

**Faculty and Resident Perceptions About Teaching and Learning
the Pediatric Musculoskeletal Examination**

BY

CLARE HUTCHINSON
M.D.C.M., McGill University, 2004

THESIS

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Defense Committee:

Ilene Harris, Chair and Advisor, Medical Education
Maria Athina Martimianakis, University of Toronto
Scott Reeves, University of London
Rayfel Schneider, University of Toronto
Rachel Yudkowsky, Medical Education

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SUMMARY

A qualitative study designed to investigate and describe the experiences of teachers and learners of the Pediatric musculoskeletal examination in a single tertiary care centre was conducted. Interviews were conducted with eight Pediatric Rheumatology teaching faculty and 15 General Pediatric residents who have completed their Pediatric Rheumatology rotation.

As themes were formulated, Bandura's social cognitive learning theory served as a framework to illuminate and interpret our findings. In particular, Bandura's description of the process of self-regulated learning provided deeper understanding of issues raised by participants, including: the onus for successful learning falling to the learner; self-monitoring behavior and the disconnect between motor skills and clinical interpretation; the role of the joint count and the hidden curriculum surrounding this issue; and diminishing skill and confidence with lack of practice in subsequent rotations. The factors that facilitate learning the musculoskeletal examination may be used to inform future curriculum development

I. INTRODUCTION

A. **Background**

Despite our efforts in teaching the musculoskeletal examination to medical students and residents, many Pediatric patients will have significant functional limitations identified on their first visit to a Pediatric Rheumatologist due to delays in recognition of their inflammatory joint disease [1]. There are multiple factors that make teaching and conducting a joint exam in children particularly difficult. The physician must be knowledgeable about the normal musculoskeletal growth of a child, must correctly interpret children's reactions to exam maneuvers in the context of their developmental ability to communicate pain and discomfort, and must have the patience and expertise to pick up on subtle clinical findings [2]. Given the challenges of performing the Pediatric musculoskeletal examination, Pediatric trainees tend to be uncomfortable examining the joints of children, and may therefore end up avoiding doing this examination [3]. We suggest that the manner in which the Pediatric musculoskeletal examination is taught and learned may contribute to resident discomfort with conducting a Pediatric joint exam and could, therefore, also be contributing to delays in diagnosis of inflammatory joint disease.

B. **Instruction and Assessment of the Musculoskeletal Examination**

Undergraduate learning objectives for adult musculoskeletal education have been outlined by a number of authors [4-6]. However, despite these published learning objectives, studies have shown that medical students, residents and family doctors have poor musculoskeletal knowledge, as documented by use of the validated Freedman-Bernstein basic

musculoskeletal knowledge written examination [7-11]. Barriers to successful teaching and learning of the adult musculoskeletal exam by medical students have been identified in qualitative studies, including inconsistency in what is taught among subspecialists, poor teacher confidence in teaching the examination, lack of time for instruction in the examination, student deficiencies in basic anatomy knowledge, and the perceived cumbersome and lengthy nature of the joint examination [12, 13].

Various strategies for teaching the musculoskeletal examination have been considered, including the use of adult “patient-partners” with arthritis as teachers of the joint examination [14-20]. To date this approach has not included the use of children as teachers, which may limit its applicability in teaching the Pediatric joint examination, although exploratory work in this area has begun [21]. The Gait-Arms-Legs-Spine (GALS) screening exam for adults has been widely used in medical schools across the United Kingdom [22]. Foster et al have described the pGALS, a modification of the adult GALS, designed to make it more appropriate for medical students conducting a Pediatric examination [23-25]. However, whether GALS or pGALS enable medical students to identify abnormalities on the joint examination in a clinical context has not been documented.

Many of the studies validating instructional approaches for the joint examination, such as GALS or patient-partners, have relied heavily on learner self-assessment as their outcome measure. Self-assessment, defined as a self-assigned global rating of how well an individual estimates they perform in a particular domain, has been shown to be unreliable, with little correlation to actual performance, and therefore not ideal for determining whether an instructional method is effective [26]. In contrast to our limited ability to aggregate our experiences into a meaningful overall self-assessment, recent literature has shown that we can

engage in accurate moment-to-moment self-monitoring, therefore showing an awareness of our strengths and weaknesses in a specific situation [27, 28]. This capacity to self-monitor is important for all medical professionals, as we are responsible for identifying and managing our own individual learning needs throughout our time in practice [29].

C. **Purpose of the Study**

Regardless of the chosen study outcome measure, of the instructional approaches described, most were designed for medical students examining adult patients, leaving the question of how to best teach the Pediatric joint examination to post-graduate trainees. We have only a limited understanding of advanced learners' perspectives on learning the Pediatric joint examination - what they experience as they go through training, why they prefer certain methods of instruction over others, and their confidence in performing this examination during and after their training. This situation creates an educational "black box" type of effect – we have some idea of what happens, but we don't know why. The purpose of this study is to elicit the perspectives of teachers and trainees about the experience of teaching and learning the Pediatric musculoskeletal examination in a post-graduate context, using rigorous qualitative methods, as a basis for designing a Pediatric musculoskeletal examination curriculum that will be relevant, learner-centered and effective.

II. METHODOLOGY

A. **Design**

We used a grounded theory approach to investigate and describe the experiences of teachers and trainees with learning the Pediatric joint examination at the Hospital for Sick Children, a tertiary pediatric hospital in Toronto [30]. The general Pediatric residents at the Hospital for Sick Children all spend a month on the Pediatric Rheumatology service during their second year, with approximately 20 to 25 residents participating annually. Access to a large number of Pediatric residents, being taught by multiple teachers, allowed for exploration of a great breadth of trainee experience.

B. **Study Population**

The study populations consisted of a purposeful sample of the following groups of participants: 1) Pediatric Rheumatology faculty members at the Hospital for Sick Children and 2) general Pediatric residents at the Hospital for Sick Children who are in the postgraduate Year Two, Three and Four cohorts and have completed their Pediatric Rheumatology rotation. In order to gain a deeper understanding of whether the skills acquired during their rotation are retained and used over time, for the purpose of analysis, the Pediatric residents were divided into two groups: junior and senior residents. “Junior residents”, who had completed their Pediatric Rheumatology rotation in the previous 12 months, will have spent the remainder of their academic year in a series of subspecialty rotations, with little chance to practice what they learned in Pediatric Rheumatology. “Senior residents” are those who completed their rotation in the previous 13-24 months and will have participated in General Pediatric rotations in the in-

patient and out-patient settings for the previous year, where musculoskeletal complaints may be more frequent.

C. **Interview Script Development**

Semi-structured individual interviews of approximately one-hour duration were conducted in-person. Separate interview scripts were developed for each group – faculty and residents, focusing on their experience as teachers and students of the Pediatric musculoskeletal examination. Learning theory, in particular Bandura's social cognitive learning theory and concepts of learner self-regulation, served as a source for interview script development [31, 32]. An iterative approach was used, associated with a grounded theory design, such that the interview scripts were altered on an ongoing basis as redundancy or new areas of interest were identified.

D. **Sample Size**

Research ethics board permission was obtained at both the Hospital for Sick Children and the University of Illinois at Chicago. Prior to beginning each interview, written informed consent was obtained. Interviews were recorded and transcribed verbatim; data was de-identified and confidentiality maintained. Sample size was determined as the study progressed. Specifically, interviews were continued until saturation was reached with the themes identified. In total, eight faculty, eight "senior" residents, and seven "junior" residents were interviewed.

E. **Analysis**

Interviews were analyzed on a rolling basis, using a constant comparative method of analysis [33]. We were open to identification and exploration of concepts we had not a priori considered; however, we were also primed by the learning theory and musculoskeletal examination literature. The primary investigator (CH) identified themes and developed a coding system. A second investigator (SR) coded a sample of the interview transcripts. Themes identified were discussed, and a set of themes, with related codes, was agreed upon. Subsequent interview transcripts were analyzed and coded in relation to the category of participant (faculty, junior resident, senior resident). As the analysis progressed, there was continued comparison of themes identified within and among groups, with input from multiple investigators (CH, TM, SR, IH).

F. **Bandura's Social Cognitive Learning Theory**

As themes were formulated, Bandura's social cognitive theory served as a framework to illuminate and interpret our findings [31, 32]. His description of the dynamic three-way interaction among the learner, their behaviors, and the learning environment rang true as themes were identified. When focusing on the characteristics of the learner in greater depth, Bandura's explanation of the method by which learners achieve self-regulated learning echoed the perspectives expressed by both teachers and trainees in our study. Learners begin with "self-observation", whereby they examine their own behaviors; they engage in "self-judgment", by comparing their performance with pre-established goals; finally, their "self-reflection" determines whether they are achieving their goals, or conversely, if progress is lacking in

achieving their goals. Bandura's description of the necessary components of self-regulated learning will serve as the framework for analysis for this research paper.

III. RESULTS

A. **Self-Regulated Learning: Onus is on the Learner**

Self-regulated learning is the cornerstone of continuing professional development for physicians. We are charged with taking an active role in identifying our areas of strength and remediating our limitations. Consistent with this philosophy, throughout the study, both learners and teachers described the importance of learner engagement in the process of acquiring musculoskeletal examination skills. Learner motivation, dedication, and self-reflection were viewed as important by participants at all levels of training. The junior trainees described the importance of seeking out opportunities to practice, because repetition was viewed as integral to skill development. A resident commented,

“I think the onus really comes down to us, through reading, through looking at videos, through practicing with our friends, to taking every patient and doing a joint exam. I think those opportunities are there, and it's up to us to seek out those opportunities.” (JR1)

Senior trainees described the need to direct their own learning to an increasing degree as they moved through the training program, paralleling their developing clinical independence: A resident commented,

“I don't get supervised as much at this stage of my learning. I don't know when the last time I was actually observed doing a joint exam was, but I probably should take the initiative to try and have myself observed doing these joint exams a little more so that I can improve my examination skills because I know they are not as good as they could be.” (SR7)

Faculty commented that the greater the motivation of the trainee, the more likely they were to be successful in acquiring the necessary skills during their rotation. A faculty member commented,

“Some residents are a little more keen about getting into exam rooms to actually see things, they're actually quite active and seeking out opportunities to learn where others are more passive and I think that makes a difference too.” (F4)

As illustrated, each group of participants described the values inherent in self-regulated learning. The steps through which one may practice self-regulatory behavior are outlined in Bandura's self-regulated learning theory and include self-observation, self-judgment and self-reflection.

B. **Self-Observation: Going Through the Motions**

Self-observation requires paying close attention to one's own performance. When considering their skill level prior to starting their Pediatric Rheumatology rotation, both junior and senior trainees felt discomfort with the musculoskeletal examination. In particular, they commented that although they may know the names and steps to complete a particular manoeuvre in a joint examination, they were often unsure of how to interpret their physical findings. Both senior and junior residents commented,

"I knew the different motions to go through to examine for effusions but I wasn't necessarily sure what I was looking for or didn't have very much comfort level in assessing whether I had positive or negative findings." (SR7)

"Reviewing what the different tests are, what the names are, what the motion is, but to actually see if I could identify if someone had a click or an effusion, or any joint laxity, I didn't feel comfortable that I would actually find the findings unless someone else pointed it out to me and then I could then imitate it." (JR3)

Conversely, there was a strong feeling among some faculty that this is a relatively uncomplicated skill, perhaps not recognizing the dichotomy that was described by the trainees between knowing where to put your hands, versus being able to identify a physical finding. A faculty member commented,

"The MSK system is a very straightforward thing, if you know what you're looking at. The options for the test that you should do to figure out what's wrong are relatively simple." (F2)

However, faculty did acknowledge that the joint examination is often not emphasized in the undergraduate curriculum. As one faculty member commented,

“I think there’s a lack of teaching of the MSK exam during medical school and it’s not emphasized by many of their rotations. The MSK exam is often the last part of the physical exam that someone would think to do in hospitalized patients, so they just don’t have the practice, and when you get out of practice you forget to do it.” (F3)

In order to counteract the lack of comfort they may have upon beginning their rotation, trainees emphasized the importance of having teaching faculty directly observe their joint examination, and providing immediate, specific feedback, as a crucial component to discovering deficiencies and improving performance. As both junior and senior residents commented,

“You can read about it, and we do read about it, and you can practice it on people, but I think until you have someone who has an expertise in the area, that’s the biggest barrier. It’s great for me to go into all of these clinic rooms and to practice the exam on patients, but you know what, sometimes it’s just nice to have someone behind you saying okay, if you move your hand a little bit this way or if you try and bend the knee this way or whatever, this is what you actually see or you missed this test, or you missed that, you need that observation” (JR3)

“Feedback right after the patient interaction is most helpful because I think that’s really hot on your mind, that’s something that you can visualize, you get a good sense of what your skills are and where your deficiencies are. I think when you get feedback in the clinic that’s really most helpful because there’s another fresh patient waiting for you and that gives you another opportunity to practice things.” (JR1)

They felt that merely observing their teacher performing a joint examination was insufficient for effective learning, and that this type of passive learning was less valuable than observed assessment of their performance. A junior resident commented,

“Sometimes when you’re observing others, it is a bit of a passive process. I think the way most people learn is you have to be actively involved and sometimes when you’re just observing, it’s a bit difficult. Especially when staff are doing the tests or fellows are doing the tests without talking through what they’re doing, I find that not as helpful obviously. When they show you a manoeuvre and then you get a chance to repeat it, that’s a little bit more active.” (JR3)

This appreciation of active learning, through practice and feedback, may reflect trainees engaging in self-monitoring behavior, which will help them identify weaknesses in their own

skills. Teachers may unknowingly be playing a crucial role in helping trainees engage in effective self-monitoring by providing timely, precise feedback during a clinical encounter.

C. **Self-Judgment: Risk of Losing the Forest for the Trees**

Self-judgment requires that a learner compare their performance to a pre-established criterion. The most common gold standard by which trainees assessed their own performance was the comparison between their joint examination and that of the Pediatric Rheumatologist they were working with. Faculty were less concerned with the exact active joint count that a trainee would report, and instead focused their teaching on identifying abnormalities in important large joints, in particular if this would affect therapy. A faculty member commented,

“If we’re going to quibble over every small joint, I think you can lose the forest for the trees. I think if they are missing some key joints like a hip or a jaw or a knee then it’s worth spending time on it... It becomes important when it affects your decisions for therapy and I think that’s ultimately what we’re talking about. For somebody in the community, do I need to refer this patient, have they gotten worse, are they the same, are they better - I think they need to be making those kinds of calls.” (F4)

For the most part trainees echoed this sentiment, assessing their performance in the areas they thought were most important. A junior resident commented,

“I think if I didn’t pick up the bigger joints and it was a bigger joint problem, I’d be more disappointed that I hadn’t picked it up. The smaller joints I would cut myself slack because I think that those are super hard in general and that really is a function of the number that you’ve seen for the most part.” (JR6)

Both trainees and faculty recognized that even faculty might disagree about the number of active joints for a given patient assessment. Comments included,

“Probably if you got 10 rheumatologists to examine the same hand then you may get 10 different opinions on, ‘is there an effusion there or not’, so in terms of exact number, I wouldn’t get too hard on myself” (JR2)

“You would have to ask the residents that, but I’d imagine they’d say, ‘he’s full of crap, how come he says there’s an effusion and she says there isn’t an effusion and what am I supposed to do, they’ve been doing it for 20 years and they don’t know’.” (F1)

Trainees commented that this discrepancy in assessment between different practitioners might play a role in decreasing their confidence in their own skills:

“In rheumatology clinic you see a patient with known arthritis, and you think that maybe a couple of the joints are active, and then the fellow goes to review the patient and they find even more joints, and then the staff goes, and they find even more joints. I think that made me less confident in being able to like identify joints with arthritis.” (SR6)

Although this issue of variation in joint assessment among Rheumatology specialists was recognized by both trainees and faculty, it seemed that it was a part of the hidden curriculum that trainees had to discover on their own, rather than an openly acknowledged fact. Trainees may benefit from early identification of this inherent discrepancy among examiners, to allow them to focus their attention on how their exam findings affect clinical decision making.

D. **Self-Reflection: Diminishing Confidence, Diminishing Skill**

When engaging in self-reflection, learners determine whether they are progressing toward their clinical goals, or are failing to do so. The structure of the residency training program, and the opportunities it provides for ongoing skill practice and therefore self-monitoring, may affect this process.

Similar to many post-graduate training programs, at the Hospital for Sick Children, residents spend their time moving from one rotation to another, generally on a month-to-month basis. One of the unintended side effects of this system of sequential immersion in different clinical settings is that although their month-long experience on a given rotation may provide them with a wealth of knowledge and skill in that particular area, by the next month they have moved on and may have little chance to practice the competencies they have just mastered. The

negative impact this may have on musculoskeletal examination skills was reflected in statements made by junior and senior residents:

“In residency, the way that it’s set up, it’s very compartmentalized. We are forced to focus on different aspects [in different rotations] and so I think as time passes and you don’t get a chance to practice your exam skills on specific rheumatological findings, I think for sure some of those skills diminish, and some of your confidence does diminish.” (JR1)

“I think [my confidence] was probably at its peak when I left the rotation and then kind of waned throughout the rest of the year as you rotate through all the different subspecialties.” (SR4)

However, some of the senior residents commented that although it may not be a top priority in terms of overall physical examination skills, there was a resurgence in confidence as their chances to practice increased over time, in rotations such as the emergency department and general Pediatric ward. Residents commented.

“Although ideally a joint exam should be done as part of your whole exam, in reality often it gets left until the end so it’s kind of cursory. I don’t think I am just speaking for myself, I think I see this in the other people’s consult notes. I think it’s one of those exams that the more frequently you do it, the more normal joints you see, the more likely you are to notice something abnormal.” (SR6)

“I do remember a couple of kids who had joint issues that I did examine, and the more experiences I’ve had, the more comfortable I feel with the exam.” (SR5)

Interestingly the faculty were more cynical than the residents about the reality of what happens to joint exam skills once residents leave their Pediatric Rheumatology rotation. A faculty member commented,

“Because most kids don’t have [rheumatological] problems, as residents get further away from their training, they pick up their own ways of getting through things quickly and will realize that this is a waste of time in the exam of most healthy patients. Residents who go into other specialties are not going to do it.” (F1)

In particular, choice of future career was thought to have a significant impact on the importance placed on mastering these skills, as reflected in comments made by both residents and faculty:

“I am going into endocrine for a fellowship, so I don’t think it will really be that important, but it’s always a good skill to have.” (JR5)

“Cardiologists, honestly, they are a one organ doctor. I am not saying they’re bad, they’re really good, it’s an important organ, but they don’t care [about the joint exam], honestly they don’t.” (F8)

The faculty were able to offer a unique perspective on how this loss of musculoskeletal examination skills manifests over time, and how this impacts the quality of the referrals they receive from community colleagues. A faculty member commented,

“I don’t think [residents] would necessarily make it a part of their general physical exam, and I think that we are probably seeing that now when we get our referrals from the community. Some of our referrals are coming from general pediatricians who we’ve had the opportunity to see through our clinic, even some of the adult fellows who come through, and I think that if they are not given the opportunity to practice, it’s just a skill that they let disappear.” (F4)

This lack of longitudinal experience is presumably not unique to Pediatric Rheumatology, but may affect multiple different specialized bodies of knowledge and skills that residents experience as they progress through training. However, given the large number of specialty clinics and experiences required to develop as a complete Pediatrician, it may be a hurdle that is difficult to overcome.

IV. DISCUSSION

A. Learning Theory

Similar to what has been found in previous studies of learning the musculoskeletal examination, our trainees reported that this is can be a challenging examination for them, both in examination skills and interpretation of findings [12, 13]. With Bandura's social cognitive learning theory as a sensitizing concept, we were able to obtain significant insight about the experiences of postgraduate trainees learning a Pediatric joint examination , although other educational theories relevant to professional practice were also considered, in interpretation of findings. Behavioral learning theory focuses on a change in behavior as evidence of learning; however, as demonstrated by the comments made by participants in this study, successfully mimicking the behavior of putting your hands in the right place does not always translate into meaningful interpretation of musculoskeletal abnormalities [34]. Although constructivist learning theories, such as Kolb's learning cycle theory, do take into account the iterative cognitive processes that take place as trainees learn to conduct a joint examination, they fail to account for the complex social forces that shape the experience [35]. Bandura's social-cognitive learning theory combines the concepts of social modeling, learner self-efficacy and the importance of the learning environment, all of which were discussed by the participants in this study [31, 32].

B. Self-Monitoring

Trainees and faculty alike made comments consistent with the concept of self-regulated learning, which is a key component of the ongoing maintenance of competence required of all

physicians [29]. Trainees described engaging in moment-to-moment self-monitoring, in particular with regards to the correct performance and interpretation of the motor skills necessary to complete a Pediatric joint examination. An initial disconnect between knowing where to put your hands, and identifying abnormalities on the joint examination, may be overcome by faculty promoting resident self-monitoring through direct observation by a teacher, with immediate, specific feedback rather than through passive observation of staff performing the examination. The importance of feedback in medical teaching has been widely discussed in the literature; there are several qualitative studies documenting the importance of feedback for trainees learning bedside physical examination skills [36-38]. What makes this study unique is the focus on both teacher and learner perspectives simultaneously, in particular in the domain of Rheumatology, in which expert physical examination skills are of paramount importance. The rich description of the lived experience of self-monitoring provided by the trainees is a distinct contribution of this study.

C. **Hidden Curriculum**

Although well recognized by faculty and trainees alike, the hidden curriculum of differing joint count among experts had the potential to cause confusion and decreased confidence among trainees. This situation may lead to difficulty with self-judgment, as the gold standard is not clear, and trainees may therefore have a difficult time benchmarking their own performance. Making this hidden curriculum more explicit may allow for more time spent focusing on what is most important – obtaining accurate findings on key large joints, correctly identifying the overall clinical picture, and translating these findings into sound clinical decision-making.

D. **Longitudinal Musculoskeletal Curriculum**

A number of medical schools have implemented longitudinal clerkship programs, which is a departure from the traditional month-to-month clinical block system that is still prevalent in postgraduate education [39-41]. Skill loss through lack of practice in sequential rotations was clearly described by trainees in our study. For those who deem the musculoskeletal examination to be unimportant, in particular those trainees who are preparing for a non-generalist career in Pediatrics, this phenomenon seemed to be even more pronounced. On a positive note, senior trainees reported that subsequent opportunities for practice in their senior rotations tended to boost their confidence over time. This potential for attrition of Pediatric joint examination skill could perhaps be combated by inclusion of a longitudinal clinical Musculoskeletal exposure throughout residency training, in order to provide repeated opportunities for practice and reinforcement.

E. **Limitations**

Although our study included a large number of trainees and faculty, these are results from a single centre and may not apply to the same degree in smaller centres, with fewer teachers, where there may be more homogeneity among faculty joint examination techniques and interpretation. Although we assume that trainees are engaging in self-monitoring behavior when they describe their experiences being observed conducting a joint examination, how exactly this may translate into successful self-regulated learning in their future career is unclear.

F. **Conclusion**

Overall, Bandura's self-regulated learning theory helped identify multiple experiences that can inform development of an effective Pediatric joint examination curriculum: 1) increased direct observation with immediate feedback to allow for effective self-monitoring; 2) explicit discussion of the discrepancy in joint count among experts, to allow trainees to focus on more important learning goals such as accurate assessment of large joints, characterizing the overall clinical picture, and subsequent clinical decision-making; and 3) consideration of instituting more longitudinal experiences in musculoskeletal medicine to allow for ongoing practice.

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VITA

NAME: Clare Hutchinson

EDUCATION: Diplome d'Etudes Collegiales, International Baccalaureate, Health Science, Champlain College (CEGEP), St. Lambert, Quebec, 1999

M.D.C.M., McGill University, Montreal, Quebec, 2004

General Pediatrics Residency, University of Toronto, Toronto, Ontario, 2007

Pediatric Rheumatology Fellowship, University of Toronto, Toronto, 2009

M.H.P.E., University of Illinois at Chicago, Chicago, Illinois, 2015

PROFESSIONAL EXPERIENCE: North York General Hospital, Department of Child and Teen Health, Active Staff Pediatrician, Dec 2008 – Present

University of Toronto, Department of Pediatrics, Lecturer, Part Time faculty, Mar 2012 – Present

North York General Hospital, Department of Child and Teen Health, Pediatric Education Co-Lead, Aug 2013 – Present

North York General Hospital, Department of Medical Education, Longitudinal Integrated Clerkship Physician Lead, Dec 2014 – Present

HONORS: Awards for academic excellence in English and Sciences. Champlain College, St. Lambert. 1999

Dean's Honour List, International Baccalaureate program. Champlain College, St. Lambert, 1999

James McGill Entrance Scholarship. McGill University, Montreal, 1999

J.W. McConnell Award for Academic Excellence. McGill University, Montreal, 2000

J.W. McConnell Award for Academic Excellence. McGill University, Montreal, 2001

Dean's Honour List Award for Basis of Medicine. McGill University, Montreal, 2004

Pediatric Rheumatology Fellow Award. American College of Rheumatology Keystone Pediatric Rheumatology Symposium, Keystone, Colorado, 2008

First place in the podium competition, Annual Research Competition of the Rheumatic Disease Unit Toronto 2008 Ogryzlo Day, Toronto, 2008

Pediatric Rheumatology Chief Fellow. Hospital for Sick Children, Toronto, 2008

Peters-Boyd Academy Clerkship Teaching Award. University of Toronto, 2014

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TEACHING:

Pediatric Ethics Seminar, University of Toronto; Tutor, 2007, 2010

Art and Science of Clinical Medicine program, University of Toronto; Tutor, 2007-2014

Mechanisms, Manifestations and Management of Disease program, University of Toronto; Tutor, 2013

Clerkship Introduction to Pediatrics program, Department of Family and Community Medicine, University of Toronto; Lecturer, 2013

Community Pediatric Lecture Series, North York General Hospital; Course creator, Lecturer, 2013-2014