Annual Research Report 2022

Advancing Research

Melbourne Dental School





Acknowledgment of Country

The University of Melbourne acknowledges the Traditional Owners of the unceded land on which we work, learn and live: the Wurundjeri Woi-wurrung and Bunurong peoples (Burnley, Fishermans Bend, Parkville, Southbank and Werribee campuses), the Yorta Yorta Nation (Dookie and Shepparton campuses), and the Dja Dja Wurrung people (Creswick campus).

The University also acknowledges and is grateful to the Traditional Owners, Elders and Knowledge Holders of all Indigenous nations and clans who have been instrumental in our reconciliation journey.

We recognise the unique place held by Aboriginal and Torres Strait Islander peoples as the original owners and custodians of the lands and waterways across the Australian continent, with histories of continuous connection dating back more than 60,000 years. We also acknowledge their enduring cultural practices of caring for Country.

We pay respect to Elders past, present and future, and acknowledge the importance of Indigenous knowledge in the Academy. As a community of researchers, teachers, professional staff and students we are privileged to work and learn every day with Indigenous colleagues and partners.





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Introduction to the School and University

The University of Melbourne's enduring purpose is to benefit society through the transformative **impact of education and research. (Advancing Melbourne 2030)**



Welcome from **Director of Research**

It gives me great pleasure to welcome you to the second Melbourne Dental School Annual Research Report. We have a long tradition of innovation, collaborative and impactful research in the School that has changed the way we view and treat human diseases and made a real difference to the oral health of people around the globe.

To address the complex human health challenges that we face requires a high level of innovation and collaboration, increasingly in a transdisciplinary manner. The Melbourne Dental School has an increasing number of strong and meaningful collaborations and partnerships at the local, national, regional and global levels. These collaborations include all levels of our society from basic research institutes, government agencies, not for profit organisations, industry, and health care providers to patients. We leverage our position in the largest biomedical research Faculty in Australia, located in the globally renowned Parkville Biomedical Precinct, that includes a high density of hospitals, leading research institutes and biotechnology companies to expand our research and apply cutting edge technologies and skills to improving oral health.

Our research higher degree students have the opportunity to greatly expand their horizons and are nurtured and supported to achieve their full potential by taking full advantage of our collaborative networks and translational opportunities. You will see their impressive achievements as you read through our annual report. You will also see how our early career researchers are expanding our knowledge and making real contributions to their disciplines and the health of Australians.

I am justifiably proud of the research that is conducted at the Melbourne Dental School and I hope you will take the time to read our Annual Research Report and learn more of that work, its impact and how you can join us on this journey.

Yours sincerely

Professor Stuart Dashper



Professor **Stuart Dashper** Director of

Welcome from the Head of School

I am delighted to introduce the Annual Research Report for the Melbourne Dental School for 2022. Since I've been at Melbourne Dental School, our research continues from strength to strength. As I listen to arguments and discussions from federal government around university research activities and their desire to see impact from research I see a huge opportunity for our research and researchers in the school.

As a researcher with several active projects, it's evident to me that research can thrive in our school that has a strong tradition of research endeavour. Critically we are able to cross the boundaries of discovery, applied, and clinical science and have the unique opportunity to translate that findings to improve patient care and wellbeing. We are lucky as a school to be situated in Australia's premier biomedical precinct here in Parkville. Indeed, the Parkville Biomedical Precinct is one of the best in the world. To be so close to Biomedical, Clinical and Epidemiological researchers in the hospitals, medical research institutes, and other schools/departments within walking distance from our school can only serve to drive excellence and collaborative opportunities to be the best we can be.

As you will see our research as Melbourne Dental School covers biomaterials, wound healing, anatomy, cell biology, cancer biology, microbiomics, nanomedicine, biomechanics, health services research, population health, and educational pedagogy. As such our reach has the potential to influence wider areas of health and biomedicine as well as our own specific areas of oral and craniofacial medicine.

This annual report provides an update and opportunity to highlight the breadth and depth of our research, our recent successes and hopefully you will be able to see the direction of travel of a number of exciting research areas in the school.

The faculty is undertaking a large review of its broad research activities and impacts as it seeks to embed the <u>Advancing Health</u>. <u>2030 strategy</u>. I'm excited by this as Melbourne Dental School clearly has the opportunity to influence positively this broad impactful faculty vision.

Yours sincerely

Professor Alastair Sloan

" Our research has the ability to influence people's lives for the better through the development of novel therapies, better understanding of the basis of disease and changes to health policy and education."



Professor Alastair Sloan Head of School



About us

Established in 1904 The Melbourne Dental School is one of Australia's leading oral health research centres. With over 60 researchers and research higher degree students, The Melbourne Dental School aims to be world leaders in the discovery and development of the next generation of preventives, therapeutics, vaccines, and diagnostics for oral diseases.

The School boasts state-of-the-art facilities in our three clinical and research laboratory buildings. Our research primarily targets prevention and cures for infectious, inflammatory, and immune diseases, with a focus on translational research that has a positive impact on global human health. The Melbourne Dental School is situated in The University of Melbourne's Parkville Campus in the Melbourne Biomedical Research Precinct, Australia's, and one of the world's, leading biomedical precincts. Comprising over 40 hospitals, research, teaching and biotechnology institutes and organisations collocated just to the north of Melbourne's CBD, the Melbourne Biomedical Research Precinct provides the Melbourne Dental School with unprecedented access to the very latest research technologies and some of the best biomedical researchers in the world.

We engage and collaborate with other research institutes, industry, and governments from across the globe, giving us significant research capacity to address significant health issues and research questions. The School's vibrant research environment and extensive collaborations provide exceptional postgraduate research higher degree opportunities. We have an exceptional track record of translating research to the clinic and to policy.







Melbourne Dental School

Research at a glance

Staff and students	3 Major Research themes			
750+	 Infection, Inflammation & Imm Repair and Regeneration Population, Health, Communit Education 	Infection, Inflammation & Immunity Repair and Regeneration Population, Health, Community and Education		
Publications	Research Income for 2022	Partnering		
 110+ per year >50% involving an international collaboration 20,000+ CITATIONS (Over 10 Years) Field Weighted Citation Impact of 1.58 (Over 5 Years) 40% of publications in top 10% international journals 	 Research grant funding \$1.4 million+ Industry & other support \$3.1 million 	Engagement with industry partners for basic research, translation and commercialisation		
Collaborations				

18+	30+	140+
Melbourne	Australia	Global

Structures and Impact

Research at the Melbourne Dental School fits into three broad themes with each theme supporting interrelated and interconnected research groups.

Infection, Inflammation and Immunity	Repair and Regeneration	Population, Health, Community and Education
Periodontal Disease Therapeutics and Vaccines	Materials, Mineralisation and Wound Healing	Dental Education
Antimicrobials, Cancer Therapeutics and Vaccine (ACTV) Research	Cariology	Oral Health Promotion and Cultural Competance
Oral Microbiology and Microbiome Group	Biomechanics	Public Health
Periodontics	Prosthodontics	
Oral Medicine and Oral Cancer Group		
Paediatric Oral Health		
Bacterial Type IX Secretion System		

Periodontal disease therapeutics and vaccines

The Periodontal Disease Therapeutics & Vaccines research group is studying the host-microbes interaction in periodontal disease in an approach to identify key microbial virulence factors and biomarkers in saliva associated with disease progression. The group use animal models of periodontitis inoculated with human pathogens and also investigate patients with periodontal disease. One clinical study is the Biomarkers in Saliva for Health Or Periodontitis (BISHOP) study where inflammation, bone resorption and immune biomarkers in saliva are being correlated with disease stability or progression. The aim of the work is to develop a saliva diagnostic and early intervention that promotes commensal/ beneficial bacterial species and reduces/ eliminates pathogenic species which resolves inflammation to produce stability, homeostasis and health.

This work is being funded by the Oral Health CRC and NH&MRC.

Clinical delvelopment of a *Porphyromonas gingivalis* vaccine

Periodontitis is a chronic inflammatory disease of the supporting tissues of the teeth associated with a dysbiotic subgingival plaque which results in destruction of those tissues and loss of tooth attachment. Periodontitis has been linked with an increased risk of cardiovascular diseases, certain cancers, pre-term birth, rheumatoid arthritis, and Alzheimer's Disease (AD). The global prevalence of severe periodontitis has been estimated to be around 12% affecting 743 million people. P. gingivalis is a keystone pathogen in subgingival plaque which causes dysbiosis and the development of severe forms of periodontitis. Studies in non-human primates and humans suggest that therapeutic vaccination targeting P. gingivalis is a novel and successful treatment option. From extensive research in a vaccine targeting the major virulence factors of *P. gingivalis* has been developed

and shown to protect therapeutically against the progression of disease. This project involves the clinical development of the *P. gingivalis* recombinant protein vaccine to test the vaccine in Phase Iab clinical trials under CTN in Australia.

Recent work by the group has also involved the creation and testing of an mRNA-lipid nanoparticle (LNP) vaccine targeting *P. gingivalis* with funding from the CRC-P program.

Recently a drug targeting *P. gingivalis* has been demonstrated to significantly reduce cognitive decline in Alzheimer's Disease (AD) patients who are orally infected with *P.gingivalis*. The PDTV group have now established a mouse model of AD linked to oral infection by *P. gingivalis* which shows typical AD brain pathology an increase in amyloid plaque, phosphor-tau and inflammatory mediators. This model is being used to test specific immunotherapeutcs against *P. gingivalis* to determine whether they will prevent the development of AD brain pathology associated with *P. gingivalis* infection. This work is funded by CUREator and CRC-P.

This work is being funded by the MRCF/ Denteric/CSL, CRC-P, CUREator, Oral Health CRC and NH&MRC.

Researchers: Laureate Professor Eric C. Reynolds, Dr James Holden, Dr Catherine Butler, Dr Nada Slakeski, Mr Geoff Adams, Mr William Singleton, Dr Christine Seers, Dr Lianyi Zhang, Ms Yan Tan.

Project Manager: Ms Gilda Pekin



Laureate Professor Eric Reynolds

Find an expert



Doctor Catherine Butler

Find an expert



Doctor Nada Slakeski



Doctor Christine Seers

Find an expert



Doctor Lianyi Zhang





Mr Geoff Adams Find an expert



Figure 1 Image of *P. gingivalis* orally-infected mouse brain showing co-localisation of the *P. gingivalis* virulence factor gingipain (green) with the development of amyloid beta (red) a biomarker of Alzheimer's Disease pathology.

Antimicrobials, cancer therapeutics and vaccine (ACTV) research

The ACTV research group is focused on designing and synthesizing peptide-based nanomaterials that have anti-bacterial or anti-cancer properties or can be used in the fabrication of vaccines targeting oral bacteria or cancer cells.

Antimicrobial materials in combatting multidrug resistant bacteria 'superbugs'

The ACTV research group applies a multi-disciplined and inclusive approach to research focusing on applying an evidence based iterative approach to understanding how the materials we make interact with the bacteria and cells they come into contact with. From this we are able to design and redesign materials to produce peptides and nanomaterials that can be translated to clinical use. Our strategy is a chemical biology approach and employ a range of organic/peptide synthetic, immunological, and microbial approaches to achieve the goals of the team to produce antimicrobials.

This year two PhD students of our team have been recognised for their outstanding work, Ms Bansari Shah was awarded the ANZ-IADR Division Colgate Award

(Senior category) for her work on "Developing a vaccine towards oral cancer" and Mx Connagh Redmond was awarded a grant to attend the European Society of Clinical Microbiology and Infectious Diseases (ESCMID) conference in Dublin (July 2022) and subsequently awarded a 'Top Poster' prize for their work 'Improving the accuracy of in-vitro antimicrobial testing using simulated body fluid'. Dr Wenyi Li has been recognised for his work and has been awarded the prestigious NHMRC Investigator grant and moved to La Trobe University to set up his own lab. Ms Tammy Matthyssen graduated with a Masters in Biomedical Science and secured a position at the Melbourne Dental School as a research assistant and Mr Bruce Lin graduated with a BSc 'First class' Honours degree. We welcomed three new members to the team Ms Harriet Liu (Master student); Ms Saharnaz Rafiee (PhD student) and Ms Laura Yeo (Honours student) who are working on:

- 1. Investigating how sepsis can be modelled;
- 2. Designing inhibitors for cancer and
- How bacteria products called outer membrane vesicles interact with immune receptors, respectively.

We published 13 papers, for two of which in the prestigious journals 'Chemical Science' and 'ACS Applied Materials & Interfaces' we designed journal front covers with artwork from Ms Ruadh O'Brien-Simpson.



Professor Neil O'Brien-Simpson Find an expert



Doctor Sara Hadjigol





Doctor Wenyi Li



Researchers (left to right) Dr Sara Hadjigol, Ms Saharnaz Rafiee, Ms Bansari Shah, Prof Neil O'Brien-Simpson, Ms Connagh Redmond, Ms Laura Yeo, Ms Harriet Liu

Oral microbiology and microbiome

The oral microbiota, like a dual edged sword, is essential for human health and yet is also responsible for major chronic oral diseases, such as periodontitis and dental caries. Further to this the human oral cavity does not exist in isolation, as oral bacteria and their byproducts permeate the body, potentially initiating and exacerbating a large range of systemic diseases and conditions. We determine how these bacteria function from the molecular to the community level and how they cause disease. The long-term goal of these studies is to identify biomarkers of disease and develop novel therapies and preventive regimes.

Oral bacteria, especially those species associated with chronic periodontitis and particularly Porphyromonas gingivalis, are being linked causally to Alzheimer's disease pathophysiology in a subpopulation of susceptible individuals. P. gingivalis secretes large numbers of membrane vesicles (MV) that are decorated with proteolytic enzymes, haem and iron capture proteins, adhesins and internalins. These enzymes and adhesive proteins have been shown to cause host tissue damage and stimulate inflammatory responses. These MVs may be the mechanistic link between a P. gingivalis focal infection in the oral cavity during periodontitis and the neurodegeneration seen in Alzheimer's disease. We are working in collaboration with colleagues with colleagues at the Florey Institute to address these research questions.

Periodontitis is a bacterial induced chronic inflammatory disease that is characterised by the progressive destruction of supporting tissues of the tooth. Periodontitis results from a shift in the composition of the subgingival bacterial biofilm community to a dysbiotic pathogenic community dominated by Gram-negative, proteolytic species. There is no cure for periodontitis and current gold standard treatment is to stop active disease and prevent further destruction, primarily by non-surgical physical removal of the subgingival biofilm. Up to 40% of treated sites fail to respond adequately to current treatment. We recently demonstrated that in those sites that did not respond to treatment there was a failure to disrupt these pathogenic



-many novel proteins

(peptidylarginine deiminase) -linked to rheumatoid arthritis

Figure 2 (A) Scanning electron micrograph showing P. gingivalis blebbing MVs. (B) Cryo-transmission electron micrograph of P. gingivalis MVs showing their surface layer of proteins. (C). Scanning electron micrograph of a polymicrobial biofilm of P. gingivalis, T. denticola and T. forsythia showing high numbers of MVs. (D) The P. gingivalis MV proteome is composed proteins that play roles in host tissue destruction, immune response dysregulation, internalisation and (micro)nutrient capture. (Liu S, Butler C, Ayton S, Reynolds E, Dashper S. Porphyromonas gingivalis and Alzheimer's disease. Critical Reviews in Microbiology 10.1080/1040841X.2022.2163613 (2023).

communities and shift the communities to a mutualistic eubiotic composition.

We are funded by the National Health and Medical Research Council, National Foundation for Medical Research and Innovation and the Medical Research Futures Fund.

We are working with colleagues at La Trobe University to mine and characterise the diversity of bacteriophages in the oral cavity with a view to employing these bacterial viruses to manipulate oral bacterial communities and prevent the development of the pathogenic dysbiotic biofilm communities that causes periodontitis progression. Bacteriophages are the most diverse and numerous biological semiautonomous entities on the planet and offer huge potential for the treatment and prevention of human disease.

Researchers: Professor Stuart Dashper, Dr Catherine Butler, Dr Ali Mohammed



Professor Stuart Dashper Find an expert



Doctor Catherine Butler Find an expert



Doctor Ali Mohammed Find an expert



Figure 3 Transmission electron microscopy image of the *Fusobacterium nucleatum* specific Siphoviridae bacteriophage showing the \approx 310 nm long tail and \approx 88 nm diameter icosahedral head. (Kabwe et al. Genomic, morphological and functional characterisation of novel bacteriophage FNU1 capable of disrupting *Fusobacterium nucleatum* biofilms. Scientific Reports 9:9107 (2019).

Periodontics

The Periodontics research group investigates all aspects of periodontal disease and surgical implant dentistry with a particular focus on periodontal microbiology and immunology as well as implants in the aesthetic zone.

Mental health and periodontal and peri-plant Diseases

Mental health disorders, particularly depression and anxiety, affect a significant number of the global population. Several pathophysiological pathways for these disorders have been identified, including the hypothalamicpituitary-adrenal axis, autonomic nervous system, and the immune system. In addition, life events, environmental factors, and lifestyle affect the onset, progression, and recurrence of mental health disorders. These may all overlap with periodontal and/or peri-implant disease. Mental health disorders are associated with more severe periodontal disease and, in some cases, poorer healing outcomes to nonsurgical periodontal therapy. They can result in behaviour modification, such as poor oral hygiene practices, tobacco smoking, and alcohol abuse, which are also risk factors for periodontal disease and, therefore, may have a contributory effect.

Stress has immunomodulatory effects regulating immune cell numbers and function, as well as proinflammatory

cytokine production. Stress markers such as cortisol and catecholamines may modulate periodontal bacterial growth and the expression of virulence factors. Stress and some mental health disorders are accompanied by a low-grade chronic inflammation that may be involved in their relationship with periodontal disease and vice versa. Although the gut microbiome interacting with the central nervous system (gut-brain axis) is thought to play a significant role in mental illness, less is understood about the role of the oral microbiome.

The evidence for mental health disorders on implant outcomes is lacking but may mainly be through behavioural changes. Through lack of compliance with oral hygiene and maintenance visits, peri-implant health can be affected. Increased smoking and risk of periodontal disease may also affect implant outcomes. Selective serotonin reuptake inhibitors have been linked with higher implant failure. They have an anabolic effect on bone, reducing turnover, which could account for the increased loss (reproduced from Periodontology 2000, 90;1).

Highlight publication

Mental health and periodontal and peri-implant diseases

Researchers: Jake Ball, Professor Ivan Darby



Professor Ivan Darby Find an expert



Oral medicine and oral cancer

The Oral Medicine and Oral Cancer Group undertakes extensive studies of oral mucosal disease, particularly in relationship to the early recognition and development of oral cancer. Oral potentially malignant disorders are studied using novel models, treatment, and diagnostic precision for the prevention and treatment of oral mucosal disease. In parallel, the group investigates the early molecular events driving the onset of oral mucosal diseases, including oral autoimmune, inflammatory, and malignant conditions. Our research aims to develop novel mechanism-based prevention and/or treatment strategies for these diseases. Our team expertise includes in silico, in vitro, in vivo and clinic to lab translational expertise with diverse expertise in application of molecular analyses. Our active collaborations include Walter and Eliza Institute, Melbourne Health, Latrobe University and industry partners MirXES, Optiscan Ltd, MoleMap Ltd, and Wintermute Biomedical, Inc.

Students involved

Doctor Ali Mohammed

Doctor Elham Moslemi

Doctor Neha Pruthi

Doctor Suhaib Alqudah

Doctor Nadia Kaunein

Doctor Rishi Ramani

Doctor Hamza Hamza

Doctor Houda Asmael

Deep learning convultional neural networks in *In Vivo* icrographical diagnosis of of oral cancer and oral potentially malignant disorders

Our group's building work within the Melbourne Dental School at the University of Melbourne has allowed us to collect more than 170 image sets in humans with oral mucosal abnormalities utilising an *in vivo* confocal microscope. Greater than 70% of these patients have matched prospective histopathology data. Additionally, in collaboration with the John Silke Lab at the Walter and Eliza Hall Institute (Australia), we have a large murine oral cancer model dataset. This dataset utilised the 4NQO model of oral carcinogenesis in wild type and mutant mice alongside in vivo capture utilising the same in vivo microscope as utilised in our human study.

This wealth of human and carefully controlled murine data will be used to train and validate deep learning convolutional neural network models to identify and predict oral cancer and OPMDs in blinded raw image datasets. Once this model is validated adequately, we plan to integrate it into a software that can be natively executed from a point scanning digital chairside confocal microscopy system. This has potential to significantly augment the real-time capabilities of in vivo assessment of micrographic oral mucosal abnormalities, whilst assisting quantitative assessment.

This project was awarded funding by the ADRF.

Researchers: Dr R Ramani, A/Prof Antonio Celentano, Professor Michael McCullough, Dr Tami Yap



Doctor Ankur Singh Find an expert



Professor Michael McCullough Find an expert



Associate Professor Antonio Celentano Find an expert



Doctor Tami Yap Find an expert



Professor Nicola Cirillo Find an expert



Doctor Warren C Crossley Find an expert



Figure 4 CD3+CD161+TCRVa7.2+phenotype analysis in oral lichen planus. From Deangelis LM, Cirillo N, Perez-Gonzalez A, Mccullough M. Characterization of Mucosal-Associated Invariant T Cells in Oral Lichen Planus. International Journal of Molecular Sciences. 2023;24(2):1490.



Associate Professor Seth Delpachitra Find an expert



Mrs Caroline Moore Find an expert



Ms Rita Paolini Find an expert

Special care dentistry

The Special Care Dentistry Group conduct extensive research in the field of Special Needs, spanning from in silico research to clinical studies. Special Needs patients have a higher prevalence of oral diseases and unmet dental needs compared to the general population, but grossly inadequate training and experience in managing patients with special needs has been highlighted as a significant barrier to accessing care. Our research aims at highlighting opportunities for future development in this critical area of dentistry to improve access to care for society's most vulnerable.



Doctor Mathew Lim Find an expert



Associate Professor Antonio Celentano Find an expert



Figure 5 Coding tree for Clinician Interviews from -Lim, Mathew Albert Wei Ting, and Liberali, Sharon Andrea Corinne, et al. "Mentoring of oral health professionals is crucial to improving access to care for people with special needs.". PLoS One, vol.17,no.4, 2022, pp. e0266879-. doi:10.1371/journal. pone.0266879

21

mentation study.

Teoh)

bcp.14373

the total number of antibiotics. We are further

focus groups, so it is ready for a scalable imple-

developing this tool through co-design and

This project was awarded funding by the

Researcher and Dean's Innovation grants

(researcher: Leanne Teoh), and the National

Investigator EL1 grant (researcher: Leanne

1 Teoh L, Stewart K, Marino RJ, McCullough MJ.

practices using education and a prescribing

Pharmacol. 2021. 87(1): 152-162. doi: 10.1111/

tool: a pilot intervention study. Br J Clin

Improvement of dental prescribing

University of Melbourne Early Career

Health and Medical Research Council

Dental therapeutics

The research conducted by the Therapeutics Group is devoted to the improvement of dental prescribing, with a particular focus on antibiotic prescribing. Our research projects in this field will collectively transform how drugs are used in dentistry, allowing for safer prescribing, improved patient management and enable dentists to play their part to tackle the global public health problem of antibiotic resistance.

Antibiotic resistance is a well established global public health problem

While dental antibiotic prescribing accounts for a significant 10% of all prescribed antibiotics globally, around 55% of dental antibiotics in Australia are prescribed inappropriately. Our group's work involves developing a digital clinical decision tool, titled Drugs4dent®, that provides dental-relevant drug information, dentist and patient education about appropriate use of antibiotics, as well as assists dentists with prescribing according to guidance.

Our pilot study demonstrating the feasibility of our antibiotic stewardship intervention: Drugs4dent® and targeted education, produced a 45% reduction in the number of inappropriate indications for which antibiotics were prescribed after the intervention and a decrease of 41% in

🍃 Drugs4dent®

Welcome to Drugs4dent[®]

Towards safer medication use: a tailored medicines resource for dental practitioners

Drugs4dent[®] is the first Australian medicines information resource designed specifically for dental practitioners. It provides succinct, dental-relevant information for practitioners in clinical settings to understand the effect of medications on dental treatment and support clinicians to accurately and safely prescribe.

With drug information constantly evolving, Drugs4dent[®] provides up-to-date dental-relevant information on prescription drugs, over-the-counter products and complementary medicines, so dental practitioners will be alerted to the impacts drugs can have on dental procedures. Drugs4dent[®] provides clinical decision support to improve medication safety by including drug and allergy interactions, pregnancy and lactation recommendations, and paediatric dosing guidance for dental indications.

Dentalspecific drug information

Succinct, dental-relevant drug information such as oral adverse effects, is provided about your patient's medications, to enable you to perform dental treatment safely with respect to medication use.

Received a set of the set of the

Patient-friendly information is provided about the appropriate use of antibiotics for specific dental scenarios.

Patient education

ormation is Med e appropriate can or specific pres deci-



Medication related effects that can impact dental treatment are presented to assist with clinical decision making and safe treatment procedures. Examples include drugs associated with increased bleeding risk, infection risk and osteonecrosis of the jaw.



Doctor Leanne Teoh Find an expert



Professor Michael McCullough

Find an expert

Paediatric oral health research

In partnership with the Murdoch Children's Research Institute, our multidisciplinary research team of clinicians and scientists strive to understand oral health and disease across the life course. Our group works collaboratively across the Melbourne Dental School and the Melbourne Children's Campus, undertaking longitudinal and interventional research to explore the many ways oral health and overall health interact. Our group strives to 'push oral health to the forefront of global and public health agendas', focussing on child oral health and its importance throughout life.

A co-designed early intervention program to improve the oral health of children with disability and developmental delay

People, including children, with disability face significant barriers to accessing dental care. Lack of engagement with dental services in childhood mean that despite considerable needs, these children miss out on essential preventive services, and support that are more readily accessible to others in the community. Preventive programs, co-designed and driven by value-based principles, is especially important for these high-risk children who not only face barriers in obtaining regular dental reviews but also for whom, management is likely to be complex and require specialist services.

Project rationale

Based on feedback from our Child & Family Team (CFT) that offer early intervention programs supporting NDIS children & parents, we are seeking to undertake a major preventive-focused, co-designed, value-based program to support these families.

This project will involve collaborations with Access Health, MCRI, Centre for Behaviour Change (Melbourne University), University of Newcastle and University of Leeds from the UK.

- 1. Improved engagement of families with children with disability and developmental delay with dental services
- Development of a co-designed 2. preventive program for families with children with special needs
- Development of inter-professional 3.
- relationships via NDIS to support 4. professional oral care for children with special needs

In 2022, This Project Received a DHSV Innovations Grant Valued At \$233,057.

Researchers: Dr Mihiri Silva, Niki Hantzis.



Doctor Mihiri Silva Find an expert



Doctor **Rachelle Welti** Find an expert



Ms Stephanie Gomez Find an expert



Ms Olivia Walsh





Study





Bacterial type IX secretion system

The Type IX Secretion System (T9SS) Group studies a newly identified bacterial secretion system of the Bacteroidetes phylum. A pathogen associated with severe periodontitis Porphyromonas gingivalis is used as the model organism to study the secretion system to focus on the structure, function, and organisation of the nanomachinery to provide mechanistic insight into its role in loading virulence factors onto the surface of the cell and outer membrane vesicles. The group uses electron cryotomography, proteomics and other techniques to probe the architecture and protein complexes of the nanomachine.

Molecular characterisation of the type IX secretion system of Porphyromonas gingivalis

The novel Type IX Secretion System (T9SS) in *Porphyromonas gingivalis* is the key pathway that allows the surface presentation of multiple virulence factors. The genes encoding the T9SS are present in many pathogenic species of the Bacteroidetes phylum. We are characterising the T9SS powertrain that loads virulence factors onto the surface of the cell and outer membrane vesicles (OMVs).

We are elucidating the mechanisms connecting energy harnessed from the inner membrane to the powering of secretion and the formation of the electron dense surface layer (virulence coat) around the cell and OMVs.

We use electron cryotomography to study the 3D architecture of the secretion nanomachine. The further elucidation of the T9SS structures and secretion and attachment mechanisms will aid in the development of novel therapies that are specific to certain human and animal pathogens and therefore may be applicable to several diseases without the risk of damage to either animal or human host cells or commensal bacteria.

This work is being funded by NH&MRC, ARC and Oral Health CRC.

Researchers: Laureate Professor Eric C. Reynolds, Associate Professor Paul Veith, Dr Dhana Gorasia. Dr Michelle Glew. Collaborator Associate Professor Debnath Ghosal.

Project Manager: Ms Gilda Pekin



Laureate Professor **Eric Reynolds**





Find an expert



Doctor Dhana Gorasia Find an expert



Materials, mineralisation and wound healing

The Mineralised Tissue Research Group investigates a range of aspects of mineralised tissues: from fundamental human bone biology to dental tissue regeneration and associated soft tissue wound healing.

These include the effects of life events and population ancestry on teeth and the craniofacial skeleton. In addition, we investigate the functional roles of stem cells in mineralised tissue regeneration and the development of 3D organotypic/ synthetic biological model systems to understand tissue injury and repair. Research is conducted by an interdisciplinary group of anatomists, dental and biological anthropologists, bioengineers, clinical dentists and specialists and earth scientists.

Tracking development of age-related cortical porosity

The collaborative project with St Vincent's Research Institute aims to understand how human bone responds in ageing. High-resolution micro-CT imaging and infrared light imaging will be combined with histomorphometry to analyse the mineralised phase of human cortical bone. This research is being carried out using samples from the Melbourne Femur Research Collection: a unique well-provenanced collection of contemporary human bone samples. This project has the potential to help answer questions about cortical bone remodelling, which applies to many aspects of dental treatment and research.

This new project will bring new understanding to the bone remodelling process, adding important information to the current body of knowledge.

Researchers: Dr Rita Hardiman, Dr Natalie Sims, Professor Alastair Sloan





Life history parameters in acellular extrinsic fibre cementum microstructure

Life-history parameters such as pregnancies, skeletal trauma, and renal disease have previously been identified from hypomineralised incremental lines of AEFC. The precise periodicity of these growth layers remains unverified, so causal life-history explanations using tooth cementum cannot be rigorously calculated or tested. We propose a new methodological approach for cementum research to measure degree and distribution of mineralization of cementum increments. The project's aim is to develop a powerful new tool for life history researchers across disciplines.

Developing a highly innovative analytical technique for establishing life history parameters and fertility rates from AEFC, within the context of the larger populations through time.

Researchers: Dr Marija Ediborough

Restorative dental materials

New direct restorative dental materials are coming on the market regularly, and bespoke material are being developed for patients' requirements. Glass-ionomer (GI) and resin-based ion-leaching restorative materials (RB-ILMs) are being developed as so called "smart materials". These restorative materials can release ions as a function of the ions present within the restorative dental material, and also recharge ions from other dental products (e.g. varnishes and tooth pastes etc) in response to their chemical surroundings. These stored ions help augment the concentration of ions present in the saliva and the oral environment to prevent tooth demineralization and encourage remineralisation. Recently (2021), a PhD student (Chirayu Ruengrungsom) investigated contemporary ILMs materials to evaluate their mechanical properties in addition to their ion release, and rechargeability to provided evidence for improved material selection for each clinical scenario.

Researchers: Dr Joseph Palamara, Ms Chirayu Ruengrungsom



Professor Alastair Sloan Find an expert



Doctor Rita Hardiman Find an expert



Doctor Marija Edinborough Find an expert



Associate Professor Joseph Palamara Find an expert



Doctor Rachael Moses Find an expert



Partially excavated Medieval necropolis of Dici, situated on the North bank of the River Ljig in central Serbia, South Eastern Europe.



Figure 6 Reflected (A1-H1) and transmitted light microscope images (A2-H2) in the same positions for each ILM, which its porosity was quantitatively measured: A, Cention N; B, Fuji VIII; C, Fuji II LC; D, Riva Light Cure HV; E, Zirconomer; F, Ketac Universal; G, Equia Forte Fil, and; H, Riva Self Cure HV.

Cariology research

The Cariology research group is studying the microbial and molecular processes of dental caries and erosion progression and regression using in vitro and in situ models as well as randomised, controlled clinical trials. The group is developing novel remineralisation and prebiotic systems using a saliva biomimetic phosphopeptide-stabilised amorphous calcium phosphate nanotechnology that acts synergistically with fluoride, particularly stannous fluoride to repair early stages of dental caries/erosion and help promote the return of oral commensal bacterial species antagonistic to plaque cariogenic species to restore homeostasis and oral health.

Repair of tooth enamel/dentine by biomimetic mineralisation

Dental caries and erosion are substantial public health problems in Australia. Fluoride ion's ability to remineralise tooth enamel has recently been shown to be calcium limited. Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) is a new remineralisation technology that enhances the efficacy of fluoride by acting as a saliva biomimetic providing bioavailable calcium and fluoride ions to promote remineralisation. However, remineralisation is a very slow process taking several months, if not more, to repair enamel and dentine lesions and usually that process does not seal those lesions such that caries and erosion can still progress. A high concentration (e.g. 60% w/w) metastable solution of CPP-ACP/SnF₂ can be prepared containing calcium, phosphate, and fluoride in the fluorapatite molar ratio. This amorphous gel can promote the formation of a stannous-hardened fluorapatite (FA) enamel/ dentine surface layer. This technology could assist in managing early stages of coronal and root caries/erosion and tooth sensitivity non-invasively by the formation of a biomimetic FA mineralised seal. The overall aim of this project is to test this highly novel biomimetic mineralisation system based on high concentrations of CPP-ACP/F in clinical trials.

This work is being funded by the Centre for Oral Health Research and NH&MRC.

Researchers: Laureate Professor Eric C. Reynolds, Associate Professor Peiyan Shen, Dr James Fernando, Mr Yi Yuan, Mr David Stanton, Ms Coralie Reynolds.

Project Manager: Ms Gilda Pekin



Laureate Professor Eric Reynolds

Find an expert



Associate Professor Peiyan Shen Find an expert



Doctor James Fernando Find an expert



Orthodontics

Solid clinical research is the future in Orthodontics, since the specialty is still lacking consensus on many important clinical issues. More specifically, the Orthodontic clinical research group mostly focusses on 3D outcomes of orthodontic treatments, stability after orthodontic treatment, digital workflows, and esthetic appliances. The projects include randomized controlled clinical trials as well as large retrospective studies, aiming to foster strong research outcomes towards better clinical guidelines in orthodontics. The group is in close contact with the Australian Association of Orthodontics and wishes to set up joint projects within the eviDent Dental Practice Based Research Network.

Comparison of the oral microbiota and clinical dental health of orthodontic patients wearing clear aligners and fixed appliances: A clinical trial

Orthodontic treatment with fixed appliances (FA) can be associated with an increased risk of developing periodontal disease and white spot lesions. Clear aligners (CA) are a removable alternative and have been suggested to pose less risk. This project aimed to determine and compare the clinical dental health outcomes and associated oral microbial changes of patients being treated with FA and CA after 6 months of treatment. Eighty-four patients were enrolled in the study. Clinical data and plaque samples were collected before the start of treatment (T0) and 6 months after commencement of treatment (T1). The clinical measures assessed were *gingival* index (GI), plaque index (PI), and ICDAS II scoring for WSLs. The plaque samples underwent 16S rRNA gene sequencing to identify the microbial changes.

After 6 months of treatment, the CA group maintained their initial PI and GI scores, whereas the FA group experienced a statistically significant increase in PI and GI scores. The incidence of WSLs was the same for both groups (2.4%). From a microbial standpoint, the alpha diversity of both groups experienced a non-significant increase over the 6-month period. Although there was no difference in the beta diversity of FA and CA subjects at T0 and T1, on a microbial species level assessment, the FA group had a higher abundance of several caries associated Leptotrichia species.

In summary, the CA group were able to maintain their initial oral hygiene and *gingival* health, whereas the FA group experienced a deterioration. Nevertheless, because the deterioration was subtle, the clinical relevance of this difference is questionable. Hence, the choice of CA over FA should not be based on the conviction that CA are better for dental health.

Researchers: Mohammed Basheti, Sachin Agarwal, Wayne Ly, Catherine Butler, Geoff Adams, Stephanie Gomez, Carra Simpson, Paolo M. Cattaneo, Marie A. Cornelis, Paul M. Schneider



Associate Professor Paul Schneider

Find an expert



Professor Marie Cornelis Find an expert



Associate Professor Paolo Cattaneo Find an expert



Figure 7 The supragingival plaque microbiome of clear aligners compared with fixed appliances (unpublished).

Prosthodontics

The prosthodontics research has a strong track record in the clinical and lab testing of dental materials. The key aim of this research group is to deliver outcomes directly applicable to current clinical practice. The clinicians and researchers in this team have established linkages with other university partners with exceptional industry relationship's providing significant scope for high level translational research. A key focus of this group is dental implants.

The biomechanical profile of an osseo-integrated rectangular block implant: A pilot *In Vivo* strain analysis

Aim: To Load-Test The Osseo-Integrated Rectangular Block Implant (Rbi), Measure The Generated Cortical Peri-Implant Strains, And Relate These Findings To Known Human Physiological Parameters.

Materials And Methods: The half mandible (implants in situ) was mounted in a servohydraulic system. Four triple-stacked rosette gauges were placed cortically (mesial, distal, buccal, and lingual). A modified ISO-14801 protocol was used (1000 N, 300, 2 Hz, 1 h) and the generated principal strains (ep, eq) and their angular orientations (F), were calculated. Results: (1) Bucco-lingual "horizontal" dimension: dominant "horizontal" compressive stresses were on the lingual aspect and "horizontal" tensile stresses on the buccal aspect. The buccal cortex was elastically tensile-stretched, while the lingual cortex was elastically compressed. (2) Bucco-lingual "vertical" dimension: dominant vertical torsional stresses were oriented buccally and apically, with an overall buccally inclined torsional effect. This was also evidenced on the lingual aspect, where there remained high torsional rotation elements (high F and e2). (3) Mesio-distal "horizontal" dimension: dominant torsional stresses oriented as a distal-lingual "counter-clockwise" rotation.

Conclusions: The applied off-axial loads generated a heterogeneous pattern of bucco-lingual and mesio-distal cortical strains, both vertically and horizontally. The short dimensioned osseo-integrated RBI design appeared to biomechanically withstand the applied loads and to maintain the strains generated to levels that were within physiological limits. More studies and statistical analyses are needed to confirm these findings.

Researchers: Efthimios Gazelakis *, Roy B. Judge, Joseph E. A. Palamara and Mohsin Nazir



Associate Professor Roy Judge

Find an expert



Associate Professor Jaafar Abdou





Associate Professor Joseph Palamara Find an expert



Figure 8 Embedded half mandible in acrylic, leaving the exposed alveolus and integrated implants.

Population, Health, Community and Education

Population oral health interventions research

We evaluate population oral health interventions for their health inequality impacts. Jointly positioned with Melbourne School of Population and Global Health. Research collaborators include Lancet Commissioners of Oral Health, National Dental Research Institute Singapore, ICMR - National Institute of Cancer Prevention and Research and UCL Dental Public Health.

Oral health and the Cambodian health and nutrition monitoring study (CAHENMS)

This research applied advanced quantitative techniques (inverse probability treatment weighting and latent class analysis) on longitudinal birth-cohort data on Cambodian children to examine if early childhood caries leads to stunting and wasting. The study found that the incidence of pulp ally involved carious lesions was associated with wasting. The latent class analysis also confirmed that children exposed to dental caries were more likely to have lower weight-for-height Z-scores. The project was led collaboratively by researchers from University of Puthisatra (Cambodia), Melbourne Dental School, Boston University, Ministry of Health (Cambodia) and University of California. Funding for this project was received through joint application to Borrow Foundation. The epidemiological aspects of this project were conceptualised by the Population Oral Health Interventions Research Group.

This research was published in two important journals of the field - Journal of Dental Research and Journal of Global Health. The research published in Journal of Dental Research was endorsed by Christopher Fox, the CEO of International Association for Dental Research as following in his words (personal communication to corresponding author):

"I thought you and your authors very elegantly demonstrated the links between oral health, nutrition, and human growth and development. Wonderful collaboration between the institutions and funders of BU, University of Puthisastra, Melbourne Dental School, Cambodia Ministry of Health, UNICEF-Cambodia, Borrow Foundation, and the French National Institute for Sustainable Development."

Researchers: Bathsheba Turton, Tepirou Cher, Sheena Sullivan, Sithan Hak, Karen Sokal-Gutierrez, Frank Wieringa, Ankur Singh



Trends in social inequalities in early childhood caries in Victoria

This research quantified the trends in inequalities in early childhood caries in Victorian children using public dental services data available from Dental Health Services Victoria. Applying inverse probability treatment weighting it guantified absolute and relative inequalities in early childhood caries annually from 2008 to 2019 by cardholder status, Indigenous status, language spoken at home, area deprivation and area remoteness. The study reported a marked increase in inequalities over time on both scales according to language spoken at home and cardholder status. This project was an outcome of a collaborative research between Melbourne Dental School and Dental Health Services Victoria.

Researchers: Diego Lopez-Peralta, Shalika Hegde, Martin Whelan, Stuart Dashper, Georgios Tsakos, Ankur Singh

Cash transfer programs and oral health

This collaborative research with Brazilian colleagues summarised the evidence on the impact of cash transfers on oral health outcomes. This paper highlighted key gaps in causal evidence for the effect of cash transfers on oral health outcomes. Colvara, B., Singh, A., Gupta, A., Celeste, R.K. & Hilgert. J. (2022). Association between cash transfer programs and oral health - a scoping review. Journal of Public Health Dentistry

Researchers: Beatriz Colvara, Ankur Singh, Adyya Gupta, Roger Keller Celeste, Juliana Hilgert

Oral health: Related birth cohort studies consortium

This collaborative research with colleagues from Singapore, UK and Australia summarised the key oral health birth cohort studies internationally. This paper was published in Journal of Dental Research and is foundational for setting up of an international birth cohort consortium.

Peres, K., Nascimento, G., Gupta, A., Singh, A., Cassiano, L. S. & Rugg-Gunn, A. (2022). Scoping Review of Oral Health-Related Birth Cohort Studies: Toward a Global Consortium. JOURNAL OF DENTAL RESEARCH, pp. 15-. doi:10.1177/00220345211062475

Researchers: Karen G Peres, Gustavo G Nascimento, Adyya Gupta, Ankur Singh, L Cassiano and Andrew Rugg-Gunn

Highlight publication

Caries Incidence Is Associated With Wasting Among Cambodian Children



Doctor Ankur Singh

Find an expert



Did you know having pulpally involved caries in children increases the risk of wasting in low-income settings by 1.35 times?

Population, Health, **Community and Education**

Dental education research

The Dental Education and Scholarship of Teaching and Learning group aim to explore how the design and implementation of learning activities, and assessment and feedback practices influence student learning. The major projects of this group are the development of a Research Assessment Program to evaluate Assessment for Learning, investigating ePortfolio pedagogy and reflective practice and the relationship between self-regulated learning and student engagement with pre-class learning in a flipped classroom. Other areas of investigation include dental simulation, technology enhanced learning and interprofessional education.

Preparing to learn and learning to prepare: Pre-Class learning and self-regulation

The flipped classroom is a pedagogical model whereby students engage with instructional content independently pre-class, which enables in-class time to be spent on activities focused on knowledge construction. However, student preparation for class depends upon multiple factors including self-regulation. This research project seeks to examine the relationships between the format of pre-class learning tasks and student preferences and perceptions of preparedness and their self-regulated learning behaviour.

Researchers: Dr Samantha Byrne, Dr Sean Kang, Associate Professor Heather Verkade, Associate Professor Kristine Elliott

Simulation in Dentistry, International **Conference Presentation**

Dr Anu Polster's "The Effectiveness of Simulation Training and Learning in First-Year Doctor of Dental Surgery Students at the Melbourne Dental School" presentation was awarded the 'Top Education Story - Full Paper' at the SingHealth Duke-NUS Education Conference 2022.



Doctor Samantha Byrne Find an expert



Associate Professor Rebecca Wong Find an expert



Doctor Clare McNally

Find an expert







Doctor Anu Polster



Doctor Asli McCarthy

nd an expert



Population, Health, Community and Education

Oral health promotion and cultural competence

The focus of this group is research addressing inequalities in oral health in underserved communities, including Indigenous peoples, migrants, people living with mental illnesses, low income, and rural communities. This encompasses partnership work to develop oral health promotion and interventions addressing the barriers to oral health and access to care. Major projects are around oral health for rural, remote and Indigenous communities- Indigenous community consultation and oral health needs assessment for rural communities; and workforce development- preparedness for practice of dental students, a national dental curriculum for Indigenous cultural safety, and the evaluation of practice of oral health practitioners.

Oral health promotion for rural adolescents in Northern Victoria: A pilot Program

Rural adolescents are more likely to have poorer oral health compared with their metropolitan counterparts due to the local barriers they face. Co-design is emerging as an effective method for health promotion, but little evidence exists to inform successful co-designed oral health promotion programs for rural adolescents. Year 11 and 12 VCAL students in a rural secondary school comprised an adolescent working group, along with schoolteachers, and the local health-service staff led by an oral health therapist. An oral health promotion program was co-designed and delivered in the school. Qualitative analysis of semi-structured interview data revealed participant benefits (intended and unintended learning outcomes; interpersonal skills), and learnings around the quality of the process (value of co-design, qualities of facilitators, and engagement); and scalability and replicability.

Co-design is useful approach to effective oral health promotion with a group of disadvantaged adolescents in a rural secondary school. With curriculum integration it achieved VCAL learning outcomes delivering unexpected benefits around engagement, extending the benefits beyond oral health knowledge alone to interactive oral health literacy. Additional benefits extended to the whole school, building capacity of key teachers, and strengthening community partnerships pivotal for co-designed program scalability.



Social determinants of health create inequalities in oral health for adolescents living in rural communities and there is little evidence to inform effective health promotion approaches for this group other than recommendations for participatory approaches.

National Aboriginal and Torres Strait Islander cultural safety curriculum

The Australian Dental Council requires cultural safety to be integrated into all dental and oral health programs in Australia to address the significant oral health disparities experienced by Aboriginal and Torres Strait Islander people as a result of colonisation. This curriculum, comissioned by the Australian Council of Dental Schools was developed with input from, and in consultation with Aboriginal and Torres Strait Islander and non-Indigenous academics, students and dental practitioners built on Indigenous methodologies using a cultural safety framework. It provides adaptable learning objectives, resources and evaluation methods to contribute to the ability of Australia's dental schools to integrate cultural safety competencies in their entry to practice programs.

The legacy of colonisation, assimilation policies, racism and victim blaming approaches to health have created inequality in health for Aboriginal people, that is reflected in their oral health status. This curriculum enables the development of culturally safe dental and oral health practitioners for the Australian context.

Researchers: Julie Satur, Cathryn Forsyth, Joanne Bolton



Professor Julie Satur Find an expert



Around half of Australia's population do not have access to regular oral health care; the people affected are clustered among those with lower incomes and other health and social disadvantages facing the greatest barriers to oral health and with the least capacity to pay for or access dental care. Aboriginal and Torres Strait Islander peoples are overrepresented in this group.

Technical Officers

The Research Team is responsible for providing high level support to multiple research groups within the Melbourne Dental School. Expert technical support and maintenance of research infrastructure is provided. The team supports compliance of laboratories throughout the Melbourne Dental School as well as provides expert technical services which enable research priorities.

Responsibilities include assisting academic staff, post-graduate students (PhD, Honours and DCD) and student research groups (DDS and BOH) on a variety of experimental designs and technical skills to enable their research withing Melbourne Dental School to run efficiently and effectively. The Team provides research support over a variety of technical skills including:

- Cell Biology
- Molecular Biology
- Microbiology
- Live cell Imaging and Confocal Microscopy
- Proteomics/Protein
- Murine Models of Disease
- Histopathology/ Immunochemistry
- Flow Cytometry

Ms Rita Paolini Find an expert

Ms Sze Wei Liu

Ms Caroline Moore

Ms Su Toulson

Researchers in Focus

of TG and

Early Career Researchers and Research Higher Degree Students

Doctor Wenyi Li Veski Victoria Fellowship 2022

Infections caused by superbugs are rapidly increasing worldwide with 106 million new cases annually. The area of antimicrobial peptides (AMPs) is a promising therapeutic family to tackle the shortage of effective antibiotics. Antimicrobial peptides widely exist in nature and are an important part of the immune system and have a wide range of inhibitory effects against bacteria and viruses.

Research by Dr Wenyi Li, from the University of Melbourne, covers the chemical synthesis of antimicrobial peptides and biomimetics and pioneers a better understanding of the antibacterial mechanism of AMPs.

During his study mission, Dr Wenyi Li will visit Germany's Leipzig University and the University of Pennsylvania, in the USA to train in high throughput screening technology of peptide library chemical synthesis (collections of peptide sequences) and computational strategies for antimicrobial peptides development to combat disease-causing bacteria. This knowledge will assist in developing new weapons to fight against infections caused by multi-drug resistant pathogens.

Doctor Ankur Singh

Australian Research Council Discovery ECR Award (DECRA)

Australian working age adults with social and economic disadvantage have significantly poorer oral health outcomes than those from advantaged backgrounds. This project explores howchanges in social position over time, and interactions between different forms of social disadvantage, contribute to social inequalities in oral health. This project expects to improve understanding of social inequalities in oral health, and its solutions, by developing and applying analytical and simulation models. This will help identify ways to reduce the persistent social inequalities in oral health outcomes in working age adults. In doing this, it will inform policies in future that will significantly improve the well-being of Australian working age adults.

Doctor Mathew Lim

Fellowship of International Association of Disability and Oral Health 2022

Mathew was inducted as an inaugural fellow of the International Association of Disability and Oral Health (IADH) at their international congress in Paris in recognition of his teaching and research contributions to the field of special needs dentistry. This was awarded based on his teaching role at the Melbourne Dental School and consistent output of highly cited research into addressing challenges faced by clinicians in managing patients with disabilities and special health care needs.

Professor Michael & Dr Leanne Teoh Manchester-Melbourne-Toronto Research Fund Award

The World Health Organisation has declared antimicrobial resistance (AMR) one of the top 10 global health threats, whose main driver is misuse/overuse of these lifesaving drugs. AMR is responsible for ~700,000 deaths worldwide annually. Given the high rates of inappropriate dental antibiotic prescribing, customised interventions, taking into account variations in health care provision and regional contexts, are needed to improve antibiotic use in dentistry.

Our group was awarded the Manchester-Melbourne-Toronto grant to develop a Canadian dental antimicrobial stewardship (AMS) program. The importance of the inclusion of dentistry in AMS programs has been recognised and some tools trialled by researchers from University of Manchester and Melbourne for the UK and Australian contexts respectively. The aim of our collaboration was to map out an action plan to develop a Canadian dental AMS program, in consultation with various Canadian key leaders and stakeholders, together with researchers from University of Manchester and Melbourne, who have successfully been working in the area of dental antibiotic use and stewardship.

This involved holding a targeted workshop in Toronto in October 2023, where Drs Leanne Teoh and Michelle Mun presented and facilitated discussion. This workshop enabled the exchange of ideas and challenges between researchers, stakeholders and leaders to develop pillars for the Canadian dental AMS framework.

This project was awarded funding by the University of Melbourne's Manchester-Melbourne-Toronto grant scheme (researcher: Leanne Teoh, Michael McCullough and Michelle Mun).

Doctor Rachael Moses

Australian Wound and Tissue Repair Society, Sydney Recipient of the 2022 Early/Mid-Career Researcher Award

Dr Rachael Moses was awarded the Early to Mid-Career Researcher of the Year 2022 by the Australasian Wound & Tissue Repair Society. This prestigious award, granted annually to only one researcher, recognises her outstanding track record, including a significant body of research, numerous publications, prizes, presentations, and professional activities.

Australasian Wound & Tissue Society Conference, Sydney

ECR Oral Presentation – Runner Up 2022

Additionally, at the Australasian Wound & Tissue Repair Society Annual meeting held in Sydney in 2022, Dr Rachael Moses received the ECR Oral Presentation - Runner Up award. This accolade was based on her presentation titled "Developing a 3D Chronic Wound Model Using Animal-Free Products."

Honours and **Masters Programs**

The Melbourne Dental School offers undergraduate students the opportunity to undertake a research-based Honours degree in the Bachelor of Biomedicine, Bachelor of Science or the Bachelor of Oral Health. For postgraduates, there are options to pursue a Master of Biomedical Science, a Master of Philosophy, or a PhD. The scope of study includes a variety of subjects such as microbiology, immunology, cancer biology, biochemistry, molecular biology, chemistry, anatomy, cell biology, dental therapy, public health, and materials engineering. Our research extends beyond oral health, encompassing wound healing, drug delivery, bone health, and microbiomics. Students engage their research in our state-of-the-art labs at the Melbourne Dental School and the Bio21 Institute, which are equipped with the latest technology.

Melbourne Dental School Mid-year 2023 Honours & Master of Biomedical Science Research **Project Handbook**

https://tinyurl.com/5n6u9fyd

Melbourne Dental School Mid-year 2023 Honours & Master of Biomedical Science **Research Project Handbook**

aculty of Medicine, Dentistry & Health Science Melbourne Dental School

Awards and Honours

Professor Eric Reynolds Cooperative Research Australia's Award University of Melbourne's Oral Health Cooperative Research Centre (OH-CRC) and commercial partners Mondelez International, GC Corporation and CSL Limited have taken out the Cooperative Research Australia's Award for Enduring Industry-Research Collaboration at its Innovation Awards at Parliament House in Canberra on Thursday night (March 31, 2022). The Oral Health CRC, led by Laureate Professor Eric Reynolds AO, has been one of the most successful CRCs in the program's 30-year history with dental health products commercialised impacting countless lives all around the world.

61st Annual Scientific Meeting of the IADR Australia & New Zealand Division

Celebrating the breadth & depth of oral health research

Proudly hosted by the Melbounrne Dental School, Facutly of Medicine, Dentistry and Health Sciences, The University of Melbourne and made possible by the generous support of Colgate Australia.

Professor Stuart Dashper Chair, ANZ/IADR Committee

Professor Sarah Baker Colgate Eminent Speaker

Dr Lorraine O'Reilly Plenary Speaker

Laureate Professor Eric Reynolds Plenary Speaker

Richard Watt Plenary Speaker

Professor Rachel Waddington Plenary Speaker

Director of International

DentAlliance Workshops

The research group of DentAlliance hosts online workshops for early career researchers. This fantastic opportunity allows participants to share and collaborate with colleagues across the four partner universities (University of Melbourne, Chapel Hill, King's College London and National University Singapore). In 2022, DentAlliance research series workshop featured research on Immunomodulatory Strate as Adjunctive Therapies to the Treatment of Periodontial Diseases, Fatty-Acid Structurally Nonoengineered Peptide Polymers kill multidrug resistant bacteria and Exploring the Applications of Microfluidic Systems in Oral, Dental and Cranofacial research.

New - Master of Clinical Dentistry

Melbourne Dental School is developing a new one-year Master of Clinical Dentistry for general dental practitioners. This program will allow candidates to undertake clinical coursework under supervision as well as research in their chosen clinical field. The business case for this new course has been approved at the faculty level and the School this progressing to approvals via the academic programs committee. The pilot disciplines for this new program will be Prosthodontics and Periodontics with a view to expand across all the specialities. Students undertaking this program will have an opportunity to inform clinical and research career paths at the completion of this program.

Bachelor of Medical Science

A highly successful relationship between the Melbourne Medical School (MMS) and Universitas Indonesia has allowed generations Indonesian students to undertake a research-based degree in Melbourne over the last 20 years. In 2022 MDS and MMS will codelivery the first dental cohort of this research-based degree for UI students. During 2021 MDS senior teaching and research academics have delivered a significant lecture-based program for UI further developing a key regional relationship with this University partner.

Collaborations Victoria

Parkville

- 1. Melbourne Medical School
- 2. Melbourne School of Engineering
- 3. Melbourne School of Health Sciences
- 4. Melbourne School of Population and Global Health
- 5. Melbourne School of Psychological Sciences
- 6. School of Agriculture and Food
- 7. School of Biomedical Sciences
- 8. School of Biosciences
- 9. School of Chemistry
- 10. School of Computing and Information Systems
- 11. School of Mathematics and Statistics
- 12. Dental Health Services Victoria
- 13. Florey Institute of Neuroscience and Mental Health
- 14. Melbourne Sexual Health Centre
- 15. Murdoch Children's Research Institute
- 16. Peter MacCallum Cancer Centre
- 17. Royal Children's Hospital
- 18. Royal Melbourne Hospital
- 19. Royal Melbourne Institute of Technology University
- 20. St. Vincent's Hospital Melbourne
- 21. The Peter Doherty Institute for Infection and Immunity

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- 22. Victorian Infectious Diseases Reference Laboratory
- 23. Walter and Eliza Hall Institute of Medical Research
- 24. Cancer Council Victoria
- 25. Deakin University
- 26. La Trobe University
- 27. Monash University
- 28. Olivia Newton-John Cancer Research Institute

Victoria

- 29. Victoria University
- 30. Western Health
- 31. ANZAC Research Institute, Australia
- 32. Australian Institute of Marine Science, Australia
- 33. Black Dog Institute, Australia
- 34. Charles Sturt University, Australia
- 35. Concord Repatriation General Hospital, Australia

Collaborations Australia

- 36. Cooperative Research Centres Australia, Australia
- 37. Curtin University, Australia
- 38. Epworth HealthCare, Australia
- 39. Federation University Australia, Australia
- 40. Fiona Stanley Hospital, Australia
- 41. Flinders University, Australia
- 42. Government of Western Australia, Australia
- 43. Griffith University Queensland, Australia
- 44. Hunter New England Health, Australia
- 45. Ingham Institute, Australia
- 46. Macquarie University, Australia
- 47. Queensland Health, Australia
- 48. Royal Brisbane and Women's Hospital, Australia
- 49. South Australian Museum, Australia
- 50. Telethon Kids Institute, Australia
- 51. The Children's Hospital at Westmead, Australia
- 52. University of Adelaide, Australia
- 53. University of New South Wales, Australia
- 54. University of Newcastle, Australia
- 55. University of Queensland, Australia
- 56. University of Sydney, Australia

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- 57. University of Tasmania, Australia
- 58. University of Western Australia, Australia
- 59. Western Sydney University, Australia
- 60. Westmead Hospital, Australia

Collaborations Global

- 61. Aalborg University, Denmark
- 62. Aarhus University, Denmark
- 63. Aix-Marseille Université, France
- 64. Al-Azhar University, Egypt
- 65. Arizona State University, United States
- 66. Atlantic Technological University, Ireland
- 67. Autonomous University of Barcelona, Spain
- 68. BC Centre for Disease Control, Canada
- 69. Boston University, United States
- 70. Bournemouth University, United Kingdom
- 71. British Dental Association, United Kingdom
- 72. Broad Institute, United States
- 73. Cambridge University Hospitals NHS Foundation Trust, United Kingdom
- 74. Cancer Research Malaysia, Malaysia
- 75. Canterbury Archaeological Trust, United Kingdom
- 76. Cardiff University, United Kingdom
- 77. CHU de Nîmes, France
- 78. CNRS, France
- 79. Complutense University, Spain
- 80. Cranfield University, United Kingdom
- 81. Damascus University, Syrian Arab Republic
- 82. deCODE Genetics, Iceland
- 83. Dublin Dental University Hospital, Ireland
- 84. Duke University, United States
- 85. Ege University, Turkey
- 86. European University Cyprus, Cyprus
- 87. Faculdade São Leopoldo Mandic, Brazil
- 88. Fudan University, China
- 89. Generalitat de Catalunya, Spain
- 90. Guilan University of Medical Sciences, Iran
- 91. Guy's and St Thomas' NHS Foundation Trust, United Kingdom
- 92. Hamilton College, United States
- 93. Harvard University, United States
- 94. Howard Hughes Medical Institute, United States
- 95. Imperial College Healthcare NHS Trust, United Kingdom
- 96. Imperial College London, United Kingdom
- 97. Indiana University-Purdue University Indianapolis, United States
- 98. InHolland University of Applied Sciences, Netherlands
- 99. International Islamic University Malaysia, Malaysia 100.IQVIA Inc., United States
- 101. Jordan University of Science and Technology, Jordan
- 102. Karolinska Institutet, Sweden
- 103.Kiel University, Germany
- 104.King Saud University, Saudi Arabia
- 105. King's College London, United Kingdom
- 106.KU Leuven, Belgium
- 107. Lebanese University, Lebanon
- 108. Leiden University, Netherlands
- 109.London School of Hygiene and Tropical Medicine, United Kingdom

- 110. Malmö University, Sweden
- 111.Manchester University NHS Foundation Trust, United Kingdom
- 112. Mansoura University, Egypt
- 113. Massachusetts Institute of Technology, United States
- 114.Max Planck Institute for Evolutionary Anthropology, Germany
- 115. Meenakshi Academy of Higher Education and Research, India
- 116. Nagasaki University, Japan
- 117. Nanjing Medical University, China
- 118.NASU Institute of Surface Chemistry, Ukraine
- 119. National Academy of Sciences of Ukraine, Ukraine
- 120. National and Kapodistrian University of Athens, Greece
- 121. National Institute for Health Research, United Kingdom
- 122. National University of Singapore, Singapore
- 123. New York University, United States
- 124. Newcastle University, United Kingdom
- 125.NHS Shetland, United Kingdom
- 126. Örebro University, Sweden
- 127. Padjadjaran University, Indonesia
- 128. Peking University, China
- 129. Queen Mary University of London, United Kingdom
- 130. Queen's University Belfast, United Kingdom
- 131. Radboud University Nijmegen, Netherlands
- 132. Riga Stradins University, Latvia
- 133. Riga Technical University, Latvia
- 134. Royal Botanic Gardens, Kew, United Kingdom
- 135.Saveetha Institute of Medical and Technical Sciences (Deemed to be University), India
- 136. Shenzhen University, China
- 137. South China University of Technology, China
- 138. Swansea University, United Kingdom
- 139. Taif University, Saudi Arabia
- 140. Technical University of Braunschweig, Germany
- 141. Tehran University of Medical Sciences, Iran
- 142. The Natural History Museum, London, United Kingdom
- 143. The University of Hong Kong, Hong Kong
- 144. Tokyo Medical and Dental University, Japan
- 145. Trinity College Dublin, Ireland
- 146. Tsurumi University, Japan
- 147.UIC Barcelona, Spain
- 148. Universidad Austral de Chile, Chile
- 149. Universidad Central de Venezuela, Venezuela
- 150. Universidad de la Frontera, Chile
- 151. Universidad Nacional Autónoma de México, Mexico
- 152. Universidade de São Paulo, Brazil
- 153. Universidade Federal de Campina Grande, Brazil
- 154. Universidade Federal do Rio Grande do Sul, Brazil
- 155. Universidade Federal Fluminense, Brazil
- 156. Universitas Airlangga, Indonesia
- 157. Universitas Indonesia, Indonesia
- 158. Université de Lorraine, France

159. Université de Montpellier, France 160. Université Paris Cité, France 161. Universiti Kebangsaan Malaysia, Malaysia 162. Universiti Malaya, Malaysia 163. University College London, United Kingdom 164. University Hospitals Bristol and Weston NHS Foundation Trust, United Kingdom 165. University of Alabama at Birmingham, United States 166. University of Amsterdam, Netherlands 167. University of Bern, Switzerland 168. University of Birmingham, United Kingdom 169. University of Bonn, Germany 170. University of Brescia, Italy 171. University of Bristol, United Kingdom 172. University of British Columbia, Canada 173. University of California at Berkeley, United States 174. University of Cambridge, United Kingdom 175. University of Campania Luigi Vanvitelli, Italy 176. University of Central Lancashire, United Kingdom 177. University of Copenhagen, Denmark 178. University of Dundee, United Kingdom 179. University of Foggia, Italy 180. University of Geneva, Switzerland 181. University of Gothenburg, Sweden 182. University of Groningen, Netherlands 183. University of Huddersfield, United Kingdom 184. University of Iceland, Iceland 185. University of Illinois at Chicago, United States 186. University of L'Aquila, Italy 187. University of Lincoln, United Kingdom 188. University of Lisbon, Portugal 189. University of Manchester, United Kingdom 190. University of Montana, United States 191. University of Münster, Germany 192. University of Nevada, Las Vegas, United States 193. University of North Carolina at Chapel Hill, United States 194. University of Notre Dame, United States 195. University of Otago, New Zealand 196. University of Oxford, United Kingdom 197. University of Papua New Guinea, Papua New Guinea 198. University of Pittsburgh, United States 199. University of Puthisastra, Cambodia 200. University of Rome La Sapienza, Italy 201. University of Rostock, Germany 202. University of Sharjah, United Arab Emirates 203. University of Siena, Italy 204. University of Southern Denmark, Denmark 205. University of the West of England, United Kingdom 206. University of Toronto, Canada 207. University of Tübingen, Germany 208. University of Vienna, Austria 209. University of Wisconsin-Milwaukee, United States 210. University of York, United Kingdom 211. University of Zurich, Switzerland 212. VA Medical Center, United States 213. Virginia Commonwealth University, United States 214. Vrije Universiteit Amsterdam, Netherlands

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Focus On Publications

The Melbourne Dental School publishes a great breadth and depth of research every year in some of the finest academic journals in the world. Here are four examples from the 2022 that give an insight into the quality and variety of our research.

Caries incidence is associated with wasting among Cambodian children Publication in the Journal of Dental Research (2022)

This study examined relationships between the development of caries lesions with subsequent stunting and wasting outcomes using data from a population-based cohort in Cambodia. Caries incidence was assessed based on the presence of a new cavitated carious lesion or a new pulpally involved lesion across a 6-mo observation period. Anthropometric measurements were taken at regular intervals. There was no association between incidence of cavitated or pulpally involved carious lesions at follow-up and stunting (relative risk [RR]=1.06; 95% confidence interval [CI]: 0.75, 1.50). The incidence of pulpally involved carious lesions had an effect on wasting prevalence (WHZ <-2; RR=1.35; 95% CI: 0.70, 2.62) and WHZ scores (average treatment effect=-0.294; 95% CI: -0.538, -0.050).

B. Turton, S Sullivan, A Singh, T Chher, S Hak, K Sokal-Gutierrez, F Wieringa, Caries Incidence Is Associated with Wasting among Cambodian Children, Journal of Dental Research, https://journals.sagepub.com/doi/abs/10.1177/00220345221126713

Breastmilk influences development and composition of the oral microbiome Publication in the Journal of Oral Microbiology (2022)

Human microbiomes assemble in an ordered, reproducible manner yet there is limited information about early colonisation and development of bacterial communities that constitute the oral microbiome. The aim of this study was to determine the effect of exposure to breastmilk on assembly of the infant oral microbiome during the first 20 months of life. The oral microbiomes of 39 infants, 13 who were never breastfed and 26 who were breastfed for more than 10 months, from the longitudinal VicGeneration birth cohort study, were determined at four ages. In total, 519 bacterial taxa were identified and quantified in saliva by sequencing the V4 region of the bacterial 16S rRNA genes.

There were significant differences in the development of the oral microbiomes of never breastfed and breastfed infants. Bacterial diversity was significantly higher in never breastfed infants at 2 months, due largely to an increased abundance of Veillonella and species from the Bacteroidetes phylum compared with breastfed infants. These differences likely reflect breastmilk playing a prebiotic role in selection of early-colonising, health-associated oral bacteria, such as the Streptococcus mitis group. The microbiomes of both groups became more heterogenous following the introduction of solid foods.

Catherine A. Butler, Geoffrey G. Adams, Jordan Blum, Samantha J. Byrne, Lauren Carpenter, Mark G. Gussy, Hanny Calache, Deanne V. Catmull, Eric C. Reynolds & Stuart G. Dashper (2022) Breastmilk influences development and composition of the oral microbiome, Journal of Oral Microbiology, 14:1, 2096287, DOI: 10.1080/20002297.2022.2096287

Focus On Publications

The effect of clinical interventions on the oral health-related quality of life in older adults Publication in the in the Australian Dental Journal (2022)

This paper reviews the effectiveness of oral health interventions in influencing oral health related quality of life (OHRQoL) in older adults. Of the published clinical studies, 45% reported a statistically significant improvement in OHRQoL. The majority of studies were conducted in adults with complete edentulism (70%) and mainly focused on implant provision to support a removable prosthesis (30%). This review demonstrates the limited scope of current literature on geriatric dental interventions, focusing mainly on denture realignments, denture fabrication and implant placement. Although the majority of the oral health interventions focused on edentulism and removable prostheses, there are many areas of oral health interventions and their potential impact on OHRQoL in this demographic group that have yet to be explored.

Ky, J., Scepanovic, T., Senthilvadevel, N., Mati, S., Ming, A., Ng, M., Nguyen, D., Yeo, P., Zhao, T., Paolini, R., Lim, M. and Celentano, A. (2022), The effect of clinical interventions on the oral health-related quality of life in older adults. Aust Dent J, 67: 302-313. https://doi.org/10.1111/adj.12932

Mental health and periodontal and peri-implant diseases Publication in the Periodontology 2000 (2022)

Mental health disorders, particularly depression and anxiety, affect a significant number of the global population. Several pathophysiological pathways for these disorders have been identified. In addition, life events, environmental factors, and lifestyle affect the onset, progression, and recurrence of mental health disorders. These may all overlap with periodontal and/ or peri-implant disease. Mental health disorders are associated with more severe periodontal disease stress and some mental health disorders are accompanied by a low-grade chronic inflammation that may be involved in their relationship with periodontal disease, and vice versa. Although the gut microbiome interacting with the central nervous system (gut-brain axis) is thought to play a significant role in mental illness, less is understood about role of the oral microbiome.

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Research Funding

Research in the Melbourne Dental School is supported by funding from major Nationally competitive funding bodies including the National Health and Medical Research Council, the Medical Research Futures Fund, and the Australian Research Council. In addition, there is significant funding for translational research.

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Thank You To Our Contributors

The Melbourne Dental School would like to acknowledge all staff, researchers and individuals for their support and contribution towards this research report. We would also like to specially thank:

Professor Stuart Dashper, Director of Research Professor Alastair Sloan, Head of School Ms Stephanie Anderson, Engagement and Content Officer, Editor, MDS Annual Research Report 2022 Ms Alissa Arpaci, Editor, MDS Annual Research Report 2022 MDS Research Staff and Students