

LiKang Chin, PhD
Graduate Program Director for the School of Engineering
Assistant Teaching Professor in the Department of Biomedical Engineering
Widener University, Chester, PA 19013
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Education

- Jan 2011 **Case Western Reserve University**, Cleveland, OH
Doctorate of Philosophy, Biomedical Engineering
“Tyramine Substituted-Hyaluronan Enriched Fascia for Rotator Cuff Tendon Repair”
- Jan 2007 **Case Western Reserve University**, Cleveland, OH
Master of Science, Biomedical Engineering
“The Effects of Mechanical and Environmental Conditions on the Mechanical Properties of Rat Tail Tendon Fascicles”
- May 2001 **University of Pennsylvania**, Philadelphia, PA
Bachelor of Science in Engineering, Bioengineering, Minor in Mathematics

Academic and Research Experience

- Jan 2021 - present **Widener University**, Chester, PA
School of Engineering
Graduate Program Director for Masters of Science in Engineering (MSE) Program and 4+1 Bachelor of Science (BS)/MSE Accelerated Program
Increased student enrollment by 78% from AY 2021-22 to AY 2024-25 using such strategies as increasing availability of graduate assistantships, hosting information sessions to recruit external candidates, promoting the 4+1 program in the classroom, and leveraging social media
- Advise changes in policy and curriculum in collaboration with SOE Deans
 - Collaborate with Graduate Admissions and Enrollment and University Relations for marketing, event planning, recruitment and overall enrollment management strategy
 - Evaluate applications for admission and render admission decisions
 - Manage defense and thesis submission processes
 - Organize and host annual student research symposium for MSE thesis candidates to showcase their projects
 - Advise new and continuing students
 - Advise graduate students in Engineering and Technology Management program
 - Manage degree audit process
 - Collaborate with faculty from all engineering departments to manage course offerings
 - Manage instructor staffing of graduate general engineering courses
 - Manage and make decisions regarding the graduate assistantship award program
 - Contribute to a biannual alumni newsletter, and idea I initiated in Fall 2023
 - Analyze enrollment data and make projections
 - Participate in strategic planning and initiation for the School of Engineering
- Department of Biomedical Engineering
Assistant Teaching Professor
- Course development and instruction of undergraduate and graduate courses
 - Average teaching evaluation = 4.6 out of 5.0
 - Developed two new graduate courses – Cellular Mechanics, A Biomedical Engineering Perspective on Autism Spectrum Disorder

- Redesigned two undergraduate courses – Biomedical Engineering Laboratory I, Biomechanics
- Developed and mentored undergraduate capstone project entitled “Design and Construction of an Economical Live Cell Imaging Microscopy System” that won the 2024 School of Engineering Dean’s Award for Best Oral Presentation, beating out 17 other senior project teams in the School of Engineering
- Maintain an active research program investigating mechanobiology in obesity and Autism Spectrum Disorders
- Mentor a research team of graduate and undergraduate students to design and implement experiments, interpret data, and disseminate their findings
- Academic advisor for BME undergraduates (first-years and seniors)
- Host numerous outreach events, including open houses for recruitment and engineering camps to provide high school students hands-on laboratory experience in a college environment
- Assist in ABET re-accreditation

May 2023 – May 2024 **Current Issues in Molecular Biology**

Guest Editor for Special Issue on “Cellular and Molecular Mechanisms of Nonalcoholic Fatty Liver Disease”

- Selected the title, aim, and scope of the special issue
- Identified and solicited potential contributors
- Supervised entire peer-review process, including making final decisions on publication status
- Promoted the special issue at conferences and on social media
- Collaborated with editorial staff

Dec 2015 – Jul 2020

University of Pennsylvania, Philadelphia, PA

Department of Medicine, Gastroenterology

Technical Director of PSOC@Penn Cell and Tissue Core

- Collaborated with investigators and clinicians from Penn and other institutions to design experiments, develop scientific techniques, and interpret data
 - Created and supervised centralized biorepository of liver cells and tissue
- Independent projects
- Investigated effects of lipid droplets on hepatocyte mechanosensing using hydrogels of varying stiffness
 - Evaluated liver mechanics during disease in zebrafish, rodents, and humans
 - Investigated relationship between liver mechanics and cytoskeletal proteins and extracellular matrix structures

Notable techniques developed

- Mouse model of liver cancer using exosome delivery
- Primary cell isolation from human cirrhotic liver and mouse liver tumors
- Visualization of cell motion and deformation during mechanical compression of tissue using confocal microscopy

Nov 2011 – Dec 2015

University of Pennsylvania, Philadelphia, PA

Institute for Medicine and Engineering, Department of Physiology

Tokushima University Hospital, Tokushima, Japan

Clinical Research Center for Diabetes

Postdoctoral Research Fellow

Postdoctoral advisors: Paul Janmey, PhD and Makoto Funaki, MD, PhD

- Investigated effects of mechanical environment on inflammation in adipocytes and adipose tissue
- Evaluated adipose mechanics during obesity in rodents
- Characterized mechanical properties of normal and diseased soft tissues, including brain, liver, and pulmonary artery

Aug 2003 – Sep 2011 **Lerner Research Institute, Cleveland Clinic**, Cleveland, OH
Department of Biomedical Engineering and Orthopaedic Research Center
Graduate Student, Postdoctoral Research Fellow
PhD advisors: Kathleen Derwin, PhD and the late Roger Marchant, PhD
PhD committee members: Eben Alsberg, PhD, Thomas Bauer, MD, PhD, Vince Hascall, PhD

- Designed, tested, and characterized methods to enrich human fascia with cross-linkable hyaluronan for tendon repair
- Evaluated chronic inflammatory response to and mechanical properties of hyaluronan-enriched fascia in rat abdominal wall model
- Investigated effects of mechanical unloading and inflammatory cytokines on mechanical properties of rat tail tendon fascicles
- Evaluated patient data of rotator cuff repair grafts in collaboration with pathologist
- Partnered with industry collaborators at Musculoskeletal Transplant Foundation (Edison, NJ)

Industry Experience

June 2001 – Aug 2003 **Cook Biotech Incorporated**, West Lafayette, IN
Product Development Engineer

- Led all aspects of design control from idea to transfer-to-manufacturing for two 510(k) FDA-cleared small intestinal submucosa devices
- Interacted with clinicians and clients to gain end-user requirements and design inputs
- Developed and mechanically tested prototypes
- Maintained design history files, performed risk analysis, authored quality system documents, and conducted design review meetings
- Developed methods for scale-up and trained manufacturing team
- Presented on SIS technology at internal and external conferences

Peer-reviewed Manuscripts

1. Parihar, K., Nukpezah, J., Iwamoto, D. V., Cruz, K., Byfield, F. J., **Chin, L.**, Murray, M. E., Mendez, M. G., van Oosten, A. S., Herrmann, A., Charrier, E. E., Galie, P. A., Donlick, M., Lee, T., Janmey, P. A., & Radhakrishnan, R. (2025). Tissue-dependent mechanosensing by cells derived from human tumors. *bioRxiv : the preprint server for biology*, 2025.01.11.632563. <https://doi.org/10.1101/2025.01.11.632563>
2. Rudolph, E. L., & **Chin, L.** (2024). Mechanobiology in Metabolic Dysfunction-Associated Steatotic Liver Disease and Obesity. *Current issues in molecular biology (Impact factor = 3.1)*, 46(7), 7134–7146. <https://doi.org/10.3390/cimb46070425>
3. Blade, S. P., Falkowski, D. J., Bachand, S. N., Pagano, S. J., & **Chin, L.** (2024). Mechanobiology of Adipocytes. *Biology (Impact factor = 3.5)*, 13(6), 434. <https://doi.org/10.3390/biology13060434>
4. Wu, B., Liu, D. A., Guan, L., Myint, P. K., **Chin, L.**, Dang, H., Xu, Y., Ren, J., Li, T., Yu, Z., Jabban, S., Mills, G. B., Nukpezah, J., Chen, Y. H., Furth, E. E., Gimotty, P. A., Wells, R. G., Weaver, V. M., Radhakrishnan, R., Wang, X. W., ... Guo, W. (2023). Stiff matrix induces exosome secretion to promote tumour growth. *Nature cell biology (Impact factor = 28.21)*, 25(3), 415–424. <https://doi.org/10.1038/s41556-023-01092-1>
5. Łysik, D., Deptuła, P., Chmielewska, S., Skłodowski, K., Pogoda, K., **Chin, L.**, Song, D., Mystkowska, J., Janmey, P. A., & Bucki, R. (2022). Modulation of Biofilm Mechanics by DNA Structure and Cell Type. *ACS biomaterials science & engineering (Impact factor = 4.749)*, 8(11), 4921–4929. <https://doi.org/10.1021/acsbiomaterials.2c00777>
6. Filliol, A., Saito, Y., Nair, A., Dapito, D. H., Yu, L. X., Ravichandra, A., Bhattacharjee, S., Affo, S., Fujiwara, N., Su, H., Sun, Q., Savage, T. M., Wilson-Kanamori, J. R., Caviglia, J. M., **Chin, L.**, Chen, D., Wang, X., Caruso, S., Kang, J. K., Amin, A. D., ... Schwabe, R. F. (2022). Opposing roles of hepatic

- stellate cell subpopulations in hepatocarcinogenesis. *Nature (Impact factor = 69.5)*, 610(7931), 356–365. <https://doi.org/10.1038/s41586-022-05289-6>
7. Affo, S., Nair, A., Brundu, F., Ravichandra, A., Bhattacharjee, S., Matsuda, M., **Chin, L.**, Filliol, A., Wen, W., Song, X., Decker, A., Worley, J., Caviglia, J. M., Yu, L., Yin, D., Saito, Y., Savage, T., Wells, R. G., Mack, M., Zender, L., ... Schwabe, R. F. (2021). Promotion of cholangiocarcinoma growth by diverse cancer-associated fibroblast subpopulations. *Cancer cell (Impact factor = 38.58)*, 39(6), 866–882.e11. <https://doi.org/10.1016/j.ccell.2021.03.012>
 8. Bhattacharjee, S., Hamberger, F., Ravichandra, A., Miller, M., Nair, A., Affo, S., Filliol, A., **Chin, L.**, Savage, T. M., Yin, D., Wirsik, N. M., Mehal, A., Arpaia, N., Seki, E., Mack, M., Zhu, D., Sims, P. A., Kalluri, R., Stanger, B. Z., Olive, K. P., ... Schwabe, R. F. (2021). Tumor restriction by type I collagen opposes tumor-promoting effects of cancer-associated fibroblasts. *The Journal of clinical investigation (Impact factor = 19.46)*, 131(11), e146987. <https://doi.org/10.1172/JCI146987>
 9. **Chin, L.**, Theise, N. D., Loneker, A. E., Janmey, P. A., & Wells, R. G. (2020). Lipid droplets disrupt mechanosensing in human hepatocytes. *American journal of physiology. Gastrointestinal and liver physiology (Impact factor = 4.871)*, 319(1), G11–G22. <https://doi.org/10.1152/ajpgi.00098.2020>
 10. van Oosten, A. S. G., Chen, X., **Chin, L.**, Cruz, K., Patteson, A. E., Pogoda, K., Shenoy, V. B., & Janmey, P. A. (2019). Emergence of tissue-like mechanics from fibrous networks confined by close-packed cells. *Nature (Impact factor = 69.5)*, 573(7772), 96–101. <https://doi.org/10.1038/s41586-019-1516-5>
 11. **Chin, L.**, Xia, Y., Discher, D. E., & Janmey, P. A. (2016). Mechanotransduction in cancer. *Current opinion in chemical engineering (Impact factor = 5.163)*, 11, 77–84. <https://doi.org/10.1016/j.coche.2016.01.011>
 12. Perepelyuk, M., **Chin, L.**, Cao, X., van Oosten, A., Shenoy, V. B., Janmey, P. A., & Wells, R. G. (2016). Normal and Fibrotic Rat Livers Demonstrate Shear Strain Softening and Compression Stiffening: A Model for Soft Tissue Mechanics. *PLoS one (Impact factor = 3.24)*, 11(1), e0146588. <https://doi.org/10.1371/journal.pone.0146588>
 13. Mihai, L. A., **Chin, L.**, Janmey, P. A., & Goriely, A. (2015). A comparison of hyperelastic constitutive models applicable to brain and fat tissues. *Journal of the Royal Society, Interface (Impact factor = 4.118)*, 12(110), 0486. <https://doi.org/10.1098/rsif.2015.0486>
 14. Bucki, R., Cruz, K., Pogoda, K., Eggert, A., **Chin, L.**, Ferrin, M., Imbesi, G., Hadjiliadis, D., & Janmey, P. A. (2015). Enhancement of Pulmozyme activity in purulent sputum by combination with poly-aspartic acid or gelsolin. *Journal of cystic fibrosis : official journal of the European Cystic Fibrosis Society (Impact factor = 5.482)*, 14(5), 587–593. <https://doi.org/10.1016/j.jcf.2015.02.001>
 15. Pogoda, K., **Chin, L.**, Georges, P. C., Byfield, F. J., Bucki, R., Kim, R., Weaver, M., Wells, R. G., Marcinkiewicz, C., & Janmey, P. A. (2014). Compression stiffening of brain and its effect on mechanosensing by glioma cells. *New journal of physics (Impact factor = 3.729)*, 16, 075002. <https://doi.org/10.1088/1367-2630/16/7/075002>
 16. **Chin, L.**, Calabro, A., Walker, E., & Derwin, K. A. (2012). Mechanical properties of tyramine substituted-hyaluronan enriched fascia extracellular matrix. *Journal of biomedical materials research. Part A (Impact factor = 4.396)*, 100(3), 786–793. <https://doi.org/10.1002/jbm.a.34025>
 17. **Chin, L.**, Calabro, A., Rodriguez, E. R., Tan, C. D., Walker, E., & Derwin, K. A. (2011). Characterization of and host response to tyramine substituted-hyaluronan enriched fascia extracellular matrix. *Journal of materials science. Materials in medicine (Impact factor = 3.896)*, 22(6), 1465–1477. <https://doi.org/10.1007/s10856-011-4325-4>

Patents

1. Pavcnik D, Kaufman, JA, Osborne T, Bates B, Patel U, Fette CD, **Chin L**, McAlexander CS, Shah B. “Vascular occlusion methods, systems and devices.” US9414843 (Aug 16, 2016), EP1686903B1, CA2547088C, JP2007528237A, W02005053547A3.
2. Kennedy KC, **Chin L**. “Surgical implant.” US8226730 (Jul 24, 2012), EP1656070B1, JP4673305B2, DE602004023302D1, W02005018468A3.
3. Derwin KA, Iannotti JP, **Chin L**, Calabro A. “Molecular enhancement of extracellular matrix and methods of use.” US8080260 (Dec 20, 2011), EP2249891B1, ES2585483T3, W02009102967A3.

4. Bosley, Jr. RW, Patel UH, Andrews MO, **Chin L**, Fischer, Jr. FJ, Ryan WN, Rosenblatt, PL, Jones, JS. "Sling for supporting tissue." US7766926 (Aug 3, 2010), EP1501444B1, W02003092546A3A.

Invited Podium Presentations - External

1. **Chin L**. "Rheological Testing of Soft Tissues to Understand Mechanobiology and Disease Progression." *NETZSCH Analyzing and Testing Webinar*, June 2025.
2. **Chin L**. "Rheological Testing of Soft Tissues to Understand Mechanobiology and Disease Progression." *NETZSCH Advanced Life Science Material Characterization Workshop* (Piscataway, NJ), April 2024.
3. **Chin L**, Calabro A, Derwin KA. "Development and characterization of tyramine substituted-hyaluronan (TS-HA) enriched fascia for rotator cuff repair." *American Society of Mechanical Engineers Summer Bioengineering Conference* (Naples, FL), June 2010.
4. **Chin L**, Calabro A, Rodriguez ER, Tan CD, Walker E, Derwin KA. "Host response and mechanical properties of tyramine substituted-hyaluronan (TS-HA) enriched fascia extracellular matrix." *International Society for Hyaluronan Sciences 8th International Conference on Hyaluronan* (Kyoto, Japan), June 2010.
5. **Chin L**, Derwin KD. "Host cell response to hyaluronan treated fascia extracellular matrix." *Biological Scaffolds for Regenerative Medicine* (Phoenix, AZ), Feb 2008.

Posters Presentations - External

1. Panichello, ZN, Blade, SP, Rudolph EL, Falkowski DJ, Schlosser JT, Pagano SJ, Eslami B, **Chin L**. "Finite element analysis of lipid-loaded adipocytes." Adipose Health and Obesogenic Memory (New York, NY), April 2025.
2. Panichello, ZN, Pagano SJ, **Chin L**. "A finite element analysis of adipocyte mechanical loading." Spring 2025 American Society for Engineering Education Mid-Atlantic Section Meeting (Reading, PA), March 2025.
3. Blade SP, Falkowski DJ, Schlosser JT, Balaji S, Johnson KE, Nicosia MA, Pagano SJ, Eslami BE, **Chin L**. "A finite element analysis of lipid-loaded adipocytes." Biomedical Engineering Society (Seattle, WA), October 2023
4. **Chin L**, Vega SL, Loneker AE, Burdick JA, Janmey PA, Wells RG. "Mechanics and hepatocyte behavior in non-alcoholic fatty liver disease." NCI-Physical Sciences in Oncology Symposium (Boston, MA), October 2017
5. **Chin L**, Kaplan DE, Furth EE, Funaki M, Janmey PA, Wells RG. "Lipid loading of hepatocytes abrogates stiffness sensitivity." NIH The Adipose Tissue Niche: Role in Health and Disease (Bethesda, MD), November 2016.
6. **Chin L**, Loneker AE, Tsai SJ, Kaplan DE, Furth EE, Janmey PA, Wells RG. "Rheological and biochemical characterization of diseased livers and hepatocellular carcinomas." FASEB Liver Biology (West Palm Beach, FL), June 2016.
7. **Chin L**, Monks B, Birnbaum MJ, Janmey PA, Funaki M. "Collagen VI knockout abrogates obesity-related adipose tissue stiffening." *American Diabetes Association 74th Scientific Sessions* (San Francisco, CA), June 2014, Abstract 4433.
8. **Chin L**, Bando Y, Monks B, Shikama Y, Birnbaum MJ, Janmey PA, Funaki M. "Tissue compression initiates proinflammatory response in adipocytes." *American Diabetes Association 73rd Scientific Sessions* (Chicago, IL), June 2013, Abstract 1761.

Grants Awarded and Fellowships

1. Widener University Faculty Development Grant, "The synergistic effect of stiffness and inflammation on adipocyte mechanosensing," AY2024-25
2. Widener University Provost Grant, "Design and construction of an economical live cell imaging microscopy system," AY2023-24
3. Widener University Faculty Development Grant, "The synergistic effect of stiffness and inflammation on adipocyte mechanosensing," AY2023-24

4. Widener University Faculty Development Grant, "Finite element analysis of cell stiffness and nuclear deformation of lipid-loaded adipocytes," AY2023-24
5. Widener University Provost Grant, "The synergistic effect of stiffness and inflammation on adipocyte mechanosensing," AY2022-23
6. National Institutes of Health University of Pennsylvania Multidisciplinary Cardiovascular Biology Training Grant Fellowship NIH T32 HL007954, Nov 2011 – Oct 2013
7. National Institutes of Health Ruth L. Kirschstein National Research Service Award Predoctoral Fellowship F31 AR057305, Mar 2009 – Jan 2011
8. National Institutes of Health Cleveland Clinic Orthopaedic Research Training Grant Fellowship NIH T32 AR50959, Sep 2004 – Aug 2006

Additional Teaching Experience

- | | |
|------------------------------|--|
| Summer 2017 –
Spring 2020 | <p>University of Pennsylvania, Philadelphia, PA
Center for Engineering MechanoBiology Research Experience for Teachers (RET)</p> <ul style="list-style-type: none"> • Mentored teachers as part of summer professional development program • Assisted in translating experiments from laboratory to classroom • Provided introductory mechanobiology lecture and laboratory practical • Invited lecturer on mechanobiology, Upper Perkiomen High School (Spring 2019) |
| Spring 2011 | <p>Case Western Reserve University, Cleveland, OH
EBME 318/319 Biomedical Engineering Laboratory</p> <ul style="list-style-type: none"> • Undergraduate level course, 6 students • Held pre-lab and lab on mechanical testing of extracellular matrix scaffolds • Developed questions and graded lab report |
| Fall 2006 | <p>Case Western Reserve University, Cleveland, OH
<i>Teaching Assistant</i>
EBME 317/417 Excitable Cells: Molecular Mechanisms, Kenneth Gustafson, PhD</p> <ul style="list-style-type: none"> • Combined undergraduate and graduate level course, 30 students • Graded homework, semester project, midterm, and final exams |
| Spring 2006 | <p>Case Western Reserve University, Cleveland, OH
<i>Teaching Assistant</i>
EBME 310 Principles of Biomedical Instrumentation, Miklos Gratzl, PhD</p> <ul style="list-style-type: none"> • Large, undergraduate level course, 120 students • Held weekly office hours • Developed and graded homework and exam questions |
| Fall 2005 | <p>Case Western Reserve University, Cleveland, OH
<i>Teaching Assistant</i>
EBME 403 Biomedical Transducers, Miklos Gratzl, PhD</p> <ul style="list-style-type: none"> • Graduate level course, 30 students • Held weekly office hours • Developed and graded homework and exam questions |

Mentoring Experience

Graduate students: Alyson Fornes (MSE candidate, Widener) Kylie Herbert (MSE candidate, Widener), Lilyanna Martuci (MSE candidate, Widener), Melissa Koch (MSE candidate, Widener), Emily Rudolph (MSE candidate, Widener), Sean Blade (MSE candidate, Widener), Dylan Falkowski (MSE candidate, Widener), Abigail Loneker (PhD candidate, Penn), Rachael Aubin (MSE candidate, Penn)

Undergraduate students: Matthew D'Angelo (visiting undergraduate from Case Western Reserve University), Alyson Fornes (Summer Undergraduate Research and Creative Activities, Widener), Colin Duong (Summer

Undergraduate Research and Creative Activities, Widener), Jacob Grossman (Summer Undergraduate Research and Creative Activities, Widener), Emily Hammer (Summer Undergraduate Research and Creative Activities, Widener), Clark Trowbridge, Kayleigh Armstrong, Jason Reyes (co-op, Widener), Sarah Bachand (Summer Undergraduate Research and Creative Activities, Widener), Jason Hsu (Swarthmore), Kaylin Johnson (Summer Undergraduate Research and Creative Activities, Widener), Katelyn Liberton (Summer Undergraduate Research and Creative Activities, Widener), Gi Yun Lee (Penn), Abigail Loneker (Undergraduate Student Scholars Program, Penn), Sarah Kim (Penn), Michelle Chen (Penn), Mone't Nelson (Research Experience for Undergraduates, Penn), Adeeb Derakhshan (Cleveland Clinic), Steven Vilt (Cleveland Clinic)

RET, Penn: James Ciccarelli, Richard Staniec

Laboratory Technician: Shannon Tsai (Penn)

Volunteer: Sameera Zaidi (Penn)

Academic Service

- Widener University Strategic Enrollment Planning Council; Graduate Recruitment, Student Success, and Retention Committee, AY 2023-24
- Widener University Breathe Board; co-chair of the Graduate Student Subgroup, AY 2023-24
- Co-chair of Widener University Faculty Mentorship Program Taskforce, 24/SP
- Widener University Standing Committees
 - Faculty Council Diversity, Equity, and Inclusion Committee, AY 2023-24, 2024-25
 - Center for Graduate and Continuing Studies Academic Council, AY 2023-24, 2022-2023, 2021-2022
- Widener University School of Engineering Standing Committees
 - School of Engineering Academic Review Committee, AY 2023-24, 2022-2023, 2021-2022
 - School of Engineering Awards Committee, AY 2023-24, SP2023
 - School of Engineering Curriculum Committee, AY 2023-24, 2022-2023, 2021-2022
 - School of Engineering Executive Committee (Leadership Team), AY 2023-24, 2022-2023, 2021-2022
- Widener University Search Committees
 - Assistant Director of International Strategy 25/SUM
 - Executive Director of International Strategy 24/SUM
 - Chair of the Department of Biomedical Engineering 24/SP
 - Dean of the School of Engineering 23/SP
- Reviewer for Journal of Biomedical Materials Research: Part A, Soft Matter, Royal Society of Chemistry Advances, MDPI Bioengineering, MDPI Biology, MDPI Biomedicines, MDPI Molecules
- Penn Reading Project discussion leader, 2014 – 2016
- Northeast Ohio's University of Pennsylvania Alumni Interview Program, Jan 2005 – Mar 2011
- Reviewer of summer funding applications for Case Western Reserve University Support of Undergraduate Research and Creative Endeavors (SOURCE), Mar 2011

Honors

- Cleveland Clinic Innovator Award, 2008