2024 BIOMARKERS OF AGING CONFERENCE

NOV 1-2 | HARVARD

2024 BIOMARKERS OF AGING CONFERENCE

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Welcome

Welcome to Harvard Medical School for the 2024 Biomarkers of Aging Conference! Building on the momentum generated by last year's inaugural meeting, we have expanded this conference to present a comprehensive two-day program that reflects the field's rapid evolution. As aging research and biomarker technologies continue to advance, setting robust standards around biomarkers of aging remains critically important. This conference offers a platform to advance this important component of the Consortium's work and share our progress over the last year.

Our expanded format features cutting-edge research presentations on Day 1, followed by a full day dedicated to clinical translation on Day 2. This structure reflects our commitment to bridging the gap between laboratory discoveries and practical applications. Our mission remains focused on consensus-building and advancing our collective understanding of biomarkers of aging, while strengthening the collaborative framework we have established. Together, we will share the latest breakthroughs, deliberate on critical implementation challenges, and define the priorities of the Consortium for the upcoming year.

We look forward to two inspiring days filled with groundbreaking insights, fruitful discussions, and collaborative efforts that will advance the integration of aging biomarkers into the clinic. Thank you for joining us as we build upon our momentum and work toward transforming the future of aging research!

2024 Scientific Chairs

Vadim Gladyshev
Harvard University

Andrea Maier
National University of Singapore

Vittorio Sebastiano
Stanford University

Michael Snyder
Stanford University

Eric Verdin
The Buck Institute

2024
Core Organizers

Mahdi Moqri

Harvard & Stanford Universities

Dane Gobel

Methuselah Foundation

Jesse Poganik

Harvard University

Chiara Herzog

University of Innsbruck

Nicholas Fiorenza

Methuselah Foundation

Andrea Cipriano

Stanford University

Ludger Goeminne

Harvard University

Kejun (Albert) Ying

Harvard University

Allison Duettmann

Foresight Institute

Program Day 1: Cutting-Edge Academic Science

Morning Session I: Omics & Multi-Omics Biomarkers of Aging

Chair: Vadim Gladyshev
Harvard University

09:00 - 09:10	**Welcome and Opening Remarks by Vadim Gladyshev**
09:10 - 09:25	 **Tony Wyss-Coray**, Stanford University *Proteomic Profiles of Aging and Neurodegeneration*:
09:25 - 09:45	 **Steve Horvath**, Altos Labs *New Advances in Epigenetic Clocks and DNA Methylation Biomarkers*
09:45 - 09:55	 **Mahdi Moqri**, Harvard University *Validation of Biomarkers of Aging*
09:55 - 10:25	**Coffee Break**

Program Day 1

Morning Session II: Molecular, Digital & Physiological Biomarkers of Aging

Chair: Jessica Su
Harvard University

10:25 - 10:30	**Session Intro by Jessica Su**
10:30 - 10:45	 **David Sinclair**, Harvard University *The Information Theory of Aging*
10:45 - 11:00	 **Eric Verdin**, Buck Institute *Measuring Human Immune Aging*
11:00 - 11:15	 **Jesse Poganik**, Harvard Medical School *Leveraging Biomarkers of Aging to Identify Solutions to Clinical Challenges*
11:15 - 12:00	**Poster Flash Talks**
12:00 - 12:30	**Group Photo @ HMS Quad**
12:30 - 13:30	**Lunch Break**
13:30 - 14:30	**Poster Session**

Program Day 1

Afternoon Session I: Systems Aging

Chair: Andrea Maier
National University Singapore

14:30 - 14:35	**Session Intro by Andrea Maier**
14:35 - 14:50	 **George Church**, Harvard & MIT *Aiming for Diseases of Aging vs. Longevity vs. Biomarkers vs. Healthspan*
14:50 - 15:05	 **Björn Schumacher**, University of Cologne *Aging By The Clock Yet Without a Program*
15:05 - 15:20	 **Jason Buenrostro**, Harvard Medical School *Single-Cell Epigenomics And The Regulatory Controls of Aging*
15:20 - 15:35	 **Omar Abudyyeh**, Brigham & Women's Hospital *Engineering Longevity Therapeutics*  **Jonathan Gootenberg**, Beth Israel Deaconess Medical Center
15:35 - 15:50	 **Raymond Mak**, Harvard Medical School *Clinical Application of Artificial Intelligence to Quantify Biological Age from Face Photographs*
15:50 - 16:20	**Coffee Break**

Program Day 1

Afternoon Session II: Longitudinal & Clinical Biomarkers

Chair: Lewis Lipsitz
Harvard Medical School

16:20 - 16:25	**Session Intro by Lewis Lipsitz**
16:25 - 16:40	 **Michael Snyder**, Stanford University *Deep Profiling Reveals Ageotypes and Periods of Aging*
16:40 - 16:55	 **Luigi Ferrucci**, National Institute on Aging *Biomarkers of Aging: Beyond Traditional Omics*
16:55 - 17:10	 **Sara Hägg**, Karolinska Institutet *General Principles of Biomarkers of Aging - A Longitudinal Perspective*
17:10 - 17:25	 **Riccardo Marioni**, University of Edinburgh *Proteomic and Epigenetic Predictors of Complex Traits & Incident Disease Outcomes*
17:25 - 17:40	 **Viviana Perez**, Hevolution *Hevolution Alliance for Aging Biomarkers (HAAB): a Roadmap for Future Clinical Applications*
17:40 - 17:45	**Day 1 Closing Remarks**

Program Day 2: Clinical Translation

Industry Roadmapping & Preclinical Development of Aging Biomarkers

Chair: Mahdi Moqri
Harvard University

09:00 - 09:05	**Welcome and Recap of Day 1**
09:05 - 09:20	 **Andrew Brack**, ARPA-H *Identifying Surrogates of Healthspan and Endpoints for Aging*
09:20 - 09:35	 **Lynne Cox**, Wellcome Trust *Refocusing Aging Biomarkers Through The Lens of Resilience*
09:35 - 09:50	 **John Earls**, Buck Institute *Refocusing Aging Biomarkers Through The Lens of Resilience*
09:50 - 10:05	 **Eric Morgen**, BioAge Labs *FDA Approval*
10:05 - 10:20	 **David Furman**, Buck Institute *Immune Biomarkers of Aging*
10:20 - 10:45	**Coffee Break**

Program Day 2

Morning Session II: Novel Biomarkers of Aging & Clinical Translation

Chair: Vittorio Sebastiano
Stanford Medical School

10:45 - 10:50	**Session Intro by Vittorio Sebastiano**
10:50 - 11:00	 **Gordan Lauc**, University of Zagreb *IgG Glycans Are Predictive Biomarkers and Modifiable Functional Effectors of Age-related Disease*
11:00 - 11:10	 **Christin Glorioso**, NeuroAge Therapeutics *Revering Brain Aging to Prevent Dementia*
11:10 - 11:20	 **Alexandra Stolzing**, University of Loughborough *Volatiles: Biomarkers of Aging*
11:20 - 11:30	 **Gavin Zhou**, Regenerative Bio *Methylation-based Organ-Level agEing (MOLE) Clock and its Application in Developing Organ-Specific Anti-aging Solutions*
11:30 - 11:40	 **Xiao-Jun Ma**, Alamar Biosciences *Highly Sensitive and Multiplexed Profiling of the Plasma Proteome to Identify Biomarker Signatures Associated with Aging*

Program Day 2

Morning Session II: Novel Biomarkers of Aging & Clinical Translation Continued

Chair: Vittorio Sebastiano
Stanford Medical School

11:40 - 11:50		**Chiara Herzog**, University of Innsbruck/Kings College London *Clinical Standards for Biomarkers of Aging*
11:50 - 12:00		**Andrea Maier**, **NUS** *Matchmaking: Biomarkers of Aging and Geroprotective Interventions*
12:00 - 12:10		**Tina Woods**, Collider Health *The Human Exposome: Going Beyond the Biology of Aging to Extend Human Healthspan, Resilience and Flourishing*
12:10 - 12:20		**Dave Gobel**, Methuselah Foundation *Making Biomarkers of Aging Actionable*
12:20 - 13:00	**Poster Flash Talks**	
13:00 - 14:00	**Lunch Break**	
14:00 - 14:55	**Poster Session**	

Program Day 2

Afternoon Session I: Frameworks for Clinical Trials featuring XPRIZE Healthspan

Chair: Jamie Justice
XPRIZE Healthspan

14:55 - 15:00	**Session Intro by Jamie Justice**
15:00 - 15:10	 **Jamie Justice**, XPRIZE Healthspan *XPRIZE Healthspan: Frameworks and Biomarkers of Aging for Clinical Trials*
15:10 - 15:30	 **John Tsang**, Yale University *Unified Metric of Human Immune Health*
15:30 - 15:45	 **Raghav Sehgal**, Yale University *Are DNAm Aging Biomarkers Ready for Clinical Trials? Progress Made and Challenges Ahead*
15:45 - 16:00	 **Nir Barzilai**, Einstein College of Medicine *Biomarkers for Gerotherapeutics*
16:00 - 16:15	 **Austin Argentieri**, Mass General Hospital *Harnessing Proteomic Aging Signatures as a Tool for Preventative Medicine*

Program Day 2

Selected Short Talks

Chair: Chiara Herzog
University of Innsbruck/Kings College London

16:45 - 16:55

Alexander Tyshkovskii, Harvard Medical School
Transcriptomic Hallmarks of Mortality Reveal Universal and Specific Mechanisms of Aging, Chronic Disease, and Rejuvenation

16:55 - 17:05

Jessica Kasamoto, Yale University
Multiverse of Clock Madness: Finding the One in One Thousand

Program Day 2

Afternoon Session II: Open Innovation

Chair: Dane Gobel
Methuselah Foundation

17:05 - 17:10	**Session Intro & Moderation by Dane Gobel**
17:10 - 17:20	 **Albert Ying**, Harvard Medical School *Biolearn - Roadmap, Federated Data, Implementations*
17:20 - 17:30	 **Seth Paulson**, Methuselah Foundation *Biolearn - Roadmap, Federated Data, Implementations Continued*
17:30 - 17:45	 **Waylon Hastings**, University of Texas *Translational Biomarkers of Inflammaging for Precision Health*  **Christian Behrens**, Bayer
17:45 - 17:50	 **Biomarkers of Aging Challenge - Phase I Announcement Presented by Alamar Biosciences**
17:50 - 17:55	 **Julian Rheinhard**, Evotec Phase I Winner Short Talk
17:55 - 18:00	**TBA** **Phase II Winner Short Talk**
18:00 - 18:05	**Biomarkers of Aging Consortium** Concluding Remarks

Sponsors & Partners

Thank you for helping to make our Conference possible with your support.

Funding for this conference was made possible, in part, by 1R13 AG092128-01 from NIA. The views expressed in written conference materials or publications and by speakers and moderators do not necessarily reflect the official policies of the Department of Health and Human Services; nor does mention by trade names, commercial practices, or organizations imply endorsement by the U.S. Government.

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A message from our Partner

ALAMAR BIOSCIENCES

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Unlocking the Secrets of Biological Aging with Gold Standard Sensitivity

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Imagine a world where early detection of age-related diseases like cancer, Alzheimer's, and autoimmune conditions is within reach. This possibility is closer than ever, thanks to breakthroughs in biological aging research enabled by high-sensitivity protein detection.

While traditional aging measurements focused on DNA, recent advances in protein analysis offer new insights. Using NULISA™, an innovative proteomics technology, researchers studied over 300 proteins to track age-related changes in blood samples. In a study of 500 individuals, aged across 70 years, scientists identified key proteins linked to aging, particularly those associated with inflammation and neurodegeneration. NULISA achieved detection rates up to 98.8% for markers like IL6, TNFA, and pTau – critical indicators of chronic disease risks.

This research lays the groundwork for a protein-based age predictor, which could transform how we monitor aging and potentially forecast age-related health outcomes. As scientists advance protein detection technologies, innovations like NULISA provide vital insights, bringing us one step closer to healthier, longer lives.

Visit Alamar's Conference booth or visit their website to learn more.

A Message from our Sponsor

Unleashing the Miracle of Human Creativity and Innovation

The mission of the Firuza Foundation is to create sustainable social impact by leveraging scientific research for the benefit of mankind. The Firuza Foundation aims to recognize and reward exceptional contributions to scientific breakthroughs in the fields of chemistry, medicine, physics and climate.

The Firuza Foundation seeks to amplify the impact of pioneering discoveries and inventions that have the potential to revolutionize our world and touch the human soul.

By honoring outstanding achievements, the Firuza Foundation not only honors the exceptional work of individuals and collaborative teams but hopes to ignite a global dialogue on the importance of scientific inquiry in shaping a brighter future for all. The Firuza Foundation hopes to unleash a global culture of curiosity, creativity, and rigor, driving forward the frontiers of knowledge for the betterment of society and our planet.

By elevating excellence in scientific inquiry, the Firuza Foundation aims to accelerate progress towards addressing the most pressing challenges facing humanity such as food security, access to quality education, finding solutions to hard-to-cure diseases, and identifying disruptive climate solutions.

Visit Firuza Foundation's Conference booth or website for more information.

A Message from our Partner

Healthy Aging Made Possible

Increasing human life expectancy is one of the greatest breakthroughs in modern history. We have more than doubled the global average in the last 100 years, but the length of our healthy lives has not increased at the same rate.

The world's population of people over 60 years of age is expected to almost double from 12% to 22% between 2015 and 2050. We have an urgent need to find novel solutions for healthy aging.

Imagine a future where aging is full of potential. A future where aging brings more time with family and friends, opportunities for continued learning, second or third careers, and fulfilled bucket lists. We designed XPRIZE Healthspan to make this future a reality.

XPRIZE Healthspan is a 7-year, $101 million global competition to revolutionize the way we approach human aging. People around the world are living longer, but spend a longer period of life in poorer health. To tackle this problem, competing teams will develop and test therapeutics that restore muscle, cognitive, and immune function by a minimum of 10 years, with an ambitious goal of 20 years, to extend healthy life. This radically collaborative effort will bring together top scientists, clinicians, policymakers, industry experts, and nonprofits to drive new science and create a future where healthy aging is made possible for everyone.

Visit XPRIZE Healthspan's Conference booth or head over to their website for more information.

A Message from our Sponsor

Regenerative Bio

Graceful Aging for Everyone

Founded in 2021, Regenerative Bio is a pioneering longevity company powered by artificial intelligence with a vision of "Health Equity - Graceful Aging for Everyone." At the cutting edge of longevity science, technology, and clinical practice, they have developed the innovative "Methylation-based Organ-Level Aging (MOLE) clock" technology.

This is integrated into their RevOrgan™ anti-aging platform, enabling precise measurement and effective interventions at the organ level. Their brand, LAIFE®—combining "life" and "AI"—demonstrates Regenerative Bio's commitment to solutions targeting the root causes of organ-specific aging, promoting not just a longer but a healthier life.

Regenerative Bio is dedicated to health equity, with a team of world-class scientists and skilled business professionals, ensuring our work is scientifically rigorous and commercially viable. We are entering a transformative era in longevity science, where the convergence of AI, omics, and regenerative medicine will extend healthspans and enhance quality of life. Together, they aim to reshape aging into a journey of vitality and wellness, transforming perceptions of healthspan.

For collaboration opportunities, visit Regenerative Bio's conference booth to connect with Chief Brand Officer Ringo Ye, or speak with Chief Technology Officer Gavin Zhou, our Day 2 speaker.

A Message from our Sponsor

Winthrop Estate

Your Longevity Retreat Destination in the Berkshires

The Winthrop Estate hosts academic, family and corporate retreats at a historic, twelve bedroom, forty-five acre staffed estate in the Berkshires. Located in Lenox, Massachusetts, just a few hours from Boston and New York, this private estate has become an ideal setting for boards retreats, family gatherings, and intellectual recreation of all sorts.

To learn more about the Winthrop Estate, visit their website or get in touch with Ethan Berg. You can reach him at Ethan@winthropestate.com

Posters

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1 **Multiverse of Clock Madness: Finding the One in One Thousand.**
Jessica Kasamoto, Raghav Sehgal, Daniel Borrus, Albert Higgins-Chen

2 **Transcriptomic Hallmarks of Mortality Reveal Universal and Specific Mechanisms of Aging, Chronic Disease, and Rejuvenation.**
Alexander Tyshkovskiy, Daria Kholdina, Kejun Ying, Maria Davitadze, Sergey E. Dmitriev, Vadim N. Gladyshev

3 **The Tyrol Lifestyle Atlas: systemic, longitudinal, multi-omic profiling of health impacts of intermittent fasting reveals tissue-specific impacts on health and biomarkers of aging.**
Chiara Herzog, Charlotte Vavourakis, Bente Theeuwes, Christina Watschinger, Magdalena Hagen, Gabriel Knoll, Umesh Kumar, Maria Cavinato, Sonja Sturm, Birgit Weinberger, Alexander Moschen, Martin Widschwendter

4 **Plasma protein-based organ-specific aging and mortality models unveil diseases as accelerated aging of organismal systems.**
Ludger J.E. Goeminne, Anastasiya Vladimirova, Alec Eames, Alexander Tyshkovskiy, M. Austin Argentieri, Kejun Ying, Mahdi Moqri, Vadim N. Gladyshev

5 **Unraveling Aging and Rejuvenation: Multi-Omic Insights from Fat Transplantation.**
Alibek Moldakozhayev, Pasquale Nigro, Alexander Tyshkovskiy, Cecília G. De Magalhães, Jesse R. Poganik, Albina Tskhay, Kejun Ying, Sirui Zhang, Alec W. Eames, Bohan Zhang, Joao A. Paulo, Wayne Mitchell, Andrei E. Tarkhov, Nicholas P. Carbone, Michael F. Hirshman, Roderick T. Bronson, Steven P. Gygi, Laurie J. Goodyear, Jeremy M. Van Raamsdonk, Vadim N. Gladyshev

6 **A Unified Framework for Systematic Curation and Evaluation of Aging Biomarkers.**
Kejun Ying, Seth Paulson, Alec Eames, Alexander Tyshkovskiy, Siyuan Li, Martin Perez-Guevara, Mehrnoosh Emamifar, Maximiliano Casas Martínez, Dayoon Kwon, Anna Kosheleva, Michael P. Snyder, Dane Gobel, Chiara Herzog9, Jesse R. Poganik, Biomarker of Aging Consortium, Mahdi Moqri, Vadim N. Gladyshev

7 **Comprehensive Organ-Specific Age Profiling Through Deep Learning Imaging Models.**
Alec Eames, Cecilia Magalhães, Anastasiya Vladimirova, Vadim N. Gladyshev

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8 **The use of epigenetic clocks to predict chemotherapy tolerance and appraise interventions to mitigate biological aging over cancer treatment.**
Alexandra M. Binder, Erin Weltzien, Elizabeth M. Cespedes Feliciano, Justin C. Brown, Catherine Lee, Michelle Ross, Kristin l. Campbell, Adrienne Castillo, Amalia Pena Perez, Jeffrey A. Meyerhardt, Kathryn H. Schmitz, Bette J. Caan

9 **PRC2 AgeIndex: a universal biomarker of aging and rejuvenation.**
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10 **Aging is associated with genome-wide splicing degeneration.**
Sirui Zhang, Alexander Tyshkovskiy, Kejun Ying, Vadim N. Gladyshev

11 **Independent validation of conventional and organ specific proteomic age clocks in the European Prospective Investigation into Cancer (EPIC).**
Oliver Robinson, Jan Homann, Antonio Agudo, Pietro Ferrari, Giovanna Masala, Domenico Pali, Salvatore Panico, Carlotta Sacerdote, Karl Smith-Byrne, Ruth Travis, Rosario Tumino, Roel Vermeulen, Monique Verschuren, Vivian Viallon, Nick Wareham, Christina M. Lill, Elio Riboli, Marc J. Gunter

12 **Exploring the use of proteomic aging as a surrogate marker in a randomized trial of calorie restriction.**
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13 **Architecture for frequent measurement of protein panels of biomarkers of aging.**
Nikola T. Markov, Matthew Bertram, Jose Navarro, Fiona Miller, Robert Cargill

14 **Transposable element methylation state predicts age and disease.**
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15 **Unifying Geroscience: Mapping Responsiveness of 100+ epigenetic biomarkers across 75+ anti-aging interventions in humans.**
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16 **CpGPT: a Foundation Model for Epigenetic Ageing**
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17 **Effects of surgery on clinical profiles, DNA methylation profiles and DNAm ages in Singaporean aged 65 and above.**
Tay J.H. , Dorajoo R , Maier A.B. Ti L.K.

18 **Deep Learning Chest X-Ray Age: Associations with Epigenetic and Cardiopulmonary Aging.**
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19 **Deep Learning to Estimate Biological Age from Spine Dual-energy Absorptiometry (DXA) Images.**
Vineet K Raghu, Alexander Cheng, Douglas P Kiel, Michael T Lu

20 **Adaptation of epigenetic clocks to the Japanese population using machine learning.**
Hidekazu Yamada, Yui Tomo, Ryo Nakaki

21 **In search of novel ageing biomarkers: immunoglobulin G glycans.**
Lucija Sironic, Sofia Shkunnikova, Anika Mijakovac, Maja Hanic, Marina Martinic Kavur, Gordan Lauc

22 **Cardiac Aging: Spatial-functional calcium markers of tissue aging for the electrical system of the heart**
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27 **An iPSC-based screening platform for investigation and validation of aging biomarkers and longevity interventions.**
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49 **Early Detection of Alzheimer's Disease Using Digital Biomarkers: Promising Insights from the Providemus Alz Project.**
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52 **Metabolomic Age (MileAge) predicts health and lifespan: a comparison of multiple machine learning algorithms.**
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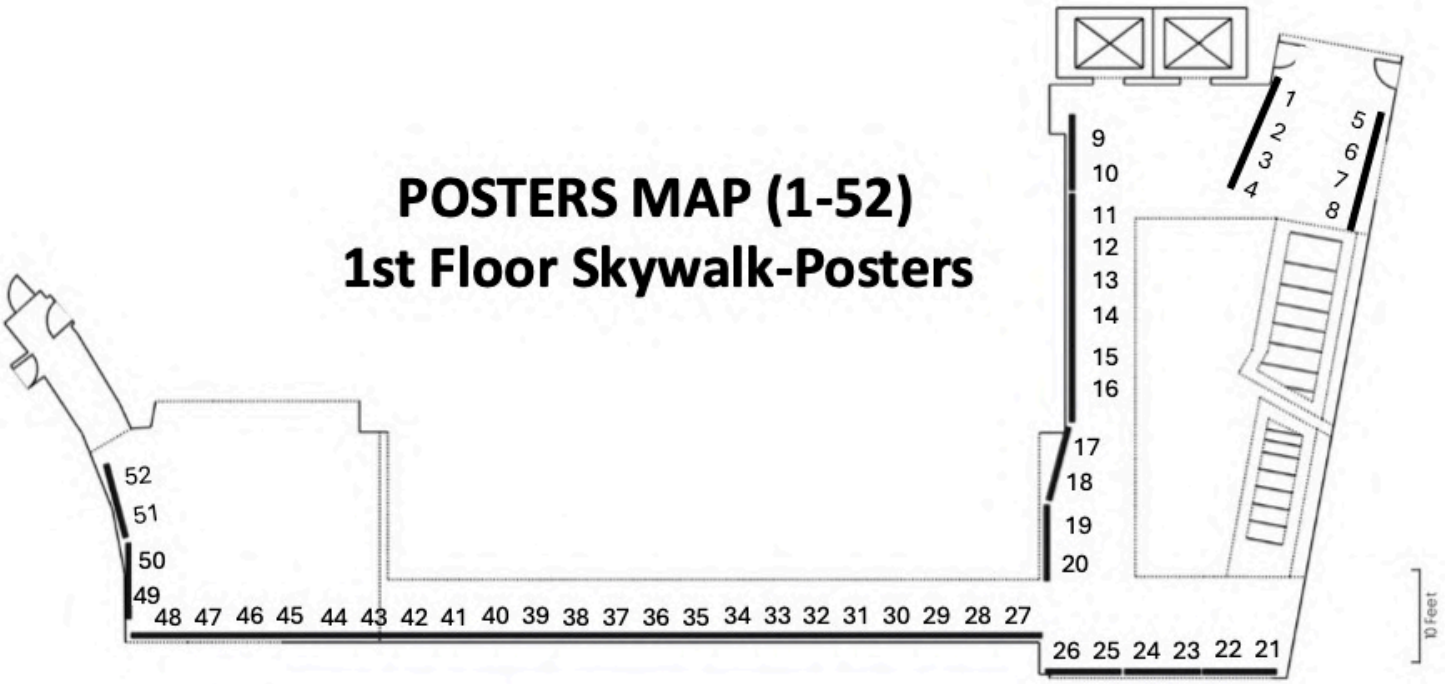
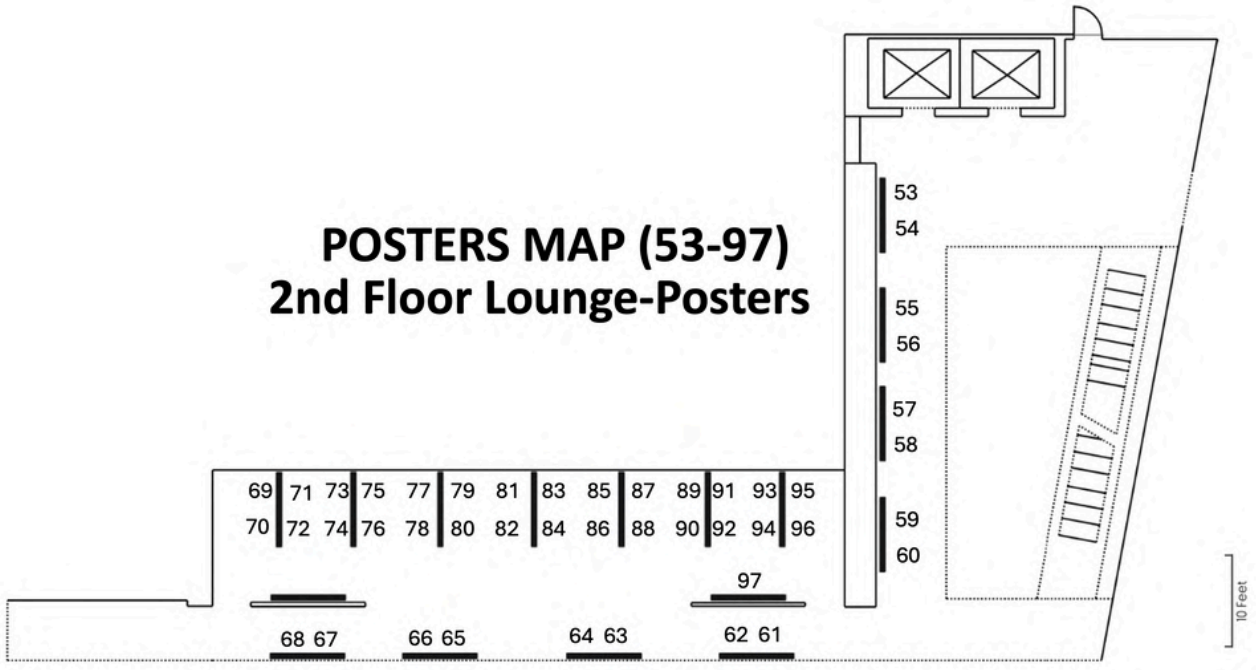

POSTERS MAP (1-52)
1st Floor Skywalk-Posters
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
52 51 50 49
48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27
26 25 24 23 22 21
10 Feet


POSTERS MAP (53-97)
2nd Floor Lounge-Posters
53 54 55 56 57 58 59 60
69 71 73 75 77 79 81 83 85 87 89 91 93 95
70 72 74 76 78 80 82 84 86 88 90 92 94 96
97
68 67 66 65 64 63 62 61
10 Feet

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Joseph B. Martin Conference Center

77 Avenue Louis Pasteur,
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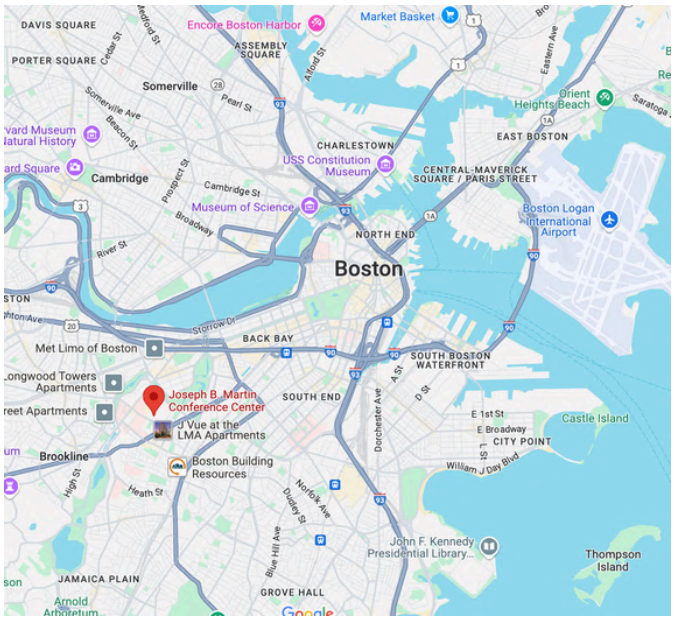

Travel details:

By Car:

- Parking garage access for staff and presenters is available. The parking facilities are very limited and do not include the option of parking on a cash basis.

By Public Transport:

- Easy to get to by public transport. Check Google Maps. Check Massachusetts Bay Transportation Authority for info on endorsed apps for use. Visit website here.

Closest Airport:

- Boston Logan International Airport (BOS)

Where to stay

Marriott Residence Inn at Fenway Park

- Located in the lively Fenway neighborhood right next to Fenway Park.
- Fifteen minutes by foot to Joseph B. Martin Conference Center.
- Google maps walking directions to the Conference Center here.
- Five minute car ride. Google maps driving directions here.

Additional info can be found on their website.

The Inn at Longwood

- Located in the heart of Longwood Medical Center.
- Five minutes by foot to Joseph B. Martin Conference Center.
- Google maps walking directions to the Conference Center here.

Additional info can be found on their website.

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