Canadian Institutes of Health Research | Instituts de recherche en santé du Canada

PROTECTED WHEN COMPLETED

Appl. # 233312

FRN # 110353

Final Report

Update Profile and Grant Information - NPI Profile

Nominated Principal Applicant/Candidate

Surname	Given Names
Gilfoyle	Elaine

Mailing Address:
Alberta Children's Hospital
2888 Shaganappi Trail NW
Calgary, Alberta T3B 6A8
Canada

Telephone 403 955-7110 Fax

How long have you been an independent researcher? 3.5

Are you a clinician, health practitioner, health professional, or health provider who is in a role in which you make clinical judgements and/or decisions? (•) Yes ( ) No

Update Profile and Grant Information - Research Team

Other Applicants

Name Annear, John

Name Bhanji, Farhan

Name Cheng, Adam

Name Duff, Jonathan

Name Gottesman, Ronald

Name Grant, Estee

Name Grant, Vincent

Name Lobos, Anna-Theresa

Name St.Georges-Hyslop, Cecilia

Name Writer, Hilary

Name

Name

Name

Name

Name

Name

Name

Update Profile and Grant Information - Financial Support

Enter the amount of the contribution received in financial support from the following organizations:

Organization	Yes - Cash support
CIHR Funding	$ 60888
Academia	$
Academia	$
Academia	$
Academia	$
Academia	$
Academia	$
Academia	$
Academia	$
Academia	$
Academia	$
Academia	$
International	$
International	$
International	$
International	$
International	$
International	$
International	$
International	$
International	$
International	$
International	$

Update Profile and Grant Information - Financial Support

Enter the amount of the contribution received in financial support from the following organizations:

Organization	Yes – Cash support
Private	$ _____
Private	$ _____
Private	$ _____
Private	$ _____
Private	$ _____
Public	$ _____
Public	$ _____
Public	$ _____
Public	$ _____
Public	$ _____
Voluntary Heart and Stroke Foundation of Canada (Ottawa, Ontario)	$ 413150
Voluntary	$ _____
Voluntary	$ _____
Voluntary	$ _____
Voluntary	$ _____
Total	$ 474038

Research and Knowledge Translation Practices - Stakeholders

Were any of the stakeholders in the list below involved in the research process? If YES, how?

Project Step / **Type of Stakeholder**	INVOLVED	Development of the research idea / question	Development of the protocol	Data collection phase/project implementation	Interpretation of the results	End of Grant KT activities
Health System/Care Practitioners/Public Health Practitioners	☑	☑	☑	☑	☑	☑
Patients/Consumers of Health System/Care	☐	☐	☐	☐	☐	☐
Study Stakeholders (who are formally listed in the grant application)	☑	☑	☑	☑	☑	☑
Health System/Care Managers	☑	☐	☐	☐	☑	☑
Health System/Care Professional Organizations	☑	☐	☐	☐	☐	☑
Federal/Provincial Representatives	☐	☐	☐	☐	☐	☐
Community/Municipal Organizations	☐	☐	☐	☐	☐	☐
Consumer Groups/Charitable Organizations	☐	☐	☐	☐	☐	☐
Industry	☐	☐	☐	☐	☐	☐
The media	☑	☐	☐	☐	☐	☑
Other Researchers/Academics (excluding Study Stakeholders)	☑	☐	☐	☐	☑	☐
Other	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

Research Findings - Lay Summary and Implications of Key Findings (max. 10000 characters including spaces)

We developed a course to teach hospital staff (doctor, nurse and respiratory therapist) how to work better as a team during the critical event of resuscitation. Resuscitation is when a patient's heart stops and they need important treatments such as CPR, shock therapy and medications in order to restart their heart. Coordinating a group of hospital staff to do all the tasks necessary is very difficult and the team must learn how to communicate, organize themselves, share ideas, etc. This course we developed teaches them how to do these teamwork skills better.
We found that teaching resuscitation team members how to work better as a team improved their performance. They did things faster and in the correct order so that they more closely followed guidelines that have been published on what to do when someone's heart stops. The teams also communicated better, assigned tasks better and shared ideas better with each other. Therefore, our course was effective in teaching the team members what we wanted them to learn.
This training will now be given on a regular basis to all resuscitation team members at the hospitals who were part of our study. We will also publish the details of our course

Research Findings - Contribution to CIHR mandate

To what extent do you feel the research results from this grant contributed to the CIHR mandate?

	Not at all	Some extent	Great extent	May in the future
1. Creating new health knowledge	○	○	◉	○
2. Translating the knowledge from the research setting into real world applications	○	○	◉	○
3. Improving health for Canadians	○	○	◉	○
4. Creating more effective health services and products	○	◉	○	○
5. Strengthening the Canadian health care system	○	◉	○	○

Research Findings - Groups aware of findings

Which groups are already/need to be aware of your findings?

Groups	Need to be aware		Are already aware		
	Yes	No	Yes	No	Don't know
Health System/Care Practitioners/Public Health Practitioners	○	○	◉	○	○
Patients/Consumers of Health Care System/Care	○	◉	○	◉	○
Study Stakeholders (who are formally listed in the grant application)	○	○	◉	○	○
Health System/Care Managers	○	○	◉	○	○
Health System/Care Professional Organizations	○	○	◉	○	○
Federal/Provincial Representatives	○	◉	○	◉	○
Community/Municipal Organizations	○	◉	○	◉	○
Consumer Groups/Charitable Organizations	○	◉	○	◉	○
Industry	○	◉	○	◉	○
The media	○	○	◉	○	○
Other Researchers/Academics (excluding Study Stakeholders)	○	○	◉	○	○
Other	○	○	○	○	○
Other	○	○	○	○	○
Other	○	○	○	○	○
Other	○	○	○	○	○
Other	○	○	○	○	○
Other	○	○	○	○	○
Other	○	○	○	○	○
Other	○	○	○	○	○
Other	○	○	○	○	○
Other	○	○	○	○	○

Broader Impacts - Human Research Participants

How many human research participants were enrolled in this study?

○ No human research participants enrolled

◉ If yes, total number of human research participants:

Participant Types	Number
Males	150
Females	150
Not Collected	0
Total	300

How many institutions were involved?

How many institutions?	From which countries?	From which province? (Canada only)
2	Canada	Alberta
1	Canada	Ontario
1	Canada	Quebec

Have human research participants benefited as a result of participating in this grant?

○ No benefit to human research participants

◉ Yes, please describe

Describe (max. 1000 characters including spaces)

The participants (health care providers) learned teamwork skills as it relates to resuscitation. This will help them during real-life resuscitation events coordinate themselves better and communicate better. We showed that better teamwork skills translates into adhering to resuscitation guidelines more closely.
Research participants can them perform their duties better with real patients, so the patients receive more timely care that is also more closely adhered to published guidelines, which may improve survival from the resuscitation events.

Broader Impacts - Stakeholders

To what extent and how has your grant had an impact on the following stakeholders?

Stakeholder(s)	Influenced						How
	N/A	Don't know	Not at all	A little extent	Some extent	Great extent	
Health System/Care Practitioners/Public Health Practitioners	○	○	○	○	○	◉	Learning new skills to help provide more efficient and better care to patients during resuscitation.
Patients/Consumer of Health System/Care	○	○	○	○	◉	○	Patient outcome may be improved with better performance of health care providers during resuscitation.
Study Stakeholders (who are formally listed in the grant application)	○	○	○	○	○	◉	We have developed a teamwork training curriculum that can be provided to local health care providers. The academic outputs (posters, manuscripts etc) will also help those co-investigators who have academic positions.
Health System/Care Managers	○	○	○	○	◉	○	Care managers are responsible for ensuring their staff provide optimal care. Education of staff to improve their performance will help managers achieve this mandate.
Health System/Care Professional Organizations	○	○	○	◉	○	○	Professional organizations like CPSI and The Royal College of Physicians and Surgeons of Canada are tasked with educating staff on quality patient care issues, which includes teamwork and interprofessional collaboration. This course addresses this issue so deals directly with a quality care domain.
Federal/Provincial Representatives	◉	○	○	○	○	○	N/A
Community/Municipal Organizations	◉	○	○	○	○	○	N/A
Consumer Groups/Charitable Organizations	◉	○	○	○	○	○	N/A

Industry	◉	○	○	○	○	○	N/A
The media	◉	○	○	○	○	○	N/A
Researchers/Academics (excluding Study Stakeholders)	○	○	○	◉	○	○	There are others interested in improving teamwork and health care provider performance during resusictation and other high stakes environments. Our findings may help inform their own research agendas.
Research Funding Organizations	○	○	○	◉	○	○	Organizations such as AIHS and CIHR want to focus on patient oriented research. This project, although doesn't use patients as subjects, can have a direct impact on the quality of care provided to patients.
Other	○	○	○	○	○	○	
Other	○	○	○	○	○	○	
Other	○	○	○	○	○	○	
Other	○	○	○	○	○	○	
Other	○	○	○	○	○	○	

Broader Impacts - Outcomes

Which of the following have resulted or will result from this grant?

Outcomes	Advanced		Newly developed		May in the future	Please describe with an example
	Yes	No	Yes	No		
Research method	◉	○	○	○	○	Other investigators have researched this area but we standardized many aspects of this study which improves the methods published by others.
Theory	○	○	◉	○	○	We have found some common sources of human error during resuscitation while analyzing our results. This will be further studied in the future.
Replication of research findings	◉	○	○	○	○	Others have published similar results within different health care environments. The main difference with our study is that we ran this study at several centres, not just 1. So we have added to the generalizability arugument.
Tool, technique, instrument, or procedure	◉	○	○	○	○	We have developed new ways to stress teams during simulated resuscitation events, as well as new procedures for running a simulation based education study.
Professional practice	◉	○	○	○	○	This education has been shown to improve health care provider performance in the simulation lab. This will likely improve performance in the real world as well.
Policies, guidelines or programs	◉	○	○	○	○	Resuscitation education policies for hospital staff should include reference to teamwork training. This is recommended by Heart and Stroke Foundation already but has not yet been widely adopted.
Information or guidance for patients or public	○	○	○	◉	○	N/A

Patients' or public behaviour(s)	○	○	○	◉	○	N/A
Vaccines/Drugs	○	○	○	◉	○	N/A
Software/Database	○	○	○	◉	○	N/A
Patent (filled or obtained)	○	○	○	◉	○	N/A
Product licence	○	○	○	◉	○	N/A
Spin-off company	○	○	○	◉	○	N/A
Intellectual property claim	○	○	○	◉	○	N/A
Direct cost savings (individual, organization, system, or population level)	○	○	○	◉	○	N/A
Findings cited by others (e.g. finding referenced/included in subsequent synthesis, practice guideline, etc.	◉	○	○	○	○	Heart and Stroke Foundation of Canada participates in international resuscitation guideline development. Teamwork training is 1 topic covered by these guidelines. Our findings strengthen the recommendation about teamwork training since we've demonstrated generalizability of this education.

Broader Impacts - Impact/Contribution of findings (max. 2000 characters)

Is there anything else CIHR should know about how findings from this grant may be having an impact/make an important contribution? (●) **Yes** ( ) **No**

Despite showing that this training that we developed improved health care provider performance overall, we found that errors still commonly occurred during this complex, high stakes environment. We need to learn more about human behaviour in stressful teamwork situations sot that we can fine tune this education to minimize the frequency of these errors. Further research (in collaboration with psychology researchers) is planned.

Research Capacity and Training - List of all staff

Please list all staff including trainees involved in this current grant (both paid and not paid).

Type		Unique Number of Individuals Paid from Grant	Total # FTE Paid from Grant	Unique Number of Individuals involved but NOT Paid	Total # FTE NOT Paid from Grant
Researcher		0	0	13	0
Research Assistant		5	1.6	0	0
Research Technician		0	0	0	0
Trainees	Postdoctoral (post Ph.D) fellows	0	0	0	0
	Post health professional degree (MD, BScN, DDS, etc.)	0	0	0	0
	Ph.D. students	0	0	1	0.5
	Fellows not pursuing a Master's or Ph.D Doctoral	0	0	0	0
	Master's students	0	0	1	1
	Under graduate student	2	2	2	2
Other					
Other					
Other					
Other					
Other					
Other					
Other					
Other					
Other					
Other					

Research Capacity and Training - Attracting new researchers

CIHR is interested in whether Canada is attracting new health researchers to Canada to build capacity. Did your grant attract foreign researchers, research staff or trainees? Yes ○ No ◉

Type	From which countries?	How many individuals?

Research Capacity and Training - Qualifications for members

Has participation in this grant led to formal qualifications (e.g. PhD) for any members of the project team or is it likely to do so? ◉ Yes ○ No

Qualifications	Year degree awarded or expected	Contributions from specific project			
		A little extent	Some extent	Considerable extent	Great extent
Master's or Equivalent	2017	○	○	○	◉
Doctorate (Ph.D) or Equivalent	2019	○	○	○	◉
Bachelor's or Equivalent	2015	○	○	○	◉
		○	○	○	○
		○	○	○	○
		○	○	○	○
		○	○	○	○
		○	○	○	○
		○	○	○	○
		○	○	○	○

Advancing Knowledge – Scientific Production

Please indicate the number of each of the following items related to this grant, by you or others on your team

	# Published	# Submitted
Journal Articles	0	1
Books/Book chapters	1	0
Reports/Technical reports	0	0

	# Invited	# Others
Presentations	6	0

	In Canada			International		
	#Print	#Broadcast	#Internet	#Print	#Broadcast	#Internet
Interviews with Journalists/Articles in Mass Media	1	1	1	0	0	0

Advancing Knowledge - Open access publications

Have you adhered to the following requirements outlined in the CIHR Open Access Policy?

Responsibilities	Yes	No	N/A
Ensure that all research papers generated from CIHR funded projects are freely accessible through the Publisher's website or an online repository within twelve months of publication	◉	○	○
Deposit bioinformatics, atomic, and molecular coordinate data into the appropriate public database (e.g. gene sequences deposited in GenBank) immediately upon publication of research results	○	○	◉
Retain original data sets for a minimum of five years (or longer if other policies apply)	◉	○	○
Acknowledge CIHR support by quoting the funding reference number in journal publications	◉	○	○

If you selected no, please explain why you were not able to comply: (max. 2000 characters including spaces)

○ I was funded prior to January 1st 2008

○ Other, please explain for each responsibility:

Advancing Knowledge - Peer-reviewed publications

Information of Peer-Reviewed Publications

1	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
2	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
3	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
4	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
5	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	

6	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
7	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
8	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
9	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
10	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	

11	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
12	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
13	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
14	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	
15	Title*	Supported by this CIHR grant ○ Fully ○ Partially
		Volume No.
	Journal*	Number
	Primary Author Name*	Page No.
	Author(s)	Year
	URL	
	DOI	

Information of Presentations

1	Title* The impact of hierarchy during pediatric resuscitation	☐ This was an invited presentation.	
	Author(s) N Delaloye, J Charles, T O'Neill, E Gilfoyle		
	Type of presentation Poster		
	Workshop / Conference Name Alberta Children's Hospital Research Institute Summer Student Symposium	Date 2014-08-19	
	Location Calgary, AB		
	URL		
2	Title* Understanding the impact of parental presence during pediatric resuscitation	☐ This was an invited presentation.	
	Author(s) J Charles, N Delaloye, T O'Neill, E Gilfoyle		
	Type of presentation Oral		
	Workshop / Conference Name Alberta Children's Hospital Research Institute Summer Student Symposium	Date 2014-08-19	
	Location Calgary, AB		
	URL		
3	Title* Improved Clinical Performance and Teamwork of Pediatric Inter-professional Resuscitation Teams With a Simulation-Based Educational Intervention	☐ This was an invited presentation.	
	Author(s) E Gilfoyle, D Koot, J Annear, F Bhanji, A Cheng, J Duff, V Grant, C St. George-H		
	Type of presentation Poster		
	Workshop / Conference Name Resuscitation Science Symposium	Date 2015-11-09	
	Location Orlando FL		
	URL http://my.americanheart.org/idc/groups/ahamah-public/@wcm/@sop/@scon/documents/downloadable/ucm_476720.pdf		
4	Title* Improved Clinical Performance and Teamwork of Pediatric Inter-professional Resuscitation Teams With a Simulation-Based Educational Intervention	☑ This was an invited presentation.	
	Author(s) E Gilfoyle, D Koot, J Annear, F Bhanji, A Cheng, J Duff, V Grant, C St. George-H		
	Type of presentation Oral		
	Workshop / Conference Name Simulation Summit	Date 2015-11-25	
	Location Banff AB		
	URL http://www.royalcollege.ca/portal/page/portal/rc/common/documents/events/simulationsummit/2015/simsummit2015_final_program.pdf		
5	Title* The Consequences of Hierarchy in Resuscitation	☐ This was an invited presentation.	
	Author(s) N Delaloye, J Charles, T O'Neill, A Kotsakis, I Bank, E Gilfoyle		
	Type of presentation Poster		
	Workshop / Conference Name Canadian Conference on Medical Education	Date 2016-04-18	
	Location Montreal, QC		
	URL		

6	Title* Measuring Situation Awareness in Medical Teams	☐ This was an invited presentation.
	Author(s) T White, T O'Neill, N Delaloye, E Gilfoyle	
	Type of presentation Poster	
	Workshop / Conference Name World Congress on Pediatric Critical Caer	Date 2016-06-06
	Location Toronto, ON	
	URL	
7	Title*	☐ This was an invited presentation.
	Author(s)	
	Type of presentation	
	Workshop / Conference Name	Date
	Location	
	URL	
8	Title*	☐ This was an invited presentation.
	Author(s)	
	Type of presentation	
	Workshop / Conference Name	Date
	Location	
	URL	
9	Title*	☐ This was an invited presentation.
	Author(s)	
	Type of presentation	
	Workshop / Conference Name	Date
	Location	
	URL	
10	Title*	☐ This was an invited presentation.
	Author(s)	
	Type of presentation	
	Workshop / Conference Name	Date
	Location	
	URL	

11	Title*	☐ This was an invited presentation.
	Author(s)	
	Type of presentation	
	Workshop / Conference Name	Date
	Location	
	URL	
12	Title*	☐ This was an invited presentation.
	Author(s)	
	Type of presentation	
	Workshop / Conference Name	Date
	Location	
	URL	
13	Title*	☐ This was an invited presentation.
	Author(s)	
	Type of presentation	
	Workshop / Conference Name	Date
	Location	
	URL	
14	Title*	☐ This was an invited presentation.
	Author(s)	
	Type of presentation	
	Workshop / Conference Name	Date
	Location	
	URL	
15	Title*	☐ This was an invited presentation.
	Author(s)	
	Type of presentation	
	Workshop / Conference Name	Date
	Location	
	URL	

Print Form

Heart and Stroke Foundation of Canada

End of Project Reporting Template

Date: Aug 31, 2017

Principal Investigator Name (Last Name /First Name/ Middle Initial): Gilfoyle/Elaine

Department and Institution: Paediatrics, Cumming School of Medicine, University of Calgary

E-mail: elaine.gilfoyle@albertahealthservices.ca

Name of Funding Initiative: Monitoring & Optimizing CPR 2010

Title of Project: Can Adherence to PALS Guidelines Be Improved by Team Training of Pediatric Resuscitation Team Members?

Health Research Theme(s)

[ ] % basic biomedical [ ] % clinical

[100] % health services/systems [ ] % population health

Date project was initiated: February 1, 2011

Date project was completed: Aug 31, 2017

A. RESEARCH TEAM

1. Please list the names and roles of all project team members, including the Principal Investigator.

Full name	Title/Position	Institution	Province	Discipline	Role on Project Team
Elaine Gilfoyle	Clinical Asst Profes	University of Calg	Alberta	Pediatrics	Principal Investig
Nicola Peiris	Research Program	University of Calga	Alberta	Simulation Progr	Program Manage
Deanna Koot	Research coordinat	University of Calga	Alberta	Pediatrics	Lead research c
Jonathan Duff	Assistant Professor	University of Alber	Alberta	Pediatrics	Site lead investig
Afrothite Kotsaki	Assistant Professor	University of Toror	Ontario	Pediatrics	Site lead investig
Ronald Gottesm	Professor	McGill University	Quebec	Pediatrics	Site lead investig

2. Is this a new research team that did not previously exist? ○ Yes ○ No

3. Was your team multidisciplinary? ○ Yes ○ No

If yes, please list disciplines.

Not all team members are listed above due to space limitations. All those not listed above are study co-investigators.
Physicians: Elaine Gilfoyle, Jonathan Duff, Ronald Gottesman, Afrothite Kotsakis, Farhan Bhanji, Vincent Grant, Adam Cheng, Matthew Weiss
Nurses: Deanna Koot, Cecilia St George Hyslop
Respiratory Therapists: John Annear, Carolyn McCoy
Non-clinicians: Thomas O'Neill, PhD (Psychology)

B. RESEARCH CAPACITY AND TRAINING

1. Please list the names, roles and details of the training opportunities made available through this grant.

Full name	Title/Position/ Degree being sought	Institution	Role on Project Team
Nicole Delaloye	Masters of Science (Medical Education)	University of Calgary	Initially research assistant, now student (conducting own
Amanda Deacon	PhD	University of Calgary	Student conducting own research from main data set
Travis Jesse White	Honours Bachelor of Psychology	University of Calgary	Student conducting own research from main data set
Jessica Charles	Undergraduate summer student	University of Calgary	Student conducting own research from main data set
Claudel Borgea	Undergraduate summer student	University of Calgary	Student conducting own research from main data set
Carol Rizkalla	Undergraduate	University of Calgary	Student conducting own
Farhan Zahid	Undergraduate	University of Calgary	Student conducting own

2. Has participation in this grant led to formal qualifications (e.g. PhD) for any members of the project team, or is it likely to do so? ○ Yes ○ No

If yes, please list:

Degree	Year Awarded/Expected
MSc	2017
PhD	2020
BA (Hons)	2015

C. RESEARCH OBJECTIVES

1. Did the project achieve each of the stated research objectives? If yes, how? If no, why?

Yes ◯ No ◯

Our primary objective for this proposed research project was to measure the effect of team training of paediatric resuscitation team members on adherence to PALS guidelines in a simulated clinical environment. We demonstrated that team training improved team member adherence to PALS guidelines.

Our secondary objectives were:
1. To measure the effect of team training of paediatric resuscitation team members on teamwork in a simulated clinical environment. Teamwork improved after participating in our team training educational intervention.
2. To measure long-term effect on adherence to PALS guidelines after team training of paediatric

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D. RESEARCH OUTCOMES

1. Scientific Summary of Key Findings (400 words)

2. Lay Summary of Research Findings (400 words)

Hospital “code blue” teams attend to a patient whose heart has stopped. They have to quickly and a ccurately find out what is wrong with the patient and try to fix it, to give him/her a chance of surviving . This takes good teamwork and effective communication, among other things. But this environment i s prone to error since team members often don’t know the patient or what is wrong with him/her so t hey have to figure this out quickly. As well, they have to coordinate and carry out many tasks at once , so they don’t waste any time.

One way to improve this teamwork is to specifically train teams on these skills. Until recently, teams were only offered training on the medical aspects of their job, like what medications to give, how to w

3. List three “main messages” (in lay language) to summarize your research findings.

1.
Resuscitation teams can be trained to work better together as a team. These trained teams improve their ability to care for patients in a better and more efficient way, which could translate into better ou tcomes for patients.
2.
Resuscitation teams work in a very complex environment and are prone to performing errors. Two c ommon sources of error are failing to speak up and check the orders given by the doctor in charge a s well as teams being distracted by parents in the room, among other things. More work needs to be

4. What are the next steps for this research?

We are planning to start observing real resuscitation events to determine the quality of teamwork, sources of common errors, and clinical performance of teams during pediatric resuscitation events. We have received seed funding from several sources so will begin this pilot work in Calgary at Alberta Children's Hospital in late fall 2017. Ultimately we will be able to observe changes in team performance and patient outcome after implementing more detailed/improved team training educational interventions after observing the teamwork issues and errors noted during real events. This is important since we cannot assume that teams perform the same in real-life as they do in the

5. Which of the following outcomes will result from this research study?

Outcomes	**Yes**	**No**	**May in the future**	**Describe**
Research Finding/ Knowledge Creation	☐	☐	☐	Team training improves resuscitation team's clinical performance
New Research Method	☐	☐	☐	
New Theory	☐	☐	☐	
Replication of research findings	☐	☐	☐	
New Practice (Clinical tool/instrument, procedure/technique)	☐	☐	☐	We now routinely offer team training to our staff who may be involved in resuscitation events
New Vaccines/Drugs	☐	☐	☐	
Software/database	☐	☐	☐	
New product license	☐	☐	☐	
New Patent	☐	☐	☐	
New or changed policy/program	☐	☐	☐	Team training educational program
Direct cost savings (individual, organization, system, or population level)	☐	☐	☐	If patient outcomes are improved with team training of staff, health care costs may also be improved. We are a long way from proving that, however.
Other (describe)	☐	☐	☐	

E. KNOWLEDGE TRANSFER AND EXCHANGE (KTE)

1. HSFC defines “knowledge transfer and exchange” as*: the dynamic, collaborative process of creating, sharing and acting upon research and other knowledge to eliminate heart disease and stroke and reduce their impact*.

Which of the following groups of stakeholders need to be aware of your findings?

Group	Need to be aware		Are Already Aware		
	Yes	No	Don't Know	Yes	No
Researchers/ Academics	☐	☐	☐	☐	☐
Health Care Practitioners	☐	☐	☐	☐	☐
Patients / Consumer of Health Care	☐	☐	☐	☐	☐
Health Care Managers	☐	☐	☐	☐	☐
Health Care Professional Organizations	☐	☐	☐	☐	☐
Federal / Provincial Representatives	☐	☐	☐	☐	☐
Community / Municipal Organizations	☐	☐	☐	☐	☐
Consumer groups/ Charitable Organizations	☐	☐	☐	☐	☐
Industry	☐	☐	☐	☐	☐
The media	☐	☐	☐	☐	☐
Other, Please specify	☐	☐	☐	☐	☐

2. From the list below, please identify the number of each of the following knowledge transfer and exchange-related activities for your project, to date.

   Publications:

	# Published to date	# Submitted to date
Journal Article (Peer Reviewed)	2	1
Books/ book chapters (non-Peer Reviewed)	1	0
Report / technical report	0	0
Doctoral Thesis	0	0
Master's Thesis	1	0
Other, Please specify. Journal articles in preparation-to be submitted fall	3	

3. Publication citations (provide citations for all publications arising from this grant):

1) Improved Clinical Performance and Teamwork of Pediatric Interprofessional Resuscitation Teams With a Simulation-Based Educational Intervention. Gilfoyle E, Koot DA, Annear JC, Bhanji F, Cheng A, Duff JP, Grant VJ, St George-Hyslop CE, Delaloye NJ, Kotsakis A, McCoy CD, Ramsay CE, Weiss MJ, Gottesman RD; Teams4Kids Investigators and the Canadian Critical Care Trials Group. Pediatr Crit Care Med. 2017 Feb;18(2):e62-e69.

2) Errors During Resuscitation: The Impact of Perceived Authority on Delivery of Care. Delaloye NJ,

4. Presentations:

	# Completed	# Accepted
Oral presentation	8	0
Poster presentation	6	0
Workshops	0	0
Other, Please specify .	0	0

5. Conventional Media and other Publications:

	Number of Articles or Media Interviews		
	Local	National	International
Newspaper	1		
Magazine			
Television			
Radio	1		
Other, Please specify	1-website		

6. What role could HSFC and its partners play in helping to disseminate the findings of your research, or facilitate the next steps required for this research?

Perhaps highlight research programs/projects in documentation sent out to mailing lists? Also could have a section on website (general public side not research side) highlighting research projects.

F. How have the grant funds been leveraged for this project (in-kind; financial) through other sources (please describe, if applicable). Estimated dollar value of leveraged resources:

In-kind: $45900

Financial (cash) $0

G. Do you have any specific comments and/or feedback for HSFC and its partners in relation to this funding initiative?

As a resuscitation researcher, I really appreciated this funding opportunity. The vast majority of HSFC grants related to CV disease or stroke. Resuscitation researchers find it hard to complete with the researchers in these other fields which are more established, bigger and represent more common conditions. So thank you and please consider doing this again!

HEART & STROKE FOUNDATION OF ALBERTA, NWT & NUNAVUT
Finding answers. For life.

Grant-In-Aid (GIA) Final Report Form 2011/2012

Please forward **an electronic copy of the completed report** by **May 25, 2012** to [redacted]

CONTACT & AWARD INFORMATION

Principal Investigator	
Last Name [redacted]	First Name [redacted]
Institution UNIVERSITY OF CALGARY	Academic Position ASSOCIATE PROFESSOR, PEDIATRICS
Project Title MODULATION OF BRAIN PLASTICITY AFTER PERINATAL STROKE	
Please indicate the grant year (2nd, 3rd, Final) FINAL	

Research Pillars: Using a scale of 0-100%, please provide percentages to indicate where your research activities may best be distributed.

Pillar	**0 -100%**
Basic Biomedical	
Clinical	80%
Health Services & Health Systems	10%
Health of Populations	10%

If applicable, please specify your success in patient recruitment (i.e. total number recruited vs. target): Currently recruited 31 of 52 subjects. Additional recruitment is ongoing.

Area of Research: Using a scale of 0-100% as outlined below, please indicate how HSF can best describe your project. Additionally, please specify the areas of focus of your research. The examples of research focus are provided in brackets under each of the priority areas (i.e. obesity under prevention).

Priority Areas *(Examples of Research Focus)*	**Prevention** *(i.e. diabetes, hypertension, obesity)*	**Diagnosis** *(i.e. imaging)*	**Treatment** *(i.e. arrhythmia heart failure, mini-stroke, transplant)*	**Rehabilitation** *(i.e. pediatrics, adult, rehab therapy)*	**Others** *(if do not fall under categories mentioned)*
Percentage (0-100)		20	20	60	
Research focus		Mapping brain pathways and functions (physiology) in children with perinatal stroke	Applying non-invasive brain stimulation (TMS) to try and enhance motor learning	Combining new therapies (constraint and rTMS) to improve motor function in perinatal stroke	

RESEARCH RESULTS AND IMPACT

In lay language a donor can understand, please provide the final outcomes of your research with highlights of significant scientific achievements made through this grant.

A brief background of your project, including the health needs addressed

Perinatal stroke is the leading cause of lifelong weakness on one side (hemiplegic cerebral palsy). Current treatments are limited. We are testing the ability of 2 new treatments to improve function in kids with perinatal stroke. Constraint therapy (CIMT) restrains the good arm with a cast to help the weak side get better. Non-invasive brain stimulation (called TMS) may also speed brain recovery. These 2 treatments are tested during an intensive, kid-friendly 2 week rehab therapy camp at the Alberta Children's hospital. We also use TMS to understand what positive changes these interventions might produce in the brain.

Final outcomes of your research (in maximum 500 – 700 words)
*(Please mention **specifics** of your achievement: any one-of-a-kind results with reference to a publication (if applicable), new knowledge generated, new program developed, enhanced risk factor management, reduced incidence of disease, improved patient care, reduced cost of health care, etc.)*

Goal: Establish the feasibility and safety of TMS trials in children.
Result: An interim safety analysis after the first 14 patients and currently complete data on 31 children confirm excellent tolerability of TMS interventions in this population. The Pediatric TMS Safety and Tolerability Evaluation was successfully completed at 4 timepoints by all participants with no serious adverse events. This is the first trial of non-invasive brain stimulation in this population and only the second published in children.

Goal: Complete complex measurements of brain physiology in children with perinatal stroke.
Result: We obtained high quality, novel neurophysiological data never before measured in kids with perinatal stroke. Our results have validated the skills of our team and the technical capacities of the ACH Pediatric TMS Laboratory which has directly leveraged additional studies in children with perinatal stroke and other conditions.

Goal: Systematic identification of kids with perinatal stroke and creation of a population-based registry.
Result: Our Alberta Perinatal Stroke Project (APSP) is now smoothly identifying all such children. Southern Alberta totals are now >400 with Edmonton now enrolling as well, creating the largest research population of >1000 children for recruitment to future studies. We have also joined a new national CP registry as a result.

Goal: Successful recruitment and retainment of subjects.
Result: A high recruitment rate was achieved with >90% of those offered participation agreeing despite substantial time commitments, missed school, and uncertainty of some children. A recruitment video was developed that has also improved public education and awareness. Retainment to all follow-ups has been 100% with no drop-outs.

Goal: Establish a pediatric camp-based rehabilitation model.
Result: Thanks to this study, a successful model for camp based rehab has evolved at ACH. We have executed 6 separate camps across different times of year and age ranges (6-18 years). Positive growth includes the advancement of integrated teams of occupational and physical therapists, therapy assistants, art, music, and horticultural therapists, and child life specialists. Such models promise to become the norm for future, evidence-based rehab interventions in children.

Goal: Advance evidence-based therapies and new programs for children with cerebral palsy.
Result: Our successful execution of camp-based CIMT has generated two new CIMT programs at our institution for much broader populations of eligible children with cerebral palsy.

Goal: Personal growth of participants.
Result: We observed larger than expected psychosocial benefits in camp participants including new personal motivation, maturity, and connections with similarly affected peers. Our impressions were validated by exit surveys completed by both parents and children and carry important implications for future programs.

Research impact (*relative to HSF mission*)
Please explain briefly what this grant permitted you to accomplish in lay terms a donor can understand. This should include the potential impacts of:

- *your research results in changing the lives*
- *the grant in building your career and future innovative ideas*

Our research has had a major impact on children and families affected by perinatal stroke. The brain mapping part of the study has provided new understanding of how the brain recoveries after early injury. The treatment part of the study has taught us many things. Non-invasive brain stimulation is safe and well tolerated in children. Intensive rehabilitation camps are an effective way to combine traditional therapies with new ones like brain stimulation and constraint. These findings are already leading to the development of new programs for larger populations of children with cerebral palsy and other neurological conditions. Perhaps most importantly, we learned first-hand how such programs can positively impact the psychology and personal well being of young people living with physical disabilities.

This funding has allowed me to chase and define a leading edge of research in my field at a critical early time in my career. It has supported the growth of our team, from local to international levels, and advanced the training and inspiration of the next generation of pediatric neuroscience researchers.

DISSEMINATION

A) Please list all peer-reviewed publications resulting from the current HSF grant and **attach one copy** of each publication/article.

Journal article *(Title of the article and journal name)*	**Date of publication**	**Approximate % HSF funding support**	**Remarks**
Kirton A. Plastic motor development after perinatal stroke: Human models and therapeutic targets. *Ped Neurol*	2012, in press.	10%	
Li D, Hodge J, Wei X, **Kirton A**. Reduced ipsilesional cortical volumes in fetal periventricular venous infarction. *Stroke*	2012, epub Jan 26.	5%	
Kirton A, Chang T, Armstrong-Wells J, Hernandez M, Carpenter J, Rifkin M, Yager J, Lynch J, Ferriero D and the Members of the IPSS. Symptomatic neonatal arterial ischemic stroke: The International Pediatric Stroke Study. *Pediatrics*	2011,128: e1402-10. Epub 2011, Nov 28.	5%	
Hernández CM, Sandoval CC, Tapia JL, Mesa LT, Escobar HR, Huete LI, **Kirton A**. Stroke patterns in neonatal group B streptococcal meningitis. *Ped Neurol*	2011, 44(4): 282-88.	5%	
Mineyko A, **Kirton A**. The black box of perinatal ischemic stroke pathogenesis. *J Child Neurol*	2011, Jun 13 epub	1%	

B) Please list abstracts/posters presented at professional meetings/conference, and others as appropriate (i.e. book/ book chapters, report/technical reports)

1. **Kirton A for** the PLASTIC CHAMPS Investigators. PLastic Adaptation Stimulated by TMS and Induced Constraint for Congenital Hemiparesis After Perinatal Stroke (PLASTIC CHAMPS). *Submitted to 2012 Canadian Stroke Congress, Calgary, Sep 2012*
2. Shinde S, Wei X, **Kirton A**. Gliosis after Perinatal Arterial Ischemic Stroke: Quantification and Outcomes. *Submitted to 2012 Canadian Stroke Congress, Calgary, Sep 2012*
3. Damji O, Kotsovsky O, **Kirton A**. Evaluating developmental motor plasticity after perinatal stroke with paired associative stimulation. *Submitted to 2012 Canadian Stroke Congress, Calgary, Sep 2012*
4. **Kirton A**, Andersen J, Vijay A, Mineyko A, Hoyt-Hallett G, O'Byrne C, Carsolio L, Lane C, Thicke T, Roe J, Hodge J, and Hill MD for the PLASTIC CHAMPS trial. Brain stimulation and constraint for perinatal stroke hemiparesis: Interim safety and feasibility in the PLASTIC CHAMPS trial. *Accepted to International Child Neurology Society, Brisbane, May 2012*
5. Hodge J, Carlson H, Goodyear B, Wei X, **Kirton A**. Diffusion tensor imaging markers of corticospinal tract integrity after perinatal stroke. *Accepted to International Child Neurology Society, Brisbane, May 2012*
6. **Kirton A**, Andersen J, Vijay A, Mineyko A, Hoyt-Hallett G, O'Byrne C, Carsolio L, Lane C, Thicke T, Roe J, Hodge J, and Hill MD for the PLASTIC CHAMPS trial. Enhancing motor plasticity after perinatal stroke with brain stimulation and constraint: Safety and feasibility of the PLASTIC CHAMPS trial. *Proceedings of the International Stroke Conference, New Orleans, Feb 2012;* CTP32, *page 230.*

7. Davies-Schinkel C, Rothenmund S, Farrell R, **Kirton A**, deVeber G, Lindsay P. Meeting the educational needs of pediatric stroke patients and their families. Accepted to *Canadian Stroke Congress*, Ottawa, Oct 2011
8. Li D, Hodge J, Wei X, **Kirton A.** Quantifying cortical injury in fetal periventricular venous infarction. Accepted to 2011 Child Neurology Society, Savannah, GA October 2011
9. Li D, Hodge J, Wei X, **Kirton A.** Ipsilesional cortical volumes are diminished in fetal periventricular venous infarction. *Proc NeuroDevNet Brain Development Conference 2011; page 32.*
10. Hodge J, Carlson H, Goodyear B, Wei X, **Kirton A**. DTI quantification of corticospinal tract integrity in perinatal stroke. *Proc NeuroDevNet Brain Development Conference 2011; page 30.*
11. Mineyko A, Wei X, **Kirton A.** Cerebrovascular enhancement on MRI in children. Accepted to 2011 *Child Neurology Society*, Savannah, GA October 2011
12. **Kirton A**, Chang T, Armstrong-Wells J, Hernandez M, Carpenter J, Rifkin M, Yager J, Lynch J, and Ferriero D. Neonatal arterial ischemic stroke: Findings from the International Pediatric Stroke Study. *Ann Neurol* 2010; 68(14):S89-90.
13. **Kirton A**, Andersen J, Hoyt-Hallett G, O'Byrne C, Yager J, Hill MD, Nettel-Aguirre A, Demchuk A, deVeber G, Kotsovsky O, Chen R. Measuring plastic change in pediatric interventional therapies with TMS: Methodology of the PLASTIC CHAMPS clinical trial. *Proceedings of the First International Workshop on Synaptic Plasticity: From bench to bed side. www.synapticplasticity.org;* 2010*, a*bstract PS1-21.

Book Chapters

1. **Kirton A** and deVeber G. Cerebrovascular disease. *In Pediatric Neurology: Principles and Practice*. 5th Edition, Swaiman K, Ashwal S, Ferriero D eds. Mosby Elsevier, Philadelphia, 2012 pp1395-1436
2. **Kirton A**. Focal ischemic stroke as a mechanism of cerebral injury in the perinatal period. In *Neonatal Encephalopathy and Cerebral Palsy: Defining the Pathogenesis and Pathophysiology*. American College of Obstetricians & Gynecologists, American Acad of Pediatrics. In press 2012.
3. **Kirton A** and deVeber G. Acute stroke syndromes. In *Nelson's Textbook of Pediatrics*. Kliegman R, Stanton BF, St. Geme J, Schor NF, Behrman RE eds. Elsevier, Philadelphia. Co 2011, 2080-86.

C) Please specify your involvement in dissemination of research findings (i.e. community presentations, public awareness, media events, HSF media spokes-person or HSF other events, press release, direct involvement with HSF fund raising activities and others as appropriate)

Activity	**Target Audience**
Heart and Stroke Mavericks Program Multiple speaking engagements, meetings with potential donors, media promotions	Donors, researchers, general public.
CPSP Website (www.perinatalstroke.com).	Includes educational resources on perinatal and childhood stroke, support systems for families, research project summaries and public updates.
Chair, Canadian Stroke Network Pediatric Task Force	Numerous KTE activities including public, policy makers and other stakeholders
Media coverage: Featured stories and documentaries on pediatric stroke, CPSP, and brain stimulation in children. Examples here: http://perinatalstroke.com/cpsp/research	General public
Perinatal Stroke Parent Support Groups, Heart and Stroke Foundation of Alberta (2010 -)	Parents of children with perinatal stroke.
Best Practice Guidelines deVeber G, **Kirton A**, D'Anjou G, Dilenge M, Lindsay P, Miller S, Nash M, Rafay M, Rothenmund S (Pediatric Stroke Care Task Group). *Canadian Best Practice Recommendations for Stroke Care 2010*, Canadian Stroke Network, http://strokebestpractices.ca/wp-content/uploads/2010/12/2010_BP_ENG.pdf	All health care professionals caring for children affected by stroke.
deVeber G, **Kirton A**, D'Anjou G, Dilenge M, Lindsay P, Miller S, Nash M, Rafay M, Rothenmund S (Pediatric Stroke Care Task Group). *A Family Guide to Pediatric Stroke*, Canadian Stroke Network, http://www.canadianstrokenetwork.ca/wp-content/uploads/2011/10/PEDSGuide-EN.pdf	Children, parents and families affected by childhood stroke.
Host and Chair, Alberta Perinatal Stroke Project Research Symposium (Sept 2010)	Provincial and national perinatal stroke research network
Movie Production: "Brain Camp". Edited movie created by children with perinatal stroke describing their experiences at the study camp	Used for health care professional and public education, awareness and trial recruitment
Organizer, "CP In Motion" conference (NeurDevNet, Edmonton, May 2012)	Included educational sessions and workshops for advances in CP therapy targeting professionals, families, and public
Medicolegal implications of new perinatal stroke knowledge	Invited speaker for CMPA law firm, Author of new stroke chapter in AAP/ACOG Neonatal Encephalopathy and CP Textbook

CAPACITY BUILDING

Please provide brief information on how this grant has helped in providing training, mentorship and building research capacity.

Category	**Name**	**Specifics** (i.e. education level: PhD, postdoctoral etc.)	**Impact on their professional career** (Please specify)
Trainees			
	[redacted]	Clinical Research Fellow	Direct training in pediatric stroke clinical research, clinical trials methods, neuroimaging. Leveraged successful independent projects and grants. Recently appointed to faculty.
	[redacted]	MSc Neuroscience	Combined neuroimaging training in perinatal stroke (DTI) with direct interaction and impact on affected children and families.
	[redacted]	MSc Neuroscience	Combined brain stimulation training with direct interaction and impact on affected children and families.
	[redacted]	PhD Clinical Psychology	PhD thesis on psychological outcomes of parenting children with perinatal stroke, runs family support groups at HSF
	[redacted]	BHSc Undergraduate	Completed honours year thesis, 1st authoured publication, accepted to medical school
	[redacted]	BHSc Undergraduate	Completed honours year thesis, 1st authoured publication, accepted to medical school
	[redacted]	BHSc Undergraduate	Completed honours year thesis, 1st authoured publication, accepted to medical school
Non-investigators (*e.g. research personnel)*	[redacted]	Research Nurse	Leads numerous initiatives including multicenter studies and trials. Coordinates and runs family support groups at HSF.
	[redacted]	Neurophysiologist	Advanced skills and methods in pediatric non-invasive brain stimulation
	[redacted]		Research experience, now accepted to clinical assistant position.
	[redacted]	12 different occupational therapists	Extensive training and new methods including coordination of day camp model, CIMT methods and new therapy interventions.

CHALLENGES

Please indicate if you experienced any major challenges in meeting the research goals. These challenges could be due to difficulties in recruiting personnel/patients; inability to spend more than 50% of grants allocations; and others as appropriate.

Yes/No

If yes, please describe the situation.

Our recruitment rate was slower than anticipated due to a variety of factors that have steadily improved through the course of the study. We are securely positioned to complete our final enrolments and camps through 2012. This will delay the publication of final results into 2013 but will not otherwise impact the quality of the project. As the funds have been spent to date, no formal extension is requested.

NOTE: *If the project is not completed within given timeframe, please request in writing to the Manager Research, for an extension following HSFA guidelines.*

HSFC final report summaries Aug 30 17

Scientific Summary

Objective: To measure the effect of a one-day team training course for pediatric interprofessional resuscitation team members on adherence to Pediatric Advanced Life Support (PALS) guidelines, team efficiency and teamwork in a simulated clinical environment.

Methods: Multi-center prospective interventional study at four tertiary-care children's hospitals in Canada from June 2011 to January 2015. Participants were interprofessional pediatric resuscitation teams, including resident physicians, ICU nurse practitioners, registered nurses, and registered respiratory therapists (n=300, 51 teams). A one-day simulation-based team-training course was delivered, involving interactive lecture, group discussions and four simulated resuscitation scenarios, each followed by a debriefing. First scenario of the day was conducted prior to any team training. Final scenario of the day was the same scenario, with a slightly modified patient history. All scenarios included standardized distractors designed to elicit and challenge specific teamwork behaviors. A different scenario involved a confederate (actor) playing a senior physician entered the scenario partway through and ordered the incorrect dose and delivery method of procainamide. Team performance was analyzed with a modified Advocacy-Inquiry Scale and a novel confederate hierarchy rating. Association between challenging behaviour and hierarchy, and whether or not the confederate's incorrect order was followed, was determined.

Results: Teams significantly improved adherence to PALS guidelines as measured by Clinical Performance Tool (CPT), (67.3% to 79.6%, $P< 0.0001$), time to initiation of chest compressions (60.8 sec to 27.1 sec, $P<0.0001$), time to defibrillation (164.8 sec to 122.0 sec, $P<0.0001$) and teamwork, as measured by Clinical Teamwork Scale (CTS) (56.0% to 71.8%, $P<0.0001$). A strong correlation was found between CPT and CTS (r=0.530, $P<0.0001$). Fifty-percent (n=24) of resuscitation teams followed the confederate's incorrect order. Challenging behaviour ($P<0.0001$) and confederate hierarchy rating ($P<0.05$) were significantly associated with whether or not the incorrect order was followed. Significant differences between rates of following the incorrect order at different study sites were observed ($P<0.05$).

Conclusions: Participation in a simulation-based team training educational intervention significantly improved surrogate measures of clinical performance, time to initiation of key clinical tasks, and teamwork during simulated pediatric resuscitation. A strong correlation between clinical and teamwork performance suggests that effective teamwork optimizes clinical performance of resuscitation. The reluctance of resuscitation teams to appropriately challenge an incorrect order resulted in a high rate of inappropriate medication administration. The rate of teams following the incorrect order was significantly associated with challenging behaviour of the team and the hierarchical characteristics of the individual stating the order.

Lay Summary

Hospital "code blue" teams attend to a patient whose heart has stopped. They have to quickly and accurately find out what is wrong with the patient and try to fix it, to give him/her a chance of surviving. This takes good teamwork and effective communication, among other things. But this environment is prone to error since team members often don't know the patient or what is wrong with him/her so they have to figure this out quickly. As well, they have to coordinate and carry out many tasks at once, so they don't waste any time.

One way to improve this teamwork is to specifically train teams on these skills. Until recently, teams were only offered training on the medical aspects of their job, like what medications to give, how to work the equipment, etc. We wanted to find out if training team members about specifics of how to work better as a team would make them do the necessary tasks for the patient more quickly, more accurately and in the right order.

We developed a team-training course and tested 51 pediatric resuscitation teams from 4 children's hospitals across Canada. We analyzed their performance in the simulation laboratory and compared their performance before and after taking part in the course.

We found out that teams improved their overall ability to do the necessary tasks on the "patient", do them more quickly, more accurately and in the right order. They also improved their overall teamwork skills (like communication, clarifying roles, etc).

We also did a deeper analysis of the teams' performances while taking part in these simulated resuscitations so that we can find out more about specific challenges in this environment. We observed that many team members had difficulty speaking up to the doctor in charge, and as a result, some teams made mistakes when trying to take care of the simulated "patient". Afterwards, we interviewed some of these staff members to try to understand better why they feel reluctant to speak up. Another thing we observed is that teams seemed not to handle distractions very well. These distractions included having an emotional "parent" in the room (played by an actor) or someone interrupting the team to give them information about the parent. Over the next couple of years we will be studying these distractions further so that we can eventually teach teams how to handle them better.

<u>3 main messages (lay language)</u>

1. Resuscitation teams can be trained to work better together as a team. These trained teams improve their ability to care for patients in a better and more efficient way, which could translate into better outcomes for patients.
2. Resuscitation teams work in a very complex environment and are prone to performing errors. Two common sources of error are failing to speak up and check the orders given by the doctor in charge as well as teams being distracted by parents in the room, among other things. More work needs to be done to understand how to improve these errors.
3. We need to start to study teams working on real patients (not just in the simulation lab) so that we understand better what team training needs to be included. This will make the training the best possible and give teams the best chance to do well by their patients.

Pathophysiology of Perinatal Stroke

Final Project Summary Report

Submitted by Dr. Adam Kirton

Dec 06, 2013

1. Overall Project Achievements (2 page max)

***Over-arching objective**: Build the largest population-based research cohort of children with perinatal stroke – the Alberta Perinatal Stroke Project. Establish the APSP as an international leader in perinatal stroke research and education while building an integrated, cross-disciplinary research network to leverage future studies.*

Achievements: The APSP is now well established as what is probably the largest, well characterized and truly population-based perinatal stroke research cohort. The ICD search strategy employed has proven both informative and highly successful in identifying virtually all affected children in southern Alberta. Our recruitment methods have enrolled >200 families affected by perinatal stroke – previous non-population-based studies perinatal stroke studies typically averaged <100 patients. An analysis of these ICD methods will be published next year.

Thanks to the progress supported by the NeurDevNet LOI, the APSP was one of <20 successful applicants from >240 LOI's for the new AIHS CRIO grants. This 3 year award of $750000 has facilitated the expansion of many of the methods and projects outlines below to collaborators in Edmonton. This will double the power of our clinical research network to continue this work while advancing new initiatives (see below).

Creation of the APSP has quickly generated productive clinical research collaboration networks. Thanks to NeuroDevNet and PHAC funding, we are enrolling patients in the Canadian CP Registry. This effort has provided a solid foundation for growth of other initiatives within our program and the CP arm of NeuroDevNet. The registry has been at the core of numerous team investigator meetings promoting cross-talk amongst NeuroDevNet members on topics ranging from basic science and animal models to knowledge translation and ethics. It has also directly complimented the aims of this OI by promoting novel perinatal stroke risk factor research as we have developed methods to identify and analyze stroke children with two upcoming international presentations and two manuscripts in preparation.

Specific Aim 1. Define and compare comprehensive clinical risk factor profiles in perinatal stroke.

This project developed the most comprehensive risk factor analysis template ever applied to perinatal stroke. We recently conducted an analysis comparing our methods to 4 other major perinatal initiatives. Ours not only carried nearly 50% more variables than the average but was the only method that employed directed parental interview with integration of common data elements from multiple sources. The complexity of this process was burdensome but the dividends are now being realized. Our initial analysis of >50 case-control pairs is yielding novel results with two manuscripts currently in preparation. More importantly, the success of this method has positioned us for major new opportunities (see below).

We have extrapolated this approach into additional data sources. For example, we recently developed a method to diagnose all perinatal stroke cases within the Canadian Cerebral Palsy Registry. This allowed us to perform a novel "syndrome-controlled" risk factor analysis with results to be presented at a major international meeting in February 2014. Our team also now leads the Perinatal Working Group of the International Pediatric Stroke Study (IPSS) – an global pediatric stroke network now crossing >40 countries with >4000 children enrolled. Our study has informed a new approach to examining risk factors across this larger network. We are also leading the International Maternal Newborn Stroke Registry – a novel approach to exploring pathophysiology that will utilize the methods developed here.

Specific Aim 2. Explore placental and inflammatory biomarkers associated with perinatal stroke.

We have advanced new biomarker methods to explore the pathophysiology of perinatal stroke. Using Bioplex technology, we developed and validated a method to obtain, process and analyze biomarkers from neonatal blood spots (Guthrie cards). Results were robust with demonstration of measurable levels of dozens of inflammatory proteins in samples seven or more years old. We compared these to newly spotted inflammatory controls (neonatal sepsis) to demonstrate accuracy and minimal decay over 12 months. The planned case-control (3 children born around each index case) study has yielded very interesting results suggesting alterations in inflammatory cytokine profiles are present in children with arterial perinatal stroke. The prospective arm has also proceeded nicely with neonatal NICU collaborators facilitating biosample collection from index cases, mothers, and infant-mother control pairs over the last 2 years. The prospective case-control data alone, and in comparison to the retrospective blood spot analyses, are anticipated to yield further insight to inflammatory

mechanisms of perinatal stroke. The data produced is complex and we have just established a new relationship with a statistical team with the required expertise to complete the analysis properly. Two or three abstracts and manuscripts are planned in the next 6-12 months.

This particular element is now lead by Dr. Aleksandra Mineyko whose clinical research fellowship was indirectly supported by this NeurDevNet award. She is now on faculty at our institution and driving forward numerous related bioanalytical approaches relevant to many different childhood neurodevelopmental disorders (see below). Additional related growth includes new industry connections and the establishment of a new dedicated pediatrics bioanalytics platform at our institution.

Specific Aim 3. Identify acute and chronic prothrombotic disturbances in perinatal stroke.

Our thrombophilia results have been particularly interesting. We have completed the first ever case-controlled study of prothrombotic disorders in term-born children with fetal periventricular venous infarction. The same methods applied to late-presenting arterial presumed perinatal stroke is also novel. Comparison of both groups to the neonatal arterial population previously suggested to commonly harbour thrombophilias provided a clinically relevant perspective comparable to existing literature. While multiple analyses have been executed, the summary conclusion is that prothrombotic disorders appear relatively uncommon in these populations. Our results are particularly strengthened by the case-control methodology. This has also translated into improved clinical care as our results are establishing new, more accurate age-dependent norms for these tests in children. Previous use of adult or otherwise compromised control values may in part explain previous estimates of higher thrombophilia rates. Our first paper has analyzed genetic thrombophilias across all the perinatal stroke types. The project has been lead by Dr. Colleen Curtis, a pediatric neurology resident, who is submitting the abstract to the CFNS 2014 along with a manuscript to be considered for the CACN President's prize. The second major paper is just awaiting a final piece of control data but is expected to confirm that levels of the remaining 10+ coagulation factors evaluated will show only very weak or no association with perinatal stroke risk. These results promise to add new perspective to the relative role of thrombophilia in perinatal stroke with implications for both understanding pathophysiology and clinical care of patients.

Training of Highly Qualified Personnel

All the following trainees were provided opportunities for cross-disciplinary research experience including attendance at rounds, research team meetings, shared learning, and sponsored opportunities to present their work at major meetings. Note: The following have projects directly related to the OI but the support of the APSP cohort has itself directly facilitated the growth of at least 10 additional trainees.

[redacted] (Clinical Research Fellow). Lead biomarkers component, integrated collaborations with biomarker technologies, neuroinflammation and national experts, and others. Written and obtained individual grants on related work. Translated into new research with immediate clinical implications. Faculty appointment.

[redacted]. Expanded clinical research nursing skills to include case ascertainment, webpage management, online survey execution. Leader in community-based knowledge translation and education, ran HSFA parent support group, authoured Canadian Stroke Network Pediatric Best Practice Guidelines.

[redacted]. Developed expertise in maternal and perinatal risk factor analysis, database management, healthy controls program and biobanking, prothrombotic analysis.

[redacted]. Skills in development of data capture forms, review of medical charts for clinical risk factor extraction, integration of clinical outcome measures, liaising with Clinical Research Unit.

[redacted]. Pediatric neurology resident supported to explore a specific research question during their clinical training. Lead prothrombotic analysis with experiences in data collection, analysis, and collaborations.

[redacted]. Neurosciences MSc (complete). Leveraged experience in case ascertainment and outcomes to complete thesis examining novel neuroimaging (DTI) and outcomes. Papers presented, manuscript submitted.

[redacted]. Undergraduate student. Acquired skills in patient recruitment, study design, and execution. Skills supported independently funded summer studentship.

[redacted] Undergraduate student. Built team relationships with Edmonton, visiting UofA to teach case ascertainment skills. Advanced own project in PVI population, presented at major meeting, paper in Stroke.

2. Project Continuation and Follow-up (1 page)

Please provide a short description of any key aspects of your Project that should be or are being continued either by your project team or with assistance from NeuroDevNet Central. Briefly highlight next steps you are actively taking, including pursuit of external funding opportunities to take this research further [e.g., what agency(ies) have you applied to and please give details regarding application success, pending, or otherwise). Also please provide suggestions on how NeuroDevNet may further assist with these next steps: e.g., relating to the research program, to collaborations and networking within and external to the network, and HQP, training, and internship opportunities.

The following examples demonstrate ongoing growth and future potential directly leveraged by this project:

POPSICLE Study: **P**athophysiology of **P**erinatal **S**troke: **I**nflammation **C**ausing **E**mbolism. This major project is the natural evolution of our work to ultimately determine the pathophysiological mechanisms of perinatal stroke. The preliminary data obtained has positioned us to compete for major funding to launch a multi-centre study within the next 12 months. The current proposal uses many of the methods developed here to execute a more focused, comprehensive evaluation of placental, inflammatory, and genetic mechanisms. Established networks though the APSP, CCPR, and IPSS will aim to fund a 4-5 year, $3-4 million multicentre study with grant submissions to multiple major agencies early in 2014.

Placental Disease. We have established two new lines of investigation through the CCPR and IPSS to obtain and correlate placental pathology results with perinatal stroke diseases with abstract submissions early in 2014. Lead by institutional trainees in combination with leading NeuroDevNet collaborators, this work has the potential to synergize with the results of our OI and develop larger scale projects to elucidate pathophysiology.

Neurogenetics. Our NeuroDevNet OI has banked DNA on >50 children with perinatal stroke. We recently obtained a Hotchkiss Brain Institute (HBI) Robertson Cerebral Palsy Grant ($30000) to study how BDNF polymorphisms influence perinatal stroke outcomes, both naturally and following therapeutic interventions. These initial ventures in simple neurogenetics will position us to work with NeurDevNet collaborators to begin to ask the more complex genetic questions that surround the pathophysiology perinatal stroke.

HICCUP: Healthy **I**nfants and **C**hildren **C**linical Research **P**rogram**.** The normative control systems developed in our OI, including obtaining healthy control blood samples, have been used to start this institutional healthy controls program including a $25000 Department of Pediatrics Innovation Award.

VIPS: **V**ascular effects of **I**nfection in **P**ediatric **S**troke. As co-investigators, we have an approved substudy in this leading pediatric stroke study to use our bioanalytical methods to explore inflammatory mechanisms in this disease. We have already published on this. The methods have also facilitated another collaborative study with the Hospital for Sick Children to explore inflammatory biomarkers. As an IPSS-driven, multicentre, 4 year, $4M NIH-funded project, the example of VIPS also provides the template for the POPSCILE study above. Collectively, this work will drive the growth of the Pediatric Bioanalytics platform.

Neonatal Hemorrhagic Stroke. This is the one variety of perinatal stroke that has been neglected in research despite common occurrence. The APSP methods for ascertainment and risk factor analysis established through this OI are now being replicated in the neonatal hemorrhagic stroke population, promising to create the same potential in another disease.

Networks: This OI has positioned the APSP as the perinatal stroke “core” of many related research networks. As the chair of the IPSS perinatal working group, we are centrally positioned on the global level. Launch of the International Maternal Neonatal Stroke Registry (IMNSR) promises to further expand the international reach of these research methods. As active investigators in the Canadian Cerebral Palsy Registry, we will expand national clinical research networks with improved approaches to perinatal stroke and other specific neurodevelopmental disorders. We are also co-investigators in the Cerebral Palsy Discovery Project, a major initiative within the coming years of NeuroDevNet growth that promises to expand the impact of this initial work. This includes our leading on the development of a CP Clinical Trials Network with the potential to increase options for systematic testing of new therapies for children with perinatal stroke, other types of cerebral palsy, and other NeuroDevNet populations.

3. Outreach and Dissemination of Research and Findings

Please note this work must be attributable to NeuroDevNet funding. Activities that arise from other funding sources and not attributable to NDN should not be listed. Please only report those activities accomplished in relation to this funding.

3A. Outreach Activities

Please indicate key public outreach activities undertaken as part of this project.

The following are activities to include:

- Workshops organized or participated in,
- Community meetings/presentations,
- KT resource development and dissemination,
- Media submissions, and
- Other KTEE activities

Type of Activity	Description	Date(s) of Activity
Community support	Alberta Perinatal Stroke Project (APSP) and Heart and Stroke Foundation (HSFA) Joint Perinatal stroke Support Groups	2010 - ongoing
Resource development	CPSP Website launch and upgrades including educational information, family support resources, research updates	2010 - ongoing
Stakeholder presentations	Heart and Stroke Foundation of Alberta – Mavericks Program, presentations to foundation, administration, donors (many)	2011 - ongoing
National patient interest networks	Heart and Stroke Foundation of Canada – Canadian Partnership for Stroke Recovery – Flagship program for pediatric stroke recovery and rehabilitation	2013 - ongoing
Workshops	CP Cell to Person, Bloorview, Toronto. Invited Speaker	May 2011
Community support	Perinatal and pediatric peer support groups – monthly group meetings, activities, and outings for school-aged kids	2011 - ongoing
Media coverage	Multiple media stories at regional , provincial, national and international levels (http://perinatalstroke.com/research/research)	2011 - ongoing
NCE program integration	Editor and Chair, Pediatric Stroke Best Practice Guidelines Information for Families, Canadian Stroke Network (renewed 2013)	2011 - ongoing
Medicolegal issues	Active involvement in medicolegal implications of perinatal stroke pathophysiology including invited speaker for CMPA law firms	2012 - ongoing
Policy development	Grassroots team for implementation of CIMT program funded by Alberta government, kids now treated in rural Alberta	2011 - ongoing
Workshops	CP In Motion series – 3 annual conferences integrating research, clinical care from patients to parents to policy makers: Co-developer and invited speaker	2011 - ongoing

3B. Translation and Commercialization of Research

Please describe other means by which research deliverables have been disseminated. The following would be items to include:

- Products and innovations*****
- Patent applications filed or Patents issued
- Copyrights
- Licenses granted or under negotiation
- New Start-Up Companies

***** The NCE defines products as "something that can be sold (such as a widget, devise, app, software, a service, etc.)" and Innovations as "a process that begins with the creating of knowledge in research and continues through its application, to benefit Canadian society (examples may include, databases, a web portal, a new policy/process for dealing with children with a disorder, an implemented KM procedure to disseminate information, etc.)

Biomarker technologies. New collaborations established with Eve Technologies (Calgary) to validate and advance biomarker methods including novel neonatal analysis using bloodspots.

3C. Publications List

Please provide citations for any publications that have resulted from the research project and collaborations supported by NeuroDevNet funds.

Peer-reviewed Papers

1. Kirton A, **deVeber** G. Life after perinatal stroke. Stroke, 2013 Nov;44(11):3265-71, epub Oct 8.
2. Murias K, Kirton A, **Brooks** B, **Iaria** G. A review of cognitive outcomes following perinatal stroke. *Develop Neuropsych, in press.*
3. Kirton A. Modulation of developmental plasticity with non-invasive brain stimulation in cerebral palsy. *Int J Phys Med Rehab*, in press.
4. Yang JF, **Livingstone** D, **Brunton** K, **Kim** D, **Lopetinsky** B, **Roy** F, **Zewdie** E, **Patrick** SK, Andersen J, Kirton A, **Watt** J, Yager J, **Gorassini** M. Training to enhance walking in children with cerebral palsy: are we missing the window of opportunity? *Sem Ped Neuro* 2013, 20(2):106-15.
5. Kirton A. Can noninvasive brain stimulation measure and modulate developmental plasticity to improve function in stroke-induced cerebral palsy? *Semin Pediatr Neurol* 2013, 20(2):116-26.
6. Kirton A. Modeling developmental plasticity after perinatal stroke: Defining central therapeutic targets in cerebral palsy. *Ped Neurol* 2013;48(2):81-94.
7. Mineyko A, Kirton A. Mechanisms of arteriopathy in childhood stroke: An inflammatory debate. *Ped Neurol* 2013; 48(1):14-23.
8. Mineyko A, **Narendran** A, **Fritzler** ML, **Wei** X, **Schmeling** H, Kirton A. Inflammatory biomarkers of pediatric focal cerebral arteriopathy. *Neurology* 2012; 79:1406-8. epub Aug 22.
9. Li D, Hodge J, **Wei** X, Kirton A. Reduced ipsilesional cortical volumes in fetal periventricular venous infarction. *Stroke* 2012, 43(5):1404-7, epub Jan 26.
10. Mineyko A, Kirton A. The black box of perinatal ischemic stroke pathogenesis. *J Child Neurol* 2011, Jun 13 epub.

Published Best Practice Guidelines and KTE

1. **deVeber** G, Kirton A, **Lindsay** P, **Rafay** MS (Pediatric Stroke Care Task Group) on Behalf of the Canadian Stroke Best Practices and Standards Working Group. In: *Canadian Best Practice Recommendations for Stroke Care 2013*, Lindsay MP, Gubitz G, Bayley M, Phillips S (Editors). Canadian Stroke Network. In press
2. **deVeber** G, Kirton A, **D'Anjou** G, **Dilenge** M, **Lindsay** P, Miller S, **Nash** M, **Rafay** M, **Rothenmund** S (Pediatric Stroke Care Task Group). *A Family Guide to Pediatric Stroke*, Canadian Stroke Network, http://www.canadianstrokenetwork.ca/wp-content/uploads/2011/10/PEDSGuide-EN.pdf

Abstracts

1. Kuczynski A, **Dukelow** S, **Yajure** J, **Leah** I, Roe J, **Scott** S, Kirton A. Robotic quantification of proprioceptive dysfunction in children with perinatal stroke. *Submitted to ICNC, Brasil May 2014.*
2. Williams E, Oskoui M, Dagenais L, Shevell M, Kirton A for the Canadian CP Registry. Perinatal Stroke in the Canadian Cerebral Palsy Registry: Disease-controlled Risk Factor Analysis. *Accepted to ISC 2014, San Diego, February 2014.*
3. Bemister TB, **Brooks** B, **Rothenmund** S, Kirton A. The POM: A novel tool to assess parental adjustment to caring for a child with perinatal stroke. *Accepted to the 27th European Health Psychology Society Conference: Well-Being, Quality of Life and Caregiving, Bordeaux, France, July2013.*
4. Bemister TB, **Brooks** B, **Dyck** R, Kirton A. The impact of perinatal stroke on parents and families. *Accepted to the 13th European Congress of Psychology, Stockholm, Sweden, July 2013.*
5. Roe J, Rajapakse T, **deVeber** G, **Wei** X, Kirton A. Cerebral diaschisis in neonatal arterial ischemic stroke. *Accepted to CFSN, Montreal, June 2013*
6. Shinde S, **Wei** X, Kirton A. Glial scaring after perinatal stroke: Quantification and correlation to outcome. *Accepted to CFSN, Montreal, June 2013.*

7. Kirton A, **Yajure** J, **Leah** I, Roe J, **Scott** S, Dukelow S. Robotic quantification of proprioceptive deficits in children with perinatal stroke. *Accepted to CFSN, Montreal, June 2013.*
8. Mineyko A, **Brooks** B, **Bello-Espinosa** L, Kirton A. EEG biomarkers of poor neuropsychological outcome following perinatal stroke. *Accepted to CFSN, Montreal, June 2013*
9. Roe J, Rajapakse T, **deVeber** G, **Wei** X, Kirton A. Diffusion imaging of cerebral diaschisis in neonatal arterial ischemic stroke. *Accepted to ISC 2013*
10. Shinde S, **Wei** X, Kirton A. Gliosis after perinatal stroke*. Stroke* 2013; 44: A75
11. Mineyko A, **Brooks** BL, **Carlson** H, **Bello-Espinosa** L, Kirton A. Electroencephalographic biomarkers of abnormal neuropsychological development following perinatal stroke. *Stroke* 2012, in press.
12. Hodge J, **Carlson** H, **Goodyear** B, **Wei** X, Kirton A. Diffusion tensor imaging markers of corticospinal tract integrity after perinatal stroke. *Develop Med Child Neurol 2012; 54:72.*
13. Mineyko A, **Narendran** A, **Fritzler** M, **Wei** X, **Schmeling** H, Kirton A. Inflammatory biomarkers of pediatric focal cerebral arteriopathy. Stroke. 2011;42:e586-e629, epub October 5 2011.
14. **Davies-Schinkel** C, **Rothenmund** S, **Farrell** R, Kirton A, **deVeber** G, **Lindsay** P. Meeting the educational needs of pediatric stroke patients and their families. Accepted to *Canadian Stroke Congress*, Ottawa, Oct 2011
15. Li D, Hodge J, **Wei** X, Kirton A. Quantifying cortical injury in fetal periventricular venous infarction. *Accepted to 2011 Child Neurology Society, Savannah, GA October 2011*
16. Li D, Hodge J, **Wei** X, Kirton A. Ipsilesional cortical volumes are diminished in fetal periventricular venous infarction. *Proc NeuroDevNet Brain Development Conference 2011; page 32.*
17. Hodge J, **Carlson** H, **Goodyear** B, **Wei** X, Kirton A. DTI quantification of corticospinal tract integrity in perinatal stroke. *Proc NeuroDevNet Brain Development Conference 2011; page 30.*

INVITED PRESENTATIONS

National / International

1. Impetus for change: Modulating developmental neuroplasticity after perinatal stroke. *Neurology Grand Rounds, Stanford University, Palo Alto, CA Jan 2014*
2. Applications of TDCS in children with stroke. *NYC Neuromodulation, New York, NY Nov 2013*.
3. Targeting developmental motor plasticity after perinatal stroke with non-invasive brain stimulation*. International Neurorehabilitation Symposium, Zurich, Sep 2013*
4. Pediatric stroke: Applications of non-invasive brain stimulation. *Grand Rounds, Universitäts Kinderspital Zürich – Eleonorenstiftung, Rehabilitationszentrum, Zurich, Sep 2013*
5. Therapeutic advances in cerebral palsy*. NeuroDevNet Brain Development Conference, Vancouver, Sep 2013*
6. Non-invasive brain stimulation to understand and enhance function in hemiparetic CP. *Progress in Motor Control IX Conference, Montreal, July 2013*
7. Brain stimulation to understand and enhance developmental plasticity in cerebral palsy. *NeuroDevNet Kids in Motion Conference, BC Children's Hospital, Vancouver May 2013*
8. Targeting developmental motor plasticity after perinatal stroke with non-invasive brain stimulation. *Visiting professor, Cornell University, Burke Rehabilitation, NewYyork, June 2013*
9. Perinatal stroke: Black boxes and brighter directions. *The Brendon's Smile Foundation Invited Lectureship in Pediatric Stroke, Washington University, St. Louis, Apr 2013*
10. A blood-brain barrier: Hematological mechanisms and targets in pediatric stroke. *Canadian Pediatric Hemostasis and Thrombosis Network National Rounds, Toronto, Dec 2012*
11. Modulation of central therapeutic targets in CP using non-invasive brain stimulation. *American Academy of Cerebral Palsy and Developmental Medicine Annual Meeting, Toronto, Sep 2012*
12. Combing child-friendly intensive rehab with non-invasive brain stimulation. *Canadian Stroke Congress, Calgary, Sep 2012*
13. Applications of Noninvasive brain stimulation in children with cerebral palsy. *CP In Motion Conference, NeuroDevNet, Stollery Children's Hospital, Edmonton, AB, May 2012*
14. Measurement and modulation of developmental plasticity using TMS in pediatric stroke. *Child Neurology Society 2011 Symposium: Non-invasive Brain Stimulation in Children: Neurophysiology and Therapeutics. Savannah, GA, October 2011*

15. Stroke in the fetus and neonate. *The Neonatal Brain Conference, Washington University, St. Louis, September 2011*
16. Perinatal stroke: An ideal human model of developmental neuroplasticty. *California Institute for Regenerative Medicine, San Francisco, CA, June 2011*
17. The black box of perinatal stroke pathophysiology: Directions for illumination. *NeuroDevNet Brain Development Conference 2011, Vancouver, June 2011*
18. Non-invasive brain stimulation to understand and enhance motor function in hemiplegic CP. *Advances in Cerebral Palsy – from Cell to Person Symposium, Holland Bloorview Kids Rehabilitation Hospital, University of Toronto's Division of Developmental Paediatrics and Neuroscience program. Toronto, May 2011*
19. Perinatal stroke: A human model of developmental neuroplasticity. *Neuroscience Grand Rounds, University of British Columbia Division of Neurology. Vancouver, February 2011*

Invited Presentations, Regional / Provincial

1. Perinatal stroke: The perfect human model of cerebral palsy and developmental plasticity. *Department of Community Pediatrics Annual Retreat, Kananaskis, Sep 2013*
2. Modulating developmental plasticity in children with perinatal stroke. *Hotchkiss Brain Institute Annual Research Day, June 2013*
3. Perinatal stroke as a human model of developmental neuroplasticity. *ACHRI Symposium 2013: Injury in the Developing Brain. April 2013*
4. Family centered care: Cultural lesions for a pediatric neurologist. *Family Centered, Culturally Responsive Care Symposium, ACH, Oct 2012*
5. Acquired brain injury in children. *Jeremy Jeanes Neurocritical Care Symposium, Banff, May 2012*
6. Stimulating conversation: Technological modulation of the developing brain to improve outcomes.

   PGME Symposium on Emerging Therapies in Pediatric Neurology, ACH, April 2012
7. Advanced neurotechnologies to understand and treat neurological disorders in children*. Developmental Neurosciences Grand Rounds, ACH, April 2012*
8. Perinatal stroke: Harnessing the power of the developing brain. *Rotary Club of Calgary, Heart and Stroke Foundation of Alberta Research Mavericks Program, October 2011.*
9. Thrombophilia: Mechanisms and investigations in children with stroke. *Division of Hematology Fellows rounds, October 2011.*