Message from the Scientific Director

Dr. David Holdsworth

This year was highly focused on engagement, building relationships and expanding collaborative opportunities internally and externally. There continues to be a great appreciation for the need to work together as we tackle needs and gaps in the area of MSK health. With such complicated conditions – that crossover and affect so many systems of the human body, aspects of people’s lives and society – a comprehensive approach is necessary. Bringing together multiple experts across disciplines will result in discoveries and innovations that will benefit millions of Canadians.

Events like our Biennial Research Retreat hosted in May enabled crucial knowledge sharing and reflection on ‘where we are’ and ‘how we are doing’. Members provided insight that contributed greatly to quality improvement of our activities and informed preliminary examination of future direction. Building on this insight, we held a series of strategic planning sessions with members and partners to have an in-depth exploration of key elements and the future of the Institute. We look forward to 2018, with a plan to focus and streamline our efforts, submit coordinated applications for major funding, advance the involvement of trainees in research, educational, and collaborative opportunities internally and beyond, and expand our facilities and capacity.

It’s a pleasure to share with you, in this 2017 annual report, highlights of the astonishing achievements of our members. The will to strengthen and grow the Institute and its activities, as well as raise awareness about the relevance of our cause and our unique approach has never been more imperative. We are seeking out broader audiences and looking to enhance our interactions with the public, industry, and government. In doing so, our research is more likely to have a positive and more immediate impact on our healthcare system, social-care systems and economy – and most importantly result in better lived experience for people who suffer from MSK conditions.
Impact on the Quality of Life for Millions of Canadians

People who live with musculoskeletal (MSK) conditions often have to prioritize, on a daily basis, their participation in domestic, work/school, community, and social activities. Despite their ability and effort to adapt and self-manage, they often experience set-backs, pain, mobility restrictions, and fatigue that affects both their mental and physical performance. This negatively influences their sense of self-worth, their mental health, and the security that good health brings to people’s lives. It also has implications for their family and loved ones.

Did you know that MSK conditions…

- will affect more than 15 million Canadians of all ages by 2031\(^1\)
- can result from a trauma (e.g. work, sports, accidents) or a disease (in childhood and/or adulthood)
- are the 3\(^{rd}\) most common diagnostic category in Canada\(^2,3\)
- have the highest total direct costs to the healthcare system \(^2,3\)
- result in disabilities that are the largest cost category of any chronic disease \(^2,3\), and
- contribute substantially to the indirect cost burden for patients, families, and society.

Many Types of Experts with a Common Purpose

Western’s Bone and Joint Institute (BJI) brings together experts to make a difference through a common vision of lifelong mobility. We are breaking down silos to open doors between academia and the public, the young and the mature, many different types of researchers and clinicians. Everyone that has an interest or an idea can play a role. Through collaboration and knowledge translation, we gain comprehensive perspectives to establish new techniques that will accelerate successful innovation. Our transdisciplinary approach will fuel economic growth, and most importantly, support the development, implementation, and scale-up of successful approaches into practice for the people who truly need it.

At BJI, we aim to…

- prevent the onset and progression of MSK conditions;
- enhance patient-centered assessment tools, rehabilitative therapies and assistive devices, and patient outcomes; and
- critically examine treatment approaches to establish best-practices.
Research Excellence & Achievements

Our BJI membership grew from 185 to 254 members in 2017. We are privileged to include 14 Research Chairs (6 Endowed/Industry-funded), 2 Royal Society of Canada Fellows, 3 Canadian Academy of Health Sciences Fellows, 1 NSERC Fellow, nearly 10 New Investigator or Early Researcher Awardees, 3 Distinguished University Professors, and 3 current Western Faculty Scholars. We continue to build strength with the recruitment of 2 Early Career Researchers (Health Economics - Jacqueline Marsh start date of July 2016 with the Faculty of Health Sciences; and Orthopaedic Biomechanics - Ryan Willing start date of July 2017 with the Faculty of Engineering – details provided in our 2016 annual report), and Michele Crites Battié as the Western Research Chair (WRC) in Exercise, Mobility, and Health in the Faculty of Health Sciences. Since being established in 2015, we also supported Faculties with MSK-related recruitments including Emil Schemitsch (Schulich School of Medicine & Dentistry), Joy MacDermid (Health Sciences), Tom Appleton (Schulich School of Medicine & Dentistry), Emily Lalone (Engineering), Mikko Karttununen (Science), Andrea Waters-Rist (Social Science), and Jay Stock (Social Science).

At BJI, we collaborate extensively beyond the Western Community to conduct high impact research and contribute as global opinion leaders. The outcomes of these significant international collaborations have important impacts worldwide. For example, 2017 showcased published work in journals such as *Lancet* and *Cell*; three publications in *Annals of the Rheumatic Diseases* (the highest impact journal in the field of rheumatology); a publication in the *European Spine Journal* (which received the 2017 Prize in Bioengineering Science from the International Society for the Study of the Lumbar Spine); and a timely editorial in the journal *Arthritis & Rheumatology*.

New evidence by our group on a broad range of MSK-related topics can be found in over 300 MSK-related papers published in 2017 alone. There are papers focused on innovating in diagnosis and evaluation, such as the paper by Holmes et al. which was selected as the Best Clinical Science Paper in 2017 by the “American Shoulder and Elbow Surgeons”. There are articles about developing and evaluating therapies, including work that ranges from biomechanics in cadavers to clinical studies and robotics. Other reported studies aim to influence key knowledge users in various settings, such as clinicians in medical centres, individuals in the work place, and people in the community. Because BJI investigators currently hold over 500 grants totaling nearly $100 M in multi-year funding, we can expect to see many more publications in the years to come.

This year, our members doubled the total number of technologies submitted to our technology transfer office, WORLDDiscoveries, for a total of nearly 50 technologies since fiscal year 2015. Given the transdisciplinary nature of our work at the Institute, it is common to have multiple inventors listed on a single submission. The total number of patent applications filed has fluctuated from 6 to 13 in the last three fiscal years. Since fiscal year 2015, there has been a total of 31 patent applications. Sixteen patents have been issued, growing to 8 in this most recent fiscal year. These data do not include applications filed independently of WORLDDiscoveries or via other Institutions.

At a local level, our Catalyst Grant Program supported the initiation of innovative, high-impact, and early-stage projects and enabled the leveraging of external funding that would not have occurred without Institute support. The work of the 2015 inaugural competition awardees was featured at our BJI Research Retreat in May 2017. Reports to date indicate that the catalyst grants of 2015 resulted in 2 publications, over 15 conference poster/oral presentations, and more than 7 manuscripts are reported as under development or submitted (results pending). The awards were leveraged to secure additional funds from various foundations or agencies, to obtain dedicated laboratory space or better access to the population of interest, and to better inform and position funding proposal to continue this work. Both 2015 and 2016 catalyst teams formed new and expanded collaborative relationships among stakeholders, within and external to academia.
Our Collaborative Training Program in MSK Health Research (CMHR) had its highest ever enrolment this year with 89 trainees. Over 20 trainees graduated from their home graduate studies program (master’s and/or doctoral) with an “in MSK Health Research” degree designation, since 2015. Some trainees transferred directly into a doctoral program that extended their home-program studies. Many graduates continue to work in academic or health-related fields. We estimate that 20 trainees will graduate in 2018, and nearly 30 in 2019.

We value and require enhanced trainee involvement in transdisciplinary MSK research and community outreach to augment career development and empower the leaders of tomorrow. Our curriculum expanded this year to include case-focused workshops in partnership with the Ivey International Centre for Heath Innovation. Our novel program will adopt a new name in 2018 to adhere to changes in the graduate studies structure: “The Collaborative Specialization in Musculoskeletal Health Research (CMHR)”.

Our current pool of trainees is outstanding. In 2017, 33 trainees self-reported being granted nearly 50 awards (various sponsors - NSERC, Arthritis Society, CIHR, OGS, WGRS, etc.) totaling over $1.4 M in multi-year funding. Also, they produced over 30 peer-reviewed MSK-related publications. In addition, multiple trainees attended and presented at national / international conferences such as the American Academy of Orthopaedic Surgery Annual Meeting, American Society for Bone and Mineral Research, Australia New Zealand Orthopedic Research Society & Radiostereometric Analysis Network, Canadian Connective Tissue Conference, Computer Methods in Biomechanics and Biomedical Engineering & Imaging and Visualization, Design of Medical Device Conference in Minneapolis, the Gordon Research Conference, the International Cartilage Repair Society, the International Society for Magnetic Resonance in Medicine, 4th International Spine Research Symposium (ORS PSRS Philadelphia), the Orthopaedic Research Society, and the Osteoarthritis Research Society International (OARSI) World Congress in OA.
Our Transdisciplinary Bone and Joint Training Awards Program supported a total of 37 trainees this year. The awards supported research projects that demonstrated clear relevance to MSK health and supervision of trainees by BJI Faculty members from at least two distinct disciplines. Furthermore, our CMHR Summer Program engaged 18 undergraduate students, 6 of whom were awarded a CMHR Summer Studentship Award. This program promotes the participation of undergraduate students in MSK research. They gain valuable experience through lunch and learn sessions, by presenting their work at the research symposium, and by contributing to a peer-reviewed publication.

Looking Outward - Inclusivity for Collaborative Success

This was the first full year of operations for the Canadian MSK Rehabilitation Research Network. Two of the Network’s 5 Principal Investigators are based at the BJI, along with the coordinator. The network held its first annual meeting in conjunction with the 2017 Quebec Congress in Rehabilitation Research, to establish research priorities. It launched the Pilot Grant Competition and the Trainee Awards Competition distributing over $150,000 to support MSK Rehab projects. Membership increased by 30%, expanding the broad involvement of multidisciplinary researchers, collaborators, and partners from across Canada.

The BJI executive team established a self-assembled national consortium of Canadian MSK research groups. Co-funded by CIHR, BJI, and the McCaig Institute for Bone and Joint Health, BJI organized a series of meetings that unified academic leaders, consumers, advocacy groups, decision-makers, and funders from across Canada. Together the representatives explored options to put together an action plan to increase the profile of MSK research in Canada. They discussed various mechanisms to solidify relationships, foster new partnerships, increase awareness of strengths, identify synergies, and recognize
national collaborative opportunities. With consensus on a name – Canadian Network for Mobility Research, slogan “Active for life! Muscle, bone and joint health research to keep Canadians moving”, and mission to “bring researchers and partners together to generate solutions that will improve the health of Canadians, through prevention and management of musculoskeletal conditions”, the group will start working on short-term goals and priorities in 2018.

Our BJI Biennial Research Retreat included over 100 participants. When addressing the group, John Capone (Western’s Vice-President – Research) stated, “Most researchers are still solitary in their view of what they do and most institutions are resistant to the changes that are needed to foster and engage multidisciplinary integrated research in the way that it needs to be done… The Bone and Joint Institute is the epitome of how to carry out this type of new research in a meaningful way.” The retreat included multiple interactive sessions to learn about and contribute to the work of Institute members. “From the morning networking breakfast, to project overviews, to advancing skills and opportunities related to knowledge translation, collaborative relationships, engaging patients in research, and training the next generation of researchers, the day was full of opportunities to move our mandate forward,” said Frank Beier, BJI Scientist and chair of the planning committee. Later in the year, the inaugural BJI Young Investigator Forum on Preclinical Musculoskeletal Health Research attracted over 60 participants from London, Guelph, and Toronto. In addition to major events described above, we invited 12 internationally recognized MSK experts throughout the year to deliver seminars that would inspire the exchange of ideas and new collaborative initiatives. BJI remains a proud member of the Arthritis Alliance of Canada (AAC) where we supported a central focus for national arthritis-related initiatives, participated on committees and in meetings/events, and sponsored the Knowledge Translation Science/Research Award.

**Key Facility & Partner - the Additive Design in Surgical Solutions (ADEISS) Centre**

With a goal “to create a paradigm shift in the delivery of healthcare that enhances the patient experience by supplying personalized medical devices that better match patient needs and treatment requirements”, ADEISS has aided numerous BJI members including researchers, orthopaedic surgeons, and dental clinicians with 3D printing of device prototypes for active research and development projects. This unique for-profit metal 3D printing solution centre develops and provides precise bio-compatible medical devices. Soon to be approved for human implants, the centre has had active success in veterinary applications. For example, the implantation of a 3D-printing “snout” that saved a Canadian family’s 7-year old Burnese Mountain dog who had severe hard tissue loss due to a tumour removal on its maxilla. [http://www.renishaw.com/en/additive-manufacturing-in-veterinary-surgery-saving-a-well-loved-member-of-the-family--42950](http://www.renishaw.com/en/additive-manufacturing-in-veterinary-surgery-saving-a-well-loved-member-of-the-family--42950).
The 10th Annual Suzanne Bernier Memorial Lecture in Skeletal Biology was held on May 1, 2017 with invited speaker Dr. Lori A. Setton, PhD, Lucy and Stanley Lopata Distinguished Professor of Biomedical Engineering & Orthopaedic Surgery at Washington University in St Louis who presented her talk – “Engineering Drug Depots to Target Local Inflammation” – that generated great discussion among BJI members, affiliates and partners. The annual Suzanne Bernier Memorial Award in Skeletal Biology was given to CMHR trainee Margaret Sun for her work characterizing the role of nuclear receptor proteins in cartilage development and disease. The BJI was pleased to partner with this event, and hosted a reception following the lecture that brought together the BJI research community. The Institute also contributed to the Arthritis Society annual fundraising “Walk for Arthritis”, the Imaging Network Ontario Annual Meeting, the Gordon Conference, and the Arthritis Society Tour of BJI Facilities to enable interaction among researchers with different backgrounds and experience levels, members of the society, and other community consumers and partners. Other outreach examples include graduate-student-led programs, community programs, and clinical workshops.

The Next Steps Towards Lifelong Mobility

A major focus of knowledge translation efforts in 2017 was to engage key stakeholders in helping to shape the strategic direction of the Institute. By including our members and partners in a series of strategic planning sessions, the leadership was successful in obtaining multiple perspectives that will influence the setting of priorities and of the research agenda for 2019 to 2024. Within the strategic planning process, approaches to facilitate and establish mechanisms for the meaningful involvement of national and international partners, private-sector representatives, and community members in the research itself were explored. Such mechanisms will be crucial to advancing knowledge translation components related to the development of meaningful products or tools, commercialization, the examination of clinical practice, health behaviours, and social actions, as well as policy development/ change.
The cumulative results of all consultation sessions were summarized and forwarded to the BJI Governing Board. Strategic planning will continue in 2018 with more working meetings to develop details about the approaches and metrics that relate to the priorities and objectives that ranked high during the consultation process of 2017. During the fall of 2018, the draft strategic plan will be provided to reviewers as part of the Formal External Review of the Institute mandated by the University. The goal is to finalize the Strategic Plan by December of 2018.

Funding of Institute operations was derived from a number of sources with the majority of our original partners confirming support for Year 4 (2017-18). This ongoing commitment will be crucial to adhere to the original senate approved 5-year budget plan and to make preparations for the next 5 to 10 years. Until the end of Year 5, there is no budgetary overlap between the Institute and Western University’s Cluster of Research Excellence Program funds, administered by the Institute. After Year 5 (2018-19), Cluster operations and activities will be the responsibility of the Institute and the early career positions enabled by the Cluster become the responsibility of the landing Faculties. To bridge the financial transition and burden, Catalyst Grants and Transdisciplinary Bone and Joint Training Awards, as well as the position for the Manager of Research and Innovation, budgeted in Year 1 (not spent due to recruitment delays and alignment with the academic calendar) have been reallocated to Year 6. To sustain Institute and Cluster activities beyond Year 5, sustainability strategies are being explored to stabilize operations and increase revenues. Activities undertaken in 2017 include: the development of a fundraising case for support by the Vice-President (external) and her team and the submission of major grants such as ORF, CFI and NCE. We look to create a future where the Institute is an integral component of the University with dedicated long-term partners that are committed to world-class achievement in the area of MSK health at Western.

### Summary

Our approach towards **engagement, relationships and collaborative opportunities** both internally and externally sets us apart and creates an environment that enables us to work collaboratively and in a comprehensive way to **tackle the complex needs and gaps related to MSK health**. The astonishing achievements of our members this year tells us that we are on the **right path to making discoveries and developing innovations that will benefit millions of Canadians**. Thus, our dedication to taking the work of the Institute to the next level, as well as raise awareness about the relevance of our cause and unique approach, has never been stronger. We know that our research can have a positive impact on our healthcare system, social-care systems and economy. Most of all, we want to contribute to people’s lives in a way that will improve their quality of life.

2. The Cost of Chronic Disease in Canada, 2004