

— THE CENTER FOR RESEARCH INNOVATION



# DRIVEN BY THE FUTURE

ANNUAL REPORT  
2021

—  
FY  
21

THE CENTER FOR RESEARCH INNOVATION  
NORTHEASTERN UNIVERSITY

# ANNUAL REPORT 2021

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## MISSION

*The Center for Research Innovation pairs solution-oriented research with real-world needs for the enrichment of society through the protection, acceleration, and commercialization of Northeastern innovation.*





# A DIRECTOR DRIVEN BY THE FUTURE



**JENNIFER  
BOYLE-LYNCH**

INTERIM DIRECTOR

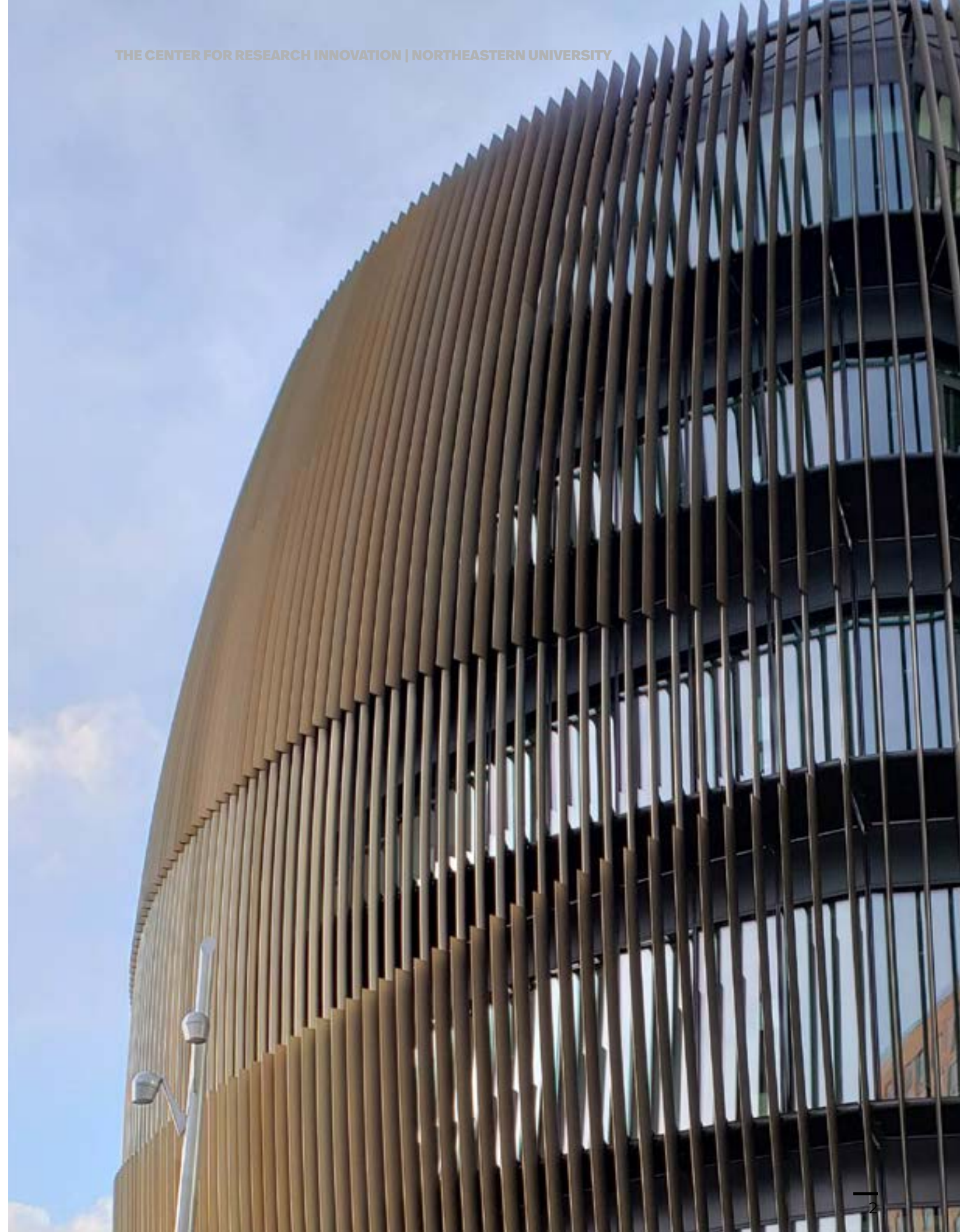
When I look to the future, excitement buzzes in my synapses. My thoughts spark and my motivation spikes. I see Northeastern researchers making crucial discoveries; innovators embarking on journeys of entrepreneurship that will revolutionize landscapes. I see collaboration with new industry partners generating ready-to-implement solutions; commercialization experts who conceive novel approaches that shift paradigms. I see Northeastern bringing unique learning opportunities to new regions, expanding our communal diversity and capacity to create. I see radical, life altering impact.

When I look to the past, I see a maturing Center for Research Innovation delivering consistent success. To start, we set a foundation of critical processes for protecting, accelerating, and commercializing Northeastern innovation and gained momentum as we maximized efficiency. Last year the challenge of COVID-19 continued, but the disruption birthed adaptation and resilience. The landmark success of FY21 builds upon this legacy. In FY21, we launched an astounding number of spinout companies (13); had our 3rd spinout acquisition in nearly as many years; awarded \$300,000 to accelerate the development of 6 technologies via the Spark Fund; and remained a global leader in protecting intellectual property with 68 granted patents. These are just a sample of the CRI achievements I am proud of.

Now, we are driven to actualize the potential the future offers. We look forward to the deployment of new programs that multiply commercialization efforts and provide educational and professional development to Northeastern graduate students. Offerings that recognize researchers for the edge-thinking they do and inspire others to become even more bold in their solution-oriented, world-bettering research. The establishment of a suite of on-demand resources that supercharge the entrepreneurial journey from launch to exit: team building, expert advice, compelling marketing, and funding support. Driving growth, evolving and refining, discovering, stepping into the future with purpose – absolutely energizing.

We have much work ahead, but clear-sightedness, gritty determination, constant innovation, and nimble execution will lead us to unprecedented success -- Success that will make the Northeastern community proud in its tireless pursuit of impacting the globe.

Sincerely,  
Jennifer Boyle-Lynch  
Interim Director





# PROTECTING OUR INNOVATIONS

INVENTION DISCLOSURES  
NEW PATENTS  
RESEARCH SPOTLIGHT

# INVENTION DISCLOSURES

**129**  
RECORD # OF INVENTION DISCLOSURES

**+8.4%**  
FROM FY 2020



# INVENTED HERE!

## KIM LEWIS AND SLAVA EPSTEIN NAMED EUROPEAN INVENTOR AWARD 2021 FINALISTS

The European Patent Office (EPO) announces that renowned US microbiologists Kim Lewis and Slava S. Epstein have been nominated as finalists in the “Non-EPO countries” category of the European Inventor Award 2021. They have developed a device that enables scientists to separate and incubate single strains of bacteria in their natural environment. Their invention, the iChip—a thumb-sized plastic chip with miniscule holes—allows a greater number and variety of microorganisms to be grown in laboratories, solving a longstanding problem in microbiology.

**140 NEW INVENTORS**

**233 PATENT APPLICATIONS**

**63 GRANTED PATENTS**

## TOP 100 WORLDWIDE UNIVERSITIES GRANTED U.S. UTILITY PATENTS

2020	2017
2019	2016
2018	2015



# 2021

## GRANTED PATENTS

### BOUVÉ COLLEGE OF HEALTH SCIENCES

Raymond Booth  
Tania Konry  
Jonghan Kim  
Alexandros Makriyannis  
Ganeshsingh Thakur

### COLLEGE OF ENGINEERING

Mahshid Amirabadi  
Nasim Annabi  
Ahmed Busnaina  
Kaushik Chowdhury  
Randall Erb  
Yun Raymond Fu

Edgar Goluch  
Yung Joon Jung  
Bradley Lehman  
Tommaso Melodia  
Yusof Naderi  
Elizabeth Podlaha-Murphy  
Shashi Murthy  
Jeffrey Ruberti  
Nian-Xiang Sun  
Hongli (Julie) Zhu

### COLLEGE OF SCIENCE

Ronald Aaron  
Raymond Booth  
Slava Epstein  
Swastik Kar  
Dmitri Krioukov  
Alexandros Makriyannis  
Latika Menon  
Sanjeev Mukerjee  
Michael Pollastri  
Srinivas Sridhar  
Meni Wanunu

### KHOURY COLLEGE OF COMPUTER SCIENCE

Yun Raymond Fu

## RESEARCH SPOTLIGHT

# Wing Design

### Engineering Duo Make Airfoil Wings Stronger Using Origami-Inspired Design

Avian life has largely inspired much of traditional airplane and other aircraft design. Professor Moneesh Upmanyu and Raman Vaidya improved upon one additional aspect of flight-capable birds that led to developing an important delta that could revolutionize airfoil maintenance through significantly reducing wear and tear.

Traditional airfoil come with hinged flaps and ailerons that do not offer much room for material manipulation. Owing to the tension in the metal, the stretching and compressing during flight leads to increased wear and tear. To combat this problem, most manufacturers build a corrugated sheet of material inside the wing of the aircraft, bonded to the top and bottom of the airfoil to lend some plasticity to the rigid wings.

Current designs use wire tension to hold the corrugated structure in place. This design however limits functionality as the wire restricts flexion leading to limited shape change. Through restriction, albeit improving flight capability from the wing morphing it allows, wire tension contributes to mechanical stress and fatigue overtime that reduces the life of the corrugate structure and ergo, the airfoil itself.

Upmanyu and Vaidya have discovered a novel method for controlled deformation of the wing structure that uses origami folds to provide corrugation to the internal material. Essentially, the stiffness of the wing structure is tunable owing to this change. As a result, this has allowed them to develop a hinge-less design that gives the controller greater command over the wingspan.

Apart from a dramatic improvement in fatigue resistance, this development leads to significant cutdowns in drag and weight, which translates to improved fuel efficiency. Additionally, it reduces overall vibration in the aerial vehicle which leads to a reduction in noise-pollution. Upmanyu and Vaidya prepare to commercialize this invention that could result in a greener and fairly inexpensive aircraft through conducting experiments that investigate the effect of scale on their discovery.

[Learn more about this research >>](#)

FEATURED INNOVATOR

# Moneesh Upmanyu

**Professor  
Mechanical and Industrial Engineering**

# ACCELERATING OUR IMPACT

INDUSTRY ENGAGEMENT  
FUNDING



# INDUSTRY ENGAGEMENT

**17** **NDA**s  
Non-Disclosure Agreements

**108** **NEW INDUSTRY RELATIONSHIPS**



This year represented a new high-water mark for our metrics related to level of industry engagement. Forming these partnerships is critical to our ultimate goal of commercialization of Northeastern research and innovation for the benefit of society.

- Mark Saulich

Associate Director, Commercialization



# FUNDING

SPARK FUND TECHNOLOGIES  
**\$300,000** awarded  
to six innovators

TOTAL APPLICANTS: 30

**RAYMOND FU**  
VENTURE: *PATHFIND*

**ANNA DURAJ-THATTE**  
VENTURE: *TANTU THERAPEUTICS*

**SAFA JAMALI**  
RESEARCH: *RHEOPOINT*

**SARA ROUHANIFARD**  
RESEARCH: *VIRALNPQ*

**TOMMASO MELODIA**  
RESEARCH: *CellIOS*

**TANIA KONRY**  
RESEARCH: *A MICROBIAL PATHOGEN DETECTION PLATFORM*

## TECHNOLOGY VENTURES

A SUCCESSFUL FUNDRAISING YEAR

SCIPHER  
\$82M

FORTIFY  
\$20M

FLASKWORKS  
ACQUIRED

BY NORTHWEST BIOTHERAPEUTICS, INC.



# SHOWCASING OUR TRANSFORMATIONAL TECHNOLOGIES

LICENSING & VENTURES  
NEW INITIATIVES



# COMMERCIALIZATION

## LICENSING & VENTURES

**14 SPINOUTS FORMED**  
**+17% from FY2020**

- |                     |                    |
|---------------------|--------------------|
| BIOVOLI             | NOVAURUM           |
| COCOPIE             | PLANCK ENERGIES    |
| CRYOXIA BIOSCIENCES | SONICA             |
| EOT BIOSYSTEMS      | SOTERIA            |
| HYDRONET            | TANTU THERAPEUTICS |
| ISCENT DIGANOSTICS  | T-OMEGA WIND       |
| NANOLYX             | ZEPSOR             |

**\$805,689**

RECORD LICENSING REVENUE

**+41.3% FROM 2020**

**11 LICENSES**

**+175% FROM 2020**

### Audax Medical Licenses Northeastern University Nano Tech to Battle COVID

Audax Medical, Inc., a Massachusetts-based medical innovations developer, worked with Northeastern University to license a repurposed pre-market technology that uses a nano-molecular approach to viral therapy and can be deployed in the fight against COVID.

>> [Read the story](#)

### Pre-Launch Briefing Event: Preparing to Spin Out a Hard-Tech Startup

Dr. Mike Fuerstman, Principal, and Becky Wilson, Associate, at Rhapsody Venture Partners walked through questions you should be asking and answering about your technology and your objections to figure out the best path forward – whether it’s a startup or something else entirely. The team provided insights based on Rhapsody’s approach with its portfolio companies in hard tech along with concrete examples and best practices.

## NEW INITIATIVES

### THE SPARK FUND

The Spark Fund is an evergreen fund dedicated to funding and growing next generation university-affiliated technologies. Its goal is to invest in licensing or spinout opportunities with identifiable commercial potential.

### THE INNOVATION COUNCIL

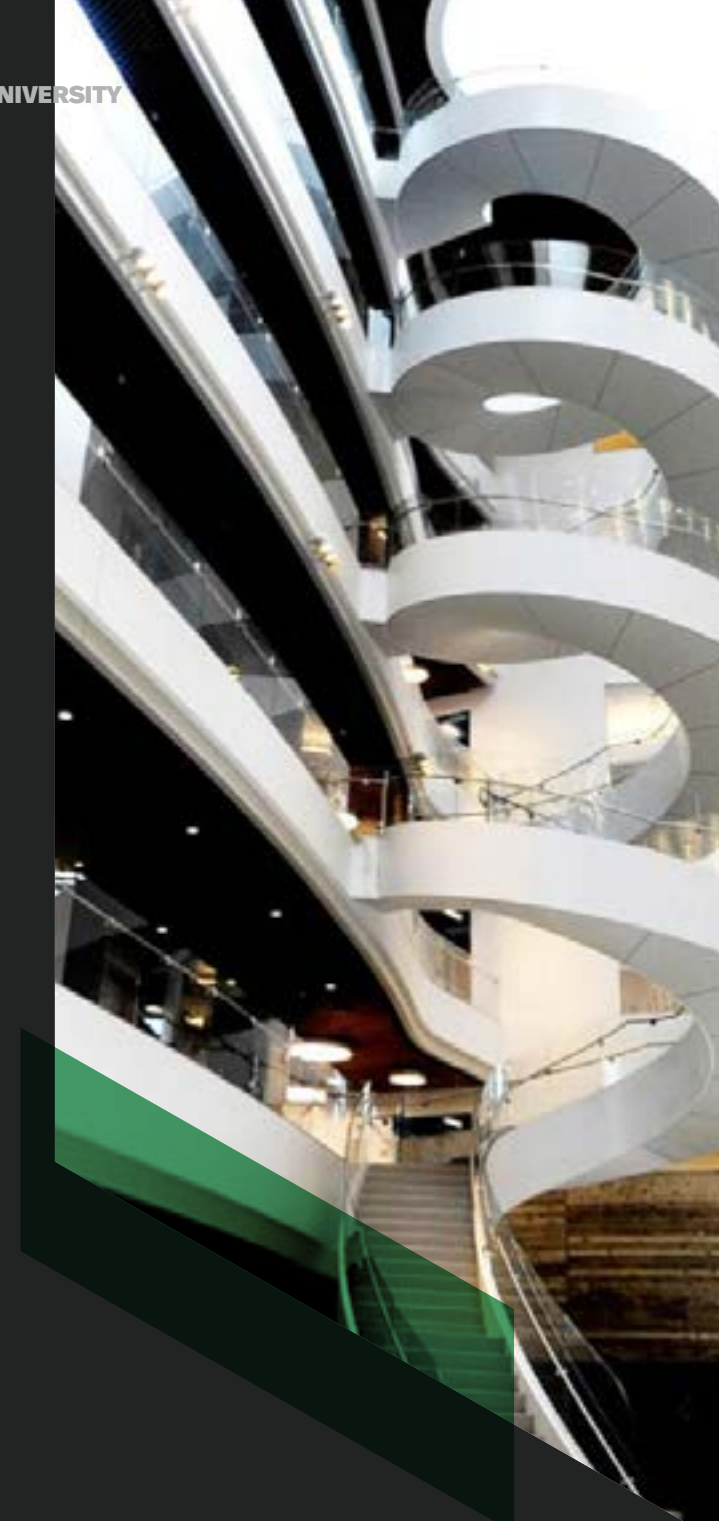
The Innovation Council is comprised of world-renowned experts across industries and technologies. They provide invaluable technical and business feedback related to technology commercialization pathways, possibilities, and potential. The council includes representatives from Thermo Fisher Scientific, Boehringer Ingelheim, BAE Systems, and more.

### SPINOUT CONSULTING PROJECTS

Via a collaboration with the D’Amore McKim School of Business, students and student teams tackle consulting projects on the most important stage-specific commercialization and business problems facing research labs and early-stage spinout companies.

### ONLINE SOFTWARE DISCLOSURE

The online software disclosure form facilitates copyright protection of original works of authorship including books and software which can lead to new and exciting commercial opportunities.



## VENTURE SPOTLIGHT

# Tantu Therapeutics

Inflammatory Bowel Disease (IBD), broadly classifiable into two variants – Crohn's Disease (CD) and Ulcerative Colitis (UC) – is a debilitating and chronic disease that has no known prevention or medical cure. While not fatal, once afflicted, IBD calls for a radical change in a person's lifestyle to manage the symptoms. Additionally, the stigma associated with the symptoms often result in dangerous levels of depression and anxiety that exacerbate the overall reduction in quality of life for patients. Treatment for IBD – specifically UC – involves invasive surgery which can cure the condition. The other variant, CD, unfortunately is incurable with surgery resulting in recurrence of the disease.

There is hope, however. "Being mindful of the magnitude of the disease, Tantu's lab initiated research with an idea to find a well-rounded solution for an IBD patient," says Neel Joshi, Associate Professor of Chemistry and Chemical Biology at Northeastern, and lead investigator at Tantu Therapeutics.

Through their efforts, Neel Joshi and his team of student researchers give those who suffer from IBD good news to anticipate. "It is a persistent long-term disease that can be diagnosed at any point in one's life," Joshi says in description of IBD. He adds, "Types of IBD include Crohn's disease and ulcerative colitis which have different presentations in terms of how they affect the GI tract."



### Prevalence and Pathology

A 2015 study found that an estimated 3 million adults in the US were diagnosed with IBD<sup>1</sup>. In 2017, there were estimated to be 6.8 million cases around the world<sup>2</sup>. These figures, not including children below 18 years of age, show no sign of trending downward as of 2021. With bouts of remission, IBD relapses chronically in an individual and peaks between the age of 10 and 40<sup>3</sup>. Various techniques in surgical, medical, nutritional, microbial and even alternative treatment show heterogeneity in the search for a solution, apart from surgery for

UC. Stem cell research in the field is admittedly rather promising, although it is something of a Faustian bargain; excessive cost and indeterminate effect characterization make it a poor candidate for clinical use.

### Safe Treatment

Patients are often concerned about surgical treatment owing to the complexity and risks associated with going under the knife. For a disease so enervating, the choice to get treatment is painfully difficult to make. The latest research at Tantu Therapeutics breaks down the barriers to effective treatment.

Tantu Therapeutics' research has culminated in the innovative development of microbe-based targeted therapeutic protein fibers. Expressed through a live bacterium engineered in their lab, this technique delivers the treatment locally to the site of the lesions in the intestine. As opposed to surgery that calls for a colectomy or bowel resection, Tantu's orally administered treatment minimizes the occurrence of post-surgical digestive complications and reduces the recovery time. This treatment results in quicker mucosal healing, better gut barrier functioning and extends the remission period in most patients. In recognition of their remarkable research and innovation to develop novel therapeutic solutions targeting the treatment of IBD, the Center for Research Innovation at Northeastern University recently announced Tantu Therapeutics as a Spark Fund awardee which will see the group receive up to US\$250k in funding.

### Additional Work

Tantu Therapeutics' work in treating IBD has led to potential solutions in treating other gastrointestinal infections as well. As a case in point, according to a World Health Organization report in 2015, children under age 5 constitute more than 30% of deaths from foodborne illnesses worldwide despite only accounting for 9% of the population.<sup>4</sup> The Americas, one of the regions least beset by foodborne diseases, are home to 31 million under the age of 5 who fall ill from contaminated food.<sup>5</sup> Joshi points out the high infant mortality rate in low-income countries and its tendency to be "flown under the radar," citing this as the impetus for Tantu's new project that addresses a prevalent social concern. Similarly to their treatment of IBD, Tantu Therapeutics now aims to create a pill comprised of

<sup>1</sup> <https://www.cdc.gov/ibd/data-statistics.htm>

<sup>2</sup> [https://doi.org/10.1016/S2468-1253\(19\)30333-4](https://doi.org/10.1016/S2468-1253(19)30333-4)

<sup>3</sup> *ibid*

<sup>4</sup> <https://www.who.int/news/item/03-12-2015-who-s-first-ever-global-estimates-of-foodborne-diseases-find-children-under-5-account-for-almost-one-third-of-deaths>

<sup>5</sup> *ibid*





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