

Training highly qualified health research personnel: The Pain in Child Health consortium

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BACKGROUND AND OBJECTIVES: Pain in Child Health (PICH) is a transdisciplinary, international research training consortium. PICH has been funded since 2002 as a Strategic Training Initiative in Health Research of the Canadian Institutes of Health Research, with contributions from other funding partners and the founding participation of five Canadian universities. The goal of PICH has been to create a community of scholars in pediatric pain to improve child health outcomes.

METHODS: Quantitative analyses enumerated PICH faculty, trainees, training activities and scientific outputs. Interviews with PICH stakeholders were analyzed using qualitative methods capturing perceptions of the program's strengths, limitations, and opportunities for development and sustainability.

RESULTS: PICH has supported 218 trainee members from 2002 through 2013, from 14 countries and more than 16 disciplines. The faculty at the end of 2013 comprised nine co-principal investigators, 14 Canadian coinvestigators, and 28 Canadian and international collaborators. Trainee members published 697 peer-reviewed journal articles on pediatric pain through 2013, among other research dissemination activities including conference presentations and webinars. Networks have been established between new and established researchers across Canada and in 13 other countries. Perceptions from stakeholders commended PICH for its positive impact on the development of pediatric pain researchers. Stakeholders emphasized skills and abilities gained through PICH, the perceived impact of PICH training on this research field, and considerations for future training in developing researchers in pediatric pain.

CONCLUSIONS: PICH has been successfully developing highly qualified health research personnel within a Canadian and international community of pediatric pain scholarship.

Key Words: *Interdisciplinary; International; Pediatric pain; Research; Training; Transdisciplinary*

Pain is a major challenge to the healthy development and quality of life of children of all ages. Inadequately treated pain can affect children's cognitive, emotional, social and physical development (1), and induce suffering in siblings, parents and caregivers (2). Children remember pain and may avoid future health care because of painful experiences (3). Pain is often underestimated and undertreated, especially in vulnerable populations such as children (4), yet most pain can be prevented, treated or reduced (5).

To improve prevention, assessment, diagnosis and treatment of pediatric pain, high-quality research conducted by highly qualified personnel (HQP) is needed. The Canadian Institutes of Health Research (CIHR) created its Strategic Training Initiative in Health Research (STIHR), with funding initially available in 2002, to "increase [Canada's]

La formation de personnel de recherche en santé hautement qualifié : le consortium de la douleur dans la santé de l'enfant

HISTORIQUE ET OBJECTIFS : La douleur dans la santé de l'enfant (PICH pour *Pain in Child Health*) est un consortium de formation internationale transdisciplinaire en recherche. La PICH a été créée en 2002 sous forme d'Initiative stratégique pour la formation en recherche dans le domaine de la santé des Instituts de recherche en santé du Canada, avec l'apport de partenaires financiers et la participation de cinq universités canadiennes fondatrices. La PICH visait à créer un groupe d'érudits en douleur pédiatrique pour améliorer l'état de santé des enfants.

MÉTHODOLOGIE : Les analyses quantitatives tenaient compte des conférenciers, des stagiaires, des activités de formation et des publicités scientifiques liés à la PICH. Les entrevues avec les intervenants de la PICH ont été analysées à l'aide de méthodes qualitatives saisissant les perceptions à l'égard des forces, des limites, des occasions de perfectionnement et de la pérennité du programme.

RÉSULTATS : La PICH a soutenu 218 stagiaires entre 2002 et 2013, provenant de 14 pays et plus de 16 disciplines. Pendant cette période, les stagiaires ont publié 697 articles de revues révisées par des pairs sur la douleur pédiatrique, entre autres activités de diffusion de la recherche, y compris des présentations lors de colloques et des webinaires. À la fin de 2013, les conférenciers étaient composés de neuf co-investigateurs principaux, 14 co-investigateurs canadiens et 28 collaborateurs canadiens et internationaux. Des réseaux ont été formés entre les nouveaux et anciens chercheurs du Canada et de 13 autres pays. Les intervenants félicitaient la PICH pour ses répercussions positives sur le perfectionnement des chercheurs en douleur pédiatrique. Ils soulignaient les compétences et les habiletés acquises grâce à la PICH, les répercussions perçues de la formation donnée par la PICH dans ce domaine de la recherche et l'examen de futures formations pour le perfectionnement des chercheurs en douleur pédiatrique.

CONCLUSIONS : La PICH perfectionne avec succès du personnel de recherche hautement qualifié dans un groupe canadien et international d'érudits en douleur pédiatrique.

competitiveness internationally in attracting new, bright, creative research talent and to ensure innovation and excellence in the next generation of Canadian health research training programs" (6). Under the leadership of Dr Patrick J McGrath, a transdisciplinary team (medicine, nursing, psychology) of six established pediatric pain researchers proposed a STIHR in Pain in Child Health (PICH). The PICH website is www.paininchildhealth.dal.ca. The goal of PICH was to create a community of researchers in pediatric pain united to cultivate new talent and promote discoveries in the basic and clinical sciences for the prevention and relief of pain in childhood. The application was successful, and PICH was established to develop HQP in pediatric pain in basic, clinical and health services research as well as in broad, cross-cutting areas such as ethics, advocacy, policy development and practice uptake.

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TABLE 1
Participants in Pain in Child Health (PICH), 2002 through 2013

Category	n
Total graduates of PICH, 2002–2013	131
Cumulative trainees (2002–2013)	218
Studying at Canadian institutions	146
International (studying at institutions outside Canada)*	72
Female/male, n/n	194/24
Entering level	
Postdoctoral fellows	36
PhD students	102
Masters students	59
Undergraduate students	14
Medical students and residents	4
Professional/employed	3
Discipline of trainees	
Medicine	18
Nursing	52
Psychology	108
Neuroscience	9
Pharmacy/pharmacology	13
Interdisciplinary studies	4
Other (including epistemology, computer science, anthropology, education, engineering, public health, veterinary medicine, occupational therapy, physics, kinesiology, pain science)	14
Faculty	
Principal investigators (Faculty at Canadian universities; PICH Management Committee)	10
Co-Investigator Members (Invited faculty at Canadian universities who formally supervise students in pediatric pain research)	14
Collaborators (Invited Canadian and international investigators working in pediatric pain research)	33

*Countries include the United States, Finland, Spain, Belgium, United Kingdom, Brazil, Australia, The Netherlands, Portugal, Thailand, Israel, Sweden and Denmark

PICH functions as a consortium of researchers and trainees, based in Canada but accepting members from around the world. A trans-disciplinary curriculum guides training activities, which include workshops, webinars, visits to other research centres, and other means of providing instruction and mentorship in pediatric pain research (7). Enrollment in PICH requires trainees to provide evidence that their goal is to become active researchers in pediatric pain.

In the present article, a brief narrative of the history, structure and function of PICH is provided, followed by a report of the results of a study providing quantitative and qualitative descriptive data obtained from current and former trainees and faculty members. The goal is to use these results to create awareness of this successful Canadian approach to training HQP in pediatric pain research, providing a model for training initiatives in other research fields and other parts of the world. Future directions in addressing the challenges of pediatric pain and developing and sustaining highly qualified research personnel are discussed.

METHODS

A mixed-methods strategy was used, including quantitative and qualitative approaches to describe and appraise PICH and its outcomes.

Narrative and quantitative appraisal

Current and historical quantitative data were collected from PICH administrative records, trainees' annual reports and PICH annual reports to CIHR from 2002 through 2013. These source documents included data regarding PICH faculty and trainees, and the nature and frequency of training activities and scientific outputs. Frequencies of descriptors and outcomes were analyzed using descriptive statistics.

The primary outcome measure of trainee contributions to scientific knowledge was their peer-reviewed published scientific journal articles. Many publications had multiple PICH trainee coauthors, but these articles were counted only once. Publications were verified by two individuals to ensure that they represented peer-reviewed journal articles and not abstracts, letters, presentations or non-peer reviewed publications. Publications that were reported as 'e-pub ahead of print' and also in published form were counted only once.

Additional outcomes analyzed quantitatively to assess attainment of the goals of PICH included indexes of participation in training activities. These descriptive analyses were also based on data for the training years 2002 through 2013.

Qualitative appraisal

To elicit the perspectives of PICH trainees, graduates and faculty on the value of their experience with PICH, a prospective, exploratory, descriptive study was undertaken. It was designed to provide rich and comprehensive qualitative data on trainee members' development as pediatric pain researchers, individually and collectively.

Following ethics approval, a sample of current PICH trainees, graduates, co-principal investigators, and collaborators was recruited. Purposive sampling was used to ensure a broad variety of participants, including those with both minimal and extensive experience. This sampling approach took into account diversity in profession, age, geographical location, years of research experience and years involved in the PICH program. Membership in PICH for at least one year was required for inclusion in the study.

Individual semistructured interviews were conducted using an interview guide that addressed the specific aims of the study. The interview guides were pilot tested with two PICH graduates in December 2012 and revised slightly. All interviews were audiotaped with the permission of the interviewee. The interviews averaged 30 min in length and were conducted by a doctoral graduate of PICH who was familiar with PICH and trained in qualitative interview methods (MCY). Participants also completed a brief demographic questionnaire providing information about their professional and educational experience, age, sex and length of time spent in PICH.

After each session, the audiotaped interview was transcribed verbatim by a trained transcriptionist. Qualitative content-analysis methods were used to analyze the interview data (8,9). Using an inductive approach, codes and categories emerged directly from the data. Due to the subjectivity of the coding process, two investigators independently analyzed the data to establish credibility. Credibility encompasses rigorous data gathering and analyses, the credibility of the researchers and a fundamental appreciation of the phenomenological paradigm (eg, qualitative inquiry, inductive analyses and holistic thinking) (10). To ensure credibility of the data, the interviews were conducted by a trained interviewer and supervised by an expert in qualitative methods. The data were analyzed by two trained qualitative researchers, both independently and as a team to ensure reliability, with discrepancies resolved by consensus. Demographic questionnaires were analyzed using descriptive statistics.

RESULTS

Narrative description of PICH

Faculty: The faculty grew from the initial six co-principal investigators in 2002 as additional research faculty and pediatric health care institutions were engaged. Following CIHR definitions, as of December 2013 there were, in addition to the nominated principal investigator (BJS), eight co-principal investigators, 14 Canadian coinvestigators, 28 Canadian and international collaborators, 87 current trainees and 131 graduates. Participants in PICH, including trainees and faculty, are described in Table 1.

Leadership structure: PICH is led by a Management Committee comprising the co-principal investigators, with the assistance of a full-time program manager. The initial functions of the Management Committee were: to develop membership criteria and recruitment strategies; to develop the PICH curriculum and related delivery models; to ensure

TABLE 2
Pain in Child Health (PICH) curriculum (9)

Domain of learning	Examples (topics for self-directed or formal study)
Biological basis of pain	Anatomy, physiology, biochemistry, genetics, evolution
Development of pain systems	Interaction of biology and experience in development, maturation of peripheral and central nervous system and behaviour
Cognitive, affective, social and cultural influences	Perception, emotion, memory, cognition, sex, family, culture, societal
Epidemiology and taxonomy	Classification by location and type of pain, diseases, acute, recurrent, chronic, palliative, special populations
Pharmacology	Analgesics, anesthetics, sedatives, anticonvulsants, adjuvants, WHO ladder, pharmacodynamics, pharmacokinetics, pharmacogenetics
Assessment	Measurement, observation, self-report, composite, brain imaging, physiological recordings, nerve conduction studies
Intervention and prevention	Pharmacological, physical, psychological, social, nerve blocks, brain stimulation, complementary and alternative methods, health care systems analysis
Study design	Quantitative: randomized controlled trials, cohort; qualitative: phenomenology, ethnography, grounded theory, evidence-based health care, experimental pain methods, n=1 studies
Ethics	Proxy consent, protection of participants, human experiments, animal experiments, placebo, Tri-Council Policy Statement
Knowledge translation	Individual, unit and systems, facilitators and barriers to change and innovation, interactive strategies, advocacy, policy
Scholarly activities	Writing grants, publications, managing a research group, understanding budgets, forming an interdisciplinary team, mentoring
Career development	Work-life balance, planning for success, institutional and discipline politics, managing your mental health

The methodology for delivering this curriculum includes: self-directed learning using many sources; PICH Institutes (two- to four-day face-to-face workshops preceding national or international meetings, such as the International Forum on Pediatric Pain); monthly international research presentations via web technology; active listserv; short-term visits by trainees to approved research sites to learn specific skills and develop aspects of their research; and interaction between trainees and mentors both within and outside PICH

stable funding models for Canadian trainees; and to expand these models to allow for the integration of international trainees. The Management Committee meets monthly by teleconference to review and revise existing and new policies, plan for future directions, review and develop training opportunities and support consistent with the curriculum, make budgetary decisions and discuss the progress of trainees in relation to the overall goals of PICH.

Five subcommittees, which include management committee members, coinvestigators and trainees, meet independently to make recommendations to the Management Committee. Subcommittees include those addressing electronic communications, evaluation and mentorship, external relations, training institute planning and trainee stipend support. Key activities of the subcommittees are integrated within the following sections.

Membership and recruitment: Details of membership requirements are provided on the PICH website (7). Trainee membership is available to individuals registered as students or trainees in university programs who provide evidence that they plan to become active researchers in pediatric pain. The distribution of levels of enrollment (from undergraduate to postdoctoral) is shown in Table 1. Trainees can remain members until graduation from their programs. Alumni can continue to participate in PICH activities at their own expense, space permitting.

PICH trainee membership began in 2002 with 22 trainees who were all students of the six founding co-principal investigators. Recruitment has expanded beyond that cohort through nominations of students from collaborating coinvestigators, word of mouth in the pediatric pain community, and direct promotion of PICH through conference talks and poster sessions at pain conferences. Overall, 77 (35%) of the 218 trainee members accepted from 2002 through 2013 had research supervisors who were PICH coinvestigators, and 141 (65%) had supervisors who were not PICH coinvestigators. Of the 218 PICH trainees, 146 (67%) were studying at Canadian institutions and 72 (33%) were international trainees. The proportion of international trainees has increased over recent years; for example, of the 28 trainee applications approved in 2013, 19 (65%) were international. Of these 28 new trainees in 2013, 26 (90%) had supervisors who were not PICH coinvestigators, indicating broad outreach beyond the research groups of the core faculty.

The initial focus on training of masters, PhD and post-PhD students resulted in under-representation of investigators from the

discipline of medicine among PICH trainees. In response to several requests for participation in PICH from early- and mid-career physicians, PICH instituted a 'Special Trainee' category of membership. Special Trainees are typically licensed family physicians, pediatricians, anesthesiologists or pediatric emergency medicine specialists who are being mentored in research skills and who have access to all PICH activities, but are not eligible for financial support. By this means, representation of medicine among the trainees was increased, although it remains disproportionately small (18 of 218 [8%]) (Table 1).

Time in PICH: A period of involvement in PICH of approximately three years has been typical. For the 131 PICH graduates enumerated in Table 1, the mean time was 38 months (median 30 months, minimum one month, maximum 99 months). For the 87 current PICH trainees, the mean up to December 31, 2013 was 26 months (median 16 months, minimum one month, maximum 114 months). The maximum periods of eight to nine years were represented by trainees who started as graduate students, had protracted PhD program enrollment and continued as postdoctoral trainees.

Funding: PICH was funded by CIHR for an initial six-year term starting in 2002, and was renewed for a second term from 2009 to 2015, for a total of approximately \$6 million over 13 years. Funding is provided annually by CIHR to the host institution, the IWK Health Centre, with the requirement of a minimum of 70% allocated to direct support of trainees (eg, stipends) and their training (eg, training institutes). Another important funding partner is the Mayday Fund, a private United States-based family foundation dedicated to advancing pain management. The Mayday Fund has partnered with PICH to expand funded training opportunities to trainees from outside Canada. Between 2004 and 2013, the Mayday Fund contributed over \$327,000, which has provided funds for 148 international trainees to attend PICH Institutes and 44 laboratory visits to Canada or other international locations.

Curriculum: PICH exists to promote trainees' development of expertise in pediatric pain research from a transdisciplinary perspective. A broad curriculum was developed to delineate knowledge areas and research skills that trainees are to consider during their training (Table 2). The curriculum was based, in part, on the pediatric pain section of the curriculum of the International Association for the Study of Pain (IASP) (11,12). The topics in the curriculum are frequently the focus of intensive two- to three-day research training workshops or laboratory exchanges. Specific activities and supports for training offered by PICH are listed in Table 3.

TABLE 3
Training opportunities and supports provided by Pain in Child Health (PICH)

Training activity or support	Detailed explanation
Stipends	Trainees may apply for scholarship funding to supplement funding from other sources. Canadian Institutes of Health Research funding guidelines are followed
Webinars	Monthly international Internet-based audio and video presentations by trainees. Participants can ask questions by typing or using their microphone. A discussant facilitates discussion of research issues arising from the presentation
Social media	A listserv allows all trainees and faculty to share resources, announce training opportunities and discuss issues. In 2012, listserv traffic averaged 13 messages per month. A newsletter has been published and is currently being replaced by a PICH website blog featuring reports on laboratory visits and profiles of trainees
Training institutes (workshops)	Once or twice annually, a two- to four-day workshop is held, usually in conjunction with a national or international conference on pain research such as the International Forum on Pediatric Pain. Workshops include community-building and mentoring activities
Laboratory visits	Trainees can apply for funding to support visits to other researchers to learn particular research methods. Reports on these visits are made available to all trainees
Travel grants	Trainees can apply for grants to attend conferences on pediatric pain research that are not associated with a PICH workshop
Community building	Via the website and communication with faculty, trainees in different disciplines and geographical locations are encouraged to collaborate and learn from one another
Mentorship	Individual assignment of PICH Management Committee members as sponsors/mentors for each trainee. Training events focusing on mentorship

Training institutes: The primary opportunity for Canadian and international trainees to come together with mentors and faculty with expertise in pediatric pain research occurs during annual or semi-annual two- to four-day training institutes held at locations across Canada, typically timed adjacent to national and international pain conferences to leverage the most value for the cost of supporting trainee travel. From 2002 through 2013, 16 training institutes have been held (Table 4). The training institute provides a key opportunity for new knowledge acquisition guided by the PICH curriculum and for networking and mentoring.

Stipend support: Direct funding to trainees studying at Canadian institutions has been provided first by distributing available funds via an equal allocation to each co-principal investigator, and later via competitions adjudicated by PICH faculty. Stipends have ranged from small top-up awards of \$5,000 to \$10,000 to scholarships of up to \$40,000 (eg, to support a postdoctoral fellowship). All funding for trainees at Canadian institutions (regardless of their citizenship) has been provided by CIHR. Trainees enrolled in programs at non-Canadian institutions were funded by the Mayday Fund (travel, accommodation and registration only).

Evaluation and mentorship: A comprehensive evaluation is conducted with all trainees annually and following PICH activities on an ongoing basis. Each year, trainee data on scientific outputs and PICH activities are collected and collated for an annual CIHR report. Evaluation of key PICH activities such as the annual training institute and laboratory visits provides insight for planning upcoming activities and the ability to ensure the curriculum components are being adequately addressed.

Mentorship complementing that provided by students' direct supervisors at their home institutions is available in PICH through five mechanisms. First, the face-to-face training institutes provide both direct mentorship (eg, small group roundtables, group work, 'speed networking' sessions) and contact with leaders in the field. Second, webinars are hosted monthly, at which time students present their research (at the proposal stage or completed) and receive input from the international cadre of faculty and students. Third, students can apply for laboratory visit funds to facilitate more in-depth mentoring on a specific methodology relevant to their research. Fourth, mentees are encouraged to contact faculty for advice and mentorship on research and career development issues. Fifth, the PICH e-mail list keeps all the members in touch with one another and provides opportunities to highlight trainee achievements.

Every trainee has an identified sponsor and mentor who is a member of the PICH Management Committee. Given the broadening of recruitment strategies, some PICH trainees have as primary supervisors faculty who are not PICH members and are not specialists in pediatric pain. Contacts between trainees and PICH faculty members in other

locations are frequent. As well, PICH faculty members without identified conflict often serve as external members of the thesis or dissertation advisory committees of PICH trainees at other institutions, across Canada and internationally. PICH training events typically include structured and unstructured methods to bring trainees and mentors together (see Training Institutes above). The PICH sponsor/mentor role has not been closely specified and has varied across trainees. In many cases, trainees have taken advantage of the opportunity to receive advice and input on their research from their PICH mentors, and to visit their laboratories. These relationships have often continued into research collaboration after PICH graduation. For example, the first international trainee, enrolled in 2003, graduated with her PhD in 2008 and is still collaborating on research with her PICH mentor in 2014.

Quantitative outcomes

The primary outcome was trainees' research productivity during their training period. The most public, prominent and most reliably tracked index available was the number of peer-reviewed publications by trainees from 2002 through 2013. Of the peer-reviewed trainee publications (697), 10.2% (71 of 697) had more than one trainee author and, of these, 39.4% (28 of 71) had trainee authors from more than one geographical location. More than one research discipline was represented among the coauthors in 15.2% (11 of 71) of the publications with more than one PICH trainee coauthor.

Figure 1 summarizes the cumulative number of peer-reviewed publications by trainees, together with the annual number of publications and the number of trainees enrolled in PICH during each year.

The total number of peer-reviewed publications per trainee during their trainee membership ranged from zero to 32, with a mean of 0.75 peer-reviewed published articles per trainee per year.

Beyond peer-reviewed publications, there is evidence that PICH has thrived through fostering collaboration across disciplines and regional boundaries. From 2002 to 2013, a total of 60 laboratory visits occurred, of which 66.7% (40 of 60) involved international students coming to Canadian training centres and 21.7% (13 of 60) were within-Canada exchanges. Recently, PICH also began to support Canadian students going to international training centres (5% [three of 60]), and international-international exchanges (6.7% [four of 60]).

Of the 16 PICH training institutes held between 2002 and 2013, 211 trainees were eligible to attend at least one institute; 181 (85.8%) did so. The number of Canadian and international trainees at each training institute is presented in Table 4.

The impact of PICH is also demonstrated by the numbers of trainees who are second or third generation, ie, trainees of former PICH

TABLE 4
Locations, themes and attendance at training institutes

Year	Location	Theme	Trainee attendance, n		
			Canadian	International	Total
2002	Nova Scotia	Pain: What's Special About Children?	19	0	19
2003	Ontario	Did It Work? Evaluating Pain-Relieving Interventions	16	1	17
2004	British Columbia	Early research career skill development	25	4	29
2004	Nova Scotia	Knowledge Dissemination	24	5	29
2005	Nova Scotia	Ethics & Mentoring	24	5	29
2006	British Columbia	Long Term Effects of Pain & Chronic Pain	29	8	37
2006	Nova Scotia	Walking The Tightrope – Balancing Success In Hope And Work Life!	21	5	26
2007	Quebec	Knowledge Transfer	25	10	35
2008	British Columbia	Policy Research	26	10	36
2008	Nova Scotia	Media Training	23	10	33
2009	Ontario	Research Ethics	23	10	33
2010	Quebec	What's In Your Toolbox? Methods For Pediatric Pain Research	23	15	38
2011	Nova Scotia	The Future of Research For Pain In Children	30	14	44
2012	British Columbia	Career Development: Translating Neurodevelopmental Research Into Clinical Application	29	11	40
2013	Manitoba	RCT Boot Camp: Design, Implementation and Interpretation of Randomized Controlled Trials	29	13	42
2013	Nova Scotia	Pediatric Pain Pharmacology	27	18	45

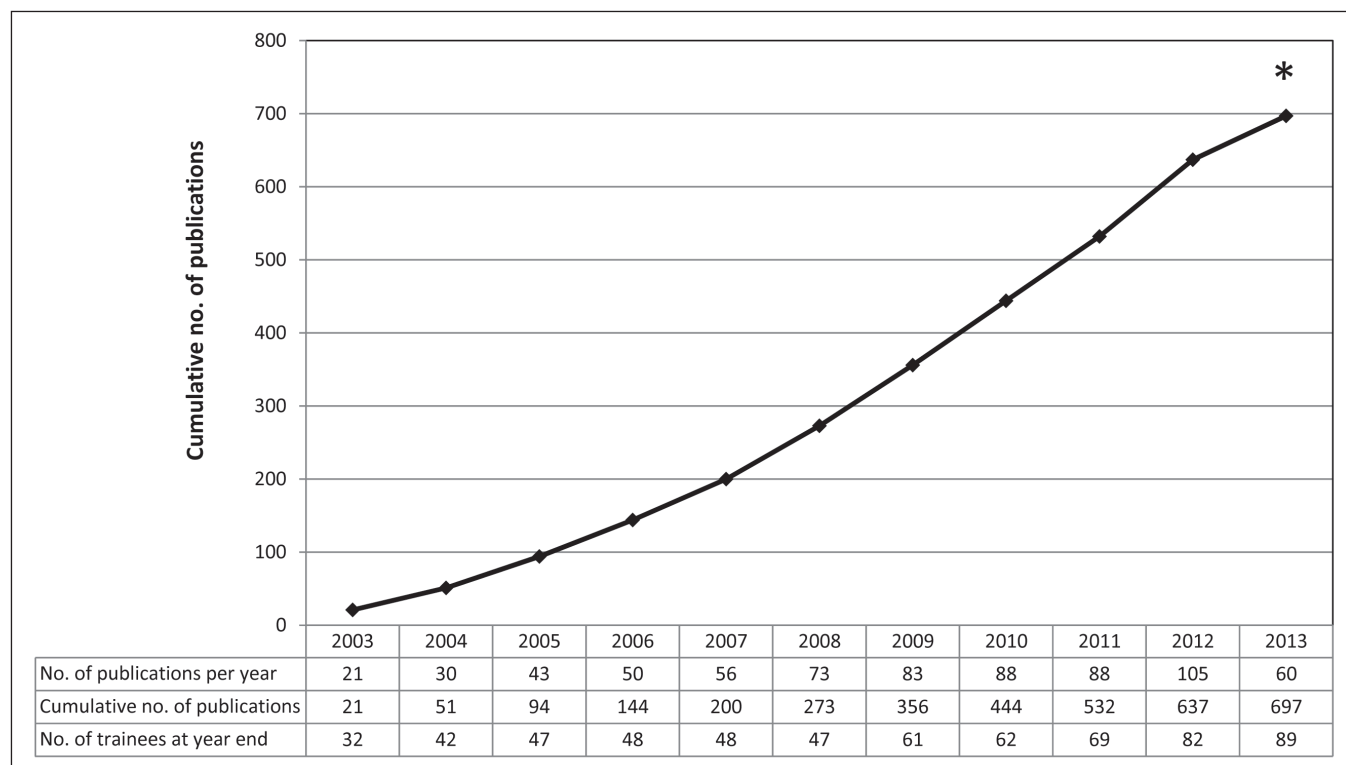


Figure 1) Peer-reviewed publications reported by Pain in Child Health trainees during their training years: number (no.) per year and cumulative number, with number of active trainees at year end. *The publication count for 2013 is partial: for September through December, it included only refereed publications previously reported as accepted or in press

graduates. Currently, 10 graduates from the PICH program are now supervising students who are PICH trainees. In addition, two graduates of the PICH program now serve on the Management Committee as co-principal investigators.

Qualitative results

Twenty interviews were conducted with participants representing various professional disciplines. Eighteen of the interviews (90%) were conducted in person and two (10%) were conducted by telephone from January to August 2013.

A summary of the demographic characteristics of the interview participants is shown in Table 5. The trainees who were interviewed (n=11) had a mean (± SD) of 7.4±8 years of professional experience (range zero to 25 years) and 5±3 years (range zero to nine years) of research experience. Of the eight mentors (alumni, collaborators, coinvestigators), six provided data on their experience: their mean clinical experience was 23±18 years (range one to 52 years) and their mean time in research was 20±16 years (range five to 50 years).

Three main themes emerged from the qualitative data: skills and abilities gained as a result of PICH; perceived impact of PICH

TABLE 5
Demographic characteristics of interview participants (n=20)

Characteristic	Interview participants, n (%)
Age, years	
20–30	8 (40)
31–40	3 (15)
41–50	4 (20)
≥51	3 (15)
Unreported	2 (10)
Female sex	16 (80)
Location	
Canadian	13 (65)
International	7 (35)
Research disciplines	
Psychology	11 (55)
Nursing	7 (35)
Physiotherapy	1 (5)
Medicine	1 (5)
Pain in Child Health involvement	
Current trainee	12 (60)
Graduate (completed training)	3 (15)
Co-principal investigator	2 (10)
Collaborator or coinvestigator	3 (15)

TABLE 6
Interview participants' perceptions of the value of Pain in Child Health (PICH)

Themes	Categories	Selected quotes
New skills and research networks gained as a result of PICH	a) Networking and collaborating with other trainees and PICH faculty	a,b) "I thoroughly appreciate the opportunities that PICH has provided for me, and the financial support, and the mentorship from not just my formal mentor but all the informal mentorship that I've received both from trainees and from faculty. I think it has built my confidence as a researcher and...I've made a lot of friends. Good friends that I will have for my life time and I really appreciate that opportunity."
	b) Trainee mentorship	a) "I can email whomever and request information because I know [faculty mentors] as friends, not just as famous people."
	c) Knowledge and skills gained	c) "And I've also received training at some of the institutes that I've been able to use so...there was one institute that was all about ethics of pediatric pain research and I definitely used that knowledge both in my clinical practice and in research."
Perceived impact of PICH training	d) Supporting scientific output	g,h) "I've been invited on a couple of other people's grants. I have people already across this country that I'm writing a grant with, who are coinvestigators on my grant now. I don't think that would be where I would be as a first-year assistant professor starting out without PICH."
	e) Ability to influence clinical, educational and policy outcomes	
	f) Career promotions	
	g) Funding opportunities	
Considerations for future development of PICH and other training in pediatric pain research	h) Leadership opportunities	
	a) Integrate more PICH trainees in the planning of institutes	a) "I felt like the input of the trainees has been highly valued. I feel like at every institute there are trainees involved with organizing."
	b) Increase interdisciplinary participation	b,c) "I think that it's important for there to be collaboration between both scientists who are doing things at the molecular level and those who are doing clinical work with patients."
	c) Create more collaboration and mentorship opportunities with international members, and between junior and senior scientists	c) "I come from an international setting whereby pain is really not a major issue therefore it's really not considered a priority. . . I'm able to learn what is happening elsewhere and to see the challenges that other people in other regions of the world are experiencing. . . so I'm not alone. There are regions of the world that are experiencing these challenges and they overcome them."
	d) Modify the length of the institutes, include more boot-camp methods workshops and make webinars more interactive and accessible	
	e) Continue mentorship and collaboration after PICH ends	e) "It would still be great to have mentorship. It would be great to give back as a mentor. Also some sort of role in future PICH institutes. That gives you a chance to really be supported to bring your students up in that PICH world too."
	f) Increase publicity of PICH	
g) Encourage mentorship between PICH alumnae trainees with new trainees	g) "I'm thinking back to the dates when I started. It was incredibly uncomfortable because I knew nobody. And everyone seemed to be very – to know each other. It's just something I always pay attention to, I always keep my eye out for people who are quieter and new, who I haven't seen before."	

training; and considerations for the future of PICH and related programs for the development of HQP. These themes, major subcategories and supporting illustrative quotes are summarized in Table 6.

Overall, based on both qualitative and quantitative data, PICH was meeting its goals, attracting a wide range of trainees from multiple disciplines across Canada and internationally. The data suggest that PICH provided a broad array of training opportunities and met the expectations of the trainees and mentors. Further discussion integrating the quantitative and qualitative results focusing on capacity building, impact, innovation and future considerations is provided below.

DISCUSSION

Capacity building

The PICH strategic training program was established to promote the development of highly qualified health researchers in pediatric pain. From the outset, the intent was to bring together mentors and trainees in a manner that bridged geographical and disciplinary boundaries. The ultimate goal was to establish a scientific training infrastructure that would support improved care for children with pain. A description of the structure and productivity of PICH has been presented to facilitate dialogue on the value of STIHRs in our national research landscape and to provide a comprehensive summary of the outcomes of PICH over the past 12 years. Peer-reviewed outputs of our trainees showed steady increases over the decade for which data were available, with a substantial portion of publications demonstrating collaboration among different sites across Canada and globally, the result of networking and mentorship at multiple levels of the PICH program. Clear evidence demonstrated influences on the growth of the next

generation of researchers with 10 of our earlier trainees having achieved the status of PICH research supervisors themselves. Planning for the sustainability of PICH was demonstrated with two alumni being invited to take on leadership roles on the expanded management committee as co-principal investigators.

Experiences of the PICH members interviewed were uniformly positive, irrespective of age, stage of research career and disciplinary diversity. The key themes suggest that skill development, professional networking and new career opportunities were the most salient advantages of membership. Looking to the future, a continuing need for greater integration of trainees in the planning of training institutes and a broadening of the discipline base of the faculty was identified.

Diversity has characterized PICH in many ways. The curriculum, comprising topics trainees are expected to learn about in the course of their training, is strongly transdisciplinary, integrating biological, psychological, social and ethical perspectives, as well as support for career development, grant writing, mentorship and related skills. The program crosses disciplinary boundaries in both basic and clinical science (rather than just including individuals from different disciplines). The term 'transdisciplinary' rather than 'interprofessional' is used because PICH does not focus on professional skills in the sense of clinical practice. For example, basic neuroscience is not considered a health care profession but is an important part of PICH training for trainees in all disciplines.

PICH trainees have often commented on the opportunities afforded at training institutes for international and interdisciplinary collaboration. Several groups of trainees from multiple countries and disciplines have convened after training institutes to pursue common interests. A frequent comment is that such opportunities would not have been available in their own training programs. Many trainees have also stressed the importance of informal access at training institutes to faculty experts.

The pedagogical approaches to learning have also been highly varied throughout the period of development of PICH. These have included Internet-based distance learning methods, residential workshops at training institutes in many locations across Canada using a wide variety of interactive and collaborative learning activities, and individual mentorship, often by mentors who are not in the same location or discipline as the trainees they are supporting. Diversity of content and learning strategies has been complemented by deliberate efforts to bring together trainees with diverse scientific, professional, nationality, ethnicity and first-language backgrounds. Feedback from trainees overwhelmingly supports the contribution that this exposure to diversity made for gains in their personal development as researchers, teachers and mentors to others.

Impact and external recognition

External, independent data support the success of pediatric pain research in Canada, with PICH at the end of its first decade contributing to the impact of Canadian research on the scientific community worldwide. In 2012, under the direction of the Canadian Minister of Industry, the Council of Canadian Academies released a report on the state of science and technology in Canada. In *The State of Science and Technology in Canada, 2012*, pediatric pain was identified as first in research productivity in a list of the top 10 Canadian highly specialized research clusters (13). Canada's share of world publications on pediatric pain, at 15.5%, was greater than Canada's proportionate share of world research on the environment, fisheries, geology, oil, gold and other major Canadian investigative themes. For reference purposes, the report indicates that Canada has <0.5% of the world's population and produces 4.1% of the world's research articles.

The high level of support in PICH for the development of female scientists has been noted as a strength. Eighty-nine percent of PICH trainees and graduates are female. To some extent, this proportion reflects the high proportion of women in the training programs from which most of the trainees are drawn – ie, psychology (pediatric psychology, clinical child psychology) and nursing (pediatric nursing).

PICH has received further external recognition. For example, in a recent article by investigators in the United States regarding training pediatric pain psychologists, participation in PICH is recommended to trainees (14). A British leader in pain research described PICH in a published interview as a "pocket of good practice" and as "very popular and very successful" (15).

Limitations of the present summary

While refereed publications by PICH trainees have been carefully tracked (Figure 1), and qualitative descriptive data are presented (Table 6), several other outcomes of PICH training could be considered. Specifically, it would have been desirable to include information on external funding received by trainees as a result of their involvement in PICH (scholarships, research grants, bursaries, travel awards, prizes). In addition, other scientific outputs, such as conference presentations, published abstracts and knowledge translation activities, could be considered. Partly as a result of difficulty in attributing these potential outcomes to PICH involvement, and partly as a result of our not having set up systems to report, collect and screen this information from the outset, these potential outcomes are not presented here. We can only offer our impression, uncorroborated by comprehensive data, that many PICH graduates have received external funding directly related to projects performed as PICH trainees, and that conference presentations (posters, workshops, invited lectures) by PICH trainees number in the thousands.

Innovation

The support of CIHR, the Mayday Fund in the United States and other organizations has allowed this strategic research training program to pioneer an innovative and successful approach to promoting the development of highly qualified researchers in pediatric pain. The program harnessed the high level of energy, skills and productivity of carefully selected trainees. Over the past decade, many PICH trainees have become emerging leaders in the field, both nationally and internationally.

The participation of trainees on different continents in the Internet-based international laboratory meetings, including those in distant time zones who have had to join the seminars late in the evening or very early in the morning, has attested to the high level of interest in these training opportunities. Specifically, trainees have contributed to the development of research projects by other trainees and faculty in other disciplines and in other locations around the world. The Internet-based research conferences have frequently given rise to continuing discussion and collaboration among separate laboratory groups who have uncovered shared interests and can contribute resources.

PICH trainees have become a highly visible, energetic and influential group at interdisciplinary conferences on pain in childhood such as the International Symposium on Pediatric Pain. They also constitute a strong trainee membership at professional meetings such as those of the Canadian Pain Society and the IASP. Trainees have an outstanding record of awards for posters and other student achievements at related conferences in aspects of child health. It is also noteworthy that leadership and mentoring has turned out to be self-sustaining as senior faculty are being replaced by new supervisors and mentors with high levels of competency.

Challenges and future development

Overall, PICH has achieved a high level of success in meeting its goals. However, there have been challenges. First, PICH was intended to be a strongly transdisciplinary training program, yet a high proportion of the trainees are from the two disciplines of psychology (50%) and nursing (24%). Although this is representative of the disciplines of the founding faculty of PICH, we continue to strive to recruit from other disciplines and have been successful in including trainees in pediatrics, anesthesia, pharmacy and pharmacology, physical and occupational therapy, anthropology, bioethics,

informatics and neuroscience. As well, these disciplines are demonstrably enthusiastic about collaborating with one another. We continue to focus on recruiting trainees from new and varied disciplines, further fostering the transdisciplinary nature of this community of scholars in pediatric pain.

With changing priorities for existing funding sources, a second challenge concerns future funding for training workshops, trainee support such as stipends, sponsored laboratory visits, other activities and administrative support associated with PICH, activities that appear responsible for the success of PICH. While the PICH community itself can continue to thrive and grow as an online community of scholars using social media at low cost, it will become more difficult to bring trainees and their mentors together in the same location for training institutes and laboratory visits. Alternative funding models and sources are a focus for future planning. For example, direct funding for trainees' participation in PICH may be built into their supervisors' research operating grants rather than into a centrally funded training initiative. To address future funding possibilities and guide the process, a strategic planning session was held in late 2013 and attended by a wide variety of national and international stakeholders from academia, health care, industry and government. Future planning is a key priority for PICH in the immediate future.

Areas for future expansion in the curriculum have been identified. These include implementation science, advocacy, new emerging research disciplines such as information technology to support pain assessment and management, public and institutional policy development, and entrepreneurship (including possible commercialization and revenue generation).

While the main focus of PICH has been on development of HQP in Canada, the program has extended internationally to include trainees and investigators in 13 other countries to date with the support of the Mayday Fund. Still to be developed further are relationships with international organizations that could use aspects of the PICH training model to promote and coordinate research training in

pediatric pain. Among these would be the Special Interest Group on Pain in Childhood (www.childpain.org) of the IASP, and the worldwide national affiliates of the IASP. An initial collaborative project of PICH with the Special Interest Group on Pain in Childhood, the Canadian Pain Society and other partners was the development of an international, interdisciplinary online course about pediatric pain, which is ready for launch in 2014.

CONCLUSION

PICH has successfully created a Canadian and international community of scholars in pediatric pain research, increasing the productivity and quality of scholarly inquiry in this field and, we believe, contributing to the prevention and management of pain in newborns, children and adolescents globally. An important strength of the program has been its capability in bringing together trainees and faculty from many different scientific and clinical disciplines involved in the study of pain. Among our successes, we have learned key lessons on the value of networking and mentoring, the ability to be nimble and adaptable to ever-changing resources and needs for HQP, and the need for effective knowledge translation to bridge the gaps between research, clinical practices and child health outcomes.

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