

# JARVIE

THE JOURNAL OF THE WILLIAM JARVIE RESEARCH SOCIETY

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Volume 66  
Spring 2023

# JARVIE

THE JOURNAL OF THE WILLIAM JARVIE RESEARCH SOCIETY

**Volume 66**  
**Spring 2023**

## **Birnberg Research Program**

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of Dental Medicine**

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*“When apparently we have reached the limits of possibility, new avenues of progress and advancement are opened to our view and advances which shall make our knowledge of today seem in the light of the future to be but the densest ignorance.”*

– William Jarvie, 1905

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## A message from the **Editors & Associates**

As the Editor-in-Chief and Senior Editor of the 2022-2023 year, we are pleased to present the 66th edition of the Journal of the William Jarvie Research Society. The projects featured in this journal and presented at the Birnberg Research Symposium reflect the tremendous efforts of CDM students and dedicated support of faculty mentors. The outstanding work contributed to this publication truly exemplifies our institution's commitment to excellence in research, interprofessional collaboration, and evidence-based education.

The creation of this journal would not have been possible without the hard work of students, faculty, and administrators throughout the CDM community. We would first like to thank Dr. Chang H. Lee, Ms. Kelli Johnson, Dean Christian Stohler, Dean James Fine, and Dean Dana Wolf for their guidance, support, and continued commitment to promoting student research at CDM. We would also like to acknowledge our Associate Editors, MJ Kang, Sam Cox and Neil Ming, who provided invaluable assistance in compiling this edition of the Jarvie Journal. Furthermore, we would like to acknowledge our executive board, especially our President Alexis Catalano and Vice President Meredith Rogers, for their exemplary leadership and unwavering support throughout the publication process. Finally, we would like to thank the members of the William Jarvie Research Society and our readers, all of whom have been integral in sustaining our school's vibrant research community.

We want to offer our sincerest congratulations to all those who have contributed abstracts to this journal, and are proud to showcase your work in this year's edition.

Sincerely,

Ian Edelman, *Editor-in-Chief*  
Alec Donelian, *Senior Editor*

It was a great privilege to review this year's body of research. How our student body manages this great work in addition to its regular academic commitments we cannot explain. We can, however, testify to the great work of this editorial board. Their leadership was timely and professional, and they provided great support throughout this endeavor. Please take the time to appreciate the great breadth and depth of research evident in this publication. It will increase your appreciation for the wonderful classmates, students, and mentors whose work it was. It will also remind you of the greater causes for which this institution, and the William Jarvie Society, strive to achieve.

Sincerely,

Sam Cox  
Neil Ming  
*Associate Editors*



Dear Members of the Jarvie Society,

Congratulations on your research accomplishments. I hope you are proud of the significant work you share in these pages. You deserve to be, and I too share in your pride.

During my years at the College of Dental Medicine, I have come to see the role played by the William Jarvie Society as one of the most important traditions at the College of Dental Medicine. The abstracts in this journal advance the school's commitment to strengthening the profession and its practice through research. Your leadership capacity in the oral health profession is demonstrated by your ability to conduct original research while meeting the requirements of your demanding professional education.

In addition, I believe you will find your participation in research has contributed to your personal development, whether as a clinician, a scholar, or both. The scientific rigor you have displayed will serve you well as you join the oral health profession at a time of profound advancement and innovation in our field.

Congratulations to all of you, our student researchers, on your achievements. I also express my heartfelt thanks to the faculty mentors and advisors who have devoted time to guiding and encouraging your efforts

Sincerely,

A handwritten signature in blue ink that reads "Christian S. Stohler".

Christian S. Stohler, DMD, Dr.Med.Dent.  
Professor and Dean, College of Dental Medicine  
Senior Vice President, Columbia University College of Dental medicine



COLLEGE OF  
DENTAL MEDICINE

Office of Academic Affairs

April 11, 2023

Dear William Jarvie Research Society Members,

Student research enriches the educational experience and promotes a culture of inquiry, discovery, and innovation at CDM. We take great pride in how students and residents at CDM are engaged in scholarly activity. Showcasing student research in the Jarvie Journal and at Birnberg Day is one of our most time-honored traditions. I am very thankful to the members of the Jarvie Society for their efforts in promoting student research and facilitating the dissemination of that research to the CDM community and beyond. I applaud the hard work of all our student researchers. My hope is that you continue to engage in research that elevates our profession and improves oral health for all. Congratulations on your research achievements!

Warm Regards,

Dana L. Wolf, DMD, MS  
Senior Associate Dean for Predoctoral Academic and Student Affairs



Office of Postdoctoral  
and Residency Programs

*College of Dental Medicine  
Columbia University Irving Medical Center*

April 19, 2023

Dear William Jarvie Research Society Members

I am delighted to say that within this great institution you remained true to our traditions and true to CDM's mission reaffirming our commitment to scholarship, research, education, and patient care. I am equally delighted that the Student Summer Research Fellowship program remains strong amongst the Columbia student body as evidence by the mix of basic research and clinical studies.

Research and scholarship are at the core of Columbia University values. The student publication and presentation of their research on Birnberg Day, are part of the College of Dental Medicine's mission of producing leaders in the field of oral health care.

We are very supportive of our student scholars, both pre and post doc who will be the future leaders both academically and clinically. Congratulations to all participating in Birnberg Research Day!

Sincerely,

James B. Fine, DMD  
Senior Associate Dean, Postdoctoral Academic & Student Affairs

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April 10, 2023

Dear Members of the Jarvie Society,

It is my great pleasure to extend my heartfelt congratulations to all of you for presenting your research work at 66th Birnberg research day. This year's event is particularly special, as it marks the first time in three years that we will be able to gather together in person after the long and challenging COVID-19 pandemic.

I am truly impressed by the dedication, creativity, and hard work that each and every one of you has put into your research projects. Your commitment to advancing knowledge and making valuable contributions to multidisciplinary dental research is truly inspiring, and I have no doubt that your work will continue to make a positive impact on the dentistry.

As you prepare for the event, I encourage all of you to embrace the opportunity to learn from one another, to share your ideas and insights, and to engage in lively and productive discussions that will help to push the boundaries of knowledge in new and exciting directions. The valuable opportunity to interact with others in CDM and CUIMC research communities on Birnberg day will be a rewarding experience, which will help you prepare yourselves to present the research findings at local, regional, national, and international dental meetings.

One of the cornerstones in CDM student research is the support from the faculty mentors. As reflected in the wide range of research topics presented on Birnberg day, our faculty members engage in various research areas, from basic biomedical science to translational and clinical research, health policy, and health services research. Let us thank all the faculty mentors for their leadership, mentorship, and unwavering commitment to supporting students and advancing knowledge in their respective areas of expertise.

Once again, welcome to the 66<sup>th</sup> Birnberg Research Day. I wish you all the very best, and I look forward to seeing the outstanding research work being presented by our students.

Sincerely,

A handwritten signature in black ink, appearing to read "Chang H. Lee".

Chang H. Lee, PhD  
Director of Research  
College of Dental Medicine  
Columbia University  
[chl2109@cumc.columbia.edu](mailto:chl2109@cumc.columbia.edu)

Columbia University Medical Center

*A message from the*  
***President and Vice President***  
*of the William Jarvie Research Society*

The William Jarvie Research Society is Columbia University's Chapter of the American Association of Dental Research National Student Research Group. On behalf of the Chapter, we are proud to put forth the 66th edition of the Journal of the William Jarvie Research Society, a compilation of contributions from our outstanding CDM student researchers and faculty mentors who are presenting at the annual Birnberg Day Research Symposium. The annual Birnberg Research Symposium provides the opportunity for students to showcase their own research projects and plethora of knowledge to various judges from the CUIMC community as well as fellow classmates and professors. Columbia students participate in projects relating to basic science, behavioral sciences, education, public health, epidemiology, and more. The vast breadth of topics under investigation at CDM fosters an atmosphere of interdisciplinary collaboration and synergetic achievement.

This year, our research community at Columbia Dental is composed of 170 active members ranging from first year dental students to post-graduate students. Within our research community, we continued to foster excitement and participation in research through various events held throughout the year. Our first event included an Introduction to Fellowships meeting, which provided an overview on how to become involved in research at CDM. Shortly after, we published our annual Mentor Guide along with this year's new Mentor Master List which helps facilitate students finding mentors and research opportunities.

A plethora of CDM researchers have been able to present at both local and national conferences. Locally, 17 Jarvie members represented CDM this year at the 2023 Greater New York Dental Meeting. Nationally, a group of 8 Jarvie members participated in the 2023 AADOCR/CADR Annual Meeting & Exhibition, which was held in Portland, Oregon. Additionally, a group of 8 students participated in the 2023 American Association for Dental, Oral and Craniofacial Research (AADOCR) and Friends of the National Institute of Dental and Craniofacial Research (FNIDCR) Advocacy Day, which was held in Washington, D.C. We are also proud to announce that our club won the AADOCR Outstanding Local Student Research Group Chapter Award due to the outstanding efforts in fostering a strong research community within CDM.

We are immensely grateful for our CDM faculty research mentors, who provide invaluable insight, and who inspire us daily with their commitment to excellence. We would like to especially thank Dr. Chang Lee and Ms. Kelli Johnson for their support and guidance throughout this year, especially as it pertains to the planning and the organization of Birnberg Research Day. We would also like to express our gratitude to Dean Christian Stohler, Dean James Fine, and Dean Dana Wolf for their steadfast support of CDM student research.

Our executive board has been very passionate in providing the CDM community with accessible and effective resources to ignite students' paths to research. We would like to thank our phenomenal executive board members, including Brianna Margulis, Maya Jeremias, Nechama Rabinovitch, MJ Kang, and Judy Choi, whose dedication and involvement have helped with the successes of our club. Thank you to our talented editors, Ian Edelman, Alec Donelian, Sam Cox, and Neil Ming, who made the publication of this year's Jarvie Journal possible. We would also like to acknowledge our class representatives, Hyerin Yoon, Shannon Park, Julian Bensadoun, and Amanda Segal, and all of our Jarvie members. It has been an honor to serve as the President and Vice President of the William Jarvie Research Society. Thank you to all for a fantastic year, and congratulations to all Birnberg participants!

Sincerely,



Alexis Catalano, President  
Class of 2024



Meredith Rogers, Vice President  
Class of 2024

# History of the William Jarvie Research Society

The William Jarvie Society for Dental Research was organized on December 16, 1920. At the invitation of Dr. William J. Gies, all the undergraduate students of dentistry at Columbia University conferred with him for the purpose of considering the desirability of organizing a society of students, teachers, and benefactors for the promotion of the spirit of research in the School of Dentistry.

After general discussion, it was unanimously voted to proceed with the proposed organization and Joseph Schroff, MD\*\* was elected temporary chairman. Because of the important relation which Dr. William Jarvie bore to the establishment of the School of Dentistry, and because of high interest in the promotion of dental research, it was unanimously voted that the society be named the William Jarvie Society for Dental Research and that Dr. William Jarvie be elected an honorary member. Dr. Schroff served ably as president during 1922. Dr. Monasch officiated during 1923, and in 1924, because of the amalgamation of the College of Dental and Oral Surgery with the School of Dentistry of Columbia University, interest in the organization diminished and the society ceased its activities in 1925. On February 7, 1929, the society resumed activity and elected officers. Interest revived, and the organization was again brought into prominent place in the extracurricular life of the school.

During 1932-33, several members of the faculty who had contributed greatly to research in dentistry and allied fields addressed the members of the society and their guests. Dr. Charles C. Bodecker, Professor of Oral Histology and Embryology, spoke on "Dental Caries and Allied Subjects" and illustrated his talk with a liberal number of lantern slides. Dr. Bodecker spoke of the various theories and the classification of dental caries and also explained the caries index for recording the extent of caries. He also briefly outlined the work done by various investigators in this field.

Dr. Byron Stookey, Associate Professor of Neurological Surgery, addressed the next open meeting, which was held as a feature of the alumni day activities. His topic was, "The Interpretation and Treatment of Painful Affections of the Trigeminal Nerve." In a most interesting and instructive lecture, Dr. Stookey showed the relationship of diseases of this nerve to dental diagnosis. He explained the past work done in this field and the newer methods of surgical treatment, illustrating his talk with many lantern slides. He also presented several patients to demonstrate the effectiveness of his surgical treatment of this disease.

The Jarvie Society recorded another year of activity and accomplishment. Student interest in the organization was never greater, and a long and vigorous future for the society seems assured. The future of dentistry lies in its research into the problems that beset it, and the Jarvie Society has done its share in stimulating interest in this long-neglected phase of our work.

*\*An excerpt from the Dental Columbian, 1933.*

*\*\*Editor's Note: Dr. Joseph Schroff, MD, one of the first two students admitted to the dental school through the Columbia admissions process, became the first student to receive the Columbia DDS degree in 1922. Dr. Schroff subsequently joined the SDOS faculty, teaching Oral Surgery to generations of students until his retirement as head of Oral and Maxillofacial Surgery in the early 1950s.*

# Birnberg Research Award

The Birnberg Research Medal Award of the Dental Alumni of Columbia University was established by the Alumni Association of the Columbia University School of Dental and Oral Surgery in the early 1950s to encourage dental research of excellence and to help stimulate public interest in support of dental research. The award is named in honor of Dr. Frederick Birnberg (1893-1968), class of 1915, who helped to establish a research fund. The College of Dental Medicine faculty research committee, in conjunction with the school's Alumni Association, considers individuals who have made important contributions to dentistry through both research and mentoring for selection as Birnberg Lecturer and recipient of the Birnberg Research Medal Award of the Dental Alumni of CU. Sixty-four outstanding scientists and teachers have been honored as the Birnberg Lecturer since the first Birnberg Research Medal Award was presented in 1954.

## Birnberg Lecturer and Award Recipients

<b>1954</b> DR. CHARLES F. BODECKER	<b>1992</b> DR. GEORGE R. MARTIN
<b>1955</b> DR. JOSEPH APPLETON	<b>1993</b> DR. RICHARD SKALAK
<b>1956</b> DR. ISAAC SCHOUR	<b>1994</b> DR. ZE'EV DAVIDOVITCH
<b>1957</b> DR. RALPH PHILLIPS	<b>1995</b> DR. IVAR MJOR
<b>1958</b> DR. REIDER F. SOQNNAES	<b>1996</b> DR. LORNE M. GOLUB
<b>1959</b> DR. JOHN KNUSTON	<b>1997</b> DR. BRUCE J. BAUM
<b>1960</b> DR. MAXWELL KARSHAN	<b>1998</b> DR. KENNETH ANUSAVICE
<b>1961</b> DR. GEORGE PAFFENBARGER	<b>1999</b> DR. JAMES D. BADER
<b>1962</b> DR. ELI GOLDSMITH	<b>2000</b> DR. LARS HAMMERSTRÖM
<b>1963</b> DR. EDWARD V. ZEGARELLI	<b>2001</b> DR. DAVID T. W. WONG
<b>1964</b> DR. FRANCIS A. ARNOLD	<b>2002</b> DR. HENNING BIRKEDAL-HANSEN
<b>1965</b> DR. SEYMOUR KRESHOVER	<b>2003</b> DR. BARBARA DALE-BOYAN
<b>1966</b> DR. PAUL GOLDHABER	<b>2004</b> DR. PAUL B. ROBERTSON
<b>1968</b> DR. SHOLOM PEARIMAN	<b>2005</b> DR. BRUCE L. PIHLSTROM
<b>1970</b> DR. MELVIN MOSS	<b>2006</b> DR. JEFFREY D. HILLMAN
<b>1971</b> DR. IRWIN MANDEL	<b>2007</b> DR. RALPH V. KATZ
<b>1973</b> DR. LESTER CHAN	<b>2008</b> DR. ROBERT J. GENCO
<b>1975</b> DR. RUSSELL ROSS	<b>2009</b> DR. DEBORAH GREENSPAN
<b>1976</b> DR. JEROME SCHWEITZER	<b>2010</b> DR. SALLY J. MARSHALL
<b>1977</b> DR. GEORGE GREEN	<b>2011</b> DR. MICHAEL LONGAKER
<b>1978</b> DR. DAVID SCOTT	<b>2012</b> DR. R. BRUCE DONOFF
<b>1979</b> DR. BERGE HAMPAR	<b>2013</b> DR. PETER J. POLVERINI
<b>1981</b> DR. RONALD DUBNER	<b>2014</b> DR. HENRY GINSBERG
<b>1982</b> DR. MARTIN A. TAUBMAN	<b>2015</b> DR. LAURIE K. MCCAULEY
<b>1983</b> DR. LOUIS T. GROSSMAN	<b>2016</b> DR. RENA D'SOUZA
<b>1984</b> DR. SOLON A. ELLISON	<b>2017</b> DR. GEORGE HRIPCSAK
<b>1985</b> DR. NORTON S. TAICHMAN	<b>2018</b> DR. JEANETTE M. WING
<b>1986</b> DR. RONALD J. GIBBONS	<b>2019</b> DR. GORDANA VUNJAK-NOVAKOV
<b>1987</b> DR. ROBERT J. GORLIN	<b>2020</b> DR. ANIL K. RUSTGI
<b>1988</b> DR. ENID A. NEIDLE	<b>2021</b> DR. ANIL K. RUSTGI
<b>1989</b> DR. DAVID H. PASHLEY	<b>2022</b> DR. RITA CHARON
<b>1990</b> DR. WILLIAM H. BOWEN	<b>2023</b> DR. MUREDACH PATRICK REILLY
<b>1991</b> DR. HAROLD C. SLAVKIN	



# 2023 Birnberg Speaker and Research Awardee

**Dr. Muredach P. Reilly,  
MBBCh, MSCE**

Muredach Patrick Reilly is a cardiovascular disease specialist, professor of medicine, and the current Director for the esteemed Irving Institute for Clinical and Translational Research. After receiving qualifications in medicine and pharmacology from University College Dublin, he trained in internal medicine and cardiology at St. Vincent's and the University of Pennsylvania Medical Center, from which he earned a masters in clinical epidemiology in 2003 and served as faculty for 16 years.

Dr. Reilly's work as a cardiovascular physician-scientist has pushed boundaries in understanding metabolic syndromes and atherosclerosis in humans. His group was the first to demonstrate that activation of innate immunity in humans induces insulin resistance coincident with adipose inflammation, attenuation of adipose insulin signaling, and modulation of adipokines. As Professor of Medicine at Columbia University, his research has been dedicated to cell specific genomic and transcriptomic contributions to human cardio-metabolic disorders, the functions of adipose tissue in insulin resistance and atherosclerotic risk, novel mechanisms of human atherosclerosis underlying recent GWAS discoveries, and the role of innate immunity in cardio-metabolic disease.

As the Director of the Irving Institute for Clinical and Translational Research at Columbia, Dr. Reilly builds clinical and translational research programs that further contribute to transforming discoveries into novel strategies for assessment and treatment of human heart diseases. His focus on collaborative team science has advanced the Irving Institute's goals of catalyzing innovations and creating agents of change that ultimately translate basic science findings into the treatment of patients.

His nearly 20 years in NIH grant funding experience and publications, as well as mentorship and teaching, have made Dr. Reilly not only an authority in clinical, translational, and genetic approaches but also a true leader in the field, making changes in patient lives. The William Jarvie society is proud to recognize Dr. Muredach Reilly as the 2023 Birnberg Speaker and Research Awardee.

# BIRNBERG RESEARCH PROGRAM

## Schedule of Events for Wednesday, April 19th Bard Hall, 50 Haven Avenue, Main Lounge

### Birnberg Research Program Lecture

#### **12:00-1:00 PM Interdisciplinary Models of Translational Research and Training**

Speaker and Birnberg Research Awardee: Muredach Patrick Reilly, MBBCh, MSCE  
Herbert and Florence Irving Professor of Medicine  
Director, Irving Institute for Clinical and Translational Research  
Vice Dean, Clinical and Translational Research  
*Vagelos College of Physicians & Surgeons, Columbia University*

### Faculty & Student Luncheon with Panel Discussion

#### **1:00-2:00 PM Transformative Research Training at CDM**

Panelists: Dr. Muredach Reilly, Dean Christian Stohler, Dr. John Grbic, Dr. Chang Lee, and Dr. Sunil Wadhwa

### Student Table Clinic and Research Poster Session

**2:00-3:00 PM Judging Session**

**3:00-5:00 PM Open Session to Public**

# William Jarvie Society Members

## 2022-2023

Courtney Brenner  
Anthony Sulvetta  
Evelyn Kotch  
Janet Lee  
Boris Chen  
Jessica Kim  
Maggie Wodicka  
Satvi Limbasia  
Kunaal Edekar  
Marcela Sordo  
Kathryn Armstrong  
Aryas Safaie  
Alina Naqvi  
Lena Yoon  
Kimia Tavakoly  
Saagar Pande  
Roa Altell  
Jonathan Wang  
Elissa Kim  
Shreya Misra  
Junyan Ge

Lilly Yaghoubian  
Atman Soni  
Alexander Kim  
Mirene Gonzalez  
Bessie Stamm  
Rishab Biswas  
Albert Wang  
Jason Luong  
Vikram Venkataraman  
Genesis Seo  
Justin Pratt  
Jay Patel  
Varun Rangnekar  
Linda Ali  
Vishrutha Arun  
Kang Wook Chung  
Youngmin Park  
Roxana martinez  
Garrett Wencel  
Michael Levit  
Lisa Ha

Abrar Shamim  
Aaron Naim  
Kee Randolph  
Matthew Yee  
Kat Dumoulin  
Yunbin Kim  
Christine Lee  
Jessica Hui  
Nile Ismail  
Neeve Chen  
Parina Bhuvu  
Elie Zaghi  
Nicole Zeidman  
Mark Gettas  
Bree Zhang  
Youri Jung  
Kamilla Azbel  
Hadi Saker  
Anmol Sahota  
Isabell Ji  
Samuel Krichavets

Trey Bailey  
Robinson Lopez  
Christina Qing  
Praneetha Inampudi  
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# **Predoctoral Abstracts**

**Molecular, Cellular,  
Tissue, System,  
Regenerative Medicine,  
Organism, Biology & Physiology**

## 1. Layer-by-Layer Nanofabrication to Orchestrate Interplay Between Macrophages and Stem/Progenitor Cells

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**Introduction:** Interplay between stem/progenitor cells and macrophages is involved in the tissue healing and regeneration processes. For a timely orchestration of macrophage polarization and stem/progenitor cell bioactivities, we applied layer-by-layer (LbL) nanofabrication to provide precise control of time, duration, and sequential release of two small molecules (SM), Oxo-M and 4-PPBP, given their distinct functions in differentiating stem/progenitor cells and macrophage polarization.

**Objectives:** Optimize nano-coating thickness of PAH/MA-HA by regulating polymer concentration and coating time, determine the loading capacity and release profile of SM from PCL patch with LbL nano-coating, and investigate bioactivities of released SM from the PCL patch with LbL nano-coating.

**Materials & Methods:** LbL nano-coatings were made on a 3D-printed polycaprolactone (PCL) patch, using a repeat of sequential deposition of cationic polymer poly-L-lysine (PLL) and anionic polymer methacrylated hyaluronic acid (HAMA), where Oxo-M or 4-PPBP was loaded between the layers. Confocal microscopy was used to examine the thickness and distribution of the nanolayers, *in vitro* release was measured, and bioactivities of released SM were tested by culturing tendon stem/progenitor cells (TSC). The SM-loaded LbL PCL patch was then applied to our well-established patellar tendon repair model.

**Results & Conclusions:** Two distinct stacks of positive and negative polymers showed the coating uniformity. The (PLL/HAMA)<sub>40</sub> layered PCL patch with sequential loading of 4-PPBP and Oxo-M showed a fast release of Oxo-M by 7 - 10 days, followed by slow release of 4-PPBP up to 42 days. Scleraxis (SCX) and Mohawk (Mkx) expressions were significantly higher in Oxo-M/4-PPBP loaded LbL patches than in the single SM-loaded samples or no SM controls. *In vivo*, SM-releasing LbL PCL patches greatly enhanced tendon healing. Our findings indicate that the LbL nanocoated PCL patch is a promising delivery system for Oxo-M and 4-PPBP for regenerative healing of complex soft tissues, including tendons and temporomandibular joint (TMJ) discs.

**Discussion:** The optimized LbL fabrication process displayed an early release of Oxo-M, reducing M1-mediated inflammation, and a prolonged release of 4-PPBP, promoting M2-regulated tissue remodeling. Also, the timely controlled release of SM from the LbL PCL patch showed its efficacy in orchestrating the tissue healing processes involving inflammation, matrix synthesis, and remodeling phases.

*Kyle Alfred was supported by the Columbia College of Dental Medicine Summer Research Fellowship.*

## 2. The Impact of Pre-operative Extramammary Findings in Patients with Newly Diagnosed Breast Cancer

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**Introduction:** Based on recent data, one in eight females receive a breast cancer diagnosis in their lifetime. The American College of Radiology (ACR) recommends that women with newly diagnosed breast cancer receive breast Magnetic Resonance Imaging (MRI) to evaluate the extent of the disease prior to treatment. Breast MRI captures images of the breast as well as adjacent anatomical structures, such as thyroid, lungs, upper abdomen, and kidneys. As a result, breast MRIs can lead to extramammary findings (EMFs) in organs that are of high-risk for metastatic lesions. Currently, there is limited data on the clinical significance of incidental EMFs in early-stage breast cancer patients and whether delay in surgery is necessary.

**Objectives:** (1) Identify the frequency of EMFs on preoperative breast MRI with contrast in newly diagnosed breast cancer patients. (2) Examine the significance of these EMFs using further work-up and imaging analysis. (3) Determine the extent to which surgery should be delayed for further investigation of EMFs in early-stage breast cancer.

**Materials & Methods:** Retrospective study of 480 newly diagnosed breast cancer patients from the Dubin Breast Center and Mount Sinai West clinic from October 2018 to October 2019. Data that was collected included type of breast cancer, size, stage, and MRI status. 290 MRIs were obtained and were reviewed by breast radiologists. Any EMFs that were identified, were further investigated to determine if subsequent workup was performed.

**Results & Conclusions:** In our study, 353 patients were diagnosed with Invasive cancer while 127 had Ductal Carcinoma In Situ (DCIS). The most frequent stage of breast cancer (45%) was stage 1b. From the cohort of patients, 290 received preoperative MRI. Incidental EMFs were found in 53 (18%) of these patients. The most common EMFs were in the liver (64%) but all were benign. Patients who presented with EMFs were older at the time of diagnosis, 58.36, compared to those with no EMFs, 53.24 ( $p=0.0028$ ). Out of 53 patients with EMFs, 28 (53%) required additional imaging: Ultrasound, MRI, Computed Tomography (CT) scan, Bone scan, or Positron Emission Tomography (PET) scan. 3 out of 28 patients required further workup. Two patients were noncompliant. The third patient, who had advanced stage breast cancer, was diagnosed with thymic squamous cell carcinoma with cystic changes post-thymectomy.

**Discussion:** Extramammary findings can be stressful for patients, impact staging, and affect course of treatment. Our study showed that EMFs are common on preoperative breast MRI. Based on our findings, although limited due to the small sample size, we encourage evaluation of EMFs as deemed appropriate, but patients with early-stage breast cancer have a low likelihood of exhibiting malignant extramammary lesions so surgical treatment can be completed without delay.

### 3. Disease Modeling and Therapeutic Interventions for Ultra-Rare X-linked HNRNPH2-Related Neurodevelopmental Disorder (Bain Syndrome)

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**Introduction:** HNRNPH2-Related Neurodevelopmental Disorder (Bain Syndrome) is a newly described ultra-rare disorder caused by missense variants in HNRNPH2, an RNA-binding protein coding gene. It is associated with developmental delay/intellectual disability, motor abnormalities, language impairment, epilepsy, dysmorphic craniofacial features and autism spectrum disorder (OMIM #300986). There is currently no specific treatment or therapy.

**Objectives:** Thoroughly characterize a newly generated human stem cell model and develop precision-based oligonucleotide therapeutics for this severe rare disorder. We hypothesize that multiple small-interfering RNA's (siRNAs) and Antisense Oligonucleotides (ASOs) can precisely target and degrade pathogenic HNRNPH2 variants.

**Methods:** In collaboration with CUIMC's stem cell core facility, a male induced pluripotent stem cell (iPSC) line from the parental line KOLF2.1J was genetically engineered (CRISPR-Cas9) to express the most common mutation, p.Arg206Trp. Both iPSC lines were expanded for multiple passages in feeder free medium, frozen and characterized for pluripotency markers by immunocytochemistry. Several siRNAs and ASOs targeting the HNRNPH2 allele were transfected into iPSCs. 150/250 thousand cells were plated, transfected and harvested for RNA after 48/72 hours. Gene expression (qPCR) was performed for HNRNPH2, HNRNPH1 and 18S (endogenous control).

**Results and Conclusions:** Several oligonucleotides from the allele agnostic knockdown screen (siRNAs, ASOs) significantly reduced HNRNPH2 gene expression (p-values <0.05). Importantly, while HNRNPH2 mRNA expression was reduced, paralog (HNRNPH1) mRNA levels remained unchanged or slightly elevated (n=3). Results showed similar knockdown between two separate iPSC lines (WT, p.Arg206Trp). An allele specific strategy to specifically target the pathogenic allele showed preferential knockdown (p-value <0.05) in the p.Arg206Trp iPSC line (n=6). Variant iPSCs displayed characteristic pluripotency markers (OCT4, NANOG) and a robust ability to rapidly differentiate into neurons within 14 days (TUJ1 and MAP2).

**Discussion:** HNRNPH2-Related Neurodevelopmental Disorder patients currently have no independence and require a lifetime of care. There is a clear unmet need to elucidate the underlying mechanisms and to develop innovative treatments to treat the root cause, the HNRNPH2 variant gene. Building and characterizing a human stem cell library harboring common variants will serve as a cellular testbed for future therapeutic strategies. Targeting the HNRNPH2 pathogenic gene through precision medicine approaches as described offers a putative pathway to treatment for this severe monogenic disorder.

#### 4. Evaluation of Amyloid like FadA Production in Various Strains of *Fusobacterium nucleatum*

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**Introduction:** *Fusobacterium nucleatum* (*Fn*) is a gram-negative oral anaerobe that has been implicated in many diseases including periodontal disease, organ abscesses, colorectal cancer, and many other GI disorders. *Fn* encodes *Fusobacterium* adhesin A (FadA) which is an important virulence factor conserved in *Fn*. Previous studies have shown that *Fn* 12230 produces amyloid like FadA during the stationary growth phase when under stress and nutrient deprivation. It is unknown whether amyloid like FadA production is consistent among the different strains of *Fn*.

**Objectives:** The goal of the study is to evaluate if amyloid FadA production is conserved across different strains of *Fn*.

**Materials & Methods:** Wild type *Fn* 12230 and the FadA-deletion mutant designated as US1 (negative control) along with *Fn* 23726 and *Fn* 25586 were grown at 37° C in Columbia broth supplemented with 5 µg/mL hemin and 1 µg/mL menadione under anaerobic conditions. The production of amyloid FadA was then evaluated using immunohistochemistry. The bacteria are fixed using 4% paraformaldehyde and resuspended in phosphate buffered saline (PBS) before being fixed on glass slides. After the slides are rehydrated in PBS and incubated in 3% hydrogen peroxide, they are blocked in 5% skim milk before incubation with anti-*Fn* antibody at 1:800 dilution overnight. After washing in PBS, the slides are blocked in 2.5% horse serum before incubation with secondary ImmPRESS Horse-Mouse IgG. The slides are then washed with PBS-T (PBS + 0.05% Tween-20) and DAB (3,3'-diaminobenzidine) is added for development. Permount is added to the slides. After drying for 24 hours, images are taken using a light microscope.

**Results & Conclusions:** Our results showed that *Fn* 23726 produced amyloid like FadA in the stationary phase similar to *Fn* 12230. It appears that both strains share similar pathogenic mechanisms and secrete amyloid FadA when metabolic activities are reduced during stationary phase. *Fn* 25586 did not appear to secrete amyloid FadA. Further optimization on growth conditions is required to make a statement on the amyloid like FadA production in *Fn* 25586.

**Discussion:** FadA is an important virulence factor in *Fn* and plays an important role in its pathogenicity. *Fn* is able to control its virulence and enhance its pathogenicity through regulating the production of amyloid FadA. *Fn* 12230 had the greatest amyloid FadA secretion during stationary phase. The experiments with IHC showed that *Fn* 23726 also produced amyloid FadA under stressful conditions. This shows that there are similarities, as well as differences, amongst the various strains of *Fn*. Future studies will investigate how production of amyloid FadA affects the virulence potential of different *Fn* strains.

*Brandon Chin was supported by a Columbia University College of Dental Medicine Summer Research Fellowship.*

## 5. Interaction Between Alveolar Bone Loss and SARS-CoV-2 Infection

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**Introduction:** The COVID-19 pandemic is an ongoing global pandemic that originated from the novel SARS-CoV-2 virus in China in December of 2019. COVID-19 is mainly transmitted by aerosol and respiratory droplets during close contact. Periodontitis is characterized by chronic inflammation which impacts the supporting structures of the tooth and leads to alveolar bone destruction.

**Objectives:** There have been many studies supporting the link between oral hygiene and subsequent COVID-19 severity. However, our study aims to investigate the reciprocal connection of COVID-19 infection with negative oral health implications and increased alveolar bone loss in this post-pandemic community through the use of artificial intelligence (AI) to measure alveolar crest height (ACH) levels on bitewing images.

**Materials & Methods:** The study utilized a sample of patients from Columbia University College of Dental Medicine split into two groups: one “pre-pandemic” group with patient data spanning from February 1st, 2017 to February 1st, 2020, and one “post-pandemic” group with patient data spanning from February 1st, 2020 to February 1st, 2023. The pre-pandemic group consisted of 231 patients and the post-pandemic group consisted of 236 patients. Bitewings from two time points were collected for each patient and ACH levels were measured by an AI program that utilized self-identified cemento-enamel junction and alveolar crestal height for the mesial and distal of each tooth present on bitewing x-rays. The average time gap between the bitewings was 19.92 months and 17.83 months for the pre and post-pandemic groups, respectively. Mean ACH and Mean ACH change (Mean ACH later time point – Mean ACH early time point) were calculated for each participant in the pre and post pandemic periods.

**Results & Conclusions:** The pre-pandemic group had a mean ACH loss of 0.06597 mm and a variance of 0.15450. The post-pandemic group had a mean ACH gain of 0.02880 mm and a variance of 0.09684. A one tailed t test with equal variance was statistically significant with a p value of 0.002. These results suggest that there was significantly greater average bone loss across the post-pandemic group compared to the pre-pandemic group.

**Discussion:** This study provides data to support the idea that COVID-19 infection is correlated with increased ACH loss in our patient groups. This supports conclusions from previous studies linking COVID-19 infection severity, periodontal disease status, and now subsequent bone loss. However, a greater window of time may be required to demonstrate changes in alveolar bone levels. Additionally, there were limitations due to errors in the ACH measurements by the AI program that should be corrected in future investigations. Nevertheless, AI in the dental setting illustrates an exciting new advancement in oral healthcare.

*Kayla Gorelick was supported by a College of Dental Medicine Summer Research Fellowship.*

## 6. Incidence of 'Drop-Off' Cancer Development Within the Oral Cavity

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**Introduction:** In the oral cavity, severe dysplasia/carcinoma *in situ* is not a prerequisite for development of an invasive squamous cell carcinoma. Invasive carcinomas can 'drop down' from the basal cell layer with the overlying mucosa showing little or no evidence of dysplasia. This phenomenon is known amongst pathologists but is rarely reported in the literature. It is critical for clinicians to be aware of this phenomena so they do not erroneously regard lesions without severe dysplasia as safe to monitor before providing definitive treatment.

**Objectives:** We seek to investigate the incidence of 'drop-off' or 'drop-down' cancer development within the oral cavity and identify if any descriptive statistics (i.e. site, sex, age, health history) are statistically significant between 'drop-down' carcinomas and carcinomas arising from severe dysplasia/carcinoma *in situ*.

**Materials & Methods:** Columbia University Medical Center's Department of Pathology database was searched to identify 100 cases of oral squamous cell carcinoma surgically treated between January 1st, 2010 and June 1st, 2022. The histologic slides for all available cases were retrieved and the mucosa overlying and adjacent to the carcinoma was histologically evaluated to determine the dysplasia grade using the two-tier grading system. Cases classified by the presence of invasive carcinoma originating from dysplastic epithelium limited to the basal layer with the majority of surface epithelium lacking dysplasia fit the criteria of 'drop-off'/'drop-down' cancer development.

**Results & Conclusions:** The study found that 9 of the 100 cases analyzed demonstrated the 'drop-off' carcinoma phenomenon while 62 demonstrated high grade dysplasia and 29 were indeterminate. More female cases were associated with low grade dysplasia, and both males and females had the highest prevalence of high grade dysplasia overall. Cases with squamous cell carcinoma on multiple sites in the oral cavity were associated with low grade dysplasia, while the lateral tongue had the highest prevalence of dysplasia associated with squamous cell carcinoma. All cases of squamous cell carcinoma were most prevalent in patients between 61-80 years old. The relationship between the 'drop-down' phenomenon and health history could not be definitively concluded. Unexpectedly, several cases were associated with ulcerated epithelium which made proper evaluation challenging.

**Discussion:** Further research studying a larger population size and selecting cases without ulcer or with enough intact epithelium is necessary. Also, exploring molecular differences between cancers that arise with and without severe dysplasia could lead to targeted treatments and improved diagnosis and outcomes, as there are currently no molecular biomarkers that indicate the diagnosis of upper aerodigestive tract epithelial dysplasia.

*Brynn Gwartzman was supported by a College of Dental Medicine Summer Research Fellowship.*

## 7. Hydrophilic Polydopamine (hPDA) Incorporated Fibrin Bio-Adhesive For Improved Healing Of Fibrocartilaginuous Tissue

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**Introduction:** Fibrocartilaginuous tissue injury, such as meniscus and temporomandibular joint (TMJ) disc likely do not heal because of insufficient biological healing capacity. Current surgical repair techniques result in tissue deterioration and subsequent osteoarthritis (OA), and there is no robust therapy to regenerate TMJ and meniscus. Our previous studies using fibrin-based bio-glues have shown the potential to regenerate torn meniscus but remain mechanically inadequate to support connective tissue healing. Polydopamine (PDA) has shown notable adhesive capabilities as it is similar to marine mussel secreted adhesion proteins but has yet to be applied in its soluble form as an adhesive.

**Objectives:** We developed a synthesis route for hydrophilic polydopamine (hPDA) from water-insoluble PDA. This study reports potential use of hPDA with fibrin gel as an excellent bio-adhesive to facilitate healing of fibrocartilaginuous tissues.

**Materials & Methods:** hPDA was extracted from water-insoluble polydopamine synthesized from dopamine (2.5 mg/mL) dissolved in TRIS/HCL buffer (pH=8.5). Live-dead assay tested cytotoxicity of hPDA in 2D and 3D cell cultures using hBMSCs. In vitro degradation testing prepared Fib with and without hPDA labeled with Alexa Fluor® 488 dye. FibGen gel (2.5 mg/ml genipin) and FibGenhPDA (2.5 mg/ml genipin and 6 mg/mL hPDA) were prepared for comparison. Lap-shear testing isolated inner-third zone menisci from bovine knee joints and applied 20 µl of bio-glue (Fib, FibGen, FibhPDA and FibGenhPDA) between tissue strips followed by displacement using CellScale UniVert uniaxial mechanical testing (CellScale Biomaterials Testing, Waterloo, Canada). Bio-glues were applied to our meniscus explant healing model through controlled delivery of bioactive cues.

**Results & Conclusions:** Live-dead assay showed >90% cells survival after 7d (similar to control) when hPDA (0.5 and 1.0 mg/mL) was applied directly on hBMSCs and demonstrated excellent bioactivity in 3D cell culture when mixed with Fibrin. FibhPDA showed slower degradation compared to Fib and similar degradation to FibGen. Lap-shear testing with hPDA incorporation showed a significant increase in the shear modulus and strength. Explant healing model demonstrated hPDA incorporated bio-glues had improved healing of the avascular menisci region with enhanced integration of fibrocartilaginuous tissues compared to fibrin-based bio-glues without hPDA. Live-dead assay showed >90% cells survival after 7d (similar to control) when hPDA (0.5 and 1.0 mg/mL) was applied directly on hBMSCs and demonstrated excellent bioactivity in 3D cell culture when mixed with Fibrin. FibhPDA showed slower degradation compared to Fib and similar degradation to FibGen. Lap-shear testing with hPDA incorporation showed a significant increase in the shear modulus and strength. Explant healing model demonstrated hPDA incorporated bio-glues had improved healing of the avascular menisci region with enhanced integration of fibrocartilaginuous tissues compared to fibrin-based bio-glues without hPDA.

**Discussion:** Polydopamine (PDA) has structural similarity to marine mussel secreted adhesion proteins with strong wet adhesion to almost any surface due to the active catechol and primary amine groups on PDA that facilitate excellent wet adhesion to almost all material surfaces. Here, we developed a method to synthesize hPDA from insoluble PDA film and particles and showed that hPDA has great potential in bio-adhesive development for musculoskeletal tissue repair and healing.

*Maya Jeremias was supported by a CDM Summer Research Fellowship.*

## 8. Post- Menopausal Women have Region Specific Mandibular Microarchitectural Bone Loss Compared to Pre-Menopausal Controls

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**Introduction:** There are conflicting reports on the effects of menopause and decreased estrogen levels on the mandibular bone microarchitecture, especially in humans.

**Objectives:** As such, the goal of this study was to evaluate and compare the trabecular and cortical bone microarchitecture in the mandibular condyle and alveolar bone by 3-dimensional Cone Beam Computed Tomography (CBCT) in postmenopausal and premenopausal women.

**Materials & Methods:** This study was approved by the Columbia University Irving Medical Center Institutional Review Board, written informed consent was obtained from all study subjects. A total of 62 females (31 pre-menopausal and 31 post-menopausal) were recruited. Menopausal status was determined by self-report. Each participant had a CBCT of their alveolar bone surrounding the mental foramen and mandibular condyles bilaterally.

For condylar bone, thirty consecutive sections without intersection gaps were stacked after skipping the first twenty consecutive sections apical to the cortical bone at the head of target condyle. Region of interest (ROI) included all trabecular and cortical bone (taken as the negative ROI from isolated trabecular bone) of the bilateral mandibular condyles in each axial sectional image. For alveolar bone, sixty consecutive sections without intersection gaps were stacked after skipping the first forty consecutive sections posterior to the opening of the mental foramen. The ROI included all trabecular and cortical bone in an 18 x 15 mm rectangle centered on the mandible with the bottom border of the rectangle at the inferior border of the mandible in each coronal sectional image. Skyscan *Ctan* Software (Bruker Corporation) was used to isolate the ROI, convert to binary image form via local thresholding, and perform quantitative 3D microstructure evaluation. Between-group differences in continuous measures were assessed with unpaired t-test, and demographic variables were assessed by Chi-square. Data are presented as means  $\pm$  standard errors. Statistical significance was recorded at  $p < 0.05$ .

**Results & Conclusions:** There was a significant difference in age between premenopausal and postmenopausal patients (pre-menopause = 43.9  $\pm$  6.9 vs. post-menopause = 57.5  $\pm$  7.6;  $p < 0.001$ ), but no difference in race and ethnicity ( $p = 0.575$ ). Post-menopausal women had a significant decrease in mandibular condyle trabecular bone volume fraction BV/TV (pre-menopause = 63.7  $\pm$  4.51 % vs. post-menopause = 57.95  $\pm$  8.87;  $p = 0.003$ ), increase in trabecular separation (pre-menopause = 0.47  $\pm$  0.11 vs. post-menopause = 0.59  $\pm$  0.14;  $p < 0.001$ ) and decrease in trabecular number (pre-menopause = 1.21  $\pm$  0.19 vs. post-menopause = 1.03  $\pm$  0.18;  $p < 0.001$ ) compared to pre-menopausal women. There were no significant differences in the alveolar bone microarchitectural parameters.

**Discussion:** This data suggests that menopause has region specific effects on the mandibular bone, negatively affecting the condyle but having a far more miniscule impact on the alveolar bone. Additional research with larger sample sizes is required to expand the generalizability of these results, which may have important ramifications for treatment planning in older individuals when considering risks of bone loss specific to different regions of the mandible.

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## 9. Dental Manifestations in Individuals with Genetic Neurodevelopmental Disorders

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**Introduction:** Children with neurodevelopmental disorders often have poor oral health and dental abnormalities. An increasing number of genes have been associated with neurodevelopmental conditions affecting the oral cavity, but the specific dental features associated with many genes remain unknown.

**Objectives:** To report the types and frequencies of dental manifestations in children with neurodevelopmental conditions of known genetic cause.

**Materials & Methods:** A 30 question survey was administered through Simon's Searchlight, a recontactable cohort of individuals with genetic neurodevelopmental disorders often associated with autism spectrum disorder. The questionnaire assessed ectodermal and dental features.

**Results & Conclusions:** Data were collected from a largely pediatric population with 620 affected individuals across 39 genetic conditions and 145 unaffected siblings without neurodevelopmental disorders for comparison. Drooling, difficulty accessing dental care, late deciduous teeth eruption, abnormal deciduous and permanent teeth formation, misshapen nails, and hair loss were more frequent in individuals with NDDs. We also evidenced three new pathogenic gene variant/oral manifestation pairs. Unusual primary teeth were frequent in individuals with pathogenic variants in *CSNK2A1*. Pathogenic variants in *DYRK1A* were shown to be associated with late primary tooth eruption. Additionally, a high prevalence of drooling was found in individuals with *PPP2R5D*-related NDD.

**Discussion:** Unmet dental care remains a significant healthcare issue for children with NDDs, highlighting the need for tailored recommendations to improve the monitoring for these individuals. This study leveraged precise genotypic characterization of the cohort that includes a large number of genetic NDDs to delineate previously unreported dental manifestations of NDDs for mutations in *CSNK2A1*, *DYRK1A*, and *PP2R5D*, providing the foundation for future personalized dental management.

*Neil Ming was supported by a Columbia University College of Dental Medicine Summer Research Fellowship.*

## 10. Homozygous Nonsense Variant in Macrophage-Expressed Gene 1 (MPEG1)/Perforin-2: A Case Study

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**Introduction:** Macrophage-expressed gene 1 (MPEG1) encodes for Perforin-2 (P2) which is an antibacterial protein belonging to the membrane attack complex/perforin forming (MACPF) superfamily of pore-forming proteins. MACPF proteins are responsible for forming large transmembrane channels known as membrane attack complexes (MAC), acting as immune effectors against bacterial pathogens. Perforin-2 (P2) is expressed in innate immune cells (macrophages, dendritic cells, natural killer cells, and neutrophils) and can be upregulated by proinflammatory signals such as type I and II interferons, lipopolysaccharides (LPS), and bacterial infections. In its resting state, P2 is located in the endoplasmic reticulum, Golgi, and early endosomal membranes. After a bacterial infection, it is monoubiquitinated in response to inflammatory signals and redistributes to the endosomal and phagosomal bodies that contain the phagocytosed bacteria. After re-localizing, P2 polymerizes and refolds to form large pores allowing lysozyme, reactive oxygen species, and nitric oxide to eliminate the phagocytized bacterial organisms. In published research, five cases with heterozygous pathogenic variants in the *MPEG1* gene have been identified, all with histories that include recurrent pulmonary or soft tissue infections. Our patient is the first documented case with a homozygous nonsense variant in the *MPEG1* gene.

**Objectives:** To analyze the phenotypic manifestations of our patient with the *MPEG1* variant. Review the published literature on documented *MPEG1* cases for phenotypes and genotypes and to compare the data with our patient.

**Methods:** Our patient was initially evaluated at Columbia University as a part of the DISCOVER program. Data collected during this initial evaluation was used to characterize the clinical manifestations. Published literature on all the published *MPEG1* cases was reviewed and compared with the clinical features of our patient.

**Results & Conclusions:** Our patient who is a 39 year old female, presented with multiple issues including bilateral sensorineural hearing loss, hyperparathyroidism, osteoporosis, a history of periodic subconjunctival hemorrhage, Crohn's disease, recurrent pancreatitis, blistering and hives on her hands, irregular menses over the last year, eczema, recent hair loss, significant dental issues and T-cell lymphocytopenia. This patient's whole exome sequencing re-analysis revealed a homozygous nonsense variant (c.445C>T (p.Arg149Ter)) in the *MPEG1* gene. There were five unrelated female subjects with heterozygous *MPEG1* mutations reported in the literature. Four of the subjects had a history of recurrent pulmonary *Mycobacterium avium* complex (MAC) infections, and the fifth subject had a history of recurrent skin and soft tissue infections.

**Discussion:** Our patient's evaluation showed symptoms consistent with an immunodeficiency; similar to that identified in the other published cases. Our subject also had additional features not clearly related to the immune system. Mechanistic studies are currently being performed to determine how a homozygous nonsense variant in the *MPEG1* gene differs from the published heterozygous cases.

*Julian Mis was supported by a Columbia University College of Dental Medicine Summer Research Fellowship.*

## 11. The Anti-Tumorigenic Role of Cannabinoid Receptor 2 in Colon Cancer: a Study in Mice and Humans

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**Introduction:** The endocannabinoid system, particularly cannabinoid receptor 2 (CB2 in mice, CNR2 in 15 humans), has controversial pathophysiological implications in colon cancer.

**Objectives:** Here, we investigate 16 of the roles of CB2 in potentiating the immune response in colon cancer in mice and determine the 17 influences of *CNR2* variants in humans.

**Materials & Methods:** Comparing wildtype (WT) to CB2 knockout (CB2<sup>-/-</sup>) mice, we performed a spontaneous cancer study in aging mice, and subsequently used the AOM/DSS model of colitis-associated colorectal cancer and a model for hereditary colon cancer (ApcMin/+). Additionally, we analyzed genomic data in a large human population to determine the relationship between *CNR2* variants and colon cancer incidence.

**Results & Conclusions:** Aging CB2<sup>-/-</sup> mice exhibited a higher incidence of spontaneous precancerous lesions in the colon compared to WT controls. AOM/DSS-treated CB2<sup>-/-</sup> and ApcMin/+CB2<sup>-/-</sup> mice experienced aggravated tumorigenesis and enhanced splenic populations of immunosuppressive myeloid-derived suppressor cells along with abated anti-tumor CD8<sup>+</sup> T cells. Importantly, corroborative genomic data reveal a significant association between non-synonymous variants of *CNR2* and the incidence of colon cancer in humans.

**Discussion:** Taken together, the results suggest that endogenous CB2 activation suppresses colon tumorigenesis by shifting the balance towards anti-tumor immune cells in mice and portray the prognostic value of *CNR2* variants for colon cancer patients.

*Aaron Naim was supported by a MASA Onward Israel Fellowship.*

## 12. Investigation of Amyloid-Like FadA Adhesin by Solid Phase NMR

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**Introduction:** *Fusobacterium nucleatum* (Fn) is a gram-negative oral commensal anaerobe implicated in various cancers. Studies on colorectal cancer (CRC), in particular, associate Fn with metastasis and poor prognosis, presumably due to adhesin protein FadA, which is not produced by other species of *Fusobacterium*. This protein, previously discovered in Dr. Han lab, exists in two metabolically active forms: pre-fadA and mature fadA (mfadA). Pre-fadA is an unmodified 129 aa peptide and differs from mfadA in that it retains an 18 aa signal peptide region. Under stress and disease states, we have observed that FadA undergoes biochemical changes and takes on amyloid character, reacting with human amyloid antibodies OC and A11. This amyloid-like form of FadA, termed FadAc, is a heterogeneous mixture of mFadA and pre-FadA where greater proportions of pre-FadA correspond to increasing size, heterogeneity, and metabolic activity of the aggregate. Considering that the 18 aa signal peptide is the only differentiating factor between the two forms, it is hypothesized that this sequence provides a major contribution to the amyloid-like character of FadAc.

**Objectives:** The goal of this study is to solve the structure of amyloid-like FadAc using solid phase NMR spectroscopy. We will also determine if inducing various mutations in the FadA gene will enhance the production of pre-FadA.

**Materials & Methods:** *E. coli* strain YH1606 transformed with a mutant *fadA* gene encoding a leucine to alanine substitution in the ninth position was previously observed to produce large quantities of pre-fadA. After Sanger sequencing the plasmid to confirm the mutation, this strain was induced in liquid culture with 0.1 mM IPTG at OD 0.5 and enriched uniformly with <sup>13</sup>C, <sup>15</sup>N isotopes. The induced and labeled pre-fadA/mfadA mixture was then purified using TALON<sup>®</sup> Metal Affinity Resin, dialyzed and lyophilized. In collaboration with Dr. McDermott lab, carbon homonuclear and carbon-nitrogen heteronuclear experiments were performed using a Bruker Avance DRX-750 spectrophotometer.

**Results & Conclusions:** Using empirical data from Pluqin prediction tool, we assigned probable confirmations for each amino acid from the obtained carbon homonuclear DARR spectrum. The majority of peaks had a probability larger than 0.6 of being in alpha helix, while threonine, which was observed twice in the structure, was more likely to present as a coil. The carbon-nitrogen heteronuclear experiment targeted the signal peptide region using two likely serine-alanine pairs and found that they were both in alpha helix.

**Discussion:** We determine that most of this structure is in alpha helix conformation, but spectral congestion due to the employed labeling scheme makes it difficult to visualize signal peptide activity with certainty. In further study, we will survey pre-FadA production in other mutants as well as use different labeling schemes, such as leucine labeling, to obtain clearer spectra.

*Saagar Pande was supported by a Summer Research Fellowship.*

### 13. Icariin-releasing 3D-Printed Scaffolds for Cleft Bone Regeneration

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**Objectives:** One in every 1,600 babies is born with cleft lip with cleft palate in the US, and satisfactory reconstruction is still unattained. Three-quarters of cleft lip and cleft palate patients require alveolar cleft osteoplasty using an autologous graft derived from the iliac crest, and as much as 45.7% of the patients develop acute or chronic graft disturbances post-surgically. Previous studies have tested 3D-printed scaffolds embedded with cells for cleft grafts with suboptimal outcomes. Icariin (ICA) has been shown to promote osteogenic differentiation of stem/progenitor cells. Here, we explored the potential of 3D-printed scaffolds with controlled delivery of ICA to promote the recruitment, integration, and formation of endogenous alveolar bone stem cells.

**Materials & Methods:** Polycaprolactone (PCL) embedded with various doses of ICA (0.1 - 0.6 wt%) was prepared per our well-established protocol, followed by 3D-printing scaffolds (5mm x 5mm x 1mm, pore size of 200µm ~ 250µm). To control the ICA release rate, various degrees of NaOH surface treatment were applied and the release kinetics were measured by UV-Vis. For in vitro tissue engineering, bone marrow mesenchymal stem/progenitor cells (MSCs) were cultured with the scaffolds for 6-week. The formation of mineralized tissue was evaluated using H&E, Picrosirius Red, Alizarin Red, and Masson Trichrome staining, and RT-qPCR for bone formation markers.

**Results:** By 6-week culture with MSC, the 3D-printed ICA/PCL scaffolds significantly enhanced bone formation, with notable variances depending on the loading doses and release kinetics of ICA. There was a promising mineralized tissue formation in 0.3% ICA/PCL scaffolds with 2-hr NaOH treatment. Consistently, RT-qPCR analysis showed the increased expressions of COL1A1, IBSP, and BGLAP in 0.3% ICA/PCL with 2- & 3-hr NaOH treatments as compared to the control group with no ICA or 0.1% ICA/PCL.

**Conclusion:** Icariin-embedded 3D-printed PCL scaffolds may have clinical benefits for cleft palate patients undergoing alveolar cleft osteoplasty as an alternative to autologous iliac crest bone graft.

*Soomin (Shannon) Park was supported by CDM Research Liaison funding.*

## 14. Genome-Wide Profiling to Identify New Signaling Pathways Critical for Cellular Functions during Osteoarthritis Pathology

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**Introduction:** The temporomandibular joint (TMJ), a craniofacial synovial joint anatomically comprised of the mandibular condylar cartilage (CC) lined with fibrocartilage superficial zone (SZ), is crucial for eating, speaking, and dental occlusion. TMJ osteoarthritis (OA), a degenerative temporomandibular disorder (TMD), causes pain, joint dysfunction, and permanent loss of cartilage tissue. There are no drugs clinically available that ameliorate OA and little is known about the global profiles of genes that contribute to TMJ OA. Furthermore, an animal model that recapitulates the complexity of signaling pathways contributing to OA is crucial for elucidating pathological mechanisms governing TMJ demise and, ultimately, for designing novel biologics that thwart OA progression.

**Objectives:** (1) Develop an animal model that recapitulates the complexity of TMJ OA pathogenesis (2) Identify molecular signaling pathways and gene expression profiles critical for cellular functions during TMJ OA pathology

**Materials & Methods:** TMJ OA was surgically induced in New Zealand white rabbits. Three months following the injury, global gene expression profiling of the TMJ condyle was performed. RNA samples from the TMJ condyles were subjected to sequencing. After raw RNA-seq data was mapped to relevant genomes, differential expression was analyzed with DESeq2. Gene Ontology (GO) enrichment analysis and Kyoto Encyclopedia of Genes and Genomes (KEGG) pathways analysis was conducted.

**Results & Conclusions:** We demonstrated an animal model that recapitulates the intricacy of the cues and signals underlying TMJ OA pathogenesis. Our study identified multiple pathways altered during TMJ OA induction including the Wnt, Notch, and PI3K-Akt signaling pathways. Analysis revealed that TMJ SZ and CC comprise distinct cell populations, including fibrocartilage stem cells (FCSCs) and chondrocytes respectively. In addition, TMJ injury induced a distinct gene expression profile from healthy TMJ in both SZ and CC tissue. Taken together, the TMJ is dependent on the maintenance of both the fibrous SZ and the underlying CC.

**Discussion:** Disease-modifying osteoarthritis drugs (DMOADs) that diminish pathological mechanisms driving TMJ demise offer an attractive, minimally-invasive alternative to surgery but are not available to date. Genome-wide profiling in the TMJ OA injury model and gene expression profiles and signaling pathways specific for the TMJ SZ and CC provide a baseline for additional investigations into cellular functions in TMJ homeostasis and disease. Furthermore, it serves as a critical model for developing new OA pharmaceutical targets.

*Samantha Schnall was supported by a Research Liaison Fellowship.*

## 15. Molecular Characterization of Pain Neurons Expressing TrpV1

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**Introduction:** TrpV1 (transient receptor potential cation channel family member V1) or a “vanilloid receptor” is a capsaicin-gated ion channel. Capsaicin, commonly associated with chilis, is an agonist for the TrpV1-ion channel whose activation in turn leads to stimulation of peripheral nerves. TrpV1 is expressed on primary afferent neurons associated with the sensations of pain, heat, and itch. Thus, stimulation of TrpV1 using capsaicin can elicit distinct responses. As such, it is hypothesized that removal of the TrpV1 receptor from specific mouse neurons will cause an absence in function of those specific TrpV1 expressing neurons.

**Objectives:** This project aims to enhance the understanding of peripheral pain reception. Long-term goals of this project seek to uncover information that may be relevant to improving clinical and pharmacological approaches to treating different types of pain, such as chronic pain and dental pain. Among the thirteen classes of trigeminal sensory neurons, TrpV1 is expressed on Class 6 through Class 12 neurons (C6-C12). This begs the question: do all neurons expressing TrpV1 confer similar or distinct functions?

**Materials & Methods:** TrpV1 was removed from certain cells that normally express TrpV1. Then, mice were tested for their responses that remain. My work investigated the PACAP-cre (pituitary adenylate cyclase-activating polypeptide; cre recombinase [for a conditional knockout {cKO} of PACAP in cre mice]) mice using behavioral assays. This means that we removed the TrpV1 receptors in neurons that express PACAP. We studied the effects of capsaicin on body temperature, sensitivity to heat, eye wiping, and cheek wiping and itching. These assays were used because TrpV1 knockout mice display deficits in them.

**Results & Conclusions:** No significant differences were found between control mice and cKO mice in body temperature, thermal gradient, laser, and eye assays; thus, PACAP is not absolutely required for the temperature response, regulating temperature preference, fast-pain response, and pain response, respectively. A reduction in hot plate response latencies was noted in the cKO mice which potentially suggests a role PACAP may play in the noxious heat response. In the cheek assay, two phenotypes manifested (wiping and scratching). There was an unexpected increase in scratching in cKO mice, which may indicate loss of the normally inhibitory effect that pain has on itch.

**Discussion:** Due to time restraints, only a small sample of mice (9 total [5 control, 4 PACAP-cre]) yielded data. However, these data will be followed up with additional trials to increase the sample size and reliability of the study. Additional future directions include confirming that the cKO mice lost TrpV1 by immunohistochemistry. The future goals of this research are to understand the nuances of TrpV1 function by characterizing other subgroups of TrpV1.

*Matthew Tiberino was supported by a NIDCR Fellowship.*

## 16. The Neurological Development of Offspring Exposed to Transplacental Infection of *Fusobacterium Nucleatum*

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**Introduction:** *Fusobacterium nucleatum* is a gram-negative oral anaerobic bacterium. While it is commensal in the oral cavity, *F. nucleatum* can turn pathogenic and cause infections in extra-oral sites leading to several human diseases, including periodontal bone loss, colorectal cancer, and pregnancy complications. *F. nucleatum* is known to cross both the placental and blood-brain barriers, raising curiosity of its role in neurological disease via transplacental infection.

**Objectives:** Preliminary studies using neurobehavioral tests have found abnormal behaviors in cognition, learning and memory in mouse pups born following transplacental *F. nucleatum* infection. In this study, we aimed to examine the brain pathology of the offspring, and to examine if and where *F. nucleatum* is located in the brain.

**Materials & Methods:** Pregnant mice were infected with 100 µl of 8 x 10<sup>5</sup> cfu of *F. nucleatum* via intravenous tail injection. The offspring were subjected to four neurobehavioral tests: 1) eye opening to assess cortical circuit assembly and maturation, 2) righting reflex to assess motor strength and coordination in early development, 3) rotarod to test neuromuscular function and learning ability, and 4) novel object recognition to evaluate recognition memory. At 28 weeks, the offspring were euthanized and perfused with 4% paraformaldehyde. IHC was performed on 5 µm paraffin-embedded sections using the Vector DAB Substrate Kit to see if, and where, *F. nucleatum* could be detected in the brain. Images of stained tissues were taken with an Olympus 1X71 microscope.

**Results & Conclusions:** The offspring born to mothers infected with *F. nucleatum* exhibited significant defects in neuromotor function, learning ability, and memory: eye opening (p<0.05), righting reflex (p<0.001) at week 1, learning ability in the rotarod trial (p<0.05), and defect in recognition memory at weeks 15 and 20 (p<0.05). IHC showed *F. nucleatum* was detected in the dentate gyrus region of the hippocampus in the *Fn*-infected pups.

**Discussion:** Through the neurobehavioral tests, we can deduce the transplacental infection of *F. nucleatum* has an effect throughout brain development and maturation. We confirmed the presence of *F. nucleatum* in the hippocampus of pups exposed to the transplacental *Fn* infection, which is consistent with the neurobehavioral abnormalities in cognition, learning, and memory. Further research will include Western blot to confirm FadA, and consequently *Fn*, in the hippocampus region, as well as transcriptomic analysis of hippocampuses to elucidate the molecular mechanisms of *Fn* infection in the mouse brain.

*Kristin Woo was supported by the Columbia College of Dental Medicine Summer Research Fellowship and Research Liaison Award.*

## 17. Periodontal Treatment as a Preventative Measure Against Preterm Birth: A Systematic Review

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**Introduction:** Preterm birth (PTB) is one of the leading causes of neonatal death worldwide and can lead to poor future health outcomes for both mother and child. Although no predictive biomarkers have been found yet, PTB is being investigated as a preventable phenomenon. PTB is linked to states of inflammation and infection during pregnancy, suggesting that periodontal disease may be a risk factor. However, the role of periodontal therapy as a preventative measure against PTB is currently unclear.

**Objectives:** This systematic review aims to: (1) identify and discuss clinical trials that test the efficacy of preventative and therapeutic periodontal treatment in reducing the frequency of PTB, and (2) evaluate gaps in the current literature and clinical practice in addressing PTB through oral health interventions.

**Materials & Methods:** A database search was conducted using controlled Medical Subject Headings and non-controlled vocabulary in PubMed, Cochrane Library, and Embase. The following inclusion criteria were used. Pregnant women were the population of interest. Interventions must have involved standard non-surgical periodontal therapy. Comparisons must have been made between pregnant women receiving periodontal therapy against those who delayed treatment until postpartum or those who did not receive treatment. Outcomes must have included periodontal clinical parameters from the perinatal period and PTB rates.

**Results & Conclusions:** Five randomized controlled trials, two non-randomized controlled trials, one pseudo-random controlled trial, and two case control trials were identified that followed the inclusion criteria. Six of these ten clinical trials reported significant beneficial effects of periodontal treatment on PTB rates. All but one of the trials compared the effects of scaling and root planing (SRP) plus oral hygiene instruction (OHI) against OHI alone. The remaining trial tested the effects of antimicrobial cetylpyridinium chloride mouth rinse in place of SRP.

**Discussion:** Sources of variation between trials included diagnostic criteria for periodontal disease, evaluation of PTB in the context of other adverse birth outcomes, intervention allocation between experimental groups, time at which periodontal therapy was administered, and selection of participants with pre-existing risk factors for PTB. Along with varying study quality, the ten trials reported inconsistent results in PTB prevention. While it is still unclear if periodontal therapy actually has a causative and preventative relationship with PTB, receiving treatment during pregnancy does not exacerbate the risk for negative birth term outcomes.

*Melissa Yap was supported by a College of Dental Medicine Summer Research Fellowship.*

## 18. Using Single Cell RNA-seq to Define TMJ Stem/Progenitor Cells in an Inflammatory Niche and Development

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**Introduction:** The temporomandibular joint (TMJ) is a site for mandibular growth and is a complex joint system for dental occlusion, mastication, respiration, and speech. Rheumatoid arthritis (RA) is a systemic autoimmune disorder that causes chronic inflammation and destruction of synovial joints with a high prevalence of TMJ involvement, including mandibular bone malformations, dental malocclusion, and facial pain. It can lead to permanent tissue loss, disability, and reduced quality of life. Juvenile Idiopathic Arthritis (JIA), which begins in the developmental stage, induces reduction in facial growth. However, the pathological mechanisms underlying TMJ RA and JIA at the single cell level are poorly understood.

**Objectives:** Determine cell populations in the TMJ condyle using single-cell RNA-sequencing (scRNA-seq) during an inflammatory state and development.

**Materials & Methods:** A transgenic mouse model of RA that expressed human TNF $\alpha$  (hTNF $\alpha$  Tg) and C57BL6 mice were analyzed using scRNA-seq. TMJ condyles were digested with Collagenase A and Dispase 2 in DMEM for 90 min at 37°C. Cells were filtered through a 40  $\mu$ m filter and processed with Chromium Next GEM Single Cell 3' GEM kit v.3.1 and cDNA libraries were sequenced by NovaSeq 6000. The significant differentially expressed genes (DEGs) were detected by DESeq2 software. Over representation analysis was conducted for functional annotation by using the gene ontology database based on biological processes through the clusterProfiler 4.0 software. Trajectory analysis was performed by using STREAM (Single-cell trajectories reconstruction, exploration, and mapping) pipeline.

**Results & Conclusions:** scRNA-seq analysis showed hematopoietic cells, proliferating chondrocytes, *Prg4*<sup>+</sup> mesenchymal cells, and *Acta2*<sup>+</sup> mesenchymal cells were increased in the hTNF $\alpha$  Tg mice compared to wildtype control. DEG analysis revealed that gene expression patterns were altered in neutrophils and *Acta2*<sup>+</sup> mesenchymal cells. Functional enrichment analysis showed that apoptotic signaling pathways were significantly changed in *Acta2*<sup>+</sup> mesenchymal cells. We performed analyses using newborn (P0) and adult (13-week-old) C57BL6 mice to identify stem/progenitor cells. scRNA-seq analysis from P0 mice showed 3 mesenchymal cell populations and a chondrocyte population which were distinct from adult mice. Trajectory analysis from the newborn cells suggested that a proliferating mesenchymal cell population differentiated into chondrocytes and mesenchymal cells. Correlation analysis demonstrated that these cells highly expressed *Mki67*, *Clspn*, *Tk1*, and *Stmn1*.

**Discussion:** *Acta2*<sup>+</sup> mesenchymal cells in the hTNF $\alpha$  Tg mice had differential expression of genes related to apoptotic signal transduction, suggesting that inflammation may drive stem/progenitor cells toward apoptosis. We identified a potential stem/progenitor cell population that highly expresses *Mki67*, *Clspn*, *Tk1*, and *Stmn1*.

## 19. Optical Clearing of Dental Hard Tissue for Comprehensive 3D Volumetric Analysis

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**Introduction:** Periodontal diseases are a major cause of tooth loss and are associated with the buildup of plaque, development of unhealthy gums, and eventual bone loss. In recent years, there has been much research into the mechanism of initiation and progression of periodontal diseases. There has also been considerable investigation into potential methods for regenerating the periodontium. Currently the imaging protocols available for hard tissue, such as dental tissue, only provide 2D discrete images leading to incomplete histological evaluation to determine the effectiveness of proposed tissue regeneration techniques.

**Objectives:** Despite its advantages for evaluating 3D volumetric tissue microstructures, optical tissue clearing has rarely been applied to dental and orofacial tissues. Here, we optimized a tissue clearing technique for tooth and periodontal tissues to investigate microstructures in dental hard tissues and periodontal ligaments.

**Materials & Methods:** Our optical clearing procedure for dense connective tissues was developed into an efficient clearing process for tooth and periodontium. Extracted human teeth underwent decalcification, fluorescence collagen staining, and refined delipidification and dehydration processes. Briefly, the samples were fixed in 10% paraformaldehyde, submerged in HCL/EDTA solution to decalcify for 12 hrs, and treated with CHP-F (15 $\mu$ M) overnight at 4°C for tissue collagen staining. For delipidification and dehydration, samples were placed in a gradient of tetrahydrofuran (THF) solutions (50 - 90% each for 2 hrs and 100% overnight) and then submerged in dibenzyl ether (DBE) overnight to be optically cleared. A laser-scanning confocal microscope (Nikon A1R MP) was used to analyze the 3D volumetric collagen fiber orientation in dentin, cementum, and periodontal ligament (PDL).

**Results & Conclusions:** Our optical clearing method optimized for dental hard tissues resulted in fully transparent tooth and periodontium. Confocal microscopy imaging of cleared tooth samples produced high-resolution images that showed the mineralized microarchitecture of the cementum and the collagen fiber orientation of the PDL. The fiber orientation of microstructures within the cementum and regional variance in PDL fibers' density and orientations are apparent.

**Discussion:** Our findings suggest an efficient and reproducible optical clearing method for dental hard tissues, enabling a comprehensive volumetric evaluation of tooth and periodontal anatomy in 3D. The limitation of this study is the lack of analysis of healthy tooth samples. Thus, we are currently working on healthy rat whole-tooth samples. This study has implications for our efforts to understand the progress of diseases like periodontitis and analyze the effectiveness of various regenerative treatments for periodontitis and other oral diseases.

*Elen Zhu was supported by a Columbia University Summer Funding Program Award.*

# **Predoctoral Abstracts**

**Social & Behavioral,  
Education, Geriatric Oral  
Health, Health Service, and  
Global Oral Health**

## 20. Why Participants Choose to Decline to Participate in Genetic Research

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**Introduction:** The advancement of technology and new tools in Genomic Medicine have streamlined efforts to collect and analyze genetic data easier than ever before. The eMERGE Study aims to utilize these tools including polygenic risk scores, monogenic genetic screening tests, platforms to capture family history, and advanced electronic phenotyping to generate genomic integrated risk assessments (GIRA) reports in ~25,000 subjects across 10 sites. The generated GIRA reports are used to assess participants' risk of developing common diseases including common forms of cancer, cardiovascular diseases, obesity, and diabetes. Recruitment of a large, diverse participant population is essential to create sufficient data to study genetic risk and assess applicable preventative and treatment care. However, various ethical, cultural, and personal concerns may influence enrollment in genetic and genomic research.

**Objectives:** To assess various reasons as to why participants choose to decline to participate in genetic research.

**Materials & Methods:** We contacted 1653 individuals through initial recruitment phone calls, emails, and follow-up calls. Potential participants were selected for recruitment based on prior consent to being contacted about research studies, both online and in-person. A standardized script was used by recruiters to introduce the study, and we contacted each individual up to three times by phone or email at different times of the day. If they responded and actively declined participation in the study, individuals were asked if there was any specific reason why they chose to decline. Responses were collected and categorized in the following: I do not want to participate in research, I do not have time to participate in research, I don't want to learn about my genetic information, I am worried about privacy, I am too sick to participate, or other.

**Results & Conclusions:** 54% of individuals who declined to participate did so in the first recruitment contact. 26% of declines came in the second recruitment contact and only 21% were from the third recruitment contact. The majority of those who chose decline cited the reason "I do not want to participate in research." The second most common response was "I do not have time to participate in research." Less than 20 individuals cited concerns with genetic information and privacy. While only 15% of individuals contacted spoke Spanish as a primary language, 22% of those who chose to decline participation spoke Spanish as a primary language.

**Discussion:** Interest in genetic research is largely driven by the same factors that influence interest in all types of research and much less frequently by genetic specific concerns.

*Shukran Babkir was supported by a Columbia University College of Dental Medicine Summer Research Fellowship.*

## 21. Inequalities in Oral Health: Understanding the Determinants of Untreated Caries Among Children in the U.S.

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**Introduction:** Although there has been a substantial overall reduction in the prevalence of dental caries in the United States, the discrepancy in dental caries cases between socially advantaged and disadvantaged children still remains. Past studies have found discrepancies in income to be an important factor, however, it is vital to understand all the disparities in order to effectively respond to this problem.

**Objectives:** Using the oral health data provided by the National Health and Nutrition Examination Survey (NHANES 2011-2014), this study aims to use data representative of the U.S. population to determine if untreated caries in children is due to biological and sociodemographic factors.

**Materials & Methods:** The examination data used for this study comes from the NHANES. The study sample consists of children 0 to 19 years of age (n = 7008) and the corresponding households reference person (HH) > 18 years of age (n = 19931). The examination data from the NHANES was arranged based on race (Mex. American, Other Hispanic, Non-His. White, Non-His. Black, Other/Multi. Race). The independent variables are race, HH income (based on federal poverty level, FPL), recent dental visits, HH parental marital status, and HH education level.

**Results & Conclusions:** The results of this study imply that the parental education level (HH education) has no influence on the amount of untreated dental caries in children. The R value for parental education level was not significant. It is important to recognize, however, that past studies find that there is an association between education level and oral health knowledge; having a higher level of oral health awareness lowers the prevalence of oral health problems. Further research needs to be done to draw strong conclusions on this matter. The factors that proved to be determinants of untreated dental caries in children are race, HH family income level, and HH marital status. The most notable determinant is that of race. Race plays a statistically significant role in the prevalence of dental caries in children.

**Discussion:** This study contributes to the conversation through its study of race, HH income (based on federal poverty level, FPL), recent dental visits, HH parental marital status, and HH education level. The results of the analysis should be used to come up with an effective school program with the goal of expanding the knowledge of oral health for children and their parents.

## **22. Use of Psychology-Based Behavioral Techniques in the Dental Setting with Individuals with Special Health Care Needs: Pediatric Dental Resident Pre- & Post- Lecture Perspectives**

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**Introduction:** Persons with Special Health Care Needs (PSHCN) face barriers to accessing oral health care including difficulty locating a dentist comfortable providing care and the patient's tolerance of treatment due to sensory sensitivities, communication challenges, intellectual impairment, and dental anxiety. These barriers to care have created alarming oral health disparities among PSHCN. Psychology-based behavioral support techniques used by educators and occupational therapists, among others, have been shown to positively impact behavior, coping skills, and adjustment to new experiences. However, oral healthcare providers have limited opportunity to learn these skills. Unknown is pediatric dental residents' knowledge and views on approaches to care of PSHCN using behavioral psychology-based techniques. Such information may inform curricula and practice during postdoctoral education.

**Objectives:** This study explores College of Dental Medicine (CDM) pediatric dentistry residents' knowledge, comfort level, and awareness of behavioral psychology-supported and sensory processing-informed approaches for treating PSHCN before and after targeted education.

**Materials & Methods:** A two-hour, interactive lecture on interdisciplinary psychology-based behavioral techniques and sensory processing disorder management in the dental setting was delivered to all 10 CDM Pediatric Dentistry Residents. Under IRB supervision (protocol #AAAU2313), all dental resident attendees were invited to complete a self-administered pre-lecture and post-lecture survey via Qualtrics. Using descriptive statistics, survey data was analyzed to evaluate the lecture experience and perspectives on the presented approaches.

**Results & Conclusions:** Response rates were 100% (pre-) and 90% (post-survey). For knowledge-based questions about hyper- and hypo-responsive behavior, 20% of residents in the pre- and 100% in the post-survey correctly identified key information. There was a positive shift in residents' comfort in treating individuals with sensory processing disorders when comparing pre- and post-lecture means (3.4 to 4.3; 1-strongly disagree to 5-strongly agree). The pre- and post-lecture mean scores in comfort using the behavioral support technique of contingent escape showed a substantial increase (3.0 to 4.6, adjusted by excluding those unfamiliar with the term). All participants felt residency programs should expand curriculum to include these materials, particularly with hands-on simulation experiences and shadowing.

**Discussion:** Results suggest a knowledge gap around patient care for PSHCN. Supplementing the postdoctoral curriculum with lecture content coupled with clinical experience may increase provider comfort, thereby reducing disparities in access to care for PSHCN. This study was limited by a small sample size and the experiential differences of PGY1 and 2 residents.

*Shriya Jain was supported by a CDM Summer Research Fellowship. Jeremy Chiu was supported by MSPH.*

### 23. COVID-19's Impact on Maxillofacial Surgical Outcomes and Complications: NSQIP Study

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**Introduction:** COVID-19 pandemic has significantly impacted healthcare, by restructuring and re-prioritizing hospital resources in order to minimize patient exposure to nosocomial settings. Our goal was to evaluate whether the case volumes, patient demographics, and post-operative outcomes and complications for OMF surgeries differed during the “lockdown” months of COVID-19 pandemic (April 2020-December 2020) versus pre-COVID-19 period (January 2018 through March 2020).

**Objectives:** This study investigated how maxillofacial surgeries fared in the U.S. during the COVID-19 pandemic in terms of patient demographics, surgical outcomes, and post-operative complications.

**Materials & Methods:** American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database was utilized to select for maxillofacial surgeries from 2018 to 2020. Cases were separated into 2 groups based on when the surgery took place: Lockdown period (April 2020 through December 2020) vs. Pre-Covid period (January 2018 through March 2020). The inclusion criteria were Current Procedural Terminology (CPT) codes pertaining to the maxillofacial fracture repairs and patient age of 18 years or older. Descriptive statistics, Pearson  $\chi^2$ , and Multinomial Logistic Regression tests were used to compare patient demographics and postoperative complications between Lockdown and Pre-covid periods.

**Results & Conclusions:** Lockdown (N=477) and pre-covid (N=1684) cohorts were compared using descriptive and Pearson  $\chi^2$  statistics. The difference in the average age of patients during Lockdown ( $41.45 \pm 17.28$  years) and during Pre-covid ( $40.32 \pm 16.66$  years) was statistically insignificant ( $p=0.193$ ). Post-operative complications decreased during Lockdown as compared to Pre-covid. Unplanned reoperation was the only statistically significant ( $p=0.013$ ) complication (1.26% during Lockdown vs. 3.44% during Pre-covid). Other complications' occurrences were statistically insignificant: readmission within 30 days of operation (1.68% during Lockdown vs. 2.79% during Pre-covid,  $p=0.173$ ), transfusions (0.629% during Lockdown vs. 1.25% during Pre-covid,  $p=0.255$ ), and superficial surgical site infections (1.05% during Lockdown vs. 1.31% during Pre-covid,  $p=0.654$ ). Organ system complications, such as urinary tract infections, deep vein thromboses, cerebral vascular accidents, and pneumonia were extremely rare, occurring in <1% of all cases. Multinomial Logistic Regression analyses showed no significance between complication rate and the COVID lockdown period.

**Discussion:** Our data suggest that there is no association between maxillofacial fracture procedures performed during COVID-19 lockdown and post-operative complication rates. Supplemental studies would be helpful in providing additional insight into how healthcare resource restructuring can be optimized to prevent complications in future pandemics.

*Ju Yeon Choi was supported by a Columbia University College of Dental Medicine's Summer Research Fellowship.*

## 24. A Novel, Culturally-Sensitive Approach to Medical Spanish Instruction

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**Introduction:** The purpose of this study is to determine the impact of a decade-long Medical Spanish program called Dígame on larger goals for addressing the needs of a growing patient population with limited-English proficiency (LEP) and to lay the foundations for a robust and sustainable method of instruction for future Medical Spanish education in the US. This research represents a milestone report in the Spanish medical education literature, providing a model for establishment and improvement of similar programs at other institutions.

**Objectives:** The aim of this project is to evaluate the long-term goals that were established for the Digame program at its inception. The long-term goals center around improved health care delivery to patients with LEP. In our evaluation process for the program we plan to measure program efficacy using a number of metrics such as quality of clinical care, degree of comprehension in clinical encounters, improvement in cultural-sensitivity, etc., using the program's initial objectives as a baseline comparison.

**Materials & Methods:** The study team invited all 600 alumni who have participated in the Digame programs to participate in the study. The study team placed phone calls to willing participants, during which essential study information was shared. Following confirmation of consent, the survey was administered verbally by research personnel who recorded Qualtrics responses in concordance with the participants' responses. Following the data collection period, the study team reviewed the collected information. The qualitative data was analyzed using standard qualitative analytic techniques, and the data were subjected to a variety of statistical analyses.

**Results & Conclusions:** Though our project is ongoing, we have successfully gathered 51 responses. Of these respondents, 30 are physicians, 5 are dentists, 11 are nurses, 4 are public health professionals, and 1 reported "Other" when asked about their current profession. 94% of participants responded "Yes" when asked whether their time in the program improved relationships with patients during the course of their training. Respondents reported that they gained greater cultural awareness from the program as well as "increased empathy and ability to emotionally connect [patients]", "a more well-rounded approach to treatment planning", and an increased motivation to "provide [patients] with a higher standard of care".

**Discussion:** These results are promising for the multi-dimensional improvements in care they portend. Should this program be implemented in other medical programs across the country, we could see these effects amplified to include a greater number of healthcare providers who will, in turn, impact the lives of more LEP patients.

*Samuel Cox was supported by a grant from the New York Academy of Medicine.*

## 25. Racial and Ethnic Disparities in Basal Cell Carcinoma Treated by Mohs Micrographic Surgery: The Columbia Experience

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**Introduction:** There is limited literature regarding racial and ethnic disparities in basal cell carcinoma clinical characteristics, severity, and demographic distribution.

**Objectives:** To investigate racial and ethnic disparities in the clinical characteristics of basal cell carcinoma (BCC) treated by Mohs Micrographic Surgery (MMS).

**Materials & Methods:** This single-center retrospective study analyzed demographic and surgical data for 2145 patients with BCC treated by Mohs Micrographic Surgery at Columbia University Irving Medical Center between January 2017 and December 2021. Pre-operative tumor size, MMS defect size, MMS stages required for tumor extirpation, and anatomical tumor location were compared between different racial and ethnic groups.

**Results & Conclusions:** Of the 2145 BCC cases included in the race comparison, 95.2% (2043) were identified as White, 0.89% (19) were identified as Black, 3.5% (75) were identified as Other, and 0.37% (8) were identified as Asian. Of the 2024 BCC cases included in the ethnicity comparison, 89.1% (1803) were identified as Non-Hispanic/Latino and 10.9% (221) were identified as Hispanic/Latino. Of the 2001 BCC cases included in the combined race/ethnicity comparison, 88.4% (1769) were identified as Non-Hispanic White, 10.4% (208) were identified as Hispanic/Latino, and 1.2% (24) were identified as Non-Hispanic Non-White. The mean MMS defect size and mean MMS stages required for tumor extirpation in White BCCs were significantly larger than those of Black patients' tumors. White and White Non-Hispanic BCC cases occurred more in males than females, however there was a statistically significant difference in sex distribution in which Hispanic females comprised a larger relative proportion of BCC cases than did White Non-Hispanic females. The majority of BCCs in all racial and ethnic groups were located in the central face region, but Black and Hispanic BCCs had a significantly larger relative distribution to this anatomic region when compared to White BCCs.

**Discussion:** This study addresses the largely unexplored issue of racial and ethnic disparities in nonmelanoma skin cancer, specifically basal cell carcinoma. Variations in BCC tumor severity, clinical characteristics, and sex distribution exist between patients of different racial and ethnic groups. The observed racial and ethnic differences in MMS defect size, MMS stages, sex ratio, and tumor location both coincide with and challenge the limited existing literature. These findings ultimately necessitate further investigation, heightened clinical awareness, and enhanced patient screening and education efforts.

## 26. Self-perceived versus actual oral health status in the WHICAP Ancillary Study of Oral Health

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**Introduction:** Self perceptions of oral health may poorly or incompletely reflect objective indicators of oral health as determined by comprehensive objective clinical dental and periodontal phenotyping. Several prior studies exploring these differences have proposed a range of explanations which may reflect complex oral health problems including awareness of oral health conditions as well as barriers to accessing routine care.

**Objectives:** This study aims to identify the prevalence and predictors of oral health quality of life as determined through a validated oral health questionnaire (previously implemented in NHANES studies) including how this may relate to various objective oral health conditions in a cohort of community-based older adults.

**Materials & Methods:** The Washington Heights Inwood Columbia Aging Program (WHICAP) Ancillary Study of Oral Health is an ongoing longitudinal study of 1130 persons, all aged 65 years and older. Initial assessments took place in 2013-2016, and included an oral health questionnaire, tooth counts, and clinical and microbial periodontal assessments. Data collected in the ancillary study allow for explorations of relationships with socioeconomic, medical, and cognitive health outcomes as collected in the primary WHICAP study. For this study, poor Oral Health Quality of Life was determined as having any 2 or more of the following within the past year: difficulty doing usual jobs/activities, being less satisfied with life due to dental problems, painful/aching in mouth, sense of taste affected, avoiding particular foods, being uncomfortable to eat any foods, or being self-conscious or embarrassed about their oral health. We explored for relationships with various predictors including age, race-ethnicity, gender, education, and periodontal status.

**Results & Conclusions:** Of the 1124 persons available for analysis, 663 (77.5%) had moderate-severe periodontal disease (based on 2012 CDC/AAP classification) and 373 (33.0%) had poor OHQOL. Periodontal status was not associated with OHQOL. Low/adverse OHQOL was significantly more likely to be identified in race-ethnic minorities and those with less than HS education history (low OHQOL among persons with less than 12 years of education, OR=2.06, 95%CI: 1.32-3.21). Low/adverse OHQOL in race-ethnic minorities remained significant after controlling for age, gender, education, and periodontal status (OR=1.73, 95% CI: 1.11-2.68 for Blacks and 2.14, 95%: 1.32-3.48 for Hispanics relative to non-Hispanic Whites).

**Discussion:** Low oral health quality of life was common in this cohort and more likely to occur in historically marginalized populations but was not related to periodontal status. Additional analyses of tooth count to OHQOL as well as awareness of periodontal status and access to care are underway. Identifying means to improve routine oral health care remains a common and incompletely addressed public health challenge.

*Mark Gettas was supported by the Columbia College of Dental Medicine Summer Research Fellowship.*

## 27. Caregiver Perspectives Regarding Barriers to and Factors Which Promote Access to Routine Dental Care for Children with Autism Spectrum Disorder (ASD)

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**Introduction:** Previous research has shown that children with ASD have greater unmet dental health care needs than the national pediatric average. Previously stated factors associated with greater unmet need include lack of a medical home, child's behavior, cost and lack of insurance. The factors promoting or impeding access to routine dental care have been identified, however, the relative importance of each previously identified factor has not been investigated. This study is unique in that the researchers assessed the relative impact of each factor influencing access to dental care. In addition, the researchers asked caregivers to qualitatively describe how a dentist's actions can increase or decrease accessibility. The qualitative aspect will provide more detail that will supplement our study with factors that were not considered in the quantitative aspect.

**Objectives:** The purpose of our study is to more fully understand which factors most positively and negatively impact access to dental care for children with Autism Spectrum Disorder (ASD), from the perspective of their caregivers. The qualitative aspect of the study aims to provide insight on caregiver perceptions of dentist's actions that facilitate access or create barriers to routine care.

**Materials & Methods:** Retrospective, cross-sectional data collection using surveys using a Likert scale to measure the importance of factors that increase or decrease access to dental care. Seventy one subject responses were recruited using public Facebook groups catered to caregivers of children with Autism in the tristate area (NY, NJ, PA). Thirty eight subject responses met the inclusion criteria. Quantitative responses were analyzed using excel. A thematic analysis of qualitative data was performed.

**Results & Conclusions:** Our results showed that the top three factors inhibiting access to routine dental care were the child's dental anxiety, child's behavior, and the dentist's unwillingness to treat. The top three rated factors promoting access to routine dental care were: dentist experience treating children with autism, the caregiver's comfortability advocating for their child, insurance acceptance by the dentist. Our qualitative data revealed that to caregivers, the dentist's ability to individualize treatment to the child is influential in access to routine care.

**Discussion:** This study found that for caregivers, the most impactful changes surrounded the dentists themselves, and their expertise and willingness to work with children with Autism and their parents. This study serves as a good starting point for future researchers to apply these surveys to greater and more diverse populations. With a greater understanding of the factors that influence access to care, dentists and healthcare providers can make the most effective changes to improve accessibility to children with ASD. While this study focused on children, a similar study focusing on the adult ASD population is greatly needed.

*Sophie Hernandez and Sophie Gysling were supported by the Summer Research Fellowship.*

## 28. The Relationship Between Language, Birth Order, and Frequency of Parent's Dental Visits and the Pediatric Patient's Dental Health

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**Introduction:** Good oral health in childhood is crucial in the development of long-term oral health in patients. Oral health can be impacted by genetics, parental influences, hygiene practices, and much more. If the dentist is aware of risk factors that correlate with poor oral health of the child, they could engage in further education of the parents and/or child to ensure the patient has optimal knowledge and resources to maintain good oral health.

**Objectives:** The objective of this study is to identify factors both in children and parents that may correlate with worse oral health outcomes for the pediatric patient.

**Materials & Methods:** Eighty-one parents of pediatric patients ages 8-13 answered survey questions regarding demographics, the parent's own dental care and perceptions of dental care, and parental involvement in the child's oral hygiene. Data obtained regarding the pediatric patient included frequency of brushing, flossing, use of fluoridated products, appointment compliance and number of decayed, missing, and filled teeth due to caries (DMFT).

**Results & Conclusions:** Oldest children in a family had significantly lower DMFT scores ( $p=0.036$ ) than non-oldest children. However, subsequent birth orders did not trend with DMFT scores. Parents with more English proficiency had children with lower DMFT scores, though not statistically significant ( $p=0.077$ ). However, children fluent in English did have significantly lower DMFT scores than non-fluent children ( $p=0.046$ ). There was also a correlation between recency of a parent's last dental visit and the DMFT scores of their children, though not significant ( $p=0.188$ ). Factors such as parental involvement in their child's dental care, age that child began to brush on their own, and patient no-show rates did not correlate with children's DMFT scores.

**Discussion:** Risk factors identified in this study are opportunities to improve the dental health of patients. While the level of English proficiency of parents and the child both correlated with the child's DMFT scores, only the child's proficiency did so significantly, highlighting the importance of the child understanding oral hygiene instruction. The oldest child tends to have a lower DMFT score, so younger children may need additional attention to ensure they have proper oral hygiene at home. Finally, dentists should be aware of the correlation between parental habits and a child's oral health. Especially if dental care is less routine for parents, interventions can be made to instill the importance of routine dental care for the parent and the pediatric patient. This survey was completed in the VC8 clinic, which accepts patients ages 8-13. The study may have minimized response bias if the survey was administered outside of the clinic and would have benefited from also including younger children. Finally, many participants were new patients, so their prior oral health records were minimal, which may have weakened the study.

*Caroline Hegemann was supported by a Summer Research Fellowship and Leavitt Public Health Award.*

## 29. Internationalization of Medical Education: Culturally Diverse Peer Exposure and Multilingualism Foster Cultural Competency in Health Professions Students

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**Introduction:** In light of the COVID-19 pandemic and globalization in healthcare, the need to improve global health education and enhance international experiences as well as global collaboration among health professionals, has increased for several reasons. It has become apparent that in the face of global emergencies, not all the communities are affected equally. Racially minor communities are disproportionately affected socially, financially, and medically as racial discrimination is increased and inequality in access to healthcare is magnified. Such exacerbation in inequalities based on race and culture calls for culturally competent medical leaders who have been identified to be capable of providing healthcare to diverse populations and decreasing health disparities. Thus, medical professionals need to be equipped with intercultural competency (IC) skills - for patient care and for international collaborations.

**Objectives:** Health professions students across the globe have different cultural characteristics, and IC learning varies among populations with diverse cultural backgrounds. Accounting for cultural and demographic differences in health professions curricula is central to improving cultural learning in future healthcare providers across the globe. This study explored demographic factors affecting IC learning to improve the integration of IC into global medical curricula.

**Materials & Methods:** Health professions students (medical, dental, nursing, biomedical, and health sciences) from 20 universities in 20 countries across four continents participated in a four-month online exchange program. Students from different backgrounds networked with each other, sharing cultural values, comparing medical curricula, and discussing current healthcare issues with respect to diverse systems and cultures. Validated questionnaires assessing IC skills were provided, and the results were analyzed for demographic differences in IC skills and preparedness, pre- and post-program, using R version 4.0.3.

**Results & Conclusions:** Analyses of pre- (n = 305) and post-program (n = 67) responses to the 40 self-graded questionnaire items targeting levels of cultural competency, attitudes towards varying cultures, IC preparedness, and IC skills revealed statistically significant differences among two demographic factors: 1) in ten of the questions relating to student attitudes towards cultural relevance in healthcare and IC skills, students from Asian countries scored lower in the pre-program questionnaire (range of p < 0.001 to p = 0.041), and 2) multilingual students scored higher on six of the questions related to IC preparedness and skills compared to monolingual students (range of p < 0.001 to p = 0.045).

**Discussion:** The lower pre-program scores among students from Asian countries could be due to the more homogenous populations in those countries and a lack of cultural diversity in their education. In such culturally homogenous countries with low intercultural exposure, IC should be further emphasized and widely integrated in medical curricula. Further, higher IC preparedness scores among multilingual students could indicate that learning additional languages can foster IC through exposure to those different cultures and is positively related to IC learning to some extent.

*Hakyoung Kim was supported by a CDM Summer Research Fellowship.*

### 30. Vitamin D Deficiencies in Bangladesh and its Effect on COVID-19: A Review

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**Introduction:** Despite its tropical climate and close proximity to the equator, vitamin D deficiency is an epidemic disproportionately affecting women and children in Bangladesh, with malnutrition often to blame for insufficient levels of the nutrient. Vitamin D is essential in many processes related to calcium homeostasis and bone metabolism. Deficiencies of vitamin D can impact the development of certain chronic conditions and infectious diseases. Recent studies have indicated that vitamin D levels can affect the severity of COVID-19 infections.

**Objectives:** This review investigates the increased risk that the Bangladeshi population faces in the ongoing COVID-19 pandemic due to widespread deficiencies in vitamin D, and postulates how supplementation of vitamin D could alleviate the intensity of COVID-19. To account for the effect of widespread food insecurity within Bangladesh, the review also focuses on how malnutrition could play a role in supplementation based treatments

**Materials & Methods:** For this review, online searches were conducted to find research pertaining to vitamin D deficiencies in Bangladesh. Searches were also conducted to find published research linking vitamin D levels and COVID-19. A variety of both qualitative and quantitative studies were utilized as sources for this review. Any articles that pertained to vitamin D deficiencies outside the scope of Bangladesh were excluded from the search.

**Results & Conclusions:** Based on the studies, low levels of vitamin D have been linked to an increase in severity in COVID-19 infections due to higher levels in underlying, nonspecific inflammation, as well as thrombotic episodes. However, it is inconclusive if supplementation would aid all COVID-19 patients with a vitamin D deficiency.

**Discussion:** Based on current research, vitamin D deficient patients are at an increased risk of contracting a severe case of COVID-19. The severity of COVID-19 is often linked to the presence of other pre-existing conditions which lead to underlying uncontrolled inflammation and cytokine storm, causing catastrophic injury to vital organs. A potential source of defense is found in T regulatory lymphocytes (Tregs), as they have been associated with a reduced level of viral respiratory disease. Treg numbers can be increased by vitamin D supplementation, suggesting a potential benefit in treating COVID-19. In another study conducted on Bangladeshi children hospitalized for severe pneumonia, there are some contradictory findings. Admitted children with sufficient vitamin D levels benefitted from extra supplementation, however, dosing vitamin D did not have an impact on vitamin D deficient children and their clinical improvement from severe pneumonia. It is possible the coexistence of malnutrition may have impaired their immune response and blunted the impact of vitamin D supplementation. Further research should be conducted to determine the effects of malnutrition on this method of treatment.

*Samah Malik was supported by the Social Enterprise Summer Fellowship.*

### 31. Evaluation of Student Telehealth Rotation at Columbia University College of Dental Medicine

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**Introduction:** Since the onset of the Covid-19 pandemic in early 2020, utilization of telehealth has skyrocketed across medical fields. At the Columbia University College of Dental Medicine (CDM), a telehealth initiative has been undertaken to allow for expanded access to care for patients and an educational experience for students where they learn how to provide telehealth services. This project seeks to understand students' perceptions of the benefits and challenges of the utilization of telehealth in an educational setting.

**Objectives:** This study aimed to assess the impact of a telehealth rotation on the attitudes and opinions toward the use of telehealth among third year dental students at CDM.

**Materials & Methods:** A newly implemented weeklong telehealth rotation at CDM engaged all 95 third-year dental students from the 2022 graduating class through assigned readings and virtual interaction with patients. The telehealth rotation involves virtual visits with patients for screening and triage. The students' post-rotation feedback was analyzed qualitatively to identify emerging themes and was coded to describe students' attitudes and beliefs regarding telehealth.

**Results & Conclusions:** Students reported that the greatest benefit of telehealth is logistical convenience, while the greatest challenge to telehealth is overcoming technological difficulties. After the telehealth rotation, students reported improvement in their own clinically relevant skills and knowledge, including patient education, facilitating access to care, and communication skills.

**Discussion:** The skills reported by students as the most important learning takeaway from the telehealth rotation are applicable to many aspects of care delivery, beyond the scope of telehealth. The incorporation of telehealth education into dental curricula allows students to improve essential clinically relevant skills and knowledge beyond the procedural skills emphasized during in-person patient appointments.

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### 32. Testing a Mobile, On-demand Hypertension Management Training App in Abuja, Nigeria

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**Introduction:** Hypertension (HTN) is a major cause of mortality and morbidity in Nigeria, responsible for around 234,000 preventable deaths per year. Currently only 2.8% of Nigerian adults with hypertension have their blood pressure treated and controlled. Training healthcare workers in hypertension management is crucial for improving diagnosis and treatment, but in-person healthcare worker training has limitations.

**Objectives:** The objective of this study is to evaluate the effectiveness of a self-paced, on-demand digital mobile app developed by Resolve To Save Lives (RTSL) for training Nigerian healthcare workers in HTN diagnosis and management.

**Materials & Methods:** Twelve HTN training modules based on World Health Organization and Nigeria guidelines were drafted under the supervision of Drs. Moran and Thomas. After review by partners from Johns Hopkins University and the Nigerian Federal Ministry of Health, the modules were piloted by Nigerian health workers at primary health care centers in Abuja. Workers were recruited to enroll in the course on their own smartphones. Hypertension knowledge was assessed before and after the course using multiple choice questions. Participants also completed a standard rating of the likelihood they would recommend the app to colleagues [scale of 0-10 (0 – not at all likely/10 – extremely likely)]. The net promoter score was calculated as the percentage of promoters (respondents rating 9 or 10) minus the percentage of detractors (respondents rating 6 or below). The app assessment was approved by the Nigeria Health Research Ethics Committee (NHREC) and each student provided informed consent.

**Results & Conclusions:** Out of 497 healthcare workers who created an account on the HTN training app, 451 sampled the course and 348 enrolled. Of those enrolled, 211 completed the course; a completion rate of 61%. Among completers, the mean pre-test score was 68.0%, which increased to a post-test 77.2%. On average, healthcare workers stated it was highly likely they would recommend the app (mean rating 9.5). These ratings led to a net promoter score of 85%.

**Discussion:** Overall, this summer project supported creation of a mobile digital HTN training app designed for Nigerian health workers. If fully deployed by the Nigerian government, the digital app will provide an easy way for healthcare workers of all cadres (doctors, nurses, community health workers) to participate in either induction or refresher training in HTN management.

*Leander Nguyen was supported by the Columbia University Global & Population Health Summer Research Fellowship.*

### 33. Eating disorders and oral health: A scoping review

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**Introduction:** Screening and treatment guidance for somatic sequelae of eating disorders typically include specifics such as laboratory testing, physical signs, and treatment interventions. Oral health guidance is notably sparse or absent from many guidelines. Often, the only mention of oral health is the potential erosion caused by self-induced vomiting and suggests a referral to an oral health professional (OHP). The guidelines generally do not include information about education and training of OHPs.

**Objectives:** The objective of this research was to explore the literature on eating disorders and oral health, including the effects of eating disordered behaviors on oral health and training of OHPs to increase their capacity to recognize and appropriately address clinical care needs of individuals with eating disorders.

**Materials & Methods:** A comprehensive scoping review was conducted to investigate what is known about the relationship between eating disorders and oral health as well as training provided to OHPs in recognition and treatment of individuals with eating disorders. The search was completed using PubMed, Embase, Science Direct, Google Scholar, and the Journal of the American Dental Association.

**Results & Conclusion:** Of 178 articles returned in the initial search, 72 full texts were read, and 44 were included based on eligibility criteria. The retained articles were categorized thematically into articles related to 1) OHP education and training, 2) the oral health effects of eating disorders, and 3) patient experiences of oral health care. Most of the research on the relationship between eating disorders and oral health examines the impact of eating disordered behaviors. There is a significantly smaller literature on the knowledge and training of OHPs related to eating disorders and individuals with eating disorders' experiences of oral health care. Research on education and training of OHPs should be expanded globally, taking into consideration the suitability of interventions for diverse models of oral health education and service delivery. Further, there is an opportunity for eating disorder professionals and professional organizations to improve understanding and care of eating disorders by building relationships with OHP organizations in their local communities.

**Discussion:** OHPs, including dentists and dental hygienists, are well positioned to observe signs of eating disordered behaviors during routine oral health care. Most of the extant research focuses on the impact of eating disorders on oral health. Smaller portions of the literature discussed education and training of OHPs and patients' oral health behaviors. Educational interventions to increase OHPs' knowledge of eating disorders and confidence in raising concerns with patients are effective, but evidence about whether they are being implemented in training programs is lacking. Further, many studies indicated the need to connect OHPs to eating disorder treatment providers. Additional research is needed to develop guidance and best practices for collaboration between fields.

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# Postdoctoral Abstracts

### 34. Parent Oral Health Knowledge and Caries Experience in Children

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**Introduction:** Prevalence of dental caries remains unacceptably high, particularly among low-income and minority populations of children. Despite improvements in the rates of decayed, missing and filled tooth surfaces (dmfs) over the past few decades, the rate of decline has recently plateaued. Caries management in young children largely relies on parents' oral health-related knowledge and practices, including eating patterns and dietary behaviors, frequency and technique of toothbrushing, as well as regular dental check-ups.

**Objectives:** The purpose of this cross-sectional survey research was to assess the relationship between parent's oral health knowledge and the rates of decayed, missing, and filled surfaces (dmfs) in children's dentition.

**Materials & Methods:** Parent/child dyads (n=100) presenting for routine appointments were recruited from the Columbia University Pediatric Dental Clinic in Northern Manhattan between 09/2022 and 01/2023. Eligibility was limited to well-children aged 2-13 years. Following written informed consent, parents completed a paper-based 18-item multiple choice bilingual (English or Spanish) questionnaire. Six questions assessed general oral health knowledge (i.e., brushing, hygiene and dental visit recommendations, fluoride benefits, plaque, oral and systemic health linkages); five assessed knowledge about children's oral health (i.e., dental visit recommendations, bedtime bottle use, brushing recommendations); two assessed parent's flossing and dental visit history; and five assessed demographics. Data on children's caries experience (i.e., number of dmfs) from 02/2019 to 1/2023 were abstracted from electronic health records. Data were descriptively analyzed and t-tests used to explore associations between parent's oral health knowledge and total dmfs of children.

**Results & Conclusions:** A total of 100 surveys were completed. Most parents were between 25-34 years old, mainly spoke English at home (n=72, 72%), were employed (n=54, 54%) and completed high school education (n=77, 77%). The average number of dmfs in children studied was 7.67 (range 0-25). After descriptive analysis of the data collected, no significant association was found between percent correct responses by parents and the child's dmfs rate. The average percent correct on the survey was 85%. The most frequently incorrectly answered question was the duration of time for tooth brushing.

**Discussion:** Although there was no statistical significance amongst the variables, parents showed to be knowledgeable regarding oral health with an average score of 85% correct. From this data, it can be noted that although parents possess oral health knowledge, they may not be adequately implementing good oral health behaviors at home as caries rates remained very high in the population. Future studies can assess the implementation of oral health behaviors at home and what challenges parents face in the application of these behaviors.

### 35. Parental Acceptance of Telehealth Nutrition Intervention for High-caries-risk Children

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**Introduction:** Worldwide, dental caries continues to be one of the most prevalent, expensive, and chronic diseases experienced in children despite being treatable. While much is understood about the largely-behavior-driven etiology of caries progression, nutrition recommendations provided to parents during routine dental examinations may be insufficient to modify behavior. Thus, it has been suggested that ECC may be more effectively addressed with a bilateral intervention approach that pairs clinical dental care with individualized, dietary counseling and behavior modification guidance outside of the dental office.

**Objectives:** The aim of this study is to determine parental compliance over the course of three virtual medical nutrition interventions, and identify any predictive factors of televisit attendance rates such as severity of past dental treatment or sedation history.

**Materials & Methods:** At Columbia University Pediatric Dental appointments between July 2022-Dec 2022, parent /child dyads (n=80) were recruited to participate in a prospective interventional study promoting low-cariogenic behavior recommendations to be delivered over three telehealth- medical nutrition counseling sessions. Eligibility criteria included parents over the age of 18 with children aged 2-6 with Early Childhood Caries ( $\geq$  cavity, restoration, or missing tooth as a result of decay). Primary outcomes were telehealth compliance rates (including completion of one, two and all three Zoom sessions) and secondary outcomes are the correlation of descriptive variables (such as the child's dmft score, OR history, severity of dental work completed and dental clinic no show rates) with telehealth compliance rates.

**Results & Conclusions:** Despite high initial interest from parents and initially enrolling 79 participants, the majority (76.5%) were lost to follow up and did not complete a telehealth nutrition session. Only 11.3% completed all three sessions. However, all parents who completed all sessions reported positive feedback and 8 of 9 parents stated that there was nothing they would do to change this study. One parent expressed that they would have preferred an in person visit to a telehealth visit.

**Discussion:** Based on initial interest and high recruitment numbers, parents demonstrated interest and acceptability of what the study aimed to provide. However, it is clear that current processes are not feasible as the majority of parents were not able to follow through in receiving the intervention. Future studies would need to streamline processes to better optimize for feasibility of this bilateral caries approach.

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### 36. Efficiency of Telehealth Medical Nutritional Therapy for Dental Caries Management

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**Introduction:** Diet has been recognized as a primary modifiable risk factor for early childhood caries (ECC), a multifactorial disease that causes tooth decay in children under six years and disproportionately affects low socioeconomic and minority communities. Anticipatory guidance to provide oral health recommendations constitutes a substantial portion of pediatric dental appointments, but may not be emphasized given limited time and high patient volume. Medical nutrition therapy (MNT), focused counseling assessing an individual's diet and providing personalized intervention, holds potential to reduce ECC risk through improved dietary behaviors. The advancement of telehealth-delivered MNT amid the COVID-19 pandemic has increased access and may provide an important vehicle for ECC prevention outside of the clinic.

**Objectives:** To evaluate the efficiency and feasibility of implementing telehealth MNT with parents of young children for behaviorally-focused disease management of ECC.

**Materials & Methods:** Parent/child dyads presenting for routine appointments were recruited from the Columbia University Pediatric Dental Clinic (July-December 2022), which serves largely low-income Hispanic communities in New York City. Eligibility was limited to well-children aged 2-6 years with ECC. Parents were scheduled to complete three videoconference-based MNT sessions over six weeks with a nutrition program graduate student to promote low-cariogenic dietary behaviors and were offered a modest incentive for participation (\$25 per session). Pre- and post-intervention surveys measured efficiency of MNT with change in knowledge of ECC risk and protective factors, and parents' telehealth experience and acceptance. Feasibility was assessed by no-show rate among those who agreed to participate but did not complete sessions, and pre-to-post change in telehealth experience among those who completed  $\geq 1$  session.

**Results & Conclusions:** A total of 79 parents were enrolled with 43 male (54%) and 36 (46%) female children aged 4.6 years on average. One quarter (n = 19) completed at least one nutrition session, with 9 successfully completing all three. The no-show rate for those who failed to complete any MNT sessions was 75.9%. Among parents who completed three sessions, all answered either *strongly agree* or *agree* for the post-intervention efficiency statements about a positive experience with virtual MNT (i.e. convenient, easy to schedule, would use again) and varied in response to preference of telehealth over in-person nutrition counseling (2 *strongly agree*, 3 *agree*, 3 *neutral*, 1 *disagree*).

**Discussion:** While telehealth MNT may be efficient for those who participated, the high no-show rate in this study limits feasibility of the intervention. This may be due in part to difficulty coordinating, scheduling, and connecting to remote MNT sessions. Future studies should explore preferred delivery method for MNT with parents in high-risk populations.

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### 37. Medicaid Participation Among Early Career Pediatric Dentists

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**Introduction:** Over 38.3 million children are enrolled in Medicaid and CHIP, demonstrating its important role in health coverage. According to the American Dental Association Health Policy Institute, 73% of pediatric dentists participate in Medicaid or CHIP. However, less than half of children with Medicaid receive preventive dental care. Given the variability in metrics used to assess providers' participation, little is known regarding longitudinal trends and capacity of participation among pediatric dentists enrolled as Medicaid providers. Understanding trends in provider participation is important to address dental care and access for children.

**Objectives:** The objectives of this study are to assess trends of Medicaid participation among early career pediatric dentists by: (1) determining the rate of Medicaid participation of pediatric dentists during their first, third, and fifth year as American Board of Pediatric Dentistry (ABPD) diplomates; and (2) analyzing national trends in provider participation during the first five years of ABPD diplomate status.

**Materials & Methods:** Medicaid participation by ABPD diplomates from the 2014 (fifth year in practice diplomates), 2016 (third year in practice diplomates), and 2018 (first year in practice diplomates) cohorts was evaluated using National Provider Identifier (NPI) numbers and the Transformed Medicaid Statistical Information System (T-MSIS) 2019 dataset maintained by the Centers for Medicare & Medicaid Services. The following data were extracted and descriptively analyzed: percentage of diplomates not enrolled in Medicaid, enrolled but not actively treating patients, enrolled and treating 1-99 patients, enrolled and treating 100-499 patients, enrolled and treating 500-999 patients, and enrolled and treating 1000+ patients.

**Results & Conclusions:** Participation trends among ABPD diplomates were bimodal among all cohorts, with rates of diplomates seeing no patients with Medicaid between 20.9% and 27.2%, and diplomates seeing more than 100 patients enrolled in Medicaid between 62.6% and 71%. The percentage of diplomates seeing more than 100 patients with Medicaid were higher among more recent cohorts. Overall, the rates of diplomates' participation are higher than past research looking at all dentists' Medicaid participation. When combining all ABPD diplomate cohorts, men saw significantly more patients with Medicaid than women. Black dentists, followed by Hispanic dentists, lead in seeing patients with Medicaid, which is consistent with previous research.

**Discussion:** The results from this study show high Medicaid participation and capacity among early career pediatric dentists. Future research should involve location-specific needs and utilization, and providers' acceptance of new patients and practice models. Policies that promote Medicaid participation will increase access to care for children.

### 38. Parent Oral Health Knowledge and Children's Missed and Emergency Dental Visits

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**Introduction:** Management of childhood dental decay largely relies on parents' oral health-related knowledge and practices, and parental education is a main predictor of caries in primary teeth. Parents influence children's eating patterns and dietary practices, frequency and technique of toothbrushing, and receipt of regular dental check-ups. Research shows that Medicaid patients have higher rates of broken appointments than non-Medicaid patients, which may influence use of emergency services among low-income populations.

**Objectives:** The aim of this cross-sectional survey research is to assess the relationships between parent's oral health knowledge and their children's missed appointment and emergency dental visit history in a high-risk population of children in Northern Manhattan.

**Materials & Methods:** Parent/child dyads (n=100) presenting for routine dental appointments were recruited from the Columbia University Pediatric Dental Clinic between 09/2022 and 01/2023. Eligibility was limited to well-children aged 2-13 years. Following written informed consent, parents completed a paper-based 18-item multiple choice questionnaire. Six questions assessed general oral health knowledge (i.e., brushing, hygiene and dental visit recommendations, fluoride benefits, plaque, oral and systemic health linkages); five assessed knowledge of children's oral health recommendations (regarding dental visit frequency, bedtime bottle use, and toothbrushing); two assessed parent's flossing and dental visit history; and five assessed demographics. Data on children's missed dental appointments and emergency dental visits between 02/2019 and 1/2023 were abstracted from electronic health records. Data were descriptively analyzed and t-tests used to explore associations between (1) parent's oral health knowledge and frequency of children's emergency dental visits; (2) parent's oral health knowledge and children's dental appointment no-show rates; and (3) dental appointment no-show rates and children's emergency dental visits.

**Results & Conclusions:** All 100 parents enrolled completed surveys. Most parents were between 25-34 years, mainly spoke English at home (n=72,72%), were employed (n=54,54%) and completed high school education (n=77,77%). The average patient age was 6.62. The average number of dmfs in children studied was 7.67 (range 0-25). 44% of the patients have had at least one emergency dental visit. After descriptive analysis of data collected, no significant association was found between percent correct responses given by parents and the child's dental emergency visits. There was also no significant association between the percent correct responses and a child's % dental no-show appointment. No significant association was found between the number of no-show visits and emergency dental appointments.

**Discussion:** Although no statistical significance was found between the variables, parents showed to be highly knowledgeable regarding oral health as the average score of 85% correct on the survey. This study shows that though parents are highly knowledgeable regarding oral health, they may not be implementing those behaviors at home as caries rate, no-show visits, and multiple dental emergency appointments still remain high in this population. Future studies can examine the implementation of oral health behaviors at home to enhance understanding of parent-related factors that may influence children's missed and emergency dental visit experience with early identification of children who may be at-risk.

### 39. Teriparatide as an Adjunct to Bovine Bone Grafting for the Repair of Critical-Sized Bone Defects in Rats

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**Introduction:** Bone grafting is the treatment of choice for osseous defect repair in maxillofacial areas due to pathologies including periodontitis and tooth loss. There is a need to further develop and optimize bone graft materials to aid in bone regeneration. Previous studies have shown that bovine bone (BB) expresses osteoconductive properties, as well as that intermittently administered parathyroid hormone (PTH) has anabolic effects on bone. We hypothesized that impregnation of BB with PTH will result in enhanced bone formation in the treatment of critical-size bone defects (CSBDs), in terms of bone volume and bone quality, as compared to BB alone.

**Objectives:** The aim of the present study was to determine if the release of PTH 1-34 (T) from the impregnated BB particles and/or subcutaneous (SC) administration of T positively modulates bone homeostasis, remodeling, micro architecture, and new bone formation.

**Materials & Methods:** CSBDs were created in both tibiae in 28 adult male Wistar rats. Animals were divided as follows (N=7/ group): G1: Control, CSBD without BB; G2: grafted with BB; G3: grafted with BB impregnated with T; G4: grafted with BB impregnated with T, in addition to daily SC injections of T for 30 days. Animals were sacrificed after 45 days. Serum samples were obtained to evaluate bone turnover markers. Tibiae were dissected to evaluate bone micro-architecture by  $\mu$ CT and bone volume (BV) by histomorphometry.

**Results:** % change (D= at 45 vs. 0 days) of serum PTHi, P1NP and CTX were substantially and statistically significantly increased, while OCN decreased when compared to G1 ( $p < 0.05$ , assessed by one-way ANOVA after Bonferroni corrections). There were no significant differences between G3 and G4.  $\mu$ CT at the cortical level showed no repair in G1, poor repair in G2; partial repair in G3 and complete repair in G4. Histologically, BV exhibited a non-significant increase in T-treated groups.

**Conclusion:** Our findings indicate that the addition of T to BB enhanced the bone repair process. The systemic and local effects of the combination of BB with T may facilitate a novel therapeutic alternative for the repair of bony defects in the oral cavity.

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#### 40. Therapeutic development to inhibit *Fusobacterium* colonization in the GI tract

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**Introduction:** *Fusobacterium nucleatum* (*Fn*) is a filamentous gram negative oral commensal organism. The opportunistic nature of *Fn* and strong pathogenicity has been previously demonstrated to be associated with various human pathologic conditions such as cardiovascular diseases, inflammatory bowel disease, cancer, premature birth and periodontitis.

*Fn* encodes several adhesion proteins that help facilitate its binding to host cells and other species. In particular, *Fn* has been demonstrated to produce amyloid-like FadA adhesion protein under stress and disease conditions. This adhesion molecule is not present in healthy tissues. It is multifunctional and has been demonstrated to play a role in biofilm formation, and most importantly plays a role in invasion, where *Fn* binds to host cells, eliciting a range of host responses. We have previously demonstrated that FadA undergoes a biochemical change into an amyloid like structure to enhance its virulence potential and have established a mechanistic link to colorectal cancer (CRC) and periodontal diseases.

**Objective:** The primary objective is to screen and identify novel compounds that inhibit the binding of *Fn* to the human colorectal cancer (CRC) cell line DLD1. We also seek to investigate the efficacy and mechanism of action of these compounds in preventing *Fn* invasion and attachment to DLD1 thereby potentially decreasing CRC progression rate. Furthermore, we also seek to investigate the binding and invasion mechanisms of *Fn* compared to other known amyloid and amyloid-like proteins.

**Materials and Methods:** Our collaborators from the Fredrik Almqvist laboratory five novel chemical compounds containing a two pyridone ring structure, of molecular weights in the 400-600 range. In addition, Beta amyloid (AB42) and RIM4 amyloid-like proteins were also used as test compounds to aid in further characterizing the unique attachment mechanisms of *Fn* to DLD1 CRC cells.

DLD1 cells were cultured in a 24 well plate, and on reaching 80% confluency, exposed to *Fn*12230 in log and stationary phases with and without test compounds for 1 hour. For control groups, we had 2 positive and 1 negative controls. The first positive control was the *Fn*12230 FadA deletion mutant, *US1*, (which has demonstrated reduced host cell attachment and invasion), and the second was the addition of FadAc to the *Fn* preparations, with the expectation that it would competitively inhibit *Fn* binding and invasion. The negative control was the addition of Bovine serum albumin (BSA) to the *Fn* preparation, as this protein is not expected to have any effect on *Fn* binding.

The *Fn*-invaded DLD-1 cells were then lysed with distilled water and lysates used to perform viable cell counts on TSA blood agar plates. The relative amounts of *Fn* colonies on the blood agar plates at 48h were then utilized to compare the efficacy of the compounds in preventing *Fn* invasion.

**Results and Conclusions:** Ongoing experiments demonstrate *Fn* invasion can be targeted, however more attachment assays of the DLD1 cells with the five novel compounds are currently being performed. Results will be presented when we collect more rounds of data.

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