

Message from the Chair

I am pleased to share with you the 2020 Annual Report for the Department of Biomedical Engineering. This report strives to summarize with a few highlights, numbers, and exhibits the extraordinary accomplishments of our faculty, staff, and students in the year marked by COVID-19.

Our achievements in research, teaching, and service are all the more remarkable. This report only captures the immediately quantifiable aspects of our contributions that can only be fully appreciated when considering these results in-depth, with context, and holistically. The numbers and figures also do not capture the grace, solidarity, and support that each of our faculty members have been providing to their students, staff, and colleagues, and to the Department as a collectivity. I would like to thank our faculty for their generosity throughout these rough times. I would also like to recognize the challenges that our students faced, who count among the age group most affected by lockdowns, and I thank them for their resilience in the face of such pervasive uncertainty and constant changes. In this context, I would like to recognize the efforts of the Biological & Biomedical Engineering Student Society (BBMESS) to forge a sense of community and nurture social interactions via numerous creative means at a time when it was needed most.

This year we celebrate the recruitment of Dr. Guojun Chen to Biomedical Engineering, who is also the first BME faculty member holding a joint position with the Goodman Cancer Research Center, where his lab is located. No less than four out of ten Department members received important awards, namely Maryam Tabrizian, Christine Tardif, Danilo Bzdok, and Rob Kearney. Congratulations! Finally, the Department also confronted COVID-19 with science and engineering, resulting in published research on the impact of loneliness, the development of rapid tests and a novel ventilator, and wide-reaching public outreach and advocacy. Way to go, team BME!

Stay healthy and stay safe!

David Juncker

At a Glance

1st

**BME Department
Established in Canada**

#1

**Doctoral Medical School
in Canada (McLean's)**

10

Core BME Professors

100+

**Core & Elective
Courses offered**

Graduate Students from

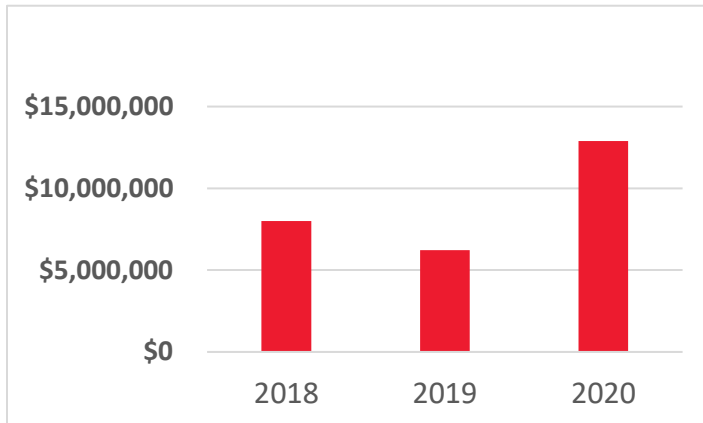
5

Continents

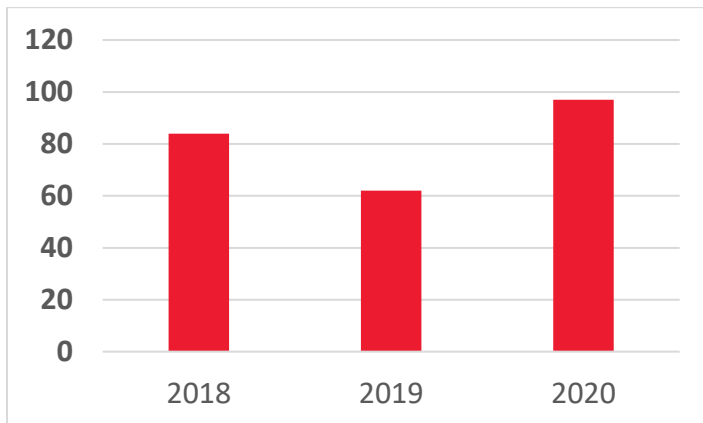
60+

**Supervisors Affiliated
with
the BBME Graduate
Program**

Major research grants awarded to BME members as Principal Investigators (2018-2020)



Publications authored by core faculty in BME (2018-2020)



Key Events & Awards

McGill BME enjoyed many proud moments and milestones in 2020. Highlights include:

- The arrival of Dr. [Guojun Chen](#) as a new Assistant Professor in BME (see [New Faculty Profile](#)), in collaboration with the Rosalind and Morris Goodman Cancer Research Centre.
- Prof. Maryam Tabrizian was [awarded a Canada Research Chair](#) in Regenerative Medicine and Nanomedicine, and joined the Canadian Academy of Health Sciences as a new Fellow.
- Prof. Christine Tardif was the recipient of the 2020 Bougie Family Young Investigator Award.
- Prof. Danilo Bzdok was awarded a [Canada CIFAR AI Chair](#) (Mila Quebec).
- Prof. Rob Kearney was the 2020 recipient of McGill's [David Thomson Award for Excellence in Graduate Supervision and Teaching](#).
- The [Dr. Henrietta Galiana Travel Award in Biomedical Engineering](#) was launched in honour the devotion to student well-being shown by Dr. "Mimi" Galiana, Professor Emerita, during her tenure at McGill.
- McGill BME launched a [departmental newsletter](#), publishing its first 2 issues in 2020.

- McGill BME held a Strategic Planning Virtual Retreat to outline our goals for community involvement and the future of BME, with faculty exercises, student presentations, and invited speakers including David Eidelman (Dean of the Faculty of Medicine & Health Sciences), Alba Guarné (Associate Dean, School of Biomedical Sciences), and Peter Zandstra (Director, School of Biomedical Engineering, UBC).

Research and Publications

Departmental members continued to produce high-quality journal publications in 2020. Our [ten core faculty members](#) authored 97 publications. The full list of 2020 research activities for the Department of Biomedical Engineering may be found at:

<https://www.mcgill.ca/bme/research/publications>

Grants

Our core faculty enjoyed continued success in securing grant funding, as demonstrated in Appendix 1: Research Grants and Awards to BME Core Faculty Members in 2020. The total new grant funding awarded to McGill, led by core members in biomedical engineering as Principal Investigators, was \$12,892,386 CAD.

All ten of our core faculty hold significant external research grants, including from: CIHR, NSERC, NIH, CIFAR, and the Bill & Melinda Gates Foundation.

Teaching & Supervision

Our core faculty continued to excel in **student supervision**, having attracted top graduate students and highly qualified personnel in 2020, as shown in Appendix 2: Student Supervision by Core Faculty Members in 2020. Together our ten core faculty members supervised 38 Master's students, 52 PhD students, 10 undergraduates, 19 postdoctoral fellows, and 10 staff members. 15 students supervised by BME core faculty successfully graduated in 2020.

Students supervised by our core faculty received numerous **student awards** for their excellence, including the [John F. and Evangeline M. Davis Award and the Leslie A. Geddes Prize](#) for Excellence in Biomedical Engineering, two prestigious awards for graduate students in the Biological & Biomedical Engineering program. The Geddes Prize, given annually to a student with an outstanding PhD thesis, was awarded to Saad Ibrahim O Aldelaijan for his thesis entitled "Advanced quality assurance methodologies in image-guided high-dose-rate brachytherapy", conducted under the supervision of Prof. Slobodan Devic (Medical Physics) and Prof. Louis Collins (core BME faculty). The John F. and Evangeline M. Davis Award is given to a graduate student enrolled in the BBME or BME Program in recognition of a significant contribution (Master's or Doctoral thesis, major conference paper or journal paper) to a subject applicable to diagnostic or treatment procedures for neurological or psychiatric disorders. Mr. Omid Zobeiri was honoured with this award for his paper entitled, "Effects of vestibular neurectomy and neural compensation on head movements in patients undergoing vestibular schwannoma resection", produced under the supervision of Prof. Kathleen Cullen (Physiology, Adjunct Professor).

Other awards to BBME students supervised by core BME faculty members include: 3 Master's and 2 PhD students received the BBME Excellence award for returning students; 8 Master's and 10 PhD

students received BBME Recruitment awards for new students; 1 Master's student received an NSERC CGSM award; 1 Master's student received a HBHL award; 2 PhD students received FRQNT awards; 1 Master's student received an MS Society award; and, 1 PhD student received an IDB award – for a total of 29 awards to students supervised by BME core faculty.

The Department also saw continued interest in **courses** taught by our core faculty members, as shown in Appendix 3: Teaching by Core Faculty Members in 2020. In total, 205 students registered in 14 courses offered by our core members. As the global pandemic touched every facet of teaching and learning at McGill, BME adapted by offering online courses remotely for much of 2020.

BME also launched a **new course** in Fall 2020 called [BMDE 520: Machine Learning for Biomedical Data](#), offered for the first time by Prof. Danilo Bzdok. We will offer another new course in Fall 2021 called [BMDE 656 Medical Device Reimbursement](#).

The [Graduate Certificate in Translational BME](#) continued to see robust enrolment, with 8 new students accepted for Winter 2020, and 12 new students in Fall 2020. This 15-credit, 1-year program enables students to lead the commercialization of innovative medical technology. Core courses are taught by [industry-leading experts](#), and complementary courses are offered by core faculty in Biomedical Engineering. 2 students graduated from the program in Fall 2020, and 1 student transferred to the Master's program in BBME.

The Department hosted 2 online **information sessions** for the Certificate program in 2020, as well as having coordinated an information session for the BBME graduate program. These live, online sessions are a great way for prospective students to find out more about our programs, admission requirements, and more. Each session is one hour and includes a question-and-answer period at the end.

Finally, in collaboration with Ryerson University, BME successfully led a **new NSERC-CREATE training program** at McGill called the [MedTech Talent Accelerator](#). This program develops industry-ready talent for the Canadian MedTech sector, providing industry-focused training to McGill and Ryerson graduate students before coordinating internships in the MedTech industry. Program components include an online course with 6 industry-focused modules (launched in Spring 2020), workshops on Equity, Diversity, and Inclusion (EDI) and professional development, industry-focused seminars (8 total in 2020), an industry-themed hackathon (held virtually in October 2020), and MedTech industry internships (16 total in 2020).

Community Involvement and Media Engagement

The Department of BME was highly active in community involvement and media engagement in 2020, with appearances in the media including:

- [Rob Kearney honoured with award for graduate supervision and teaching](#), McGill Health e-News (Rob Kearney, BME Professor)
- [Maryam Tabrizian receives Canada Research Chair in Regenerative Medicine and Nanomedicine](#), and [joins the Canadian Academy of Health Sciences as a new Fellow](#), McGill Health e-News (Maryam Tabrizian, BME Professor)
- [nplex-McGill partnership selected by CQDM for a \\$1M grant to apply next-generation ELISA in drug discovery](#), McGill Health e-News (David Juncker, BME Professor & Chair)

- [New laboratory to advance research in 3D brain modelling](#), McGill Newsroom (Louis Collins, BME Professor)
- [Scientists show what loneliness looks like in the brain](#), McGill Newsroom (Danilo Bzdok, BME Associate Professor)
- [What do breast cancer cells feel inside the tumour?](#), McGill Newsroom (Chris Moraes, BME Associate Member)
- [McGill brain-scanning spinoff acquired by French firm](#), McGill Newsroom (Louis Collins, BME Professor)
- [A blood test for the new space age](#), McGill Alumni Magazine (Roozbeh Safavieh, Kate Turner, Juncker lab alumni)
- [Neonatal screening app wins funding at MIT start-up challenge](#), McGill Reporter (Samantha Latremouille, Graduate Certificate in Translational BME alumni, '20)
- [McGill researchers awarded \\$1.5 million in NRC collaborative funding](#), McGill Reporter (Maryam Tabrizian, BME Professor; Mark Driscoll, BME Associate Member)
- [Researchers awarded \\$2.7M to study loneliness and Alzheimer's](#), McGill Reporter (Danilo Bzdok, BME Associate Professor)
- [Christopher Moraes: Excelling in the lab and in the classroom](#), McGill Reporter (Chris Moraes, BME Associate Member)
- [Novel Dual-Hormone 'Artificial Pancreas' Is Promising](#), Medscape (Ahmad Haidar, BME Assistant Professor)
- [We can avoid a lockdown by creating a national mass testing program](#), Globe & Mail (David Juncker, BME Professor & Chair)
- [The Montreal Children's Hospital wants to become a "smart" facility](#), The Canadian (Rob Kearney, BME Professor)
- [L'Hôpital de Montréal pour enfants veut devenir un hôpital « intelligent »](#), La Presse (Rob Kearney, BME Professor)
- [How rapid tests work and why timing is critical](#), CBC News (David Juncker, BME Professor & Chair)

Danilo Bzdok was repeatedly featured in the media due to his two seminal publications in 2020 on mass social isolation and its potential consequences for society and the brain: “The Neurobiology of Social Distance” (Bzdok & Dunbar, 2020 Cell Press) and “The default network of the human brain is associated with perceived social isolation” (Spreng, ..., Bzdok, 2020 Nature Publishing Group). These two publications sparked a wave of curiosity, garnering attention from household news organizations like CTV National News, CNN, and Fox News. In addition to traditional media, Danilo was highly active on social media, with his work reaching more than 1,100,000 views on Twitter in less than 4 weeks following his publication on social isolation. Seemingly going viral, his research contribution was even featured on the frontpage of Reddit (known as “the front page of the internet”). Danilo’s public presence expanded globally, from Montreal (The Gazette), to Quebec (Radio Canada), to Ontario (Toronto Telegraph), to Canada-wide (Globe and Mail, CTV News), to Belgium (RTBF), Germany (Focus Online), France (Sciences et Avenir), Italy (keynote lecture), India

(India Today), and internationally (CNN, Fox). BME published a [New Faculty Profile on Prof. Bzdok](#) in 2020, including links to his media coverage.

BME also responded to the global pandemic by participating in public outreach and advocacy, and launching COVID-19 related research projects. We published an article on [BME's "Rapid Response" to COVID-19](#) in 2020, including features on an NSERC Alliance COVID-19 grant awarded to David Juncker to study a "COVID-19 test chip for simultaneous detection of SARS-CoV-2 and antibodies using a single non-invasive sputum sample" in partnership with Sensoreal Inc, and on McGill BME joining a the COVID-19 Emergency Digital Health Task Force, led by Marc Saab, Founder and Managing Director at BML Technology Ltd., and McGill BME alumnus.

Appendix 1: Research Grants and Awards to BME Core Faculty Members in 2020

Major research grants awarded to BME members as Principal Investigators:

Name	Project Title	Role	Funding Period	Total Grant (CAD)
Bzdok, D	<u>US National Institute of Aging / NIH R01</u> : Investigating the impact of loneliness on brain aging and pre-symptomatic Alzheimer's disease progression. (PIs: Danilo Bzdok & Nathan Spreng)	PI	09/2020 - 04/2025	2,700,000
	<u>CIHR</u> : The effects of neuropsychiatric CNVs on the integrity of brain structure and connectivity. (PIs: Danilo Bzdok & Sebastien Jacquemont)	PI	10/2020 - 09/2024	800,000
Collins, L	<u>Weston Rapid Response</u> : Development and validation of MRI neuromelanin prognostic biomarker of PD neurodegeneration	PI	06/2020 - 12/2022	340,000
Funnell, R	<u>MITACS Accelerate</u> : Facial expression identification over a time series of images	PI	01/2020 - 08/2020	30,000
	<u>FMHS</u> : Bridge funding	PI		12,000
Haidar, A	<u>Adocia</u> : Industry contract	PI	2020 - 2021	15,000
Juncker, D	<u>MI4</u> : Rapid and sensitive diagnostic test for COVID-19 using saliva	PI	11/2020 - 05/2021	50,000
	<u>NSERC Alliance COVID-19</u> : COVID-19 test chip for simultaneous detection of SARS-CoV-2 and antibodies using a single non-invasive sputum sample	PI	05/2020 - 05/2021	50,000
	<u>NFRF – Exploration</u> : Rapid identification of antibody-producing cells against viral agents of new emerging threats and epidemics (Co-PI: A. Sakuntabhai; Co-applicant: G. Kobinger)	PI	01/2020 - 12/2022	200,000
	<u>CQDM Program</u> : Quantum Leap Program: The 200-plex nano-ELISA: A Next-Generation Immuno-Proteomic	PI	01/2020 - 12/2020	859,000

	Technology for Biomarker and Drug Discovery (Co-Applicant: nPlex Biosciences Inc.)			
Kearney, R	<u>Bill & Melinda Gates Foundation: EARLY study</u> : Enhanced Real Time Detection of Fetal Deterioration Study (Co-PI: Yvone, Wu, Co-Applicants: Doina Precup, Phillip Warrick, Emily Hamilton, Michael Kuznciewicz)	PI	4/2020 - 10/2021	USD839,644
Tabrizian, M	<u>CIF: Nanotool III</u> (PIs: Peter Grütter, Co-PI: D. Perepichka, Y. Simine, M. Tabrizian, G. Demopoulos, L. Childress, Jack Sankey, W. Reisner, S. Zhao, E. Kao)	PI	2020 - 2022	6,799,788

Co-Principal Applicant grants awarded to BME staff:

Name	Project Title	Role	Funding Period	Total Grant (CAD)
Bzdok, D	<u>La Fondation Neuro Canada / Brain Canada for McConnell Brain-Imaging Center</u>	CO-PI	04/2020 - 03/2022	4,674,000
Collins, L	<u>IPND: Diagnostic and prognostic precision medicine for behavioral variant frontotemporal dementia</u>	CO-PI	08/2020 - 07/2023	EUR 1,324,706
Kearney, R	<u>NIH/NICHD, R01HD094155-01A1 MAESTRA (Maternal Antecedents of Encephalopathy in Term Infants)</u>	CO-PI	06/2020 - 03/2025	USD 2,993,332

Awards (salary, honours) received by BME staff:

Name	Title	Role	Funding period	Total grand (CAD)
Kearney, R	David Thomson Award for Excellence in Graduate Supervision and Teaching			
Tabrizian, M	Fellow of Canadian Academy of Health Sciences			
	American Dental Education Association (ADEA) Leadership Institute Fellow			
	Charles P Leblond award			
Tardif, C	Bougie Family Young Investigator Award	PI		25,000
Bzdok, D	<u>Canadian CIFAR Artificial Intelligence Chair program: Big-data approaches to study human-defining thought in the higher association cortex</u>	PI	01/2020 - 12/2025	1,000,000
	Google research award	PI		USD15,000

Appendix 2: Student Supervision by Core Faculty Members in 2020

Name	Students supervised				
	Masters	Ph.D	Undergraduate	PDF	Staff
Bzdok, D	5	2			
Collins, L	2	12		5	2
Funnell, R	3	2			
Haidar, A	5	3			
Juncker, D	12	8	5	4	7
Kearney, R	1	5			
Prakash, S	3	1	2	2	
Rudko, D	2	2		2	
Tabrizian, M	3	15		4	1
Tardif, C	2	2	3	2	
TOTAL	38	52	10	19	10

Appendix 3: Teaching by Core Faculty Members in 2020

<i>Winter 2020</i>			
Instructor(s)	Course Number & Title		Enrollment
Kearney, R Haidar, A	BMDE 502	BME Modelling & Identification	3
Tabrizian, M	BMDE 504	Biomaterials & Bioperformance	15
Prakash, S	BMDE 505	Cell and Tissue Engineering	18
Collins, L	BMDE 650	Advanced Medical Imaging	11
Haidar, A	BMDE 655	Biomed Clin Trials-Med Devices	11
Tardif, C Near, J Rudko, D	BMDE 660	Advanced MRI/S of the Brain	10
Tardif, C	BBME 600 (D2/N1)	Seminars in Biological and Biomedical Engineering	21
<i>Fall 2020</i>			
Instructor(s)	Course Number & Title		Enrollment
Funnell, R	BMDE 501	Selected Topics: Biomedical Eng	22
Wagner, R	BMDE 503	Biomedical Instrumentation	10
Juncker, D	BMDE 508	Introduction to Micro & Nano- Bioengineering	16
Funnell, R	BMDE 512	Finite-Element Modelling: BME	19
Kearney, R	BMDE 519	Biomedical Signals & Systems	17
Bzdok, D	BMDE 520	Machine Learning for Biomedical Data	10
Tardif, C Reznikov, N	BBME 600 (D1/N2)	Seminars in Biological and Biomedical Engineering	22
TOTAL	14		205