby syndrome as part of the licensure process.

.....

Explanation: Matter added to current law appears in *bold italics*.
 Matter removed from current law appears [~~in brackets and struckthrough.~~]
 Matter which is either (a) all new or (b) repealed and reenacted appears in regular type.

STATE OF NEW HAMPSHIRE

In the Year of Our Lord Two Thousand Nineteen

AN ACT relative to shaken baby syndrome.

Be it Enacted by the Senate and House of Representatives in General Court convened:

1 1 New Section; Health Facility Licensure; Information on Shaken Baby Syndrome Required.
2 Amend RSA 151 by inserting after section 2-g the following new section:

3 151:2-h Information on Shaken Baby Syndrome Required. Every facility licensed as a hospital
4 under RSA 151:2, I(a) that discharges a newborn child shall request that each maternity patient
5 and father of a newborn child, if available, view a video presentation and read printed materials,
6 approved by the department of health and human services, on the dangers of shaking infants and
7 children, the symptoms of shaken baby syndrome, the dangers associated with rough handling or
8 the striking of an infant, safety measures which can be taken to prevent sudden infant death, and
9 the dangers associated with infants sleeping in the same bed with other children or adults. After
10 viewing the presentation and reading the materials or upon a refusal to do so, the hospital shall
11 request that the mother and father, if available, sign a form stating that he or she has viewed and
12 read or refused to view and read the presentation and materials. Such presentation, materials, and
13 forms may be provided by the department.

14 2 New Paragraph; Child Day Care; Licensing Training on Shaken Baby Syndrome Required.
15 Amend RSA 170-E:8 by inserting after paragraph IV the following new paragraph:

16 V. As part of the licensure process under this chapter, day care providers shall be required
17 to participate in training on shaken baby syndrome.

18 3 New Subparagraph; Rulemaking; Training on Shaken Baby Syndrome. Amend RSA 170-
19 E:11, I by inserting after subparagraph (m) the following new subparagraph:

20 (n) Procedures for training on shaken baby syndrome as required under RSA 170-E:8,
21 V.

22 4 Effective Date. This act shall take effect January 1, 2020.