



TEMERTY FACULTY OF MEDICINE
UNIVERSITY OF TORONTO

Temerty Medicine 2022 Grant Writing & Research Resources Workshop

Future Funding Streams

Wednesday, June 15, 2022

Office of the Vice Dean, Research & Health Science Education

Temerty
Medicine



Welcome!

- 9:00 am **Welcome – Justin Nodwell, Vice Dean, research & Health Science Education (5 mins)**
- 9:05 am – **Panel Discussion: How to incorporate EDI into grant proposals (50 mins)**
 - **Panel Members;**
 - **Dr. Nicole Kaniki, Director of Equity, Diversity and Inclusion, VPRI**
 - **Dr. Bojana Stefanovic, Dept. of Medical Biophysics**
 - **Dr. Karl Zabjek, Dept. of Physical Therapy**
- 9:55 am – **Additional time for Q&A (10 mins)**
- 10:05 am – **Future funding streams (10 mins) Joanna King**
- 10:15 am – **Temerty Medicine Core Facilities Update (10 mins) Betty Poon**
- 10:25 am – **Grant Fundamentals (45 minutes) Golnaz Farhat & Alex De Serrano**
- 11:10 am – **Q&A (15 minutes)**

Future Funding Streams

- Pathway Grants
- Temerty Knowledge Translation
- EPIC Funding Opportunities
- Temerty Research Excellence Award
- Industrial Partnerships Officer

Pathway Grants

Pathway Grants function as an internal CIHR bridge grant for top-rated Project Grant proposals from on-campus Temerty Faculty of Medicine applicants:

- Up to 6 grants per Project competition (Spring and Fall) of \$50,000 for 1 year, with a potential 1-year no-cost extension.
- The top 6 eligible unfunded proposals, determined by percentile rank within their committee, will receive Pathway Grants



Pathway Grants

To be eligible for a Pathway Grant – you must be a member of the [Temerty Faculty of Medicine's College of Internal Scientific Reviewers](#) at the point the grant is submitted to the CIHR Project Grant competition **and** submit your application for Internal Peer Review.

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- **You must have your grant reviewed in order to be eligible.**
- A PI can hold no more than **two** active Pathway Grants at one time.



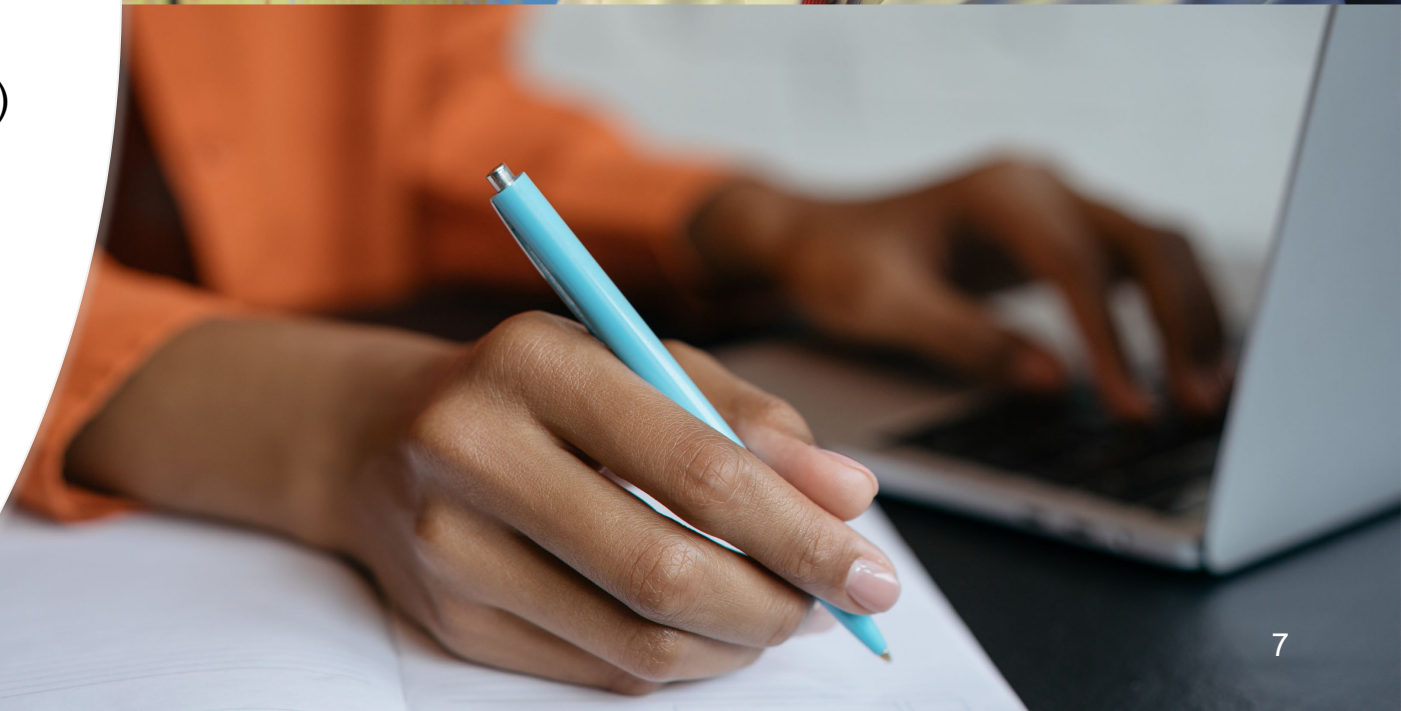
Pathway Grants

- Results from the Spring 2022 CIHR Project Grant competition will be announced in July 2022.
- Pathway Grants winners will be contacted shortly after.
- Dates and details for the Fall 2022 Project Grant internal peer review process will be released soon.



Temerty Knowledge Translation Grants

- There have been two previous competitions;
 - The Development of Novel Antibody Tools for COVID-19 Diagnosis or Immunotherapies (Spring 2021)
 - Addressing health inequities in disadvantaged populations (Summer 2021)
- A third competition will be held in 2022/23
- The theme, dates and eligibility details for the third round will be shared via the [What's New in Research Funding](#) newsletter





EPIC

Emerging & Pandemic
Infections Consortium

DEFY
GRAVITY

ACADEMIC DIRECTOR:

SCOTT GRAY-OWEN, PH.D.

DIRECTOR, STRATEGY & PARTNERSHIPS:

NATASHA CHRISTIE-HOLMES, PH.D.



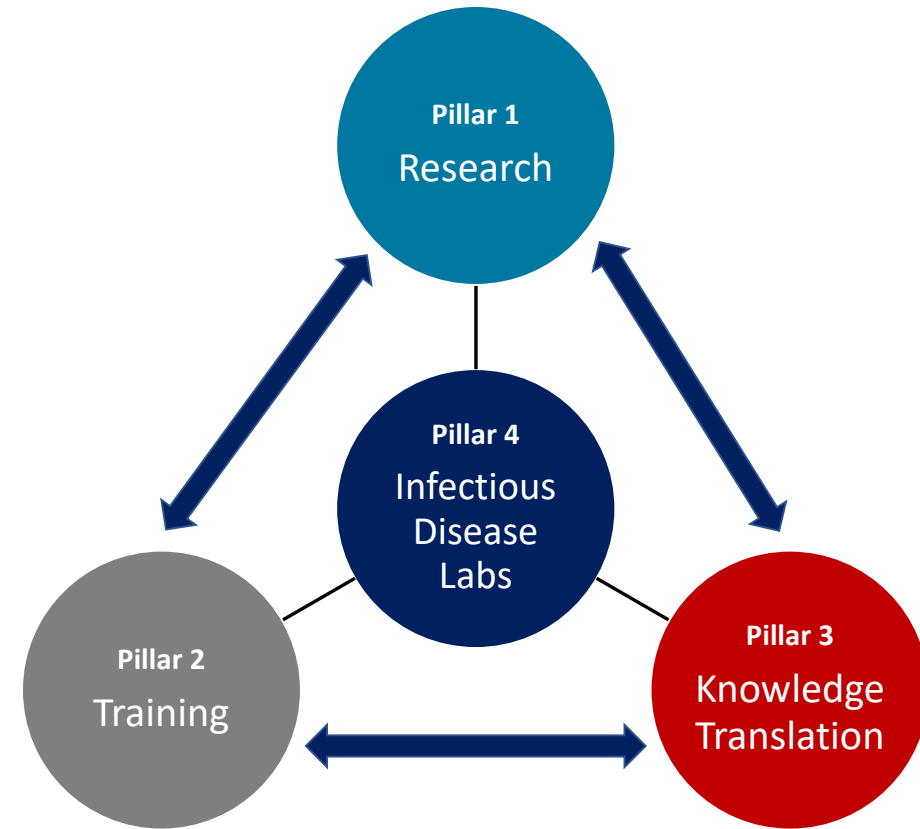
UNIVERSITY OF
TORONTO

EPIC PILLARS AND APPROACH

EPIC WILL COORDINATE, LINK, AND SUPPORT CRITICAL SCIENTIFIC AND CLINICAL EXPERTISE THAT LEVERAGES THE IDL'S STATE-OF-THE-ART FACILITIES

VISION: An **ecosystem of collaboration** bringing together academic, government and industry scientists, engineers, clinicians, public health and policy experts to foster **ground-breaking imagination** around **Four Pillars**:

1. **Research** that is collaborative and attracts top talent in the area of infectious diseases
2. **Training** the next generation of infectious disease experts
3. **Knowledge Translation** to accelerate the adoption of EPIC's innovations, support public policy, and increase public awareness
4. The **Infectious Disease Laboratories** will serve as a physical anchor and provide expert support for all network activities



Infection Countermeasures for Pandemic Preparedness

EPIC PILLARS & PROGRAMS

PILLAR 1. RESEARCH

Program	Description
New Connections Grant	<ul style="list-style-type: none">• Collaborative projects and support for early career researchers• \$100,000/year
Proof of Principle Grant	<ul style="list-style-type: none">• Funds to test concepts and generate preliminary data• Up to \$50,000/year
Ideation Workshops	<ul style="list-style-type: none">• Investigator-driven to convene researchers to explore potential ideas• One in collaboration with Institute for Pandemics
Global Scholars	<ul style="list-style-type: none">• Visiting researchers from LMIC (will begin year 2)

EPIC PILLARS & PROGRAMS

PILLAR 2. TRAINING AND TALENT

Program	Description
Graduate Studentships	<ul style="list-style-type: none">• Providing additional year of funding to successful Tri-Council funded students• \$15,000/year
PDF Fellowships	<ul style="list-style-type: none">• Stipend + research allowance• \$50,000/year; awarded for 2 year period
Career Transition Award	<ul style="list-style-type: none">• To senior PDF/RA for independent project• \$120,00/year
Interact Workshops	<ul style="list-style-type: none">• Building connections across trainee network.• Diverse topics: Regulatory/policy, Industrial partnerships and pipelines (quarterly)
Trainee Mobility	<ul style="list-style-type: none">• Travel grants for partnership/training exchange

EPIC PILLARS & PROGRAMS

PILLAR 3. KNOWLEDGE TRANSLATION

Program	Description
Annual Symposium	<ul style="list-style-type: none">• Present EPIC research• Convene stakeholders from government, industry and academia
Networking Events	<ul style="list-style-type: none">• Infectious disease themed events based on Pillars of Health, KOL Practice Pitches, TR Talks
Speaker Series	<ul style="list-style-type: none">• Toronto-wide, high impact lecture series with leading international authorities
Promotion and Communication	<ul style="list-style-type: none">• Website development• Strategic Partnership development• Conference presence• Media outreach
Trainee Internships	<ul style="list-style-type: none">• MITACS / Industry supported

Temerty Research Excellence Award

- **Two** awards of \$5,000 each will be awarded to successful applicants.
- The winning applicants will **also have their submission materials revised and submitted to an external award** in the 12-month period following award competition.
- The external award will be selected in consultation with the applicant and the award review committee.
- Eligibility criteria and submission deadlines will be shared via the [What's New in Research Funding](#) newsletter

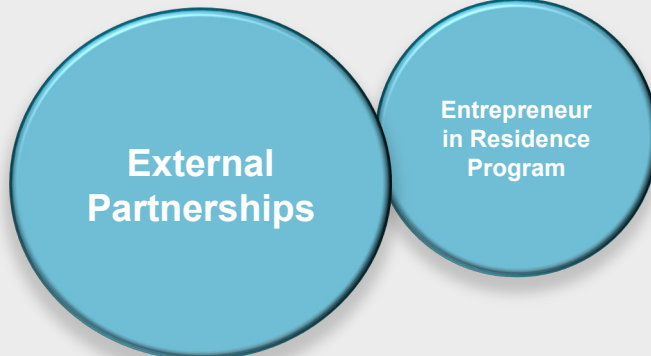




INDUSTRIAL PARTNERSHIPS OFFICER

ABOUT JARROD LADOUCEUR

- 8 years in post secondary institutions building programs to support commercialization and partnerships.
- Former national lead for AIMday. An international program designed to establish industry academic collaborations.
- Former member of the I-Inc steering committee. A network work 14 Canadian universities developing programs to support research commercialization.



HOW TO CONNECT

- E-mail (reach out anytime) – jarrod.Ladouceur@utoronto.ca
- New partnerships web page - <https://temertymedicine.utoronto.ca/partnerships-0>
 - Office hours – Quick 20min time slots every Friday to connect with partnership staff from across UofT
- **Partnership updates – Bi-Monthly email updates with partnership opportunities, events, news (Coming soon: sign up on the partnerships webpage)**



HOW JARROD CAN HELP

- Connecting you with organizations
- Advising on partnership options and policy
- Support creating new partnership programs and services
- Promoting opportunities to external organizations
- Helping you to navigate the partnership community in and around UofT.



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Medicine

Core Facilities and Services

Betty Poon, Research Operations Officer

betty.poon@utoronto.ca

June 15, 2022



TEMERTY FACULTY OF MEDICINE UNIVERSITY OF TORONTO

- Dedicated management teams to provide specific technical expertise, training and protocol development assistance for research personnel
- Maximizing the impact of funding success to propel research at a Faculty-wide level and support future grant applications
- Supported through cost-recovery structures and strategic planning of grant-associated operational funding

<https://medicine.utoronto.ca/core-facilities-services>



TEMERTY FACULTY OF MEDICINE UNIVERSITY OF TORONTO

Division of Comparative Medicine (DCM)

- Director: Kerri Nielsen, DVM
- Manager: Frank Giuliano, RMLAT
- <http://www.dcm.utoronto.ca/>
- Federally and Provincially accredited Animal Care program at the Faculty of Medicine
- Preeminent veterinary technical staff including 4 Masters level animal technicians
- Over 25, 000 ft² dedicated to *in vivo* research, including germfree, gnotobiotics and SPF+ exclusion
- Multiple full animal imaging modalities on-site supported by dedicated technical expert

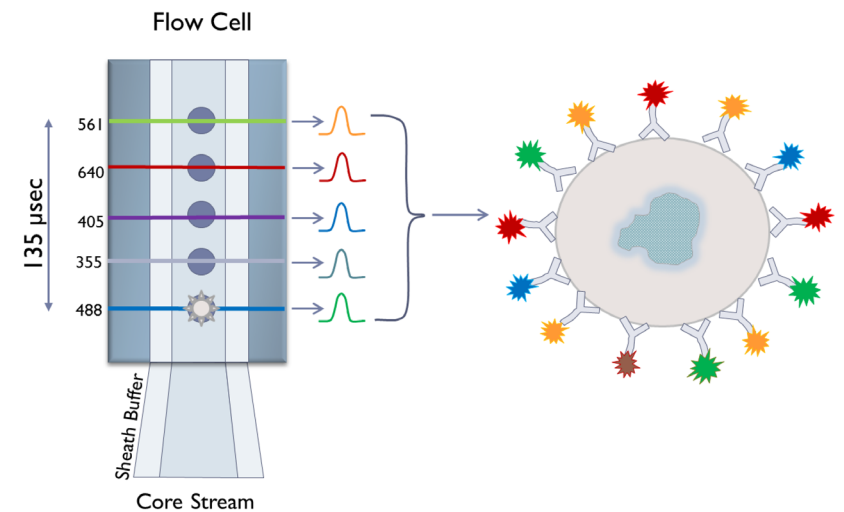




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Flow Cytometry Facility

- Director: Tania Watts, PhD
- Manager: Natalie Simard, PhD
- <http://flowcytometry.utoronto.ca/>
- Equipped with 4 analyzers (3 to 5 laser each; up to 18 colour acquisition) and 3 cell sorters allowing for large multiparameter analysis
- Supported by dedicated operators with extensive FCM knowledge and over 20 years of experience
- Comprehensive training program partnership with WORK-FLOW for research personnel

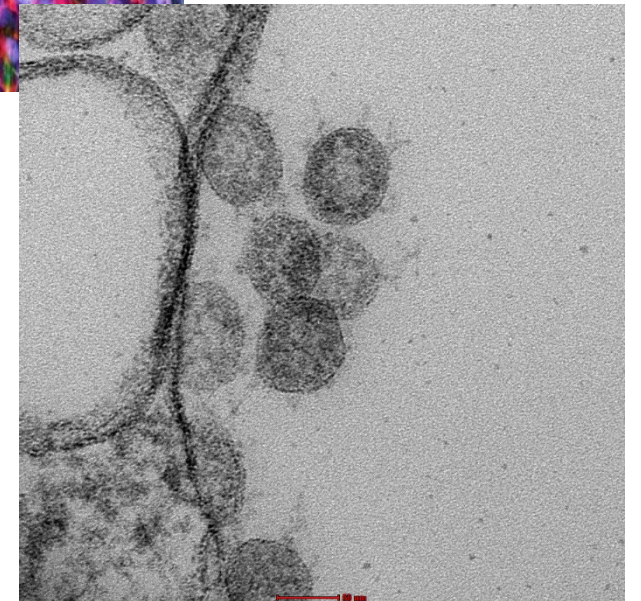
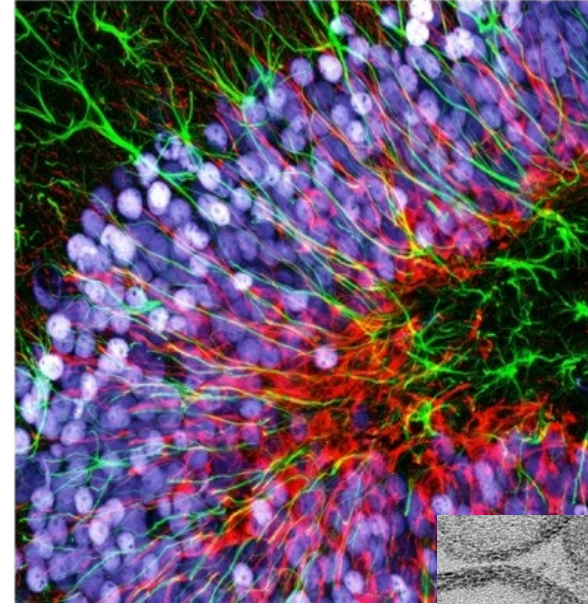




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Microscopy Imaging Lab (MIL)

- Director: Stephen Girardin, PhD
- Manager: Lindsey Fiddes, PhD
- Consolidated microscopy core including confocal, fluorescence, scanning (SEM) and transmission (TEM) electron microscopes
- Expanding Cryo-EM capabilities
- Expert technical team trains research personnel in microscopy techniques and development of protocols
- Dedicated preparatory lab for SEM/TEM samples, Equipped for Cryo-TEM preparation
- Providing full-service microscopy (prep and scanning)



TEM of Vero cells infected with SARS-CoV-2, 120,000x
(Isolated in C-CL3 Unit, Imaged by MIL)
Banerjee et al, 2020



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Combined Containment Level 3 (C-CL3) Unit

- Director: Scott Gray-Owen, PhD
- Manager: Jessica Lam, MSc
- Federally licensed facilities for research involving RG3 pathogens
- Dedicated regulatory team providing guidance, validation and oversight
- Facilities for small animal *in vivo* studies and molecular *in vitro* research
- NEW! BDMelody FACS Cell Sorter, Luminex Multiplex, 10X Genomics Chromium Single-Cell RNA-Seq System





TEMERTY FACULTY OF MEDICINE UNIVERSITY OF TORONTO

Virology Core Lab and Biobank

- Director: Scott Gray-Owen, PhD
- Manager: Jessica Lam, MSc
- New, adaptive CL2+ space for viral research
- Foundational work on seasonal coronaviruses, HIV
- Extends TFoM infectious disease expertise to support other Faculties
- Leveraging opportunities for collaboration and building foundation for future studies on COVID-19 samples





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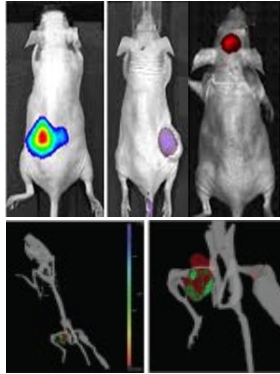
Central Sterilization Service (CSS)

- Providing glass-washing, laundry and sterilization services
- Centralized stock of glass and plasticware for all MSB researchers to access
- Multiple sterilization cycles daily allowing flexibility for lab schedules
- After-hours autoclaves available to trained users



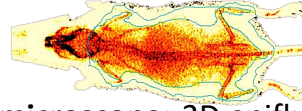


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Non-invasive (live & tissue) rodent imaging

IVIS & Bruker: 3D and 2D imaging of fluorescence/bioluminescence and X-ray (high-def head, bone density & body fat).



Leica Stereomicroscope: 3D epifluorescence, surgery & imaging station.

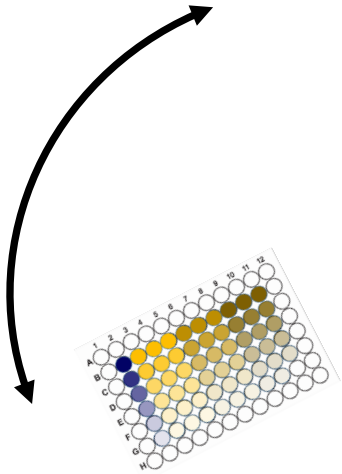
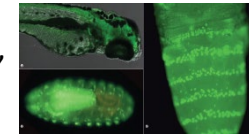
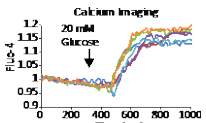
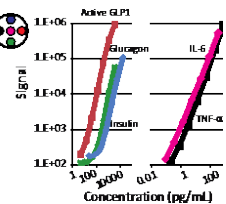


Plate assay imaging



BMG PHERAstar: Multimodal, FRET compliant plate reader.

Mesoscale: 10-channel, kit-based plate reader.

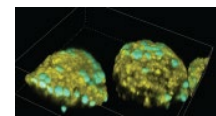
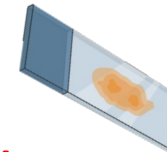


ViiA7: 6-channel qPCR reader.



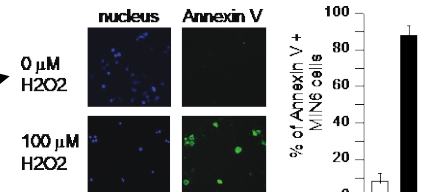
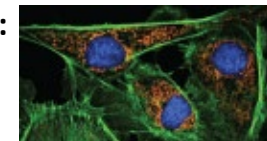
3D Facility
Animal-to-cell
imaging
www.cfi3d.utoronto.ca
a.hardy@utoronto.ca
Full Level 2 Biosafety

Live/fixed cell imaging



Nikon Swept Field confocal & TIRF microscopes: 3D and 2D multicolour imaging.

Nikon Multi-photon microscope: Deep 3D and 2D multicolour imaging.



ThermoFisher Cellomics: Automated high-throughput multicolor imaging.



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Core Facilities add value in grants

Build the foundation for early-stage investigators

- Established infrastructure, expertise and support

Show sustainability for established investigators

- Requested infrastructure can be well implemented
- Ongoing support for maintenance/operations

<https://medicine.utoronto.ca/core-facilities-services>



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Grant-Writing Fundamentals

June 15, 2022

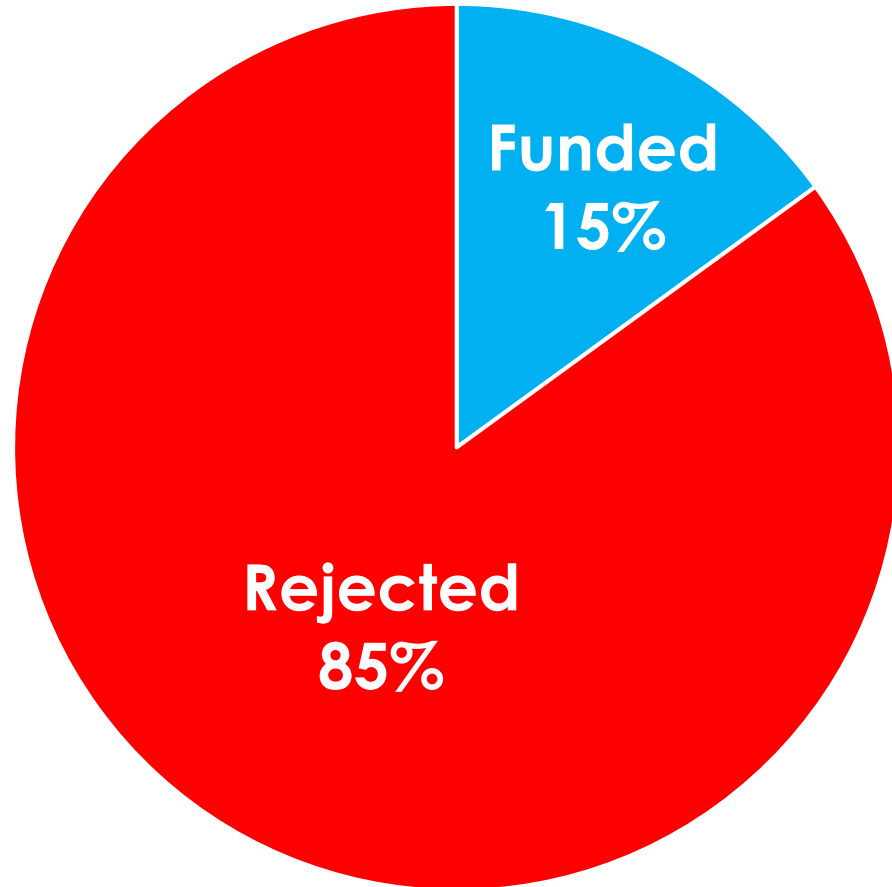
Alex De Serrano & Golnaz Farhat

OFFICE OF THE VICE-DEAN, RESEARCH AND HEALTH SCIENCE EDUCATION

Temerty
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What are the chances your grant gets funded?

Average National CIHR PG Success Rate



Your grant has to stand out in order for it to be funded

- The facts are not enough
- You need a strong **sales pitch**
- A compelling **story**

Common reasons grants are not funded



- Weak impact and low significance
- Too ambitious / lacks focus
- Does not align with sponsor's priorities
- Does not adhere to application guidelines
- Too many gaps in logic
- Lacks appropriate expertise / not feasible
- Poorly written



Understand your audience



- They are busy, distracted, tired, and bored
- They are reviewing many proposals
- They are skeptical

Understand your audience

“Who is my audience” is *the number one issue in grant writing*. Almost all grant panels are very heterogeneous. Therefore, you are usually writing for **intelligent researchers who are not experts in your area**, except for maybe **two to three experts**.

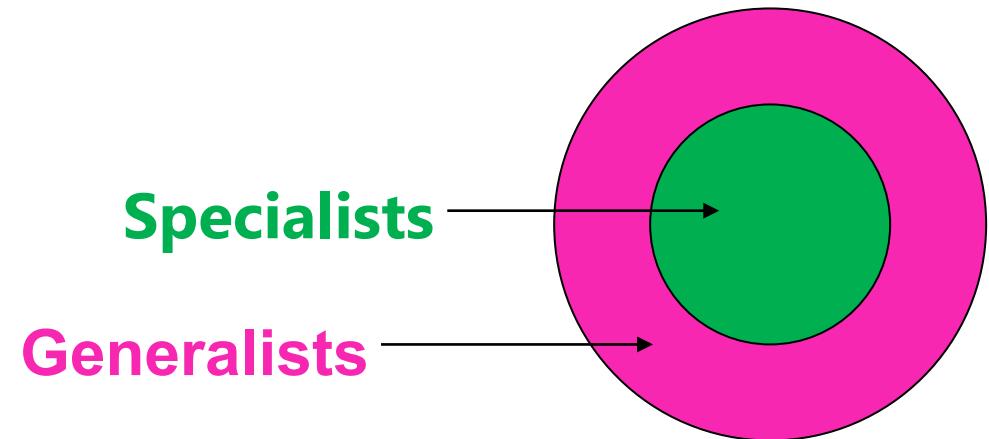
—“Tips for Good Grant Writing” CIHR



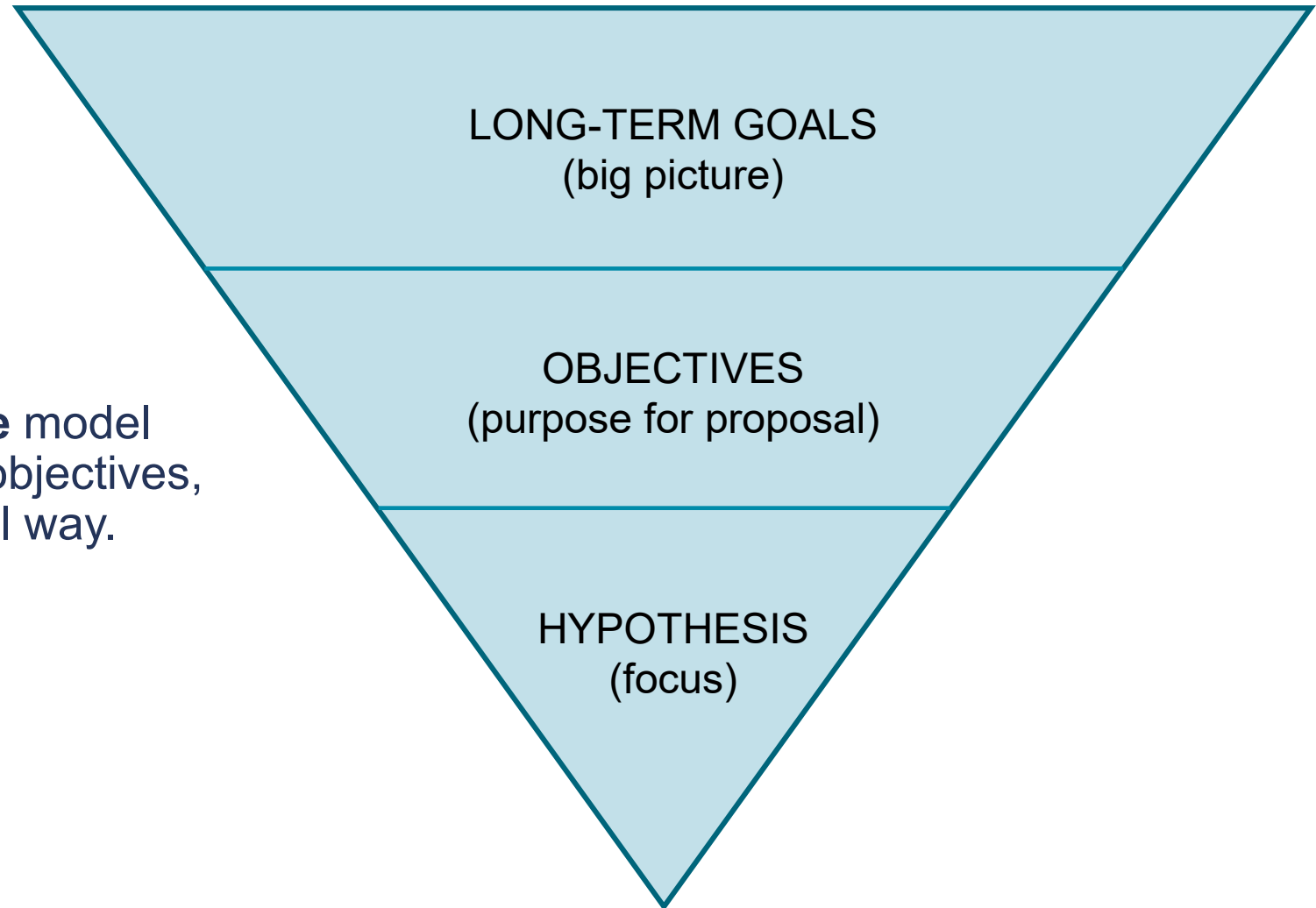
Understand your audience

Specialists: researchers from your sub-field, with whom you share terminology and theoretical background

Generalists: researchers from the larger field or related fields



Start by defining your Goals, Objectives and Hypothesis



The **upside-down triangle** model helps present your goals, objectives, and hypotheses in a logical way.

Goals, Objectives, Hypothesis

Our long-term goal is to find new strategies for remediating biofilm infections by addressing their physical properties.

This proposal's objective is to determine the role of the spatial structure and mechanics of biofilm infections on virulence, antibiotic resistance, and immune evasion.

Our central hypothesis is that spatial structure and mechanics are the major *physical* factors controlling the development of pathogenicity, antibiotic resistance, and immune evasion in biofilm infections.

The specific aims are the backbone of your proposal

They should:

- Be specific
- Use strong verbs
- Use accessible language
- Be related but not interdependent
- Allow for multiple possible outcomes

The specific aims are the backbone of your proposal

They should:

- Be specific and descriptive
- Use strong verbs
- Use accessible language
- Be related but not interdependent
- Allow for multiple possible outcomes

“Investigate biofilm-immune system interactions.”



“Determine the impact of biofilm spatial structure and mechanics on the ability of biofilms to evade neutrophils.”



Specific Aims

Aim 1. Characterize the spatial structure (size and number density of bacterial aggregates) and mechanics (viscoelastic properties) of biofilm infections in wounds.

Aim 2. Measure the impact of biofilm spatial structures on bacterial growth, biofilm microenvironment development, antibiotic resistance, and virulence.

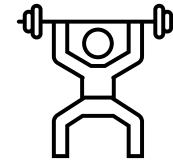
Aim 3. Determine the impact of biofilm spatial structure and mechanics on the ability of biofilms to evade neutrophils.

Two questions drive the reviewers' decision

SHOULD they
do it?



CAN they
do it?



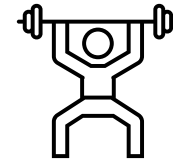
Two questions drive the reviewers' decision

SHOULD they
do it?



SIGNIFICANT?
IMPACTFUL?
INNOVATIVE?

CAN they
do it?



right APPROACH?
right TEAM?
right ENVIRONMENT?

Make Your First Page Impactful



Significance of the problem

Significance and Impact of Research

Annually, chronic infections affect 17 million Americans, cause at least 550,000 American deaths, and cost the US healthcare system billions of dollars [1-8]. Chronic bacterial infections often resist antibiotics and evade the host immune defense [10, 15-18], making them resistant to treatment. Most of these treatment-resistant infections are caused by biofilms, aggregated bacteria that are embedded in a matrix of polymer and protein. Unlike well-mixed, liquid cultures, biofilm infections have well-defined spatial structure, which is determined by bacteria traits (size and position of aggregates) and matrix heterogeneity. Matrix polymers and proteins also confer intercellular cohesion on biofilm bacteria, which affects mechanical resistance of the biofilm to physical breakup. The impact of spatial structure and matrix mechanics on biofilm properties, such as virulence, antibiotic resistance, and immune evasion are largely unknown. Indeed, we know little about what specific structures and mechanics develop in biofilm infections, and extant techniques to probe these properties are largely lacking. Because current biofilm treatments, which target genes or specific bacteria, have proven ineffective [55], new approaches that integrate knowledge of the physical properties of biofilms are needed.

Goals, Objectives, Hypothesis

As such, our **long-term goal** is to find new strategies for remediating biofilm infections by addressing physical properties.

This proposal's **objective** is to determine the role of the spatial structure and mechanics of biofilm infections on virulence, antibiotic resistance, and immune evasion.

Here, our **central hypothesis** is that spatial structure and mechanics are the major *physical* factors controlling the development of pathogenicity, antibiotic resistance, and immune evasion in biofilm infections. This hypothesis is based on a synthesis of our own and others' published work.

Aims

We will test our central hypothesis and attain our objective *via* the following **specific aims**:

Aim 1. Characterize the spatial structure (size and number density of bacterial aggregates) and mechanics (viscoelastic properties) of biofilm infections in wounds.

Aim 2. Measure the impact of biofilm spatial structures on bacterial growth, biofilm microenvironment development, antibiotic resistance, and virulence.

Aim 3. Determine the impact of biofilm spatial structure and mechanics on the ability of biofilms to evade neutrophils.

Impact

The **expected outcome** of this work is a comprehensive understanding of what structures and mechanics develop in biofilm infection of chronic wounds, and the degree to which these structures and mechanics give rise to pathogenicity, antibiotic resistance, and evasion of the immune system. The results will have an important *positive impact* because they lay the groundwork to develop a new class of targeted treatments.

The first paragraph provides context

Context is:

“the circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood and assessed”

- Helps the reviewer understand and relate to the problem
- Makes your work relevant and current
- Through story-telling, plays on the reviewer’s emotions



Use storytelling to engage the reviewer

‘Story’ is the concept that should underlie the structure of the entire proposal. The clearer and simpler, the more engrossing it is.

[This] will give the **generalist** a context in which to understand the significance of the work, but **fellow specialists** will also appreciate [it].





The attention grabbing first paragraph

Annually, chronic infections affect 17 million Americans, cause at least 550,000 American deaths, and cost the US healthcare system billions of dollars [1-8]. Chronic bacterial infections often resist antibiotics and evade the host immune defense [10, 15-18], making them resistant to treatment. Most of these treatment-resistant infections are caused by biofilms, aggregated bacteria that are embedded in a matrix of polymer and protein. Unlike well-mixed, liquid cultures, biofilm infections have well-defined spatial structure, which is determined by bacteria traits (size and position of aggregates) and matrix heterogeneity. Matrix polymers and proteins also confer intercellular cohesion on biofilm bacteria, which affects mechanical resistance of the biofilm to physical breakup. The impact of spatial structure and matrix mechanics on biofilm properties, such as virulence, antibiotic resistance, and immune evasion are largely unknown. Indeed, we know little about what specific structures and mechanics develop in biofilm infections, and extant techniques to probe these properties are largely lacking. Because current biofilm treatments, which target genes or specific bacteria, have proven ineffective [55], new approaches that integrate knowledge of the physical properties of biofilms are needed.



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Big picture



The first paragraph sets up the hypothesis

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resistant in

embedded

biofilm infec

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Big picture

Context for
the
Hypothesis



The attention grabbing first paragraph

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Big picture

Context for
the
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The attention grabbing first paragraph

The impact of spatial structure and matrix mechanics on biofilm properties, such as virulence, antibiotic resistance, and immune evasion are largely unknown. Indeed, we know little about what specific structures and mechanics develop in biofilm infections, and extant techniques to probe these properties are largely lacking. Because current biofilm treatments, which target genes or specific bacteria, have proven ineffective [55], new approaches that integrate knowledge of the physical properties of biofilms are needed.

Gap/Problem
that the
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Gap/Problem that the proposed project will solve

Why is the gap important?

Goals et al. directly follow first paragraph



First Paragraph of Proposal

Goals, Objectives, Hypothesis

Aims

Impact

Significance and Impact of Research

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The **expected outcome** of this work is a comprehensive understanding of what structures and mechanics develop in biofilm infection of chronic wounds, and the degree to which these structures and mechanics give rise to pathogenicity, antibiotic resistance, and evasion of the immune system. The results will have an important *positive impact* because they lay the groundwork to develop a new class of targeted treatments.



Convey significance and impact to engage the reviewer

- Chronic infections caused by biofilms annually affect 17 million Americans, cause at least 550,000 American deaths, and cost the US healthcare system billions of dollars.
- Biofilm infection in chronic wounds afflicts both diabetic and non-diabetic patients and can lead to amputation.

socio-economic costs

evoke emotion



Convey significance and impact to engage the reviewer

- Chronic infections caused by biofilms annually affect 17 million Americans, cause at least 550,000 American deaths, and cost the US healthcare system billions of dollars. } socio-economic costs
- Biofilm infection in chronic wounds afflicts both diabetic and non-diabetic patients and can lead to amputation. } evoke emotion
- Our work will provide novel insight into the structures and mechanics of *P. Aeruginosa*-dominated biofilms—an important first step in developing therapeutics for patients with chronic wounds. } why fundamental knowledge is important
- The work proposed here will develop a platform of complementary techniques and knowledge that will be extensible to future studies of other infection sites and other organisms, including multi-species infections and engineered microbial consortia. This platform will be a foundational resource for the emerging field of physical microbiology & medicine. } opens new doors



Specificity adds credibility to impact statements

The more specific you are in your arguments, the more credible your arguments will be.

“This research will have a meaningful impact on....” OR

“This research will improve our understanding of the field of....”





Specificity adds credibility to impact statements

The more specific you are in your arguments, the more credible your arguments will be.

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“Characterizing the interaction between biofilm structure and neutrophils opens up the possibility of manipulating biofilm structure to counteract their evasion of the immune system.”





Innovation

Differentiate your approach from what has already been done.

The common approaches to developing new treatments for biofilms are either to find genes important for forming biofilms or to directly kill the bacteria in biofilms by novel drugs. These approaches most often fail to eradicate infections [55].

Our goal is to determine the structural and mechanical characteristics of biofilms and to identify the impact of these physical properties on disease course. Our innovative approach combines techniques from both biological and physical sciences and will elucidate the mechanistic relationship between the physical characteristics of biofilm infections and the course of biofilm disease, which are not accessible by conventional methods.



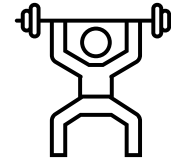
Two questions drive the reviewers' decision

SHOULD they
do it?

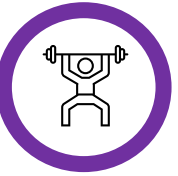


SIGNIFICANT?
IMPACTFUL?
INNOVATIVE?

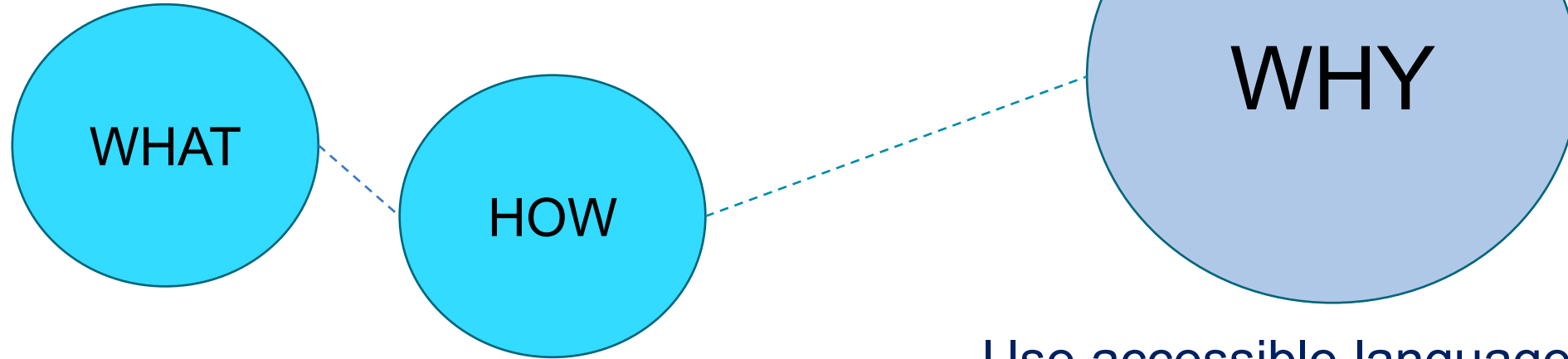
CAN they
do it?



right APPROACH?
right TEAM?
right ENVIRONMENT?



Approach: Writing your methods

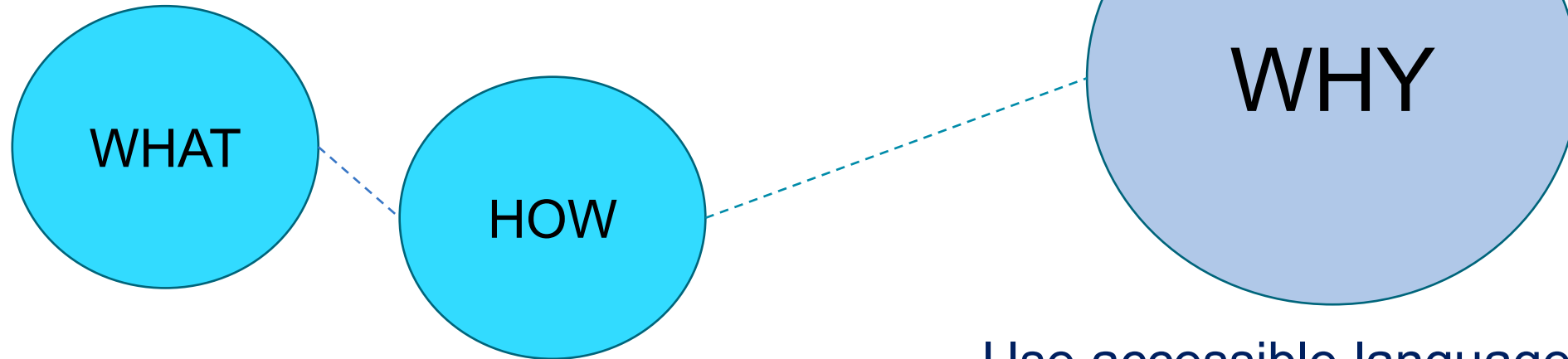


Find a balance between excessive and necessary detail

Use accessible language to provide a rationale behind your methods



Approach: Writing your methods



Find a balance between excessive and necessary detail

Use accessible language to provide a rationale behind your methods

- Remember, reviewers:
- **DO NOT** want to replicate your methods
 - **DO** want to understand **WHY** you chose a specific approach

How to write the methods section

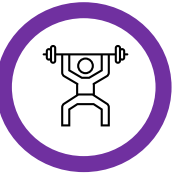
Specific Aim 1: Determine the spatial structure and mechanics of biofilm infections in chronic wounds

We will determine, in three dimensions, the size, number, locations, and heterogeneous matrix content of bacterial aggregates in a mouse model of chronic wound infection. Our approach will be to use advanced imaging to assess biofilm structure and to use atomic force microscopy (AFM) and microrheology to measure mechanics. Both structure and mechanics will be measured *in situ*. The rationale for this aim is that *P. aeruginosa* is an important biofilm-forming human pathogen, but the types of structure and mechanics that arise in *P. aeruginosa* biofilm infections are largely unknown. These gaps in knowledge preclude identification of physical properties of biofilms as therapeutic targets.

WHAT you will do

HOW you will do it

WHY it should be done this way



Provide a rationale for methodological choices

Although artificial skin models have been used for studying wound healing, there are currently no good *in vitro* models for evaluating the host response to wound infection. For the experiments described in this proposal, we will require a model that, as closely as possible, reflects the infection sequela seen in human wound patients.

Rationale for using an approach



Provide a rationale for methodological choices

Although artificial skin models have been used for studying wound healing, there are currently no good *in vitro* models for evaluating the host response to wound infection. For the experiments described in this proposal, we will require a model that, as closely as possible, reflects the infection sequela seen in human wound patients.

Rationale for using an approach

We will embed bacteria into gel beads, using both a WT and a highly-virulent strain, so that we can probe the interplay between phagocytosis timescale and virulence.

Rationale for a step



Are you the right TEAM?

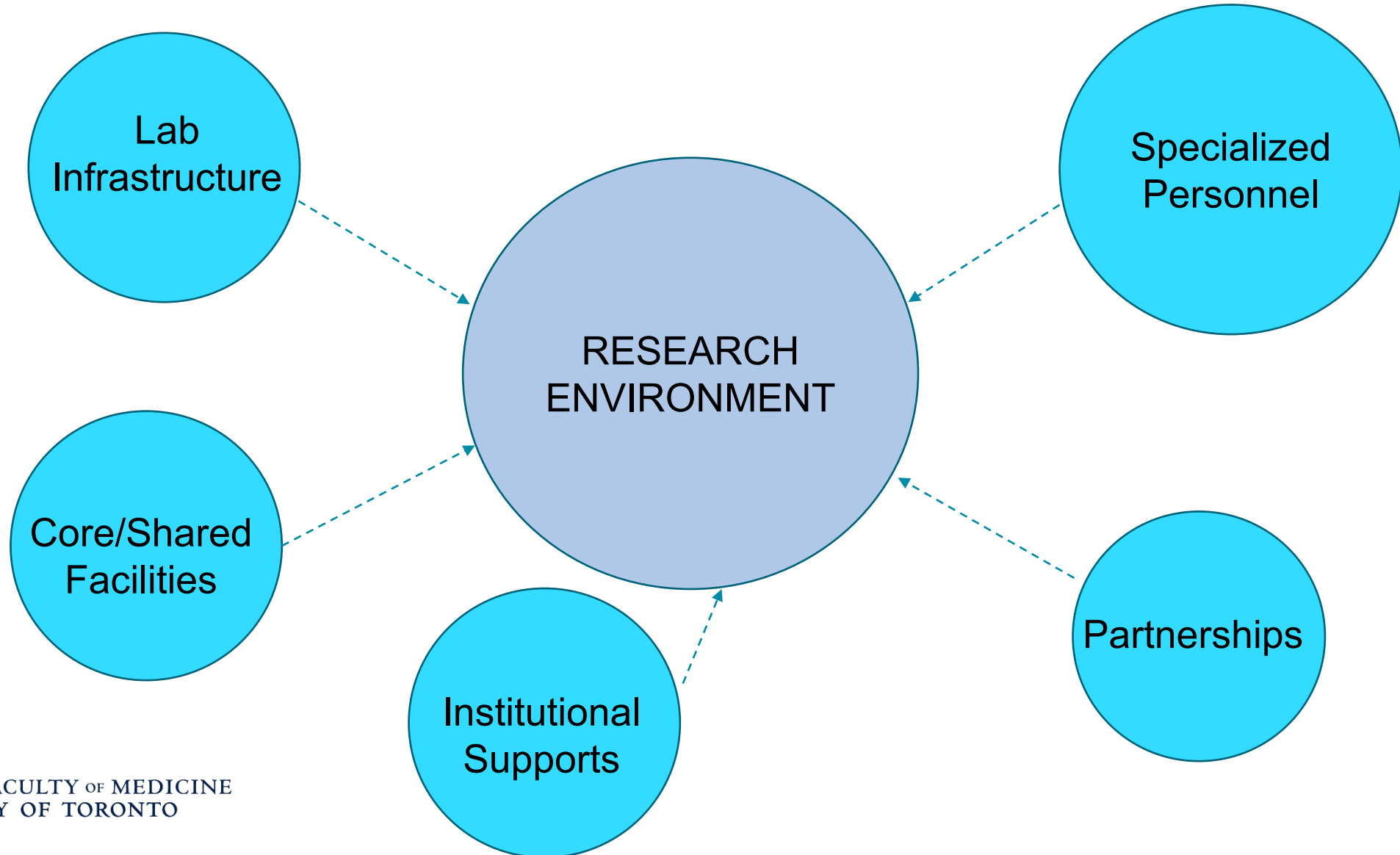
Listing publications and grants is not enough

- How does each member's expertise make them perfect for this project?
 - be explicit; make the connections for reviewers
- How does your team come together to be more than the sum of its parts?
 - evidence of previous team successes
 - synergies





Do you have the right research ENVIRONMENT?



Formatting

1. Break up the text

Headings and subheadings specified in the application

White space

Figures and tables

2. Emphasize important points

Bolded text

Lists / Bullets

Significance and Impact of Research

Annually, chronic infections affect 17 million Americans, cause at least 550,000 American deaths, and cost the US healthcare system billions of dollars [1-8]. Chronic bacterial infections often resist antibiotics and evade the host immune defense [10, 15-18], making them resistant to treatment. Most of these treatment-resistant infections are caused by biofilms, aggregated bacteria that are embedded in a matrix of polymer and protein. Unlike well-mixed, liquid cultures, biofilm infections have well-defined spatial structure, which is determined by bacteria traits (size and position of aggregates) and matrix heterogeneity. Matrix polymers and proteins also confer intercellular cohesion on biofilm bacteria, which affects mechanical resistance of the biofilm to physical breakup. The impact of spatial structure and matrix mechanics on biofilm properties, such as virulence, antibiotic resistance, and immune evasion are largely unknown. Indeed, we know little about what specific structures and mechanics develop in biofilm infections, and extant techniques to probe these properties are largely lacking. Because current biofilm treatments, which target genes or specific bacteria, have proven ineffective [55], new approaches that integrate knowledge of the physical properties of biofilms are needed.

As such, our **long-term goal** is to find new strategies for remediating biofilm infections by addressing physical properties.

This proposal's **objective** is to determine the role of the spatial structure and mechanics of biofilm infections on virulence, antibiotic resistance, and immune evasion.

Here, our **central hypothesis** is that spatial structure and mechanics are the major *physical* factors controlling the development of pathogenicity, antibiotic resistance, and immune evasion in biofilm infections. This hypothesis is based on a synthesis of our own and others' published work.

We will test our central hypothesis and attain our objective *via* the following **specific aims**:

Aim 1. Characterize the spatial structure (size and number density of bacterial aggregates) and mechanics (viscoelastic properties) of biofilm infections in wounds.

Aim 2. Measure the impact of biofilm spatial structures on bacterial growth, biofilm microenvironment development, antibiotic resistance, and virulence.

Aim 3. Determine the impact of biofilm spatial structure and mechanics on the ability of biofilms to evade neutrophils.

The **expected outcome** of this work is a comprehensive understanding of what structures and mechanics develop in biofilm infection of chronic wounds, and the degree to which these structures and mechanics give rise to pathogenicity, antibiotic resistance, and evasion of the immune system. The results will have an important *positive impact* because they lay the groundwork to develop a new class of targeted treatments.



Figures: DOs and DON'Ts



DON'T:

- Copy and paste figures or figure captions from a manuscript
- Use multi-panel figures



DO:

- Keep figures simple
- Use a figure to illustrate an approach / scientific concept
- Present **select** preliminary results that support your approach
- Ensure text is legible at 100% magnification



Complex figures are challenging to navigate

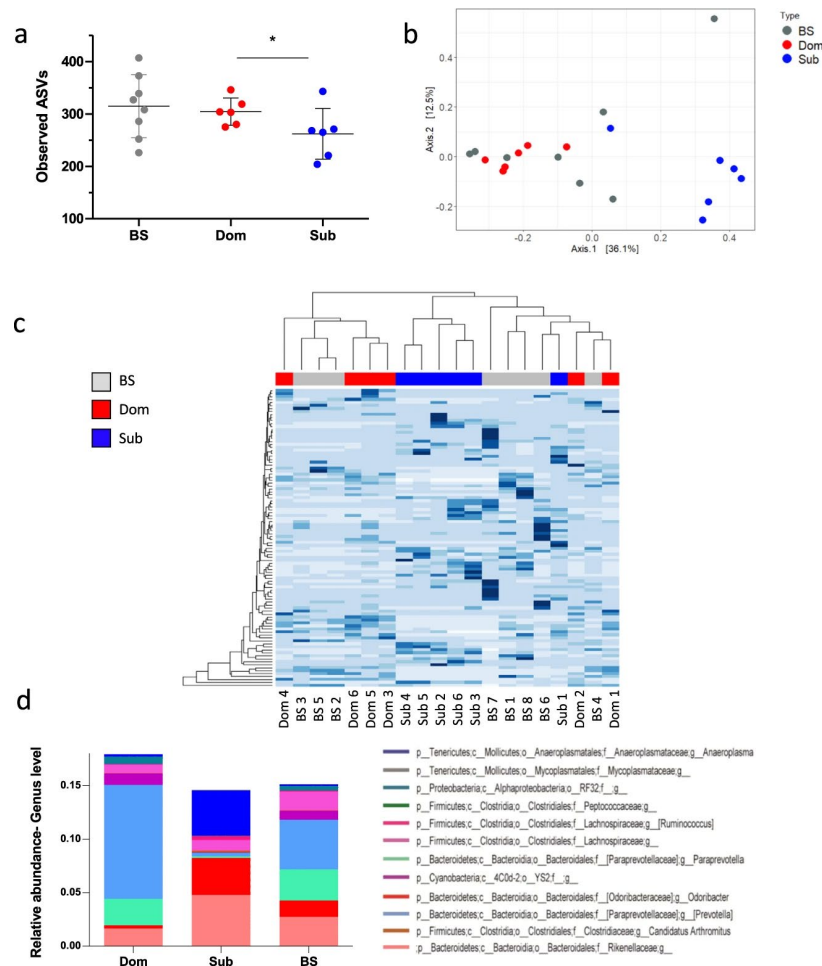
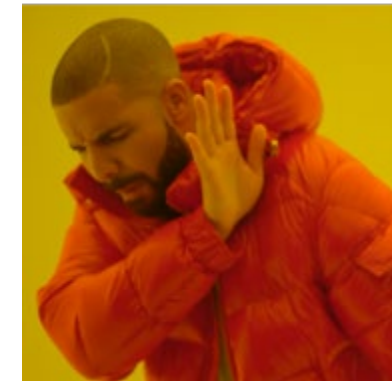


Fig. 4: Gut microbiota compositions and unique taxa in Dom, Sub, and BS mice. **a** Alpha diversity of the gut microbiome of Dom, Sub, and background-strain (BS) mice ($n = 20$; SD = 26.10, 48.44, and 60.15, respectively). The alpha diversity of BS and Dom mice was not significantly different. **b** A principal component analysis showing the clustering of the gut microbiome of mice with the same social behavior phenotype. **c** A heatmap of the 100 most variant species identified; taxa with similar distributions are grouped together. **d** Relative abundance up to the genus level. Statistical significance was assessed by using a one-way ANOVA with Bonferroni correction, $*p < 0.05$. Error bars show standard deviation.





Use figures to describe a scientific concept

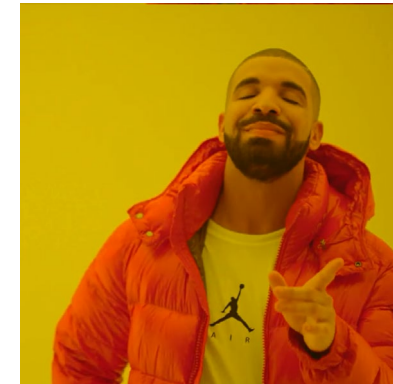
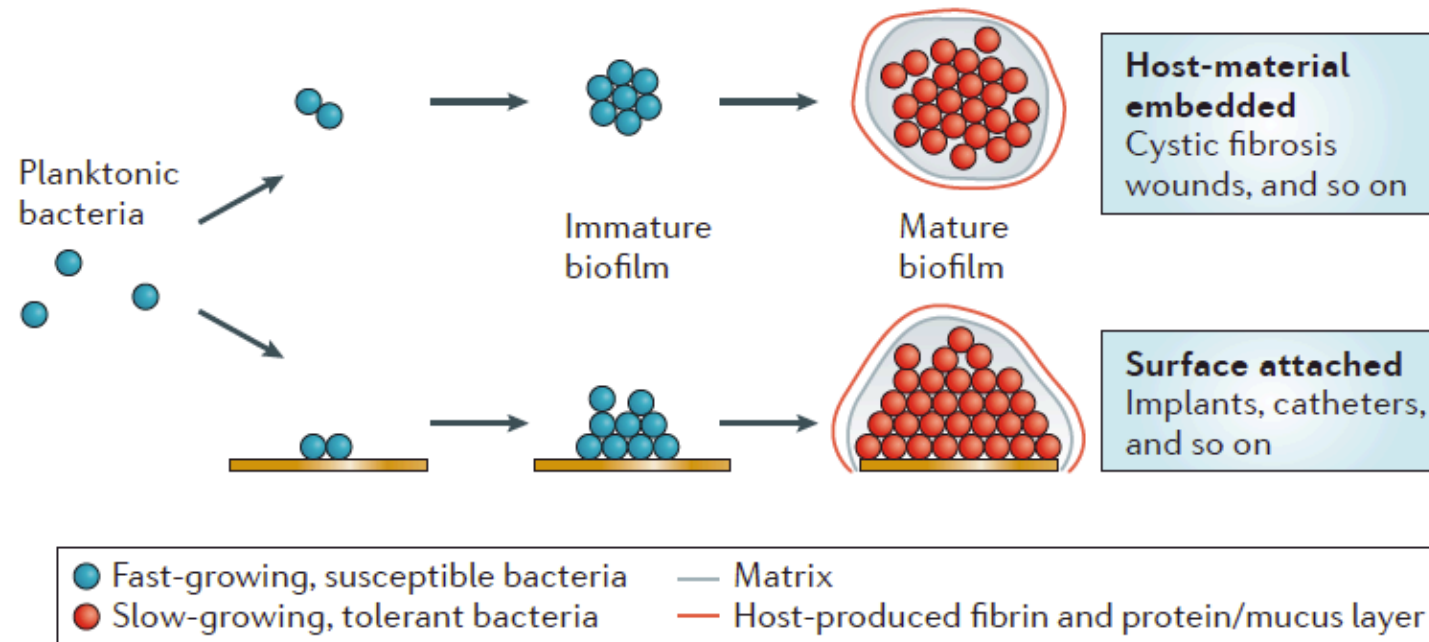
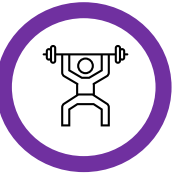
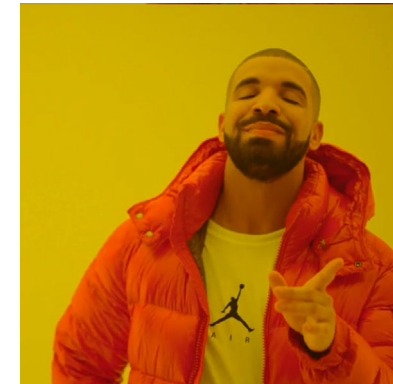
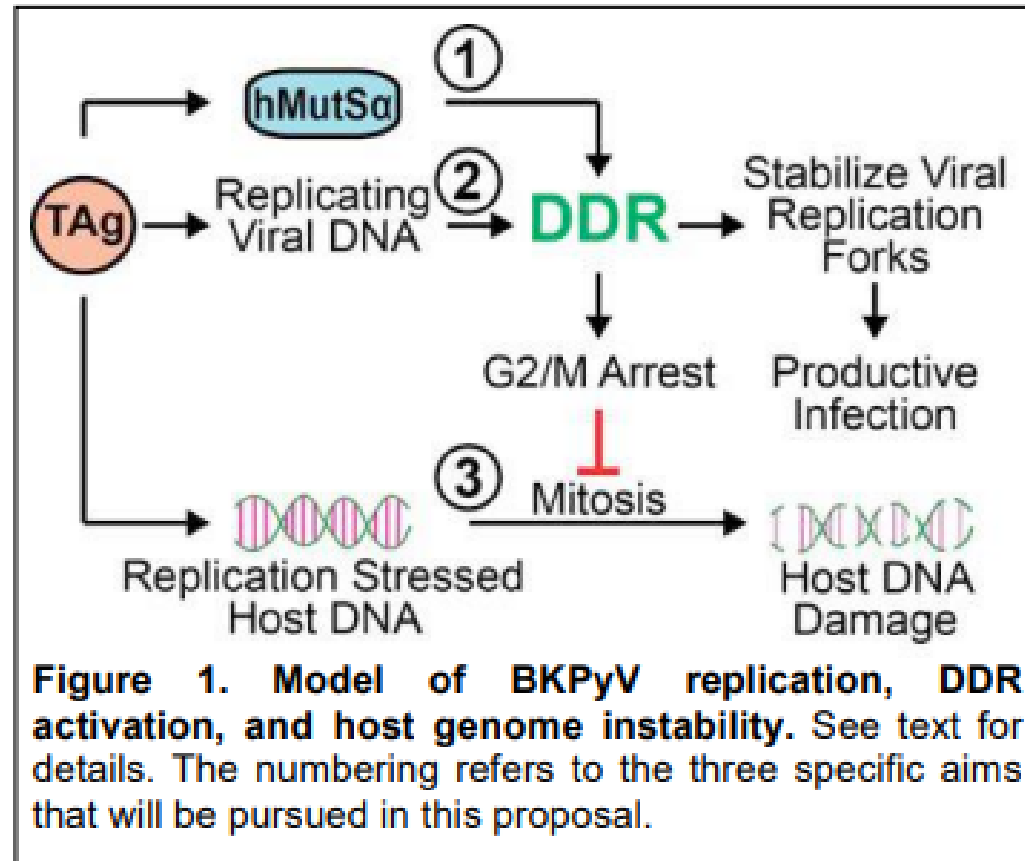


Figure 1 | **The development of bacterial biofilms from planktonic bacteria.** The pathway on the top depicts the development of non-surface-attached biofilms. These can, for example, form in chronic wounds or the lumen of the bronchi in patients with cystic fibrosis, where bacteria are not attached to a surface but instead embedded in mucus or other host material. The pathway below depicts surface-attached biofilms, where bacteria are attached to the surface of biomaterials such as implants or catheters. Blue circles represent susceptible bacteria and red circles represent tolerant bacteria.



Use figures to illustrate your approach



Final thoughts and next steps



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Research proposal writing, editing and developing

The Office of the Vice Dean, Research and Innovation provides a grant editing service to UofT medical science investigators. The Office prioritizes CIHR, CFI, and CRC grants for editorial review, but will review all grant proposals to any funding agency or foundation on an ad hoc basis. This service is free to Temerty Faculty of Medicine on-campus investigators. Hospital-based off-campus investigators are charged a fee of \$60.00/page

Questions about grant-writing?



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