

**2020-21 Academic Year
Auditory Science Lab
Robert V. Harrison**

The Auditory Science Laboratory at the Hospital for Sick Children has been a part of our university Department of Otolaryngology-Head & Neck Surgery since 1984. Over that period our team has enjoyed continuous funding from CIHR (and originally MRC), as well as supplementary grants, large and small, from other agencies. We have generated over 200 peer-reviewed research papers, as well as hundreds of conference lectures and posters.

However, as is often said, “all good things come to an end”, and the lab is in the process of being decommissioned (that sound better than “shut down”).

Over the years this facility has been the base for basic lab research projects as well as clinical studies in close collaboration with clinical colleagues. Numerous graduate students, residents and fellows have trained in the lab, and for many their research has formed the thesis for a Master’s or Doctoral level degree.

As the laboratory ramps down, no new trainees can be recruited, but existing projects are being finalized. One important ongoing study is a collaborative effort with the University of Utah (Dr. Albert Park) on hearing loss associated with cytomegalovirus infection. We are presently supported by the Barberian Scholarship fund for this work.

Our mission has always been to increase knowledge about the complex biological mechanisms of the auditory system and to understand the exact nature of hearing deficits. I hope that the new knowledge generated by the lab may contribute to improved strategies for prevention, diagnosis and remediation of hearing disorders.

Finally, I would like to thank all the team members, research collaborators, post-doctoral fellows, graduate trainees and summer students that have contributed to, and gained from being in the Auditory Science Laboratory.

**2020-21 Academic Year
Neurotology and Vestibular Research
John Rutka, Phillip Gerrestsen and Paul Ranalli**

Ongoing clinical care programs for the management of those with dizziness and imbalance continue to be a major subspecialty interest at UHN. The multidisciplinary approach to the dizzy patient remains a major focus of ours. Unique to UHN is the Hertz Multidisciplinary Neurotology Program that involves neurotology, neurotology and psychiatry in conjunction with the UHN Centre for Advanced Hearing and Balance Testing, Vestibular Rehabilitation Therapy through Vestibular Health and Vestibular Nursing. It is through our team approach that we are able to handle the most challenging patients with disorders and imbalance. As always, we remain committed to the development of innovative educational systems in both vestibular and oculomotor physiology.

We are delighted to announce that Dr. Neil Bailie will be joining us as our second neurotologist in September 2021. Neil, one of our former fellows, now returns to Toronto after 12 years where he was on staff at Queen's University in Belfast, Northern Ireland. It is anticipated that he will provide a further commitment to care for those with disorders of dizziness and imbalance.

Our current research projects involve:

1. The Burden of Dizziness in the Province of Ontario from OMA/MOHLTC data from 2007-2017.
2. A Substantive Review of our Prospective Workplace Safety and Insurance Board (WSIB) Neurotology Data base of over 4,500 Head Injured Workers.
3. Analysis of the UHN Multidisciplinary Gentamicin Monitoring Program for the Prevention of Ototoxicity.
4. Analysis of the Effects of Vestibular Rehabilitation Therapy in Cerebellar Ataxia and Bilateral Vestibulopathy (CABV).
5. Creation of a Teaching Portfolio from the UHN Neuroradiology and Neurotology Rounds.
6. The Adverse Effects of Litigation/Claims in the Functioning Improvement of those Receiving Psychiatric Care or Vestibular Rehabilitation.
7. Creation of a Vestibular Implant Program.

We also continue to work in conjunction with our vestibular psychiatrist, Dr. Philip Gerrestsen, in evaluating:

1. Outcome analysis of patients with Cognitive Vestibular Dysfunction and Mood Change
2. Reactivity of the Vestibular System to Caloric Vestibular Stimulation in Schizophrenia.

Neurotology/Vestibular Publications for the academic year 2020-21 included:

Fu TS, Douglas-Jones P, Dillon W, Ilan O, Syed IM, Leis J, Gold W et al. Gentamicin Vestibulotoxicity. Further Insights from a Large Clinical Series. *Otol Neurotol* 2020; 41(7): 864-872.

Hassannia F, Misale P, Harvey K, Yu E and Rutka JA. Elevated Ocular VEMP Responses in the Absence of a Superior Semicircular Canal Dehiscence. *Am J Otolaryngol Head Neck Med Surg* 2021,42: doi.org/10.1016/j.amjoto.2020.102789.

Lee J, Hassanania F, Rutka JA. Contralateral High Acceleration Vestibulo-Ocular Reflex Function in Vestibular Schwannoma. *Otol Neurotol* 2021, 42: doi: 10.1097/MAO.000000000000327.

2020-21 Annual Report
Cochlear Implant, Neurotology & Otology Research
Vincent Lin, Trung Le, Joseph Chen, and Andrew Dimitrijevic

The COVID-19 pandemic unfortunately had a major effect on cochlear implant research activities. As elective surgeries were cancelled for a large proportion of waves 1-3, our clinical volumes were significantly reduced. As a result, for the first time in the history of the program, we were unable to meet funding targets. Also, due to hospital restrictions, most of our clinical research studies were put on hold as patients were unable to attend testing sessions. Like most worldwide scientific meetings, cochlear implant meetings during the pandemic were either cancelled or shifted to virtual.

However, as the province and country ramp up our vaccination efforts and our numbers of vaccinated individuals start to approach herd immunity numbers, we are hopeful that the fall will allow us to resume all studies that were put on hold during the pandemic.

During this downtime period, however, we did embark on a few major changes within the research program.

Under the strong leadership and guidance from Dr. Justin Lui, our previous clinical fellow who has now returned to the University of Calgary, we shifted our data collection repository from excel and paper format to REDCAP. Patients are now required to complete their pre-operative and post-operative QOL questionnaires online and modules have been set up for both the entry of surgical information as well as post-activation speech scores. This system will allow more consistency in data collection and extraction as well as provide a very effective means of performing internal quality control on patient outcomes. REDCAP has now become the de facto data collection and repository for many large clinical research programs across North America.

We were able to complete some of our first QI studies led by Dr. Valerie Dahm. These studies first looked at narcotic prescriptions in patients' post-cochlear implantation and compared that to our Austrian colleagues. We then ran a clinical trial comparing post-operative cochlear implant pain management using a combination of traditional narcotics compared to regular use of anti-inflammatories. This study which has been submitted for publication demonstrates clinical efficacy and potentially superiority with the use of anti-inflammatories post-op cochlear implant surgery and this has already altered our clinical practice which is very timely especially in light of the recent attention placed on narcotic overdoses and dependency.

Finally, Dr. Lin and his colleagues in neurology have embarked on the creation and validation of a more robust cognitive screening and testing paradigm. Our previous work focused on modifying the MoCA but our new test is designed to be more sensitive and potentially to be used for longitudinal monitoring in our older patients pre- and post-implantation. We have started testing early versions in clinic and are hopeful that we will be able to have a version for more widespread distribution early next year.

2020-21 Annual Report
Auditory Development & Regeneration
Alain Dabdoub & Trung Le

The Dabdoub Lab remains a leader in discovering the underpinning molecular biology of the inner ear. While my research program remains rooted in fundamental science, we are moving into a new phase that utilizes our foundational knowledge to develop regenerative therapies. We are entering a stage of developing novel therapeutic and delivery strategies for hearing and balance disorders.

All our accomplishments are a result of all the efforts of a dedicated group of trainees and the vision and support of the Sunnybrook otolaryngology department. Two graduate students successfully defended their work this year and the lab had several podium presentations at international meetings as well as international invited talks.

Our lab is supported by grants from the Natural Sciences and Engineering Research Council – NSERC, the International Hearing Restoration Project – Hearing Health Foundation, and the Krembil Foundation as well as by the Koerner Foundation.

Follow us on Twitter: @LabDabdoub

2020-21 Annual Report
Paediatric Cochlear Implant Research Lab
Karen Gordon, Blake Papsin, Adrian James, Sharon Cushing

This has been a year unlike any other but within the new realities of the COVID-19 pandemic, the Cochlear Implant Laboratory at the Hospital for Sick Children has continued to investigate auditory and vestibular development and plasticity. We ask: 1) What aspects of auditory and vestibular development are arrested in children with hearing loss; 2) What changes in the auditory and vestibular system occur during the period of deafness; and 3) To what extent can auditory and vestibular plasticity and development be promoted by cochlear implant use? We are also interested in innovations in cochlear implant design and programming which seek to improve the resilience of the device as well as to preserve residual hearing and binaural cues. Our work is supported by research funding from the Canadian Institutes of Health Research along with the Cochlear Americas Chair in Auditory Development and generous donations. Specific hypotheses which stem from these questions are tested through a number of studies currently underway.

Our team includes Jaina Neghandi, our Research Project Co-ordinator and Al Blakeman, our Research Project Co-ordinator.

We have had some changes in our graduate students and post-doctoral fellows. In August 2020, Robel Alemu successfully defended his MSc at the Institute for Medical Science (IMS) and began a PhD degree program at IMS in September 2020. He is assessing spatial hearing in children with and without hearing loss and recently received a 1-year funding award from the Ontario Government Scholarship program. We were joined by Angela Fung in January 2020 who began her MSc degree program at IMS. She is investigating methods to improve access to binaural hearing in children with hearing loss.

Rebecca Benjamin is in the second half of her MSc program in IMS. Despite COVID-19 related restrictions, she was able to collect important data on postural stability in individuals with cochleo-vestibular impairments. The work has been recognized with a recent podium presentation at the virtual Conference on Implantable Auditory Protheses and with an award from the Collaborative Program in Neuroscience at the University of Toronto.

Dr. Carly Anderson completed her post-doctoral fellowship in our lab in May 2021. Her work pivoted this year to investigations of cortical plasticity in adolescents who receive bilateral cochlear implants through already collected EEG measures. She was awarded a prestigious Wellcome Trust Fund Fellowship (UK) and is now beginning work related to that award at the University of British Columbia. We also said farewell to Lee Phan who completed her MSc at IMS which focused on a collaborative project between our lab and that of Dr. Liz Pang on language processing in children with Autism Spectrum Disorder.

We were disappointed to have to cancel plans to take on several undergraduate summer students due to COVID-19 restrictions but were pleased to welcome a research volunteer, Maya Daien, in 2020 who supported studies on auditory function in children with genetic (GJB-2) and acquired (congenital cytomegalovirus) hearing loss and on effects of COVID-19 restrictions, including school closure, on children's auditory environments. This summer (2021) we were able to welcome Emily Wener, a medical student from the University of Ottawa, and Praveen Sritharan, an undergraduate student as summer students in person in the lab and Cole Sandler, an undergraduate student, was able to volunteer remotely.

We continue to have important collaborations both locally (Robert Harrison, Adrian James, Evan Propst, Susan Blaser, Frank Russo, Jenny Campos, Andrew Dimitrijevic, Elizabeth Pang, Birgit Ertl-Wagner), nationally (Sam Doesburg) and internationally (Robert Cowen, Ruth Litovsky, Andrej Kral).

Despite COVID-19 restrictions to our clinic and research, the past year has been very productive: 25 publications came out or are in the press. Between this summer and last, we collectively presented over 16 abstracts at international meetings and gave more than 20 invited talks at virtual international meetings.

Some highlights from the past year include:

- Karen Gordon appointed as Chair of OHNS Promotions Committee

- Five student/trainee awards including the Canada Graduate Scholarship-Master's Program to Robel Alemu

- Open Scholarship Award, Institute of Medical Science, University of Toronto to Robel Alemu and Angela Fung

- Summer Undergraduate Research Program 2019, Joint Funding Award, Institute of Medical Science, University of Toronto to Praveen Sritharan

2020-21 Annual Report
OtoSim™ Lab
Paolo Campisi and Vito Forte

Dr. Vito Forte continues to serve as CEO and CTO of OtoSim™ Inc and he also is an active member in the CIGITI Lab at SickKids. This has resulted in a successful collaborative team involving engineering students from UofT as well as other programs across Canada. This activity continues to stimulate innovation for OtoSim™ and several other projects within the department.

The COVID-19 pandemic provided educational challenges and therefore the impetus to develop solutions such as remote simulation teaching models. This success to-date has been made possible thanks to the ongoing efforts of team members and collaborators. The UofT clerkship has pivoted to the OtoSim™ Mobile to maintain clerkship activity. This innovative initiative has been led by Dr. Al Vescan and Dr. Stacey Bernstein (Clerkship Director, MD Program, Temerty Faculty of Medicine, University of Toronto) and made possible through a generous grant to the UofT. Simulation and teaching are carried out through a combined Zoom lecture delivered by Dr. Campisi while students can simultaneously practice their otoscopy or ophthalmoscopy skills using a real scope viewing pathologies through the mobile device attached to their smartphone or tablet either during the virtual lecture or later at the student's leisure.

These technologies have been adopted by over 650 universities around the world. Development continues for both smart-phone based mobile simulators bringing another dimension to teaching of otoscopy and direct ophthalmoscopy applying effective, efficient and affordable simulation achieving a global impact.