AMR One Health Consortium

2022

Project Snapshots

AMR - One Health Consortium

Alberta Government

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PROJECT SNAPSHOT

1A: Validation of Novel Targets

Pillar: Treatment Optimization
Theme: Innovation and Commercialization
Keywords: Bacterial Pathogenesis; Phage Therapy

PRINCIPAL INVESTIGATOR: Amit Bhavsar, PhD

CO-INVESTIGATOR(S): Tracy Raivio, PhD; Jon Dennis, PhD; Alexei Savchenko, PhD; Dongyan Niu, PhD; Wael Elhenawy, PhD

AIM

The focus of this project is to examine alternatives to antibiotics as antimicrobial strategies. We will explore the use of phage or pathogenesis inhibitors in this context.

WHY IS THIS IMPORTANT?

We know that the rampant use of antibiotics is contributing to resistance against these drugs. We aim to develop non-antibiotic strategies to disarm AMR bacterial pathogens and prevent AMR transfer from the environment to people.

OUTCOMES

1. Publications and/or IP identifying targets that subvert bacterial pathogenesis or mediate phage toxicity.
2. Proof-of-principle therapeutics that validate targets.

RESEARCH QUESTIONS

1. Can we target bacterial pathogenesis as an antimicrobial strategy?
2. Can phage be used to combat AMR, or prevent its transfer?

OUR APPROACH

1. We will combine structural biology and biochemistry to study virulence factors from bacteria and examine small molecule and protein-based inhibition strategies.
2. We will examine environmental phage and their interactions with important AMR bacterial pathogens at the cellular and molecular levels.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Canada Foundation for Innovation • Canadian Institutes of Health Research • Li Ka Shing Institute of Virology • National Institutes of Health • Natural Sciences and Engineering Research Council of Canada

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Catalyze new research partnerships
- Develop new antimicrobial targets that can be exploited by other researchers or industry

HIGHLY QUALIFIED PERSONNEL

- 1 PhD
- 6 MSc
- 5 Undergraduate students
- 1 Research Associate

AFFILIATIONS: University of Alberta • University of Calgary

CONTACT INFORMATION: Amit Bhavsar (amit.bhavsar@ualberta.ca)

PROJECT SNAPSHOT

1B: Drug Discovery: From Antivirals to Antibiotics?

Pillar: Treatment Optimization

Theme: Innovation and Commercialization

Keywords: Drug Discovery; Transcription; Replication; Translation; Enzymology

PRINCIPAL INVESTIGATOR: Matthias Götte, PhD

CO-INVESTIGATOR(S): Hans-Joachim Wieden, PhD; Trushar Patel, PhD; Ute Kothe, PhD; Fred West, PhD

AIM

The major objective of this project is to identify novel compounds that interfere with replication and translation of important pathogens including but not limited to multi-resistant Mycobacterium tuberculosis.

WHY IS THIS IMPORTANT?

The WHO created a priority list of antibiotic-resistant bacteria to support drug discovery efforts in important areas. The ultimate aim of the proposed research is to identify novel classes of inhibitors against these pathogens.

OUTCOMES

1. Develop inhibitors that are more effective by studying antibiotics and related antivirals.
2. Establish systems to study bacterial targets that are crucial for genome replication and translation and discover “hits” that interfere with the function of these targets.

RESEARCH QUESTION

Can we apply knowledge in antiviral drug discovery to bacterial targets?

OUR APPROACH

We will use biochemistry to study the molecular basis for drug action and resistance to antivirals. Primarily we will look into enzymes like polymerases or nucleases that depend on divalent metal ions. We will then use this knowledge and apply it to functionally equivalent targets in bacteria.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Canadian Institutes of Health Research • Natural Sciences and Engineering Research Council of Canada

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- New partnerships with the private sector

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 PhD
- 1 MSc
- 1 Research Associate

AFFILIATIONS: University of Alberta • University of Calgary • University of Lethbridge

CONTACT INFORMATION: Matthias Götte (gotte@ualberta.ca)

PROJECT SNAPSHOT

1C: Investigating the Mechanisms Governing the Dissemination of Antibiotic Resistance Among Bacteria

Pillar: Treatment Optimization

Theme: Innovation and Commercialization

Keywords: Bacterial Conjugation; Type IV Secretion System; Antibiotic Resistance

AMR One Health Consortium

PRINCIPAL INVESTIGATORS: Wael Elhenawy, PhD; Matthias Götte, PhD

AIM

Discover drugs that can interfere with the replication and transfer of the extrachromosomal elements that carry antibiotic resistance cassettes.

WHY IS THIS IMPORTANT?

Infections by antibiotic resistant-bacteria are expected to be the leading cause of mortality among humans by 2050 (Mahoney AR et al., 2021). The environmental factors that promote the spread of drug resistance genes among bacteria remain unknown. By uncovering the mechanisms that drive the spread of resistance genes, new therapies can be developed to interfere with this process

OUTCOMES

1. Identify the factors that promote the replication and spread of antibiotic resistance genes among bacterial communities.
2. Developing new drugs that can be coupled with antibiotics to inhibit the spread of antibiotic resistance among the persistent bacteria.

RESEARCH QUESTION

What are the factors that promote the spread of antibiotic resistance genes among bacteria?

OUR APPROACH

Using state-of-the-art genetic screening platforms, we aim at identifying the mechanisms that drive the spread of antibiotic resistance among bacteria. In the second phase of this project, we will employ chemogenomics to identify novel drugs that can interfere with the lateral transfer of antibiotic resistance genes between bacteria.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Li Ka Shing Institute of Virology

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- New partnerships with the private sector.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 2 MSc

AFFILIATIONS: University of Alberta; LKSIoV

CONTACT INFORMATION: Wael Elhenawy (elhenawy@ualberta.ca) and Matthias Götte (gotte@ualberta.ca)

Alberta Government

PROJECT SNAPSHOT

2A: BLOOM-Antimicrobial Resistance: Impacts of Intrapartum Antimicrobials on the Health of Albertan Infants

Pillar: Treatment Optimization
Theme: Innovation and Commercialization
Keywords: Intrapartum Antimicrobials; Maternal Microbiome; Infant Resistome

PRINCIPAL INVESTIGATOR: Laura Sycuro, PhD, MSc
CO-INVESTIGATOR(S): Ian Lewis, PhD; Tarah Lynch, PhD; Eliana Castillo, MD; Marie-Claire Arrieta, PhD; Anita Kozyrskyj, PhD

AIM

This project aims to better understand the use of intrapartum antimicrobial prophylaxis (IAP) in Alberta and its impact on the neonatal resistome.
We will also explore how intrapartum pathogens could be more reliably detected, potentially decreasing the need for IAP exposure.

WHY IS THIS IMPORTANT?

Over 25% of Albertan women receive IAP or other antimicrobial therapies during labour or shortly after giving birth. These antimicrobial exposures disrupt the natural process by which the neonate is colonized by maternal microbes and increase the burden of resistance genes in the infant microbiome.

OUTCOMES

1. Expanded knowledge of how inherited resistomes are propagated in term and preterm neonates exposed to IAP.
2. Preliminary steps toward better detection of dangerous intrapartum pathogens affecting Albertan hospitals.

RESEARCH QUESTIONS

1. How do bacterial species, plasmids, and phage in women exposed to IAP contribute to the neonatal resistome?
2. Could rapid genetic or metabolite-based diagnostics be used to screen women at POC for more selective use of IAP?

OUR APPROACH

1. This study will engage 50 women delivering at term and 100 women delivering preterm in its first year.
   - Exposure to intrapartum antimicrobials will be captured through database and chart review.
   - Maternal vaginal and rectal swabs, breastmilk, and infant feces will be analyzed to determine the source of resistance genes in 20 term and 20 preterm infants exposed to maternal IAP.
2. iGAS and GBS strains banked by ALS from maternal and neonatal infections at Foothills Hospital will be sequenced and tested in a metabolomics-based diagnostic platform.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Canadian Institutes of Health Research: Early Career Investigator Award • Snyder Institute for Chronic Diseases • University of Calgary, Office of the Vice President (Research): IICD Big Ideas Campaign

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Technologies for understanding how resistome inheritance and propagation occurs
- Feasibility of new approaches for detecting prevalent obstetric pathogens at POC

HIGHLY QUALIFIED PERSONNEL

- 1 Postdoctoral Fellow
- 1 MSc
- Medical and nursing students will be involved in BLOOM data capture and analysis
- ALS faculty are partnered in exploring the feasibility of new POC diagnostics

AFFILIATIONS:

CONTACT INFORMATION: Laura Sycuro (laura.sycuro@ucalgary.ca)

PROJECT SNAPSHOT

2B: Gut Innate Immunity Across Microbiome Differences During Infectious Colitis and Immunomodulatory Therapeutics in Pigs

Pillar: Treatment Optimization

Theme: Innovation and Commercialization

Keywords: Swine Dysentery; Free-Antibiotic Therapies; Gut Immunity

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Eduardo R Cobo, PhD

CO-INVESTIGATOR(S): Andre Buret, PhD; Leluo Guan, PhD; Ben Willing, PhD

AIM

Our aim is to develop immunomodulatory antimicrobials to alleviate and reduce gut pathogen colonization in swine dysentery (SD). Such approach is of interest in Canadian agriculture (livestock productivity and animal welfare) to reduce the use of antibiotics in food producing animals.

WHY IS THIS IMPORTANT?

Diarrheic colitis by Brachyspira hyodysenteriae is a devastating disease in growing pigs. SD reduces pork productivity and is an animal welfare issue. There is emergence of antimicrobial-resistant SD bacteria.

OUTCOMES

1. Discover immunomodulatory antimicrobials for controlling SD.
2. Explore the use of diet/probiotics to promote intestinal microbiome associated with disease resistance.

RESEARCH QUESTIONS

1. How is the microbiome in the colon of pigs infected with B. hyodysenteriae affected and what is the impact on the associated immune factors?
2. Can novel immunomodulatory antimicrobials (e.g., IDRs) function as gut health promoters against SD?

OUR APPROACH

1. **SD Model.** B. hyodysenteriae colitis in (5 wk. old) pigs (UofC) cathelicidin and derived peptides (e.g., bovine neutrophil bactenecin, IDR-1018) (different routes/times).
2. **Grade colitis.** Histology, neutrophil/macrophage accumulation, cytokines, host defense peptides, gut permeability.
3. **Gut microbiome.** To assess gut microbiota-driven immune functions in relating to pathogen challenge (diarrheic colitis and therapeutics). Microbial profiling (diversity & content).

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

UofC Department of Microbiology, Immunology and Infectious Diseases • UofC Veterinary Science Research Station

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- A multidisciplinary program with the industry and producers to develop novel therapeutic alternatives to reduce antibiotic use in the pork industry

HIGHLY QUALIFIED PERSONNEL

- 1 Postdoctoral Fellow
- 1 PhD
- 2 Undergraduate Students
- DVM Students are involved in pig SD experiments and data analysis

AFFILIATIONS: UNIVERSITY OF CALGARY · UNIVERSITY OF ALBERTA

Alberta Government

CONTACT INFORMATION: Eduardo Cobo (ecobo@ucalgary.ca)

PROJECT SNAPSHOT

2C: Development Of Antimicrobial Therapeutics From The Natural Products Of Microbiomes

Pillar: Optimization
Theme: Innovation and Commercialization
Keywords: Natural Products; Microbial Ecology; Antibiotic Potentiators; Counter-Resistance

PRINCIPAL INVESTIGATOR: Joe J. Harrison, PhD
CO-INVESTIGATOR(S): Kathy McCoy, PhD; Darren Derksen, PhD

AIM

The proposed program seeks to elucidate microbial chemical interactions that drive the AMR of bacterial communities. This research is predicated on an ecological principle that we term “counter-resistance,” which posits that many Archaea, bacteria and other microbial eukaryotes have evolved the means to produce metabolites that block AMR because of competitive interactions for resources and space.

WHY IS THIS IMPORTANT?

Microbiologists have acquired most of the information known about the genetic and biochemical mechanisms of AMR by studying model organisms in monocultures. However, bacteria are rarely found in any environment alone and we know very little about the scope and impact of polymicrobial interactions on the AMR of even the best-studied model organisms.

OUTCOMES

We have identified that many bacteria produce low molecular weight molecules (called N-acylamides) that block AMR, including carbapenem-resistance of Pseudomonas aeruginosa and Acenitobacter baumanii. These carbapenem-resistant bacteria top the World Health Organization (WHO) global priority list of antibiotic-resistant pathogens to guide research, discovery, and development of new antibiotics.

RESEARCH QUESTIONS

1. Can we identify additional microbe-microbe interactions and bioactive, natural small metabolites that prevent AMR?
2. How do microbial metabolites, such as the N-acylamides, block AMR?
3. Can we develop models to measure the AMR and fitness of organisms in polymicrobial communities?

OUR APPROACH

Our team has led the development of technology platforms for prospecting chemical microbe-microbe interactions. Our platforms include the Alberta Microbiota Repository (a living library containing hundreds of species of bacteria and fungi native to Canada) and robotics enclosed in air-tight chambers to handle these organisms. We also work with experts in natural product chemistry and processes for identifying bioactive molecules from complex mixtures. We will use synthetic chemistry to execute structure-activity relationship studies of identified biomolecules. Our expertise in biochemistry and molecular genetics will be used to elucidate mode-of-action. Using gnotobiotic animal models, we will investigate the impact of natural antibiotic adjuvants and the microorganisms that produce them on antibiotic therapy outcomes.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Alberta Children's Hospital Research Institute • Canada Foundation for Innovation • Canadian Institutes of Health Research • Natural Sciences and Engineering Research Council of Canada • University of Calgary, Office of the Vice President (Research)

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- We will develop molecules that can rescue existing antibiotic drugs from AMR.
- We are developing polymicrobial biofilm susceptibility testing models with a corporate partner.

HIGHLY QUALIFIED PERSONNEL

- 1 Postdoctoral Fellow
- 1PhD
- 1MSc

AFFILIATIONS:

CONTACT INFORMATION: Joe J. Harrison (jjharris@ucalgary.ca)

PROJECT SNAPSHOT

3A: Investigation of AMR Spread via MGEs and Developing Machine Learning Biotools for Quantitative AMR Level Prediction

Pillar: Surveillance

Theme: Innovation and Commercialization

Keywords: Biotools; Mobile Genetic Elements; Horizontal Gene Transfer; Genomics; Antimicrobial Resistance

PRINCIPAL INVESTIGATOR: Tim McAllister, PhD; Athan Zovoilis, PhD

CO-INVESTIGATOR(S): Chad Laing, PhD; Rahat Zaheer, PhD; Vic Gannon, PhD

AIM

To expand information on the role of mobile genetic elements (MGE) in the spread and persistence of AMR from a "One Health" perspective and to develop machine learning biotools for quantitative AMR prediction and transmission.

WHY IS THIS IMPORTANT?

MGEs such as plasmids and integrative and conjugative elements (ICE) are integral to the exchange of antimicrobial resistance genes (ARGs) within bacterial populations and converting susceptible bacteria to multidrug resistant (MDR). Regulatory factors that control the mobility and the expression of ARGs are critical for assessing risk and developing AMR policy as part of a "One Health" initiative.

OUTCOMES

1. Information to detect and manage MGE in human and livestock health settings to reduce the risk of AMR.
2. New biotools for AMR prediction and knowledge on the function of MGEs to support risk assessments and the development of AMR policy.

RESEARCH QUESTIONS

1. Can phenotypic antimicrobial resistance be predicted from genomic information?
2. What are the factors that determine the mobility of MGEs?
3. Can methods/tools be developed to reduce the risk that MGEs pose to the development of MDR bacteria?

OUR APPROACH

1. Insights will be garnered through the development of machine learning tools that draw heaviliy upon phenotypic, genomic and metagenomic analyses to formulate predictive outcomes for AMR.
2. The application of high throughput omics tools with an emphasis on a combination of Illumina short-read and nanopore long read sequencing technologies to understand the entirety of MGEs/ICE and to predict their horizontal transferability intra- and inter species.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Agriculture and Agri-Food Canada • Alberta Agriculture and Forestry • Beef Cattle Research Council • Canadian Food Inspection Agency • Genome Alberta • Genome Canada • Genomics Research and Development Initiative • Results Driven Agriculture Research (RDAR) • University of Lethbridge Infrastructure

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Identification of new tools for the management of AMR within livestock and humans
- Understanding role of MGEs within bacterial pathogens
- Informing policy and risk management
- Partnership with commercial sector

HIGHLY QUALIFIED PERSONNEL

- 1 PhD
- 2 MSc
- 1 Research Assistant

AFFILIATIONS: University of Lethbridge; Agriculture and Agri-Food Canada; Canadian Food Inspection Agency

CONTACT INFORMATION: Tim McAllister (tim.mcallister@canada.ca) & Athanasios Zovoilis (athanasios.zovoilis@uleth.ca)

Alberta Government

PROJECT SNAPSHOT

3B: Human Exposure to and Risk from Antimicrobial Resistant Campylobacter, Enterococcus and ESBL E. coli: A Farm-to-Fork Assessment

Pillar: Surveillance
Theme: Innovation and Commercialization
Keywords: Campylobacter, Enterococci; E. coli; Risk Assessment; Integrated Assessment Model

PRINCIPAL INVESTIGATOR: Simon Otto, PhD
CO-INVESTIGATOR(S): Richard Reid-Smith, DVSc; Carolee Carson, PhD; Colleen Murphy, PhD; Ben Smith, MSc; Ainsley Otten, BEng; Tim McAllister, PhD; Rahat Zaheer, PhD; Sylvia Checkley, PhD; Scott McEwen, DVSc, DipACVP; Lynora Saxinger, CTropMed, MD, FRCPC; Eduardo Taboada, PhD; Doug Inglis, PhD; E. Jane Parmley, DVM, PhD

AIM

The focus of this project is on quantitative modeling strategies to understand the risk of AMR transmission through the food chain to people.

WHY IS THIS IMPORTANT?

We must understand the magnitude of exposure for these foodborne AMR risks (Fluoroquinolone-resistant *Campylobacter* and ESBL *E. coli*) to design One Health antimicrobial stewardship approaches for veterinary and human medicine.

OUTCOMES

1. New quantitative modeling tools to understand the exposure and risk of AMR transmission through the food chain to humans.
2. Understanding of the farm-to-fork pathway for AMR transmission, including potential interventions to reduce this transmission.

RESEARCH QUESTIONS

1. What is the human exposure to and risk of foodborne transmission of AMR from *Campylobacter*? (Fluoroquinolone, macrolide or tetracycline-resistance in poultry, swine, and beef cattle)
2. What is the human exposure to foodborne transmission of other AMR from beef cattle? (Macrolide-resistant *Enterococcus* spp. & ESBL *E. coli*)

OUR APPROACH

We will first conduct a scoping review on the risk factors for human infection with AMR *Campylobacter*. Integrative Assessment Models will be utilized as they are designed to deal with complex issues, providing a comprehensive mechanism for organising, and processing evidence and uncertainty. We will also use QMRAs as they can assess the effects of factors and interventions influencing the public health impacts of exposure to AMR *Campylobacter* from poultry.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Canadian Integrated Program for Antimicrobial Resistance Surveillance • Genomics Research and Development Initiative NRC1 + NRC2 • Agriculture and Agri-Food Canada • Ontario Ministry of Agriculture, Food and Rural Affairs • Public Health Agency of Canada • University of Alberta School of Public Health

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Identification of risk management interventions to curb the transmission of AMR through the foodchain.
- Changes in veterinary antimicrobial prescribing practices.

HIGHLY QUALIFIED PERSONNEL

- 2MSc
- 5 Research Assistants

AFFILIATIONS: University of Alberta • Public Health Agency of Canada • University of Calgary • Agriculture and Agri-Food Canada

Alberta Government

CONTACT INFORMATION: Simon Otto (simon.otto@ualberta.ca)

PROJECT SNAPSHOT

3C: Molecular Epidemiology of Antimicrobial Resistance in Enterococcus From Poultry, Cattle, Humans, and the Environment

Pillar: Surveillance

Theme: Innovation and Commercialization

Keywords: Enterococci; Comparative Genomics; Virulence; Antimicrobial Resistance

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Sylvia Checkley, DVM, PhD

CO-INVESTIGATOR(S): Tim McAllister, BSc, MSc, PhD; Simon Otto, BSc, DVM, PhD; Rahat Zaheer, , PhD; Karen Liljebjelke, BSc, MSc, DVM, PhD; Susan Cork, BVSc, BPhil(vet), PhD, PG Diploma Public Policy, CBiol, MRSB, MRCVS; Sheryl Gow, BSc, DVM, PhD; Cheryl Waldner, DVM, PhD; Richard Reid Smith, BSc, DVM, DVSc; Carl Ribble, BSc, DVM, MSc, PhD; Carolee Carson, BSc, DVM, PhD; Norman Neumann, BSc, MSc, PhD

AIM

1. Characterization and comparison of antimicrobial resistance phenotypes and genotypes in Enterococcus spp. isolated from cattle feces, poultry feces, and beef and poultry retail meats in Alberta, Canada as it relates to surveillance.
2. Antimicrobial resistance in Escherichia coli isolated from food animals, retail meat, and water samples in Alberta: Comparative genomics and molecular epidemiology
3. Modelling Antimicrobial Resistant Enterococcus Spp. in the Canadian Beef Industry: A One-Health Approach

WHY IS THIS IMPORTANT?

Enterococcus and E. coli are bacteria that are part of the normal flora of intestines and feces of humans and animals. They can cause difficult-to-treat infections in people due to resistance to antibiotics. They may carry genes that convey resistance to antimicrobials, which are of high importance in human medicine. They can be used as an indicator of fecal contamination in water samples.

OUTCOMES

1. Inform surveillance and policy through better understanding of the relatedness of enterococci isolated from different sources, modelling Enterococcus and E. coli and antimicrobial resistance gene transmission dynamics, comparison of resistant phenotypes and genotypes.
2. Information that supports the mitigation of AMR.

RESEARCH QUESTIONS

1. What is the role of the environment in transmission or maintenance of bacteria and genes that convey antimicrobial resistance?
2. How have genomics been used to contribute to surveillance for AMR in Enterococcus spp?
3. How related are E. faecium and E. faecalis isolated from different sources?
4. What is the distribution of specific mobile genetic elements and AMR genes in E. faecium and E. faecalis across different sources?
5. How are AMR phenotypes and genotypes associated?

OUR APPROACH

We use a One Health approach to investigate this issue. We will complete a scoping review as well as use comparative genomics, molecular epidemiology, and sophisticated bioinformatics tools with an extensive “One Health” collection of enterococci from humans, livestock, poultry, sewage, surface water, lagoons, and meat processing plants. In addition, use of an integrated assessment model and other epidemiologic techniques will be used to look at specific associations between outcomes and risk factors.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Agriculture and Agri-Food Canada • Alberta Agriculture and Forestry • Alberta Graduate Excellence Scholarships • Genomics Research and Development Initiative • Natural Sciences and Engineering Research Council of Canada • Public Health Agency of Canada • University of Calgary, Faculty of Veterinary Medicine: One Health Training Award; VMS Recruitment Award

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Identification of new tools for the management AMR throughout the One Health environment
- Validate tools and develop operating procedures for adoption by industry

HIGHLY QUALIFIED PERSONNEL

- 1 Postdoc Fellow
- 2 PhD
- 1 MSc
- 1 Summer Student

AFFILIATIONS: University of Calgary; University of Lethbridge; University of Alberta; University of Saskatchewan; Public Health Agency of Canada; Agriculture and Agri-Food Canada

Alberta Government

CONTACT INFORMATION: Sylvia Checkley (slcheckl@ucalgary.ca)

PROJECT SNAPSHOT

3D: Lineage Analysis of Clinical Isolates of Mycobacterium tuberculosis in Alberta

Pillar: Surveillance

Theme: Policy, Economics & Sustainability

Keywords: Tuberculosis; Drug Resistance; Epidemiology

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Gregory J. Tyrrell, PhD, FCCM, D(ABMM)

CO-INVESTIGATOR(S): Linda Chui, PhD; Ryan Cooper, MD.

AIM

The project focuses on determining the global lineage of TB cases that have occurred in Alberta from 2013 to current. Emphasis will be placed on those TB isolates that display drug resistance.

WHY IS THIS IMPORTANT?

Alberta is experiencing increases in drug resistant TB. Greater than 90% of TB cases occur in the foreign born suggesting Alberta experiences a high rate of imported TB. We do not know what lineages of TB constitute our greatest numbers of cases or which lineages are contributing to the highest rates of drug resistant TB in Alberta.

OUTCOMES

It is expected that specific lineages will be identified that have a higher antimycobacterial drug resistance than others. The data generated will allow Alberta to actively be a part of the global TB community through providing a clear understanding of what TB lineages are affecting Albertans.

RESEARCH QUESTIONS

1. What TB lineages are present in Alberta?
2. What are the predominant TB drug resistant lineages?
3. Are there unrecognized TB clusters in Alberta and are they drug resistant?
4. Where else do the lineages seen in Alberta appear globally?

OUR APPROACH

TB isolates will be analyzed and the resulting data will be used to identify global lineages of TB. We will initially focus on understanding the lineages of drug resistant TB. Major and minor TB lineages will be identified using on line TB lineage analysis tools. In addition, all drug resistance data will be accessed through the APL-Public Health and drug resistant lineages identified. This data will be linked to clinical presentation of cases.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Alberta Precision Laboratories • National Microbiology Laboratory

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- The knowledge learned from this work will be used by physicians in TB Services who care for TB patients as well as the National and Global TB communities with respect to understanding how TB in Alberta relates to the rest to the world.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 0.5 Postdoctoral Fellow (will also be linked with the Provincial antibiogram program)

AFFILIATIONS: University of Alberta • Alberta Precision Laboratories – Leaders in Laboratory Medicine • Alberta Health Services

Alberta Government

CONTACT INFORMATION: Greg Tyrrell (gjt@ualberta.ca)

PROJECT SNAPSHOT

3E: Development of a Single Human Antibiogram for Alberta

Pillar: Surveillance

Theme: Innovation and Commercialization

Keywords: Antimicrobial Resistance; Antibiogram; Surveillance

PRINCIPAL INVESTIGATOR: Tanis Dingle, PhD, D(ABMM), FCCM

CO-INVESTIGATOR(S): Greg Tyrrell, PhD, FCCM

AIM

The primary goal of this project is to collate antimicrobial susceptibility testing data from the clinical microbiology laboratories in the province and generate a single provincial antibiogram accessible to researchers and health care professionals in Alberta.

WHY IS THIS IMPORTANT?

Understanding the antibiotic resistance rates of bacterial pathogens is critical information for clinicians treating patients. While antibiograms (i.e. antimicrobial susceptibility profiles for individual bacterial pathogens) exist in Alberta there is no one overarching antibiogram for the province as a whole. The work funded here will target the development of a provincial antibiogram in Alberta.

OUTCOMES

1. A public-facing, interactive, provincial antibiogram to help guide AMR Research Scientists on the most important human AMR issues in Alberta to tackle.
2. Generate valuable human AMR surveillance data from Alberta over time. 3) Link Alberta data into National Surveillance Programs (AMRNet, for example).

RESEARCH QUESTIONS

1. What are the provincial antibiotic resistance rates for the most commonly encountered human bacterial pathogens?
2. Do these antibiotic resistance rates vary by zone, age range or specimen type?
3. Are resistance rates changing over time?

OUR APPROACH

Data from the Laboratory Information Systems (LIS) from across the province will first be combined into a format that can be easily analyzed. The data will be analyzed according to Clinical and Laboratory Standards Institute guidelines (M39 document). The antibiogram will be presented in a public-facing, interactive, Tableau dashboard.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Antimicrobial susceptibility data is produced daily in laboratories across the province. This data is provided in-kind to this project.

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- The province-wide antibiogram will be shared publicly for use by research scientists and healthcare professionals. A tableau dashboard will be used as a platform to display the data.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- The PI is in charge of Antimicrobial Resistance Surveillance at APL - Public Health Laboratory.
- 0.5FTE Postdoctoral Fellow
- 0.5FTE is shared with Project 3D

AFFILIATIONS: University of Calgary; Alberta Precision Laboratories – Leaders in Laboratory Medicine; University of Alberta

CONTACT INFORMATION: Tanis Dingle (tanis.dingle@ucalgary.ca)

PROJECT SNAPSHOT

3F: COVID-19 and AMR: A Systematic Review and Policy Brief

Pillar: Surveillance

Theme: Education & Societal Impact

Keywords: Antimicrobial Resistance; COVID-19; Antimicrobial Stewardship

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Herman Barkema, PhD, DVM

CO-INVESTIGATOR(S): Ruwandi Kariyawasam, PhD; Greg Tyrrell, PhD; Tanis Dingle, PhD; John Conly, MD

AIM

The focus of this project is to understand the overall incidence of antimicrobial resistance during COVID-19 by taking a systematic approach to synthesizing the literature.

WHY IS THIS IMPORTANT?

We know there is significant and widespread use of antibiotics in patients with and without COVID-19. This widespread use has implications for antimicrobial resistance (AMR) and could potentially threaten global efforts to control AMR. Tracking available AMR data can help inform antimicrobial stewardship during and after the COVID-19 pandemic.

OUTCOMES

The rate of antimicrobial utilization during COVID-19.

RESEARCH QUESTION

What is the prevalence of antimicrobial resistance in co-infected COVID-19 patients?

OUR APPROACH

We will conduct a systematic review looking at AMR incidence during COVID-19 to ideally inform our current practices and policies surrounding antimicrobial stewardship.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- We will create a policy brief to convey major findings from our systematic review.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 2 Postdoctoral Fellows
- 2 MSc

AFFILIATIONS: University of Alberta; University of Calgary

CONTACT INFORMATION: Herman Barkema (barkema@ucalgary.ca)

Alberta Government

PROJECT SNAPSHOT

3G: Impact of the Cefazolin Inoculum Effect in Patients with Methicillin Susceptible Staphylococcus Aureus Infections in Alberta

Pillar: Treatment Optimization

Theme: Education & Societal Impact

Keywords: Cefazolin Inoculum Effect; Antimicrobial Resistance; Staphylococcus Aureus

PRINCIPAL INVESTIGATOR: Tanis Dingle, PhD

COLLABORATOR: Daniel Gregson, MD

AIM

To understand the impact of the cefazolin inoculum effect (CIE) in methicillin-susceptible Staphylococcus aureus (MSSA) on clinical outcomes of Alberta patients.

WHY IS THIS IMPORTANT?

MSSA infections are associated with significant morbidity and mortality. Anti-staphylococcal penicillins, such as cloxacillin, and cefazolin remain the primary treatments for MSSA infections including bacteremia and infective endocarditis. The CIE is an antimicrobial resistance mechanism found in some MSSA isolates harbouring the BlaZ B-lactamase enzyme. When present, the CIE causes minimum inhibitory concentrations to cefazolin to be elevated in proportion to the number of bacteria present in the inoculum. The presence of the CIE can cause treatment failure and has been associated with increased disease severity and mortality in a handful of studies. In a recent study testing sterile-site MSSA isolates from 7 laboratories across North America for the CIE, 0-26% of isolates were positive depending on site (n=307, manuscript in preparation by T. Dingle). The only Canadian site, the University of Alberta Hospital, had the highest positivity rate at 26% (11/43 isolates). The impact of the presence of the CIE in North American MSSA isolates is unknown as laboratories do not routinely perform testing for the CIE.

OUTCOMES

The primary outcome will be a better understanding of the prevalence of the CIE in Alberta sterile-site MSSA infections and how that impacts clinical outcomes.

RESEARCH QUESTION

Sterile-site infections with MSSA isolates that are positive for the cefazolin inoculum effect are associated with increased patient morbidity and mortality compared to infections caused by MSSA isolates without the cefazolin inoculum effect in Alberta patients.

OUR APPROACH

Our approach to this project will be two-fold: 1) Test additional sterile-site MSSA isolates for the CIE to increase the power of the clinical outcomes portion of the study. Additional isolates will be pulled from the UAH Microbiology Laboratory. In addition, an APL-Calgary collaborator will be identified in order to incorporate Calgary patients into the study. 2) Assess clinical outcomes by performing a chart review of patients with sterile-site MSSA infections with and without the CIE. Charts from the patients with characterized isolates from the previous study (UAH patients) will be reviewed in addition to those identified in 1).

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

MSSA isolates will be provided in-kind from both Calgary and Edmonton laboratories for CIE characterization.

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Results from this project will be shared in peer-reviewed publication and infectious diseases colleagues.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- Postdoctoral Fellow (hired under Project 3D & 3E)
- Summer student

AFFILIATIONS: UNIVERSITY OF ALBERTA

CONTACT INFORMATION: Tanis Dingle (tanis.dingle@ucalgary.ca)

PROJECT SNAPSHOT

4A: Does Antibiotic Use and Wastewater Treatment Encourage the Development of Antimicrobial Resistance?

Pillar: Prevention of Transmission

Theme: Innovation and Commercialization

Keywords: Wastewater; Treatment; Disinfection; Horizontal Gene Transmission; AMR Evolution

PRINCIPAL INVESTIGATOR: Leland Jackson, PhD

CO-INVESTIGATOR(S): Gopal Achari, PhD; Tao Dong, PhD

AIM

The goal of this project is to understand if current wastewater treatment and disinfection processes are encouraging the development of antimicrobial resistance within wastewater treatment facilities and whether receiving environments act as reservoirs for antimicrobial elements.

WHY IS THIS IMPORTANT?

If treatment processes encourage or facilitate antimicrobial resistance development, changes to those processes or the addition of new disinfection strategies will be required to protect environmental and human health. This is particularly relevant to the development of water reuse strategies and options.

OUTCOMES

1. An understanding of the risk of current treatment and disinfection processes to facilitate AMR development
2. An understanding of the role of receiving environments as reservoirs for AMR elements (genes, bacteria)

RESEARCH QUESTIONS

1. What ozone (O3) dose and contact times lead to complete wastewater disinfection?
2. What bacteria survive current O3 dosing regimes?
3. What variation of AMR is present in municipal wastewater treatment plants and their receiving environments?
4. What are the rates of horizontal gene transmission in environmental reservoirs?

OUR APPROACH

1. We will manipulate the O3 dose and contact times, followed by the measurement of wastewater disinfection endpoints. We will then identify treatment survivors (species or functional groups).
2. We will survey wastewater treatment plants and agricultural (dairy and beef) operation's wastewater isolates for antimicrobial resistance.
3. We will grow periphyton communities on unglazed tiles in replicated, naturalized research streams to evaluate the changes in antimicrobial elements over time.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Department of Biological Sciences, Department of Civil Engineering and Faculty of Veterinary Medicine, University of Calgary • Alberta Innovates

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Recommendations regarding ozone dose and contact times plus quantification of the nature and amount of antimicrobial resistance, including antibiotic resistance, will be translated to utilities and regulators.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 4 PhD
- 4 Summer BSc Research Associates

AFFILIATIONS: ACWA Advancing Canadian Wastewater Assets An Urban Alliance initiative; University of Calgary; Lakeland College; Olds College 1913

Alberta Government

CONTACT INFORMATION: Leland Jackson (ljackson@ucalgary.ca)

PROJECT SNAPSHOT

4B: Structure and Function Study of Glycopeptides as Anti-adhesive Agent

Pillar: Prevention of Transmission
Theme: Innovation and Commercialization
Keywords: Ovomucin; Glycopeptide; Anti-adhesive Agent; Piglet

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Jianping Wu, PhD

CO-INVESTIGATOR(S): Michael Gänzle, PhD; Ruurd Zijlstra, PhD

AIM

The aim of this project is to develop egg protein derived glycopeptides as an anti-adhesive agent against swine infection. The focus is to test the efficacy of glycopeptides in a swine infection model.

WHY IS THIS IMPORTANT?

Infection of piglets with enterotoxigenic Escherichia coli (ETEC) is a major cause of diarrhea, leading to significant economic losses in pig production. Using antibiotic such as Colistin is known to cause highly resistant E.coli in swine.

OUTCOMES

1. A method to prepare glycopeptides from egg protein.
2. An anti-ahdesive agent with potential use as an alternative to antibiotics.

RESEARCH QUESTIONS

Can glycopeptides derived from ovomucin be applicable as an antibiotic alternative?

1. How to prepare glycopeptides?
2. How to determine the anti-adhesive activity in cells?
3. Will glycopeptides be effective in piglet model?
4. Will genes coding for resistant be reduced after the treatment?

OUR APPROACH

Glycopeptides will be prepared from egg white protein ovomucin, and then validated in piglet models in 5 groups: positive control (antibiotic), negative control, glycopeptides, probiotics, glycopeptides with probiotics.

1. Ovomucin will be first extracted from egg white and then glyopeptides will be prepared using proteolysis method
2. Anti-adhesive activity of glycopeptides will be studied in porcine endothelial cell with pathogen
3. Efficacy of glycopeptides will be validated in piglet models 4. Sequencing the fecal metagenome will be performed.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

CRC • China Scholarship Council • Egg Farmers of Canada • Natural Sciences and Engineering Research Council of Canada

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- New alternatives to antibiotics
- Reduced antibiotic resistance

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 2 PhD
- 1 MSc

AFFILIATIONS: Egg Farmers of Canada – Dedicated to Quality; China Scholarship Council; University of Alberta; NSERC CRSNG

Alberta Government

CONTACT INFORMATION: Jianping Wu (jwu3@ualberta.ca)

PROJECT SNAPSHOT

4C: Reducing Antimicrobial Use by Selecting for Animals More Resilient to Infectious Disease

Pillar: Prevention of Transmission

Theme: Innovation and Commercialization

Keywords: Host Animal; Microbiota; Genetics; Immunity; Resilience

PRINCIPAL INVESTIGATOR: Graham Plastow, PhD

CO-INVESTIGATOR(S): Michael Dyck, PhD; Paul Stothard, PhD; Ben Willing, PhD; Leluo Guan, PhD; Tim McAllister, PhD; Trevor Alexander, PhD

AIM

Animals show variation in susceptibility to specific diseases. This variation could potentially be targeted to select for animals that are more resilient to infection. This project aims to identify methods of identifying resilient animals.

WHY IS THIS IMPORTANT?

Disease resilient animals have improved animal health and welfare, while maintaining performance and reducing antimicrobial use (AMU) after infection. They require fewer antimicrobial treatments to reach market weight or to produce eggs and milk. The selection of disease resilient animals has the potential to increase the sustainability and competitiveness of livestock agriculture in Canada.

OUTCOMES

1. New tools to identify disease resilient animals for use in the selection or management of livestock to help reduce AMU.
2. New knowledge of disease resilience mechanisms.
3. Microbial populations that support resilience and can be targeted as probiotics.

RESEARCH QUESTIONS

1. Can disease resilience be predicted in healthy animals from new phenotypes?
2. How to apply these phenotypes to develop selection tools? (e.g. genomic selection).
3. Can tools be developed to improve the management of susceptible animals? (e.g. targeted treatment of individuals vs. the population).

OUR APPROACH

1. A natural disease challenge model for pigs will be used to mimic commercial disease exposure. Samples and phenotypes are collected to identify and predict resilient animals in high health units.
2. High throughput multiomic tools will be used to study variation in susceptibility to disease. Case control studies of field samples will be used, e.g. for Bovine Respiratory Disease.
3. Analysis of omics data will be done to determine associations of disease response (resilience vs susceptibility) with the potential to screen for resilience and identify performance outcomes in young animals.
4. Leveraging links across the Consortium to obtain new funding support. This includes the use of samples from Project 5B.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Agriculture Funding Consortium (RDAR and Alberta Innovates) • Beef Cattle Research Council • Genome Alberta • Genome Canada • PigGen Canada • University of Alberta, University of Calgary and Agriculture and Agri-Food Canada Infrastructure • USDA National Institute of Food and Agriculture (with Iowa State University)

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Identification of new tools for the management of groups and individuals based on their genetics.
- Validate tools and develop operating procedures for adoption by industry.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 Research Assistant (Project Manager)
- Other HQP trained within the associated projects (e.g. 1 Technician, 1 summer student, 2 PhDs, 2 Postdoctoral Fellows)

AFFILIATIONS: University of Alberta; University of Calgary; Agriculture and Agri-Food Canada

CONTACT INFORMATION: Graham Plastow (plastow@ualberta.ca)

PROJECT SNAPSHOT

4D: Identification Of Novel Group B Streptococcal Proteins Associated With Virulence

Pillar: Prevention of Transmission

Theme: Innovation and Commercialization

Keywords: Group B Streptococcus; Virulence; Antibiotic Resistance

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Gregory J. Tyrrell, PhD, FCCM, D(ABMM)

AIM

1. Identify and characterize novel GBS proteins involved in virulence. Identification of novel GBS proteins will be explored as potential GBS vaccine candidates.
2. Understand GBS macrolide resistance in Alberta and the mechanisms associated with this resistance.

WHY IS THIS IMPORTANT?

GBS causes invasive disease in both adults and neonates; however, it is in the neonate that the invasive disease is the most devastating. Understanding the mechanisms involved in GBS pathogenesis will allow for novel targeted therapies to be developed.

OUTCOMES

1. Identification of novel GBS proteins associated with virulence (two proteins have already been identified).
2. Determination if identified proteins are protective in an animal model of disease.
3. Publication of GBS antibiotic resistance rates for Alberta with updated recommendations for antibiotic prophylaxis for pregnant women.

RESEARCH QUESTIONS

1. Are there novel GBS proteins associated with virulence that have the potential to be protective vaccine candidates in animal models?
2. What are the current rates of antibiotic resistance in GBS, most notably erythromycin and clindamycin resistance rates, and do these rates warrant recommendation changes in Alberta?

OUR APPROACH

Our approach will be three-fold:

1. Mutagenesis and mass spectroscopy
2. In vitro and in vivo virulence assays
3. Antimicrobial susceptibility assays and PCR for detection of genes associated with resistance

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Alberta Precision Laboratories-Public Health (ProvLab) • Canada Foundation for Innovation •Tyrrell - General Research Funds

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Input of funds will help in identifying potential new targets for preventing invasive GBS disease.
- In addition, funds will help in identifying whether GBS antibiotic prophylaxis recommendations need to be adjusted in Alberta.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 Postdoc Fellow
- PhD

AFFILIATIONS: University of Alberta; Alberta Health Services; Alberta Precision Laboratories – Leaders in Laboratory Medicine

Alberta Government

CONTACT INFORMATION: Greg Tyrrell (gjt@ualberta.ca)

PROJECT SNAPSHOT

4E: Understanding the Epidemiology of Invasive StrepA in Alberta Leading to the Development of Novel Therapeutic and Prevention Strategies

Pillar: Prevention of Transmission

Theme: Innovation and Commercialization

Keywords: Invasive StrepA

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Michael Good, MD, PhD; Gregory Tyrrell, PhD, FCCM, D(ABMM)

CO-INVESTIGATOR(S): Matthew Croxen, PhD

AIM

We will develop a clear understanding of the epidemiology of invasive Group A streptococcal disease in Alberta. We will understand the circulating strains, their antibiotic resistance, their toxin profiles, and the populations most severly affected. This information will aid in laying the ground work for a vaccine trail in 2020.

WHY IS THIS IMPORTANT?

This information is important in guiding a planned StrepA vaccine trail and in trailing new experimental therapies for invasive Group A streptococcal disease.

OUTCOMES

This work will provide the needed information to generate targeted tools such as specific antibodies against these StrepA proteins thereby potentially treating invasive StrepA disease.

RESEARCH QUESTIONS

1. Of the various StrepA emm types circulating in Alberta, how close of a match are they to current experimental vaccines?
2. What are the superantigen toxin profiles of circulating StrepA in Alberta?
3. In addition to the above, have the antibiotic resistance rates of StrepA changed significantly in the last 10 years, focusing on erythromycin and clindamycin resistance?

OUR APPROACH

1. Whole genome sequencing of circulating invasive StrepA isolates.
2. Bioinformatics analysis of genomic data for StrepA isolates.
3. Determination of erythromycin and clindamycin susceptibility rates in Alberta and identification of mechanisms utilizing bioinformatics data.
4. Clinical trail of an experimental StrepA vaccine in early 2020.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Alberta Precision Laboratories-Public Health (ProvLab) • Li Ka Shing Institute •Tyrrell - General Research Funds

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Will provide much needed data regarding the recent increase in the rates of iStrepA in Alberta..
- Will lead to new therapuetic stratgies for the treatment and prevention of iStrepA disease.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- Currently recruiting one PhD student.

AFFILIATIONS: University of Alberta • Griffith University • Alberta Precision Laboratories – Leaders in Laboratory Medicine

CONTACT INFORMATION: Greg Tyrrell (gjt@ualberta.ca) & Michael Good (michael.good@griffith.edu.au)

Alberta Government

PROJECT SNAPSHOT

5A: Development of Firstline DVM: An iOS and Android "App" for Veterinary Stewardship WHO Essential Antibacterials "App" Development

Pillar: Treatment Optimization

Theme: Education and Societal Impact

Keywords: One Health; Antimicrobial Stewardship; Application; Veterinary Medicine

PRINCIPAL INVESTIGATOR: John Conly, MD[1,2,3]

CO-INVESTIGATOR(S): Karin Orsel, DVM, PhD[1]; Herman Barkema, DVM, PhD[1]; Scott Weese[1], DVM ; Holly Hoang[3], MD

AIM

1. To promote optimal use of antibiotics for selected veterinary species-specific syndromes with Canadian or provincially specific guidelines.
2. To facilitate collaboration and management of the WHO essential medicine antibacterial list by syndrome content and to develop a tele-stewardship platform in Alberta.

WHY IS THIS IMPORTANT?

Appropriate use of antibiotics from a One Health perspective may diminish bacteria becoming resistant to antibiotics. Use of algorithmic apps and tele-stewardship represent novel platforms.

OUTCOMES

Improve optimal selection of antibiotics for appropriate syndromes within a One Health lens.

RESEARCH QUESTIONS

1. Can an antibacterial algorithmic app be developed for selected species-specific syndromes guidelines for veterinary settings?
2. Can the WHO essential medicine antibacterial list deployment by syndrome content (21 syndromes in adults and children/5 specific childhood infections and 3 STIs) be facilitated by app development?
3. Can we build a platform to enable capacity building by developing the Alberta Tele-stewardship Network?

OUR APPROACH

Investigators in Calgary, Edmonton, and Guelph, with the aid of software consultants in BC and tele-stewardship personnel within AHS, will be working to facilitate appropriate syndromic specific prescribing using modern platforms and appropriate guidelines.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Alberta Health Services • Canadian Institutes of Health Research Joint Programming Initiative on Antimicrobial Resistance • World Health Organization

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Modelling the app after the successful Firstline Calgary app.
- Capacity building for stewardship in remote areas.
- Collaboration with the CVMA and Firstline Clinical to co-design and implement a veterinary antimicrobial stewardship (AS) app, which was completed and launched in November 2021.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1.5 Research Associates
- Firstline Software Developers

AFFILIATIONS:

CONTACT INFORMATION: John Conly (john.conly@ahs.ca)

PROJECT SNAPSHOT

5B: Health Impacts of Optimized Pre-conditioning in Beef Cattle

Pillar: Antibiotic Optimization

Theme: Education and Societal Impact

Keywords: Antimicrobial Use; Beef Cattle; Pre-Conditioning

PRINCIPAL INVESTIGATOR: Karin Orsel, DVM, PhD

CO-INVESTIGATOR(S): Ed Pajor, PhD; Frank van der Meer, DVM, PhD; Kathy Larson, MSc; Sean Thompson, MSc, PAg; Trevor Alexander, PhD; Henry An, PhD

AIM

The focus of this project is to evaluate the impact of pre-conditioning on performance, health, and welfare of calves in the feedlot. We aim to add to the body of evidence regarding the costs and benefits of pre-conditioning as it relates to disease prevention and reduced antimicrobial use.

WHY IS THIS IMPORTANT?

Bovine Respiratory Disease (BRD) is a common disorder, and it requires the use of antimicrobials. Evidence in support of BRD risk reduction can promote pre-conditioning which is currently not a well-adopted practice.

OUTCOMES

We will be able to collect data on the morbidity, mortality, and performance of pre-conditioned calves when commingling with conventionally raised calves. We will gain an understanding of microbiome development under different circumstances.

RESEARCH QUESTIONS

1. What is the impact of optimized pre-conditioning on calf health outcomes in conventional feedlot environments?
2. Does the economic benefits from pre-conditioning erode when commingling occurs?
3. What is the impact of pre-conditioning on microbiome development?

OUR APPROACH

Pre-conditioned calves (optimized vaccination, timing of interventions, and weaning strategy), will be placed in feedlot pens in different ratios with conventionally raised calves. Data will be collected on:

1. Morbidity and mortality
2. Respiratory microbiome
3. Economic parameters, such as cost-benefit

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Anderson-Chisholm Chair for Animal Care and Welfare • Natural Sciences and Engineering Research Council of Canada • Olds College in-kind • Results Driven Agriculture Research (RDAR) • Simpson Chair for Beef Cattle Health and Wellness • University of Calgary UCVM in-kind

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Change in beef practices
- Increased animal welfare
- Alternatives to antimicrobial use

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 PhD
- 4 Masters as graduate students
- 2 Animal Health Technicians at Olds College
- Undergraduate students

AFFILIATIONS: University of Calgary; Olds College 1913; Agriculture and Agri-Food Canada; University of Alberta

CONTACT INFORMATION: Karin Orsel (karin.orsel@ucalgary.ca)

Alberta Government

PROJECT SNAPSHOT

6A: Reducing Inappropriate Antibiotic Prescribing in Emergency Departments and in Primary Care Settings in Alberta

Pillar: Surveillance

Theme: Education & Societal Impact

Keywords: Pediatric; Urinary tract infection; Antimicrobial stewardship

PRINCIPAL INVESTIGATOR: Joan Robinson, MD

CO-INVESTIGATOR(S): Cora Constantinescu, MD; Alena Tse-Chang, MD

AIM

The focus of this project is promoting optimal use of antibiotics when children or adults are seen in a clinic or in an emergency department with a common bacterial infection.

WHY IS THIS IMPORTANT?

Overuse of antibiotics leads to bacteria becoming resistant to these antibiotics. We need more research on how to convince doctors that they can practice safely without overusing antibiotics.

OUTCOMES

Doctors will prescribe the right antibiotic for the right duration in children with pneumonia or urinary tract infections and will not prescribe antibiotics for children or adults with viral respiratory tract infections.

RESEARCH QUESTION

What type and duration of antibiotics are prescribed for children discharged from the ED with suspected UTI or pneumonia?

OUR APPROACH

Investigators in Edmonton and Calgary will be working together to improve use of antibiotics. Most antibiotics are prescribed in clinics or in Emergency Departments but most previous studies have focused on use of antibiotics in patients admitted to hospital. Current practice will be determined by reviewing recent cases. Doctors will be sent a comparison of what they do, what other doctors do and what guidelines recommend. Data will be collected again to see if the doctors improve. If not, we will meet with them to discuss what might work and will then give that a try. Data will then be collected again to see if that worked.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

University of Alberta and University of Calgary Departments of Pediatrics (Infrastructure)

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- A formal program to rationalize antibiotic use will be established and evaluated as a means of translating the knoweldge gained into practice

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 MSc
- 1 Research Assistant
- 2 Research Scientists
- Medical students or residents will be involved in data analysis and in designing the interventions

AFFILIATIONS: University of Alberta; University of Calgary

CONTACT INFORMATION: Joan Robinson (jr3@ualberta.ca)

PROJECT SNAPSHOT

6B: Reducing Inappropriate Improving Antibiotic Stewardship in Primary Care Clinics: A Co-design Approach

Pillar: Surveillance

Theme: Education & Societal Impact

Keywords: Antibiotic Prescribing; Stewardship; Primary Care; Appropriate Usage; Dispensing

PRINCIPAL INVESTIGATOR: Myles Leslie, PhD

CO-INVESTIGATOR(S): Lee A Green, MD

AIM

This project will provide the first provincial-level analysis of appropriateness of antibiotic prescribing in Alberta's primary care settings. The project aims to link provincial diagnostic data with prescription dispensing data to gain a better understanding of Albertan family doctors' antibiotic stewardship practices. Aiming long-term to work with Alberta's Primary Care Networks (PCNs), the project has the potential to provide more granular analyses of, and interventions into, primary care provider antibiotic prescribing decisions.

WHY IS THIS IMPORTANT?

Understanding the patterns of antibiotic prescribing in Alberta's primary care is an essential first step in designing and implementing evidence-based programs to improve antibiotic stewardship in the province. Further, documenting the rates of 'inappropriate' antibiotic prescribing both at a provincial and, eventually, at the PCN-level will give insight into primary care's relationship to AMR in Alberta. Developing a collaborative relationship with PCNs – the most impactful organizations in primary care – is an important first step towards improving stewardship amongst primary care providers.

OUTCOMES

Our project will produce a comprehensive analysis looking at the appropriateness of antibiotic prescribing in Alberta's adult primary care practices. Beginning relationships with PCN partners, the project will set the groundwork for future, local-level projects to understand, and intervene to improve, prescribing patterns.

RESEARCH QUESTIONS

1. What are the patterns of antibiotic prescribing in adult primary care settings in Alberta?
2. What proportion of Albertan family physicians are prescribing antibiotics 'appropriately'?
3. Which antibiotic drugs are most commonly prescribed inappropriately by family physicians in Alberta?
4. How severe is the problem of inappropriate prescribing of antibiotics in adult family medicine in Alberta, and what contribution does this make to AMR in the province?

OUR APPROACH

Researchers and quality improvement experts from the University of Calgary (UofC), the Clinical Research Unit (CRU), and the University of Alberta (UofA) will be working together with administrative data provided by Alberta Health (AH) and, over time, from partner PCNs.

Our teams will analyse the data provided by AH and replicate a methodology from a US-based study to detail the levels of appropriateness in prescribing. This will be done with a method that links provider diagnostic billing codes to prescriptions dispensed to patients within a certain 'lookback' window of time.

Looking forward, to working with PCN-level data, our team will engage with quality and practice improvement managers to extract data from local electronic medical records (EMRs). This will allow for links to be established between provider diagnostic codes and written prescriptions within PCNs. Our team will work with PCNs and their member-providers to develop quality improvement programs that target antibiotic stewardship based on this evidence.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

University of Alberta Dept. of Family Medicine (expert input & advice) • University of Calgary Clinical Research Unit (analytic expertise & tools) • University of Calgary School of Public Policy (Infrastructure) • Data from EMRs at various partner PCNs

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- We will work in conjunction with data from Alberta Health and, longer-term, with provincial PCNs to produce a comprehensive snapshot of antibiotic stewardship in primary care. This data will be shared and form the basis of quality improvement programs targeting prescribing with PCNs and other partners in the province.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 2 Research Associates (SPP)
- 1 Research Scientist (CRU)

AFFILIATIONS:

CONTACT INFORMATION: Myles Leslie (myles.leslie@ucalgary.ca)

PROJECT SNAPSHOT

7A: Identification of Sociotechnical System Elements, to Inform Knowledge Products and Internet of Things (IoT) Innovations

Pillar: Prevention of Transmission

Theme: Education & Societal Impact

Keywords: Human Factors; Information Design

PRINCIPAL INVESTIGATOR: John M. Conly, MD
CO-INVESTIGATOR(S): Brian Traynor

AIM

The aim of this research is to apply human factors in the design and evaluation of sociotechnical systems. Also, we aim to implement Internet of Things (IoT) enabled design strategies for surveillance, behaviour change, and education.

WHY IS THIS IMPORTANT?

There is currently a lack of understanding of the sociotechnical factors associated with antibiotics. The systems approach is meant to generate knowledge applicable to all system stakeholders (e.g. health care professionals, policy makers, technology developers, end-users).

OUTCOMES

1. Knowledge translation through interaction/information design.
2. An increase in system knowledge among stakeholders.
3. Develop a real-time, open-source system for data collection and management (e.g., keeping track of vaccines for cows).

RESEARCH QUESTIONS

1. What sociotechnical system elements influence the use of antibiotics in humans and food animals?
2. How can these characterizations be translated into knowledge products for key stakeholders within the system?
3. Can these knowledge products inform technology development opportunities to encourage behaviour change among key stakeholders?

OUR APPROACH

Apply Human Factors Methodologies to evaluate the interconnectedness of products, processes, and environments as they relate to AMR in a one health "system". The sociotechnical model reflects an emphasis on mixed-methods research to describe the barriers and facilitators to optimized system performance across individual, organizational, geographical, and cultural boundaries.

Internet of Things' enabled strategies capitalize on the ability to transform products, environments, and people into interconnected data sources through network-enabled sensing and monitoring technologies. These strategies enable novel applications of Interaction Design principles for behaviour change and surveillance.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Mount Royal University (Infrastructure) • W21C Human Factors in Healthcare Laboratory

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Knowledge in the form of information/ interaction design and open source software solutions meant to inform technology development opportunities that will encourage behaviour change.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 4 Research Associates (W21C)
- 4 Summer Students (3 Master of Biomedical Technology, 1 Information Design)
- Collaborative Input (WP5 - Treatment Optimization) from 3 Research Associates (1 PHD./DVM, I BHSc and 1 MA)

AFFILIATIONS: University of Calgary • Mount Royal University

Alberta Government

CONTACT INFORMATION: Brian Traynor (btraynor@mtroyal.ca)

PROJECT SNAPSHOT

8A: Antimicrobial Resistance and the Law

Pillar: Treatment Optimization
Theme: Policy, Economics & Sustainability
Keywords: Regulatory Strategies; Policy; Law

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Lorian Hardcastle, LLM/SJD, JD

AIM

The focus of this project is to identify regulatory strategies that may help to address AMR and to identify existing regulations that are a barrier to efforts to address AMR.

WHY IS THIS IMPORTANT?

Regulations can complement other strategies to address AMR and, through their enforcement, can compel the adoption of practices that would reduce AMR.

OUTCOMES

1. The legal literature on AMR is almost non-existent; this project would help to fill this gap.
2. To generate recommendations for policy-makers on using regulatory strategies to address AMR.

RESEARCH QUESTIONS

1. What regulatory strategies might Canada/Alberta employ to help address the issue of AMR?
2. What existing laws could be amended to help address the issue of AMR?

OUR APPROACH

Researchers will conduct a review of Canadian and international primary and secondary legal literature for regulations associated with AMR or regulatory opportunities to address AMR. Researchers will also review health policy literature, grey literature, and governmental documents for regulatory opportunities to address AMR.

Researchers will assess the feasibility of those regulatory strategies for the Canadian/Alberta context and explore how they may be adapted to fit that context.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

University of Calgary Faculty of Law

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Researchers will generate a report outlining the potential regulatory responses to AMR and present research findings to policy-makers.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 2 Research Assistants
- Future trainees will include a Masters Student and a Postdoc Fellow

AFFILIATIONS:

UNIVERSITY OF CALGARY

CONTACT INFORMATION:
Lorian Hardcastle (lorian.hardcastle@ucalgary.ca)

Alberta Government

PROJECT SNAPSHOT

8B: Canada's Role in Supporting Antibiotic R&D

Pillar: Treatment Optimization

Theme: Policy, Economics & Sustainability

Keywords: Antibiotics; Research and Development; Canada

PRINCIPAL INVESTIGATOR: Aidan Hollis, PhD

AIM

We aim to provide policy guidance for federal and provincial governments as to how Canada should support innovation in antibiotics.

WHY IS THIS IMPORTANT?

Many high-income countries are making significant investments in alternative mechanisms to support antibiotic R&D such as market entry rewards, CARB-X, and GARDP. Canada has stayed on the fringes of this international effort.

OUTCOMES

Research papers leading to policy journals that help inform Canadian policy-makers.

RESEARCH QUESTIONS

1. Among the international initiatives, which would be most effective for Canada to join?
2. How should we weigh direct Canadian industrial spin-off benefits relative to progress in antibiotic research?
3. Should Canada offer its own "made in Canada" solution?

OUR APPROACH

1. Literature review of international drug development mechanisms.
2. Structured interviews of policy makers in Canada and antibiotic organization management.
3. Extension of literature from other industrial R&D models.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Informing policy
- Partnership with the commercial sector

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 PhD
- 2 MSc

AFFILIATIONS: UNIVERSITY OF CALGARY

CONTACT INFORMATION: Aidan Hollis (ahollis@ucalgary.ca)

PROJECT SNAPSHOT

8C: Clostridioides difficile Near-Patient Testing Versus Centralized Laboratory Testing: A Cluster Randomized Trial

Pillar: Treatment Optimization

Theme: Policy, Economics & Sustainability

Keywords: Diagnostics; Nosocomial Diarrhea; Near-patient Testing; C. difficile

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Dylan Pillai, MD, PhD

CO-INVESTIGATOR(S): Aidan Hollis, PhD; Jenine Leal, PhD; Eldon Spackman, PhD; Oscar Larios, MD; Jospeh Kim, MD

AIM

The focus of this project is to investigate through implementation the clinical and economic impact of decentralizing C. difficile testing from a centralized regional laboratory to near-patient.

WHY IS THIS IMPORTANT?

By moving C. difficile diagnostics to near-patient testing the time required to report actionable results can be reduced. This has the potential to improve patient management and reduce unnecessary patient isolation and antibiotic use while ruling out a primary infectious cause of nosocomial diarrhea.

OUTCOMES

1. Quicker de-isolation of C. difficile negative patients in hospitals.
2. More targeted clinical treatments as a result of faster reported.
3. Negative diagnostic results.

RESEARCH QUESTIONS

1. Does near-patient testing meaningfully reduce unnecessary isolation time by shortening wait times for diagnostic results?
2. Are less antibiotics used when healthcare providers can more quickly rule out potential C. difficile infections?
3. Are clinical outcomes improved with C. difficile near-patient testing implementation?

OUR APPROACH

Calgary presents a unique opportunity to examine the effects of decentralizing C. difficile infection testing to near-patient. All inpatient care units at Foothills Hospital have been randomized to one of two study arms. The standard of care arm will continue to have samples tested at the central lab using SOP, while the near-patient testing arm will screen samples at Foothills Hospital (NPT) using a lateral flow assay with negatives results reported out immediately (positive samples still confirmed at the central lab). This is a cluster randomized crossover study and at study midpoint all patent care unit will switch to the opposite study arm.

Interim data prior to cross-over confirmed that NPT significantly reduced the time of patient isolation. Current efforts are focused on translating this to cost-savings if any and determining the change in antibiotic use with NPT.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Alberta Health Services, Alberta Precision Laboratories, Foothills Hospital, University of Calgary Cumming School of Medicine (Infrastructure) • CIHR Funding

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Evaluate the potential benefits and hurdles for potential wider integration of C. difficile near-patient testing in Alberta.
- Reduce unnecessary antibiotic use.
- Reduce the length of stay and the costs of isolation.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 PhD
- 2 MSc
- 0.5 MLA
- Broad multidisciplinary team involving medical staff, laboratory personnel, research, economics, epidemiology, management, and IPC

AFFILIATIONS: University of Calgary; Alberta Precision Laboratories — Leaders in Laboratory Medicine

Alberta Government

CONTACT INFORMATION: Dylan Pillai (dylan.pillai@albertaprecisionlabs.ca)

PROJECT SNAPSHOT

8D: Aligning Industry Incentives with AMR Control Goals: Exploring the Feasibility of an Antibiotic Susceptibility Bonus for Drugs to Treat Gram-negative Infection

Pillar: Treatment Optimization

Theme: Policy, Economics and Sustainability

Keywords: Antimicrobial Resistance; Antibiotics; Incentives; Pharmaceutical Industry

PRINCIPAL INVESTIGATOR: Aidan Hollis, PhD

CO-INVESTIGATOR(S): Stephan Harbarth, MD; Olof Lindahl, PhD

AIM

Large new financial incentives to accelerate antibiotic research and development are being considered. The proposed Antibiotic Sustainability Bonus would make some part of those payments conditional on sustained pathogen susceptibility.

WHY IS THIS IMPORTANT?

Appropriate incentives will help direct research to antimicrobials that have sustained effectiveness, and help companies to support stewardship.
The feasibility of this approach is not currently known.

OUTCOMES

Research papers that help guide government policy around market entry rewards for novel antibiotics.

RESEARCH QUESTIONS

1. How to best to assess whether a given antibiotic retains effectiveness?
2. How large would an antibiotic sustainability bonus have to be to affect behaviour?
3. How should measurements of susceptibility reflect use in different countries?

OUR APPROACH

1. We are exploring the range of existing international susceptibility measures, focusing on Gram-negative bacteria.
2. We are examining estimates of costs of drug development and clinical trials as well as recent antibiotic drug sales revenues.
3. We are examining the international distribution of antibiotic sales.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Joint Programming Initiative on Antimicrobial Resistance in collaboration with Canadian Institutes of Health Research

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- We hope that this project will help to inform policy around "market entry rewards" for new antibiotics.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 PhD

AFFILIATIONS: University of Calgary; jpiamr Joint Programming Initiative on Antimicrobial Resistance; Uppsala Universitet; HUG Hôpitaux Universitaires Genève

CONTACT INFORMATION: Aidan Hollis (ahollis@ucalgary.ca)

Alberta Government

PROJECT SNAPSHOT

9A: Wastewater treatment-adapted organisms as a model to understand environmental AMR

Pillar: Surveillance

Theme: Policy Economics and Sustainability

Keywords: Wastewater Effluents; Pathogens; Treatment; Resistance

PRINCIPAL INVESTIGATORS: Norm Neumann, PhD; Simon Otto, DVM, PhD
CO-INVESTIGATOR(S): Paul Stothard, PhD

AIM

To investigate a wastewater sample bank from Alberta to identify ESKAPE pathogens, with an initial focus on the coliforms Klebsiella spp., Enterobacter spp., and Citrobacter spp., to identify wastewater treatment resistance and AMR through whole genome sequencing.

WHY IS THIS IMPORTANT?

Drinking water treatment and waste sanitation are the most important public health intervention strategies for control of infectious diseases. Water treatment is recognized as the most cost-effective intervention for infectious disease control, but our research has demonstrated that there are strains of E. coli highly adapted to resist waste-water treatment and that these strains possess a variety of diverse and concerning AMR genes.

OUTCOME

Scientific information and data to inform the development and revision of current wastewater treatment guidelines at the provincial, national, and international levels.

RESEARCH QUESTIONS

1. Do treated wastewater effluents in Alberta contain strains of ESKAPE pathogens that are resistant to typical wastewater treatment mechanisms, such as chlorination, heat, and ozonation?
2. Do these strains possess AMR genes and phenotypic resistance?

OUR APPROACH

1. Develop an expanded library of Klebsiella spp., Enterobacter spp., and Citrobacter spp. from treated wastewater effluents.
2. Validate chlorine-, heat-, and antibiotic resistant phenotypes of isolates.
3. Comprehensive evaluation of whole genome sequencing (WGS) and comparative genomic and phenotypic analysis of chlorine-, heat-, and antibiotic resistance in clinically relevant strains of Klebsiella spp., Enterobacter spp., and Citrobacter spp. surviving water treatment.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Alberta Innovates grant • CIHR (Environments and Health Programmatic Grant in Intersectoral Prevention Research)

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Scientific publications and conference abstract presentations.
- Future interactions with municipal, provincial, and federal governments on wastewater reuse frameworks and guidelines.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 2 PhD
- 1 MSc
- 2 Research Assistants

AFFILIATIONS: UNIVERSITY OF ALBERTA CENTRE FOR HEALTHY COMMUNITIES, A CENTRE OF THE SCHOOL OF PUBLIC HEALTH; UNIVERSITY OF ALBERTA

CONTACT INFORMATION: Norm Neumann (nfneuman@ualberta.ca) and Simon Otto (simon.otto@ualberta.ca)

Alberta Government

PROJECT SNAPSHOT

10A: Implementation of Decolonization for Staphylococcus Aureus Prior to Hip and Knee Replacements in Alberta

Pillar: Prevention of Transmission

Theme: Policy, Economics and Sustainability

Keywords: Decolonization; Quality Improvement; Health Economics

PRINCIPAL INVESTIGATOR: Elissa Rennert-May, MD, MSc; Jenine Leal, PhD

CO-INVESTIGATOR(S): John Conly, MD; Stephanie Smith, MD, MSc; Shannon Puloski, MD; Braden Manns, MD, MSc; Myles Leslie, PhD

AIM

The purpose of this project is to study the implementation of a new decolonization protocol prior to hip and knee replacement in Alberta, as well as study relevant patient outcomes.

WHY IS THIS IMPORTANT?

There are an increasing number of hip and knee replacements annually in Alberta and with this we have seen a rise in the number of deep surgical site infections which are costly and result in poor quality of life. However, it is difficult to standardize changes to care across varying healthcare zones.

OUTCOME

Successful implementation of a decolonization protocol for Staphylococcus aureus prior to hip and knee replacement.

RESEARCH QUESTIONS

1. Is it possible to implement an effective decolonization protocol prior to knee and hip replacements?
2. Are the rates of resistance to topical antimicrobials affected by decolonization bundles?

OUR APPROACH

1. With the co-operation of the Alberta hip and knee clinics and the Alberta Bone and Joint Health Institute we will assess patient compliance with decolonization through secondary information sources.
2. Infection prevention and control surveillance will be used to capture infection rates.
3. Administrative costing data will be utilized to capture costs of patients who do and do not develop a complex surgical site infection.
4. The research microbiology laboratory will test isolates from patients who develop a complex surgical site infection to determine if resistance to topical antimicrobials has developed.
5. We are conducting qualitative focus groups with the Alberta hip and knee clinics and orthopedic surgeons to better understand challenges and barriers with implementing a decolonization protocol.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

3M • Infection Prevention and Control • University of Calgary Department of Medicine (Infrastructure)

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- This work will serve to inform best-practice pre-operative policy.
- This study will help understand barriers to implementing changes in care pathways across different health care zones.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 2 New Investigator Research Scientists
- Researchers from UofA and UofC
- 1 MSc
- 1 Summer Student
- 1 Research Associate
- 1 Research Analyst

AFFILIATIONS: University of Alberta • University of Calgary • Alberta Health Services

CONTACT INFORMATION: Elissa Rennert-May (elissa.rennertmay@ucalgary.ca) & Jenine Leal (jenine.leal@ucalgary.ca)

Alberta Government

PROJECT SNAPSHOT

10B: Economics of Reduced AMU in Swine and Beef Cattle

Pillar: Prevention of Transmission

Theme: Policy, Economics and Sustainability

Keywords: Antimicrobials; Livestock; Antibiotic Use

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Ellen Goddard, PhD, MSc, BSc

CO-INVESTIGATOR(S): Xiaoli Fan, PhD, MSc, BA

AIM

The focus of this projects is studying the economic implications of optimal use of antimicrobials in swine and beef production in Alberta.

WHY IS THIS IMPORTANT?

In Canada currently, 80% of antibiotic use is in livestock. We need to understand what the implications of current and potential future responses to regulations on livestock antibiotic use are likely to be in order to reduce the barrier to the adoption of these new restrictions.

OUTCOME

Livestock producers will actively participate in reducing their antimicrobial use, potentially reducing AMR in Alberta.

RESEARCH QUESTIONS

1. What are the behavioural responses to current and future restrictions on AMU in swine and beef supply chains?
2. How do the behavioural changes affect markets? (effects on productivity, consumption, trade, animal welfare, and AMR)

OUR APPROACH

We will use surveys and interviews to collect data from decision makers in the swine and beef supply chains (farmers, processors, and consumers) about their response to new and potential future AMU restrictions. We will then use models to understand how the regulations and behavioural responses impact farm level outcomes as well as to understand the effects of farm level AMU decisions on domestic and international market outcomes.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Related projects that share common elements, such as breeding for disease resilience in pigs, will be used to support the research • Genome Canada

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- The research outcomes will be used to identify policies that could be used to encourage AMU reductions and support farmers/industries in the production transitions.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 Postdoctoral Fellow
- 1 MSc

AFFILIATIONS: UNIVERSITY OF ALBERTA

CONTACT INFORMATION: Ellen Goddard (egoddard@ualberta.ca)

Alberta Government

PROJECT SNAPSHOT

10C: A Cost Analysis of the Effectiveness of Rapid Identification and Susceptibility Testing of Positive Blood Cultures

Pillar: Prevention of Transmission

Theme: Policy, Economics and Sustainability

Keywords: Antimicrobial Resistance; Bacteremia; Outcome; Costs; Rapid Diagnosis

AMR One Health Consortium

PRINCIPAL INVESTIGATOR: Daniel Gregson, MD

CO-INVESTIGATOR(S): Elissa Rennert-May, MD; Ranjani Somayaji, MD; John Conly, MD; Jenine Leal, PhD; Bruce Dalton, PharmD

AIM

The focus of this project is to determine the costs and outcomes in the management of bacterial bloodstream infections along with the effect of rapid diagnostic tests on these factors.

WHY IS THIS IMPORTANT?

Bacteremia is common in hospitalized patients with an increasing incidence of disease caused by drug-resistant pathogens resulting in high costs of hospitalization and poor outcomes. Rapid diagnostic tests have been utilized to provide faster identification and susceptibility of pathogens leading to a reduction in time to appropriate therapy.

OUTCOME

An understanding as to whether or not rapid diagnostic tests will lead to a reduction in time to appropriate therapy, reduced costs, and improved patient outcomes.

RESEARCH QUESTIONS

1. What are the attributable costs of bacteremia in hospitalized patients?
2. What is the cost effectiveness and outcomes of novel rapid diagnostic tests in identifying bacteremia and determining susceptibilities?
3. What are the clinical outcomes of bloodstream infections?

OUR APPROACH

1. Investigators in the Calgary Zone will use laboratory and clinical databases to compare those without bacteremia to those with bacteremia between 2011 and 2018. The costs associated with each episode of bacteremia will be analyzed to determine the incremental costs associated with bacteremia.
2. Cost effectiveness analysis models will be used to assess the impact of novel rapid diagnostic tests with standard microbiological testing methods implementing data garnered from the first research question.
3. Clinical outcomes such as mortality, length of hospitalization, antimicrobial usage, and quality-adjusted life years will be evaluated between the two groups.

ALIGNMENT WITH THE AMR - ONE HEALTH CONSORTIUM

LEVERAGED SOURCES OF SUPPORT

Alberta Precision Laboratories (Infrastructure & Database) • University of Calgary Department of Medicine (Infrastructure)

KNOWLEDGE & TECHNOLOGY EXCHANGE AND EXPLOITATION

- Evaluation of which rapid diagnostic tests to fund.
- Targeted antimicrobial therapy for those with drug-resistant bacteremia.
- Informing and improving patient care and outcome.

TRAINING OF HIGHLY QUALIFIED PERSONNEL

- 1 Medical Micobiologist
- 3 Early Investigator Research Scientists, including expertise in health economics and economic analyses
- 1 Infectious Diseases Fellow
- 1 Clinical PharmD
- 1 Biostatistician/Analyst

AFFILIATIONS: University of Calgary • Alberta Health Services

Alberta Government

CONTACT INFORMATION: Daniel Gregson (Dan.Gregson@albertaprecisionlabs.ca)