

# **LVIF Final Technical Report**

**Project title:** Veterinary vaccine fellowships for female post-docs in developing countries

**IDRC Project Number:** 109123

**Research Organizations involved in the study:** The Roslin Institute, University of Edinburgh, Easter Bush Campus, Midlothian, UK

**Location of Study:** UK

**By:** Dr Carly Hamilton, International Veterinary Vaccinology Network, The Roslin Institute, University of Edinburgh, Easter Bush Campus, Midlothian, UK

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## **Executive Summary**

Women continue to be underrepresented in science, particularly in low-and-middle income countries (LMICs). As part of efforts to address this challenge, the project team designed a fellowship programme specifically for women working in veterinary vaccinology in LMICs. The programme funded fellowship awards of up to £50,000 per fellowship to support the professional development of women in LMICs by enabling them to work with senior local and international mentors on a defined piece of research.

The project team designed a two-stage application process - the first part of the application process was a letter of intent stage which ensured proposals were within remit and importantly, gave applicants who had not yet identified a mentor the opportunity for the project team to assist them to find a mentor. The programme was advertised widely and the project team received 18 full stage applications. The applicants underwent peer review and were reviewed by both external and internal reviewers before a decision was made by the IVVN Network Management Board to fund a total of six fellowships (three of which are funded by the IDRC and will be the focus of this report). After issuing award letters and fellowship terms and conditions, all three IDRC-funded fellowships commenced on 1 December 2020. The project team conducted scientific and financial reporting at the halfway point and end of the fellowships to allow awardees to report on the progress of their projects and next steps.

Despite challenges faced by Covid-19, all three projects were a success and developed effective mentee-mentor relationships. All three projects delivered scientific results which are being prepared for publication in high-impact journals. Further outputs were wide-ranging and included presentation of projects and results at meetings, capacity building within their organisations, opportunities to train junior members of staff, follow on funding and importantly, continuing relationships with international and local mentors.

## **Research Problem**

Due to the underrepresentation of women in science in LMICs and the continued feedback from female IVVN members based in LMICs that mentoring is critical, this project awarded three fellowships to support the professional development of female post-doctoral researchers in LMICs. Fellowships enabled female post-doctoral researchers (Mentee) to work with both a local mentor within their current research organisation and an international mentor based in the UK or other institutes outside the Mentee's country.

The overall goal of the project was to build capacity of early career female researchers in veterinary vaccinology in LMICs. The specific objectives of the project were:

1. To provide funding for three fellowship grants for early career female researchers in veterinary vaccinology.
2. To provide mentorship for early career female researchers in vaccinology and enable them to develop a long-term career plan.

The project progressed well despite challenges faced by Covid-19 and all three fellowships have scientific results and a wide range of outputs. The research problem is still relevant after this project has ended and this project highlighted the continued need to support women in science, particularly in LMICs, and illustrates the incredible amount that can be achieved with relatively small amounts of research funding, short research projects and great mentorship.

## Progress towards Milestones

Milestone	Achievement (in %)	Evidence (indicator)	Comment
1) To provide funding for three fellowship grants for early career female researchers in veterinary vaccinology.	100%	Funding was awarded to three early career researchers to undertake a fellowship project.	
2) To provide mentorship for early career female researchers in vaccinology and enable them to develop a long-term career plan.	100%	Mentorship is a large component of the funded fellowships and each mentee identified a local and international mentor. Mentorship was very successful across all three fellowships and their next steps for their careers were clearly outlined.	

### **Milestone 1: To provide funding for three fellowship grants for early career female researchers in veterinary vaccinology.**

#### **1) Generating paperwork for the call:**

- The project team worked with LVIF and the University of Edinburgh's legal department to develop application forms and guidance notes for the fellowship call (<https://www.intvetvaccnet.co.uk/fellowships>). The programme and a call for applications was launched on 27 February 2020.

#### **2) Promoting and advertising the fellowship programme:**

- The call was advertised widely to ensure maximum exposure. The call was sent by email to the IVVN mailing list (>1,200 members) on 27 February 2020. In addition, details of the call were emailed to representatives of the following organisations: African Women in Agricultural Research and Development (AWARD), Jenner Institute, African Vaccinology Network, One Health Poultry Hub, KEMRI-Wellcome Trust Programme, International Livestock Research Institute (ILRI), Centre for Tropical Livestock Genetics and Health (CTLGH), BactiVac and GALVmed.
- Using Google Analytics, the call webpage ([www.intvetvaccnet.co.uk/fellowships](http://www.intvetvaccnet.co.uk/fellowships)) received:
  - Total page views (27 February 2020 to present): 2,267 (1,933 unique views).
  - Page views on day of launch (27 February): 364 (301 unique).
  - Page views in first month since launch: 1,503 (1,276 unique).
  - Average time spent on page: 6 minutes 41 seconds.
- The call was shared widely on IVVN social media channels (Twitter and LinkedIn):
  - Twitter: Launch tweet (<https://twitter.com/IntVetVaccNet/status/1232976511852072961>) had 13,198 impressions and 376 total engagements (153 link clicks, 58 retweets, 39 likes).

- LinkedIn: 335 impressions over three posts, average click-through rate of 6%).

### 3) Peer review process:

- The project team implemented a two-stage application process, involving an initial letter of intent stage followed by a full stage application. The purpose of the letter of intent was to allow the project team to assist applicants who were struggling to find an international mentor. Of the 25 letters of intent submitted, only four had not yet identified an international mentor. The project team assisted these four applicants by suggesting and contacting potential mentors on behalf of the applicant, and successfully found international mentors for three of the four applicants (the fourth applicant received support from their organisation to find a mentor). Letters of intent were reviewed by IVVN directors and a member of the LVIF to 1) identify the proposals were within remit and 2) to ensure applicants had identified a mentor.
- Following an approved letter of intent, applicants were invited to submit a full fellowship application.
- 18 full stage applications were submitted and one external reviewer and two internal reviewers (members of the IVVN Network Management Board (<https://www.intvetvacnet.co.uk/members/network-management-board>) reviewed each application. External reviewers are selected as experts in the relevant research area for each application. 18 external reviewers (3 female, 15 male) were recruited: 12 from the UK, 2 from Australia, 1 from Norway, 1 from The Netherlands, 1 from South Africa and 1 from Germany. Applications and scores were then reviewed during an IVVN Network Management Board meeting on 1 September 2020 and funding was awarded to six projects. The three projects funded by IDRC are detailed below:
  - 1) Surveying Salmonella antigens for use in a bacteriophage-based vaccine enabling homologous and heterologous protection and colonization-inhibition effect in poultry  
Mentee: Dr Angela Makumi (International Livestock Research Institute, Kenya)  
International Mentor: Dr Andrea McWhorter (University of Adelaide, Australia)  
Local Mentor: Dr Nicholas Svetik (ILRI, Kenya)  
Duration: 11 months
  - 2) Title: Identification and characterization of circulating coronaviruses and host receptor diversity in non-human primates  
Mentee: Dr Mercy Yvonne Akinyi (Institute of Primate Research, Kenya)  
International Mentor: Prof George Warimwe (University of Oxford, UK)  
Local Mentor: Dr Lucy Ochola (Institute of Primate Research, Kenya)  
Duration: 11 months
  - 3) Title: Use of Molecular epidemiology of bovine *Staphylococcus aureus* and *Streptococcus agalactiae* to guide vaccine development and improved control measures for contagious mastitis in Brazil  
Mentee: Dr Laura Oliveira (Federal University of Rio de Janeiro, Brazil)  
International Mentor: Prof Ruth Zadoks (University of Sydney, Australia)  
Local Mentor: Dr Tatiana Pinto (Federal University of Rio de Janeiro, Brazil)  
Duration: 11 months
- Unsuccessful applicants received full, anonymized feedback from external and internal reviewers.

### 4) Issue award letters and projects commence:

- Award letters and terms and conditions of the fellowships were issued to successful applicants in September 2020.

- Upon receipt of signed offer acceptance forms from both the research organisations of the Mentee and International Mentor, fellowships could commence on 1 December 2020. All three IDRC-funded projects began as expected on 1 December 2020.

## 5) Announcement of fellowships:

- Awarded fellowships were announced in a [news article](#) that was published on the IVVN website on International Women's Day 2021 and in the [March edition](#) of the IVVN newsletter. A [short video](#) was also produced to highlight the fellows and their projects.
  - Using Google analytics to measure metrics, the news article received 503 page views with 2 min 5 seconds spent on the page on average.
  - The news article (with video) was shared on Twitter (2,580 impressions, 371 views of video, 18 likes, 12 RTs) and LinkedIn (140 impressions, 41 video views).
- A [blog piece](#) entitled "Bridging the career-advancement opportunity gap for women researchers in LMICs" was written by IDRC. The post was published on the IVVN website on International Women's Day and in the [March edition](#) of the IVVN newsletter.
  - Using Google analytics, the blog piece received 165 page views with 3 min 10 seconds spent on the page on average.
  - The blog piece was also shared on Twitter and created 2,752 impressions with 14 likes and 9 RTs.

## 6) Networking between fellows:

- Networking and communication between fellows was encouraged and the project team hosted meetings on 15 September 2021 and 24 April 2022 to facilitate interaction.

## 7) Dissemination event:

- The project team hosted a dissemination event with IDRC on 21 June 2022 to showcase the fellowship programme and give the fellows the opportunity to present the research results and outputs from their fellowships. More information and a full recording of the event can be accessed [here](#).

## **Milestone 2: To provide mentorship for early career female researchers in vaccinology and enable them to develop a long-term career plan.**

The fellowship programme provided an opportunity for the Mentee to establish a Mentee/Mentor relationship, which supports the Mentee's professional development and enables the Mentee to work on a defined piece of research to advance veterinary vaccine development. Mentoring is a key component of the programme and the three funded projects contain both a senior local and international mentor to ensure that the Mentee is fully supported throughout the fellowship. Information received from the final reports submitted by the fellows showed that the mentee-mentor relationships developed well and meetings between the mentee and both local and international mentors were hosted regularly (information about the meetings and relationship detailed below).

- 1) **Surveying Salmonella antigens for use in a bacteriophage-based vaccine enabling homologous and heterologous protection and colonization-inhibition effect in poultry**  
**Mentee: Dr Angela Makumi (International Livestock Research Institute, Kenya)**  
**International Mentor: Dr Andrea McWhorter (University of Adelaide, Australia)**  
**Local Mentor: Dr Nicholas Svetik (ILRI, Kenya)**

(Text copied from final report)

While the majority of this fellowship was virtual between the mentors, this created a space to build around interactive discussions, guided reflection, and collaboration. Being a part of poultry vaccine professionals was invaluable and the mentors have been a great sounding board for finding my direction, validating purpose statements, and testing hypotheses. The mentors selected for this fellowship were in no doubt experienced, had vast knowledge and skills to guide the scientific work of this fellowship. The interaction between myself and the mentors involved 1-hour meetings, once a month that included virtual presentations and in some cases emails if need be. The virtual presentations included different sections such as: a summary from previous discussions, results on ongoing work and further discussions on the results. This style of presentation helped the mentors to oversee the work and also provide substantial recommendations.

Through this interaction there was transmission of knowledge and expertise on different subject matters which has led to the efficient achievement of the fellowship milestones and my own personal career advancement. This Mentee-Mentor relationship has also led to growth in different areas such as networking to engage social and professional support, growth in confidence with respect to connecting with stakeholders in the poultry value chain and managing the work environment such as prioritizing work that was most fruitful to advancing research and career objectives within the time line provided. The mentor-mentee relationship has been of great benefit to me and has transformed my career both scientifically and professionally. To this end, this relationship shall be maintained and in the near future a book chapter currently in writing shall be published and also after analysing the results from this fellowship, a research manuscript will be written to show case the results we have obtained. Also, to further foster this relationship in the future, and having the same goals in poultry research, we plan to endeavour into poultry vaccines and their efficacy to control priority diseases affecting the poultry value chain, through joint grant writing and collaboration. We envisage the nature of this relationship shall not only be fruitful, but the research will also have an impact in the poultry value chain.

## **2) Identification and characterization of circulating coronaviruses and host receptor diversity in non-human primates**

**Mentee: Dr Mercy Yvonne Akinyi (Institute of Primate Research, Kenya)**

**International Mentor: Prof George Warimwe (University of Oxford, UK)**

**Local Mentor: Dr Lucy Ochola (Institute of Primate Research, Kenya)**

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My mentors have been extremely helpful for the duration of the project. I participated in several activities:

1. Weekly virtual seminar meetings on Monday mornings and Thursday afternoons at KEMRI-Wellcome Trust Research Programme (international mentor's institute)
2. Weekly meetings with students and local mentor (Dr. Lucy Ochola) on Monday afternoons at Institute of Primate Research.
3. Weekly laboratory meetings on Tuesday afternoons with members of the International mentor's institute
4. Training on nanopore sequencing and bioinformatics skills at KWTRP and technical support during sequencing runs at IPR.
5. Writing of manuscripts and proposal development with mentors.

Through this project, the mentee-mentor relationship has strengthened with more interactions between both parties. These meetings ensured continuous participation in important scientific meetings and further allowed me to gain knowledge in my field on interest. The weekly meetings allowed me to quickly resolve any challenges in the lab these issues.

### **3) Use of Molecular epidemiology of bovine *Staphylococcus aureus* and *Streptococcus agalactiae* to guide vaccine development and improved control measures for contagious mastitis in Brazil**

**Mentee: Dr Laura Oliveira (Federal University of Rio de Janeiro, Brazil)**

**International Mentor: Prof Ruth Zadoks (University of Sydney, Australia)**

**Local Mentor: Dr Tatiana Pinto (Federal University of Rio de Janeiro, Brazil)**

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An effective mentee/mentor relationship has been established with Dr Ruth Zadoks since the beginning of the fellowship. Dr Ruth and I had regular e-mail contact, at a weekly basis, and we also held monthly online meetings for formal discussion/mentoring sessions. The meetings with DR Ruth were an opportunity to enrich my scientific knowledge about SAU and GBS and to learn how a respected and successful scientist behave on supporting the career of a young scientist. My relationship with my local mentor, Dr Tatiana Pinto, was established before the IVVN Fellowship award as she was one of my mentors during the development of my PhD thesis, and we have worked together since 2014. Dr Tatiana and Dr Ruth have supported me on the development of the IVVN Fellowship proposal, and they mentored my research activities since the fellowship's beginning. Our mentor/mentee relationship is based on daily interactions via email conversation and in-person contact in our lab at Universidade Federal do Rio de Janeiro. Dr Tatiana also participates in the e-mail conversations with Dr Ruth and is always present in the online mentoring meetings. During the online mentoring sessions, we discuss the project's activities that were done and the planned activities for the next months. I usually prepared a PowerPoint presentation with detailed information about the experiments done and results obtained from them, including preliminary data analysis, and a next steps' schedule, and present it to my mentors. This way we were able to track all activities/experiments included in the project, ensuring that all the deadlines were met and that all the project's objectives were achieved. In addition to project management related topics, we discussed more general topics such as our publication strategy and future funding opportunities.

In addition, through e-mail and virtual meetings, both my mentors introduced me to additional collaborators within and outside of Brazil. This research network led me to identify new opportunities to strengthen the project (e.g., more isolates from different host species in Brazil, collaboration on MALDLI-ToF) and my career through specific training (e.g., bioinformatics).

In November 2021, Dr Ruth and I participated in the Australia–Brazil Virtual Research Collaboration (VRC) event to meet and get to know potential new collaborators from both countries and discuss future possibilities of funding. Furthermore, we plan to publish together a total of 12 papers in high impact scientific journals, highlighting the results generated from the IVVN's project. Thus, we plan to keep our collaboration and have online meeting to discuss



the topics and results addressed in the papers and future funding opportunities. Dr Ruth and Dr Tatiana were wonderful mentors in the fellowship, they supported me in the challenging moments we've faced in the past year and always provided guidance to overcome the hurdles and to ensure we would achieve our goals. Besides, they always encouraged me and provided opportunities for me to thrive in my career, standing out as perfect role models and great examples of how women should support women in science. Overall, the collaboration established between Dr Tatiana, Dr Ruth, and I was a very fruitful and successful, and we plan to pursue other scientific endeavours together.

## Synthesis of research results and development outcomes

### **Milestone 1: To provide funding for three fellowship grants for early career female researchers in veterinary vaccinology.**

Funding was provided to three fellowship grants and the research results from their projects are detailed below (please note, the information provided is a summary of each of the fellowship outcomes, further information on objectives, milestones and results can be found in each of their final reports):

#### **1) Surveying Salmonella antigens for use in a bacteriophage-based vaccine enabling homologous and heterologous protection and colonization-inhibition effect in poultry**

**Mentee: Dr Angela Makumi (International Livestock Research Institute, Kenya)**

**International Mentor: Dr Andrea McWhorter (University of Adelaide, Australia)**

**Local Mentor: Dr Nicholas Svetik (ILRI, Kenya)**

(Text copied from final report)

With increased biosecurity in poultry farms, Salmonella infections will soon be a neglected disease for developing countries. However, for Low- and Middle-income countries (LMIC's) the use of vaccination is still a timely strategy to control Salmonella. Although some challenges such as achieving efficacious vaccination against Salmonella, on-farm challenges such as the lines of poultry and Salmonella serovars used in vaccine development necessitate the need for additional research into vaccine discovery suited for LMIC's. Furthermore, in farms having multiple serovars of Salmonella as is the case of backyard livestock farming in Kenya where different livestock species are kept together, control by vaccination will be compromised as cross protection against different serovars is reduced. As Salmonella colonization and invasion is initiated by adhesion to intestinal epithelial surfaces and cell lines and to intestinal mucins, inhibiting adhesion can play an important role in reducing its pathogenesis. Looking at Salmonella infections, the first adaptive line of immune defense is the mucosal immune system, including mucosal immunoglobulin A (IgA) and mucosa-associated lymphocytes and leukocytes. Secretory IgA prevents Salmonella from adhering to intestinal epithelial cells, limiting its mucosal colonization which is key for developing better vaccines to control Salmonella infections. However, the current Salmonella vaccines are administered either intramuscularly or subcutaneous which is not practical for commercial farmers especially in LMIC's. This fellowship enabled research into Surveying Salmonella antigens that enabling homologous and heterologous protection and colonization-inhibition effect in poultry. In brief, commercially available vaccines against host specific and zoonotic foodborne Salmonella were used to induce antibodies in different lines of poultry such as broilers, layers and indigenous chicken. Sera was collected at different points and using the in vivo induced antibody technology (IVIAT), sera, from the different lines of poultry were panned against different genomic Salmonella enterica isolated from different Kenyan poultry farms in 2019, to discover common antigenic signatures between all the strains. The strains used to create the genomic library include host specific Salmonella: *S. Gallinarum*, *S. Pullorum* and zoonotic Salmonella: *S. Typhimurium*, *S. Enteritidis*, *S. Heidelberg* and *S. Kentucky*. More than 100 Immunoreactive clones spanning across the different strains were sequenced and will be checked for immunogenicity. In summary, it is possible to use IVIAT as a technique to identify common antigenic signatures spanning across the different Salmonella serovars which could have a potential to be used as a multivalent

vaccine. The future goal will be to design a vaccine using a nano particle or Virus-like particle (VLP's) such as a bacteriophage to present the different selected antigens from our collection that could be delivered through the oral route and elicit protection across the different serovars of Salmonella creating a vaccine that will be suited for the poultry value chain in Low- and middle-income countries.

**2) Identification and characterization of circulating coronaviruses and host receptor diversity in non-human primates**

**Mentee: Dr Mercy Yvonne Akinyi (Institute of Primate Research, Kenya)**

**International Mentor: Prof George Warimwe (University of Oxford, UK)**

**Local Mentor: Dr Lucy Ochola (Institute of Primate Research, Kenya)**

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The world population is projected to increase by 2 billion persons in the next 30 years and with this, encroachment of humans into animal habitats will continue to lead to the emergence of new as well as recurrent infectious zoonotic diseases characterized by high mortality and morbidity. Seventy five percent of zoonotic pathogens arise from wildlife such as non-human primates (NHPs), because they can cross the species barrier to infect humans. Zoonoses will continue to shape human life and will contribute to the overall global infectious disease health burden and economy. The presence of zoonotic diseases highlights the importance of continuous disease surveillance in wildlife through monitoring for the presence of pathogens known to circulate in humans and screening for known and novel species circulating in wildlife. However, disease surveillance in wildlife is challenging because of logistical and financial challenges associated with longitudinal sample collection especially in developing countries. There is thus scarce knowledge on pathogens that circulate in wildlife. In addition, mechanisms by which pathogens cross species barriers to infect multiple hosts including humans are still poorly understood. The overall objective of this study was to identify and characterize circulating coronaviruses and their associated host receptors in understudied wild primate populations in Kenya.

Our first objective was to determine the prevalence of circulating coronaviruses in Sykes monkeys (*Cercopithecus mitis*) and Colobus monkeys (*Colobus guereza*). We conducted both molecular and serological assays targeting SARS-CoV-2 virus and other coronaviruses that are endemic to either humans or other mammals. The molecular assays did not pick up any coronaviruses. Serological assays showed varied responses to one human endemic virus in a few study animals but did not pick up any responses to SARS-CoV-virus. We also screened for the other respiratory viruses using basic PCR and metagenomics and are yet to finalise on data analysis. Our second objective focused on characterizing the ACE2 receptor diversity in both colobus and Sykes monkeys to determine the susceptibility of these animals to Sars-Cov-2 viral infection. In particular, we focused on the receptor binding region for the SARS-CoV-virus. For comparative purposes, we also sequenced samples from baboons and vervet monkeys. Sequences retrieved from this study were compared to available sequences from other primates and humans. Our results were consistent with previous primate studies. We found that the ACE2 receptor binding region was highly conserved and similar to the existing available sequences from online databases. Our results are confirmatory and add onto the scarce pathogen surveillance data for understudied primate species. In conclusion, continuous pathogen screening, typing and creation of a database is critical in monitoring reservoirs of epidemic pathogens and this in turn would provide a starting point for vaccine development in the event of an outbreak.

### **3) Use of Molecular epidemiology of bovine *Staphylococcus aureus* and *Streptococcus agalactiae* to guide vaccine development and improved control measures for contagious mastitis in Brazil**

**Mentee: Dr Laura Oliveira (Federal University of Rio de Janeiro, Brazil)**

**International Mentor: Prof Ruth Zadoks (University of Sydney, Australia)**

**Local Mentor: Dr Tatiana Pinto (Federal University of Rio de Janeiro, Brazil)**

(Text copied from final report)

Brazil is a top-5 milk producer globally, but its dairy industry suffers major losses from contagious bovine mastitis (CBM) caused by *Staphylococcus aureus* (SAU) and *Streptococcus agalactiae* (GBS). CBM control is challenging because 70% of dairies are small family farms and use antibiotics without proper advice. SAU and GBS are highly heterogeneous pathogens. Surveillance of their molecular and cellular characteristics (e.g., capsule, surface proteins) is a crucial step towards design of vaccines to prevent CBM. We lack data on strain-specific characteristics of SAU and GBS in Brazilian herds because genomic methods are expensive and restricted to research-specialized laboratories. In this project, we intend to develop a locally appropriate alternative method based on MALDI-TOF MS for molecular typing of GBS and SAU to enhance our knowledge of molecular epidemiology, inform vaccine development, and aid in antimicrobial stewardship efforts. In Brazil, MALDI-TOF MS stands out as alternative approach for simultaneous diagnosis and strain-typing as this technology is fast, cheap, and available in most third-party laboratories. We also gathered unprecedented genomic data on SAU and GBS (historical and current) from bovine milk in Brazil. Isolates represented major dairy regions in the country, which have different farm types. We showed the usefulness of MALDI-TOF MS for species identification (in milk and on pure cultures), and to identify biomarkers for strain-typing (constitutively and universally expressed vs strain-specific proteins). We also demonstrated the potential of CRISPR1-RFLP for molecular typing and differentiation of GBS clones from bovine and human hosts. Data derived from whole genome sequences show the circulation of multi-host (CC103/serotype Ia) and bovine adapted GBS lineages (CC91/serotype III) in dairy farms, and strain replacement possibly driven by the acquisition of antimicrobial resistance (AMR) genes. Most GBS and SAU strains harboured AMR markers (genes and mobile genetic elements) that confer resistance to antimicrobial agents commonly used for treatment (human and veterinary medicine settings) and growth promotion (beta-lactams, macrolides, lincosamides, aminoglycosides, tetracycline) in Brazil, highlighting the circulation of methicillin resistant SAU (MRSA) and clindamycin-resistant GBS strains which are recognized as global public health threats. Importantly, however, most GBS was susceptible to penicillin whereas most SAU was not. This implies that narrow spectrum antimicrobials can be used for treatment of GBS to reduce the risk of selection for AMR, whilst also highlighting the need for easy and affordable access to diagnostics that can differentiate between GBS and SAU. Furthermore, we expanded the project to included additional isolate collections, including piscine GBS isolates. CC552 represented the predominant clone among fish isolates, but 33% of them belonged so ST283, a hypervirulent lineage associated with foodborne outbreak of invasive disease in humans, indicating significant zoonotic potential. Data generated in this study can be used to guide local farmers and policymakers on CBM control practices, including antibiotic choice and vaccine targets for future investigation. In addition, our results shed light on the epidemiologic scenario of piscine GBS in Brazil, where it has emerged as an important and potentially zoonotic pathogen in aquaculture. This fellowship fostered professional development, strengthened the international network, improved research skills of a promising young

middle-income country-based female scientist, and established new national and international collaborations that will continue beyond the current project.

**Milestone 2: To provide mentorship for early career female researchers in vaccinology and enable them to develop a long-term career plan.**

The previous section on progress against milestones detailed the nature of the mentee-mentor relationship for each fellowship, however another important aspect of the second milestone was to develop a long-term career plan and outline the effect that fellowships had on their careers.

**1) Surveying Salmonella antigens for use in a bacteriophage-based vaccine enabling homologous and heterologous protection and colonization-inhibition effect in poultry**

**Mentee: Dr Angela Makumi (International Livestock Research Institute, Kenya)**

**International Mentor: Dr Andrea McWhorter (University of Adelaide, Australia)**

**Local Mentor: Dr Nicholas Svetik (ILRI, Kenya)**

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This project gave me the opportunity to take the skills I already had and apply them in a new and different context creating stretch assignments and an out-of-expertise experience. This further led to developing not only my professional skills, but also my leadership ability. The venture into using several new technologies and acquiring new knowledge, improved my skills also helped me gain the hands-on experience that is needed to reposition my career direction to join the scientific community of vaccine development. Through the fellowship period under the guidance of the mentors, I gained the confidence to conduct poultry vaccine research and I was able to add value by contributing towards Salmonella vaccine efficacy across the different lines of poultry. Having a background in bioscience engineering, scientific innovations are of key importance, but this felt too far removed from the wide-reaching impact. Therefore, this fellowship led to a jump-start of a career transition that would bring me closer to making a lasting impact within my profession by getting back to more innovative work that directly creates a positive impact and transition my area of focus from fundamental to applied research. Also, this fellowship was a perfect arena to test some of the ideas I had for the next career trajectory which was to explore beyond my comfort zone. It was difficult to figure out how to navigate that transition, but this fellowship offered the professional development training, hands-on experience I was looking for to take that leap. I am planning to use these skills to keep supporting novel vaccine research in the poultry sector creating a lasting change in most sustainable and impactful way.

**2) Identification and characterization of circulating coronaviruses and host receptor diversity in non-human primates**

**Mentee: Dr Mercy Yvonne Akinyi (Institute of Primate Research, Kenya)**

**International Mentor: Prof George Warimwe (University of Oxford, UK)**

**Local Mentor: Dr Lucy Ochola (Institute of Primate Research, Kenya)**

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As an early career scientist, this project has enhanced my research portfolio. I generated valuable information that will add to the extremely scarce data on disease surveillance in wildlife in Kenya. This preliminary data can be used to secure and source for more funding from wildlife disease monitoring and management grant applications. The acquisition of new equipment and technology will allow me to expand my research. In the past my main focus has been in projects that identify and characterize pathogens. I have now acquired novel skills, in pathogen whole genome and metagenomic analysis. I

am now considering developing research questions that utilize both genetic and genomic tools to provide answers to emerging human threats. My local mentor, Dr. Lucy Ochola, and I recently submitted a grant application to the National Institute of Health on one-health surveillance for microbiome, soil transmitted helminths and antimicrobial resistance. We propose to use nanopore sequencing technologies to address some of the aims in this proposal.

This project has also provided me with the opportunity to strengthen my existing partnerships with my international mentor Prof. George Warimwe and my post doc mentor, Prof. Isabella Ochola-Oyier who are both at the KEMRI-Wellcome Trust research project. Due to these partnerships, KWTRP provided a fully paid training for my research fellow and I to ensure that we had technical and computational capacity to set up our sequencing facility. In addition, I have been able to consult them when we have setbacks or have to trouble shoot our sequencing runs. Apart from this IVVN project, I still continue to collaborate with them on multiple projects and anticipate to jointly apply for more grant opportunities.

As a woman in the STEM field, this project provided a good platform to mentor other students, especially upcoming young women scientists. During the duration of this project, I mentored 3 research fellows and 2 masters' students. Two research fellows have secured jobs as research fellows and the masters' students are yet to finish their projects. I have also mentored undergraduate interns who were present at IPR during their short 3-month student attachments.

### **3) Use of Molecular epidemiology of bovine *Staphylococcus aureus* and *Streptococcus agalactiae* to guide vaccine development and improved control measures for contagious mastitis in Brazil**

**Mentee: Dr Laura Oliveira (Federal University of Rio de Janeiro, Brazil)**

**International Mentor: Prof Ruth Zadoks (University of Sydney, Australia)**

**Local Mentor: Dr Tatiana Pinto (Federal University of Rio de Janeiro, Brazil)**

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This fellowship has hugely fostered my professional development, strengthened my international network, and improved my research skills as a promising young middle-income country-based female scientist. During the fellowship, I was trained in genomic data analysis using bioinformatics tools and proteomic data analysis, and gained knowledge related to vaccine-preventable veterinary diseases (e.g., molecular epidemiology, immunology, microbiology) – please see section 6. In the present project, I applied this expertise to study the epidemiology of SAU and GBS mastitis in Brazil and I can also apply it to current and future studies on other pathogens and diseases.

Our research group in Brazil has expertise in phenotypic and molecular characterization of gram-positive cocci and has been uncovering novel aspects of their biology and tracing their epidemiological evolution in Brazil, using our exclusive historical collection of strains from different clinical sources. Collectively, we have extensive experience in molecular typing, antimicrobial susceptibility testing and in vitro virulence assays, skills that I strengthened personally through the current project. However, there was a gap in knowledge and practice regarding use of WGS data and vaccinology, which has been overcome by the professional development courses I could attend through this fellowship. These courses (please see item 6) allowed me to develop research skills in genomic and proteomic analysis.

In addition to developing scientific and technical skill, by developing this project in collaboration with my mentors and the national network of researchers that we established I was able to improve her transferable skills, which are essential to development of a research career. The transferable skills improved over this fellowship include project management, multi-institutional collaboration,

teamwork, time management, leadership and communication skills, preparation and presentation of progress reports and Gantt charts, managing funds and lab work. In addition, I had the opportunity to learn about dealing with collaboration, competition, and authorship considerations.

The fellowship expanded my professional network. I started my first international collaboration with a renowned researcher in the field, Dr Ruth Zadoks, and her collaborators at the University of Glasgow, which included Dr Taya Forde and Chiara Crestani, experts in bacterial genomics who conduct the analysis of animal isolates for the JUNO project on GBS. In addition, Dr Ruth introduced Dr Tatiana and I to Prof. Claudia Daubenberger and Dr Valentin Pflüger, two collaborators from Switzerland. This collaboration led us to be included in a global effort to develop MALDI-TOF GBS strain-typing, which strengthened our project. This international environment allowed me to be trained in scientific tools and techniques, but also in understanding the dairy industry and current approaches to the communication and implementation of mastitis control and antimicrobial stewardship. In addition, through e-mail and virtual meetings, I coordinated a research network in Brazil gathered renowned scientists of different universities in the country through the scientific network of Dr Ruth and Dr Tatiana with Brazilian scientists. The Brazilian network includes the following scientists: Dr Lucia Teixeira (Universidade Federal do Rio de Janeiro), Dr Renata Rabello (Universidade Federal Fluminense), Dr Carlos Pantoja (Universidade Estadual Paulista), Dr Carlos Leal (Universidade Federal de Minas Gerais), Dr Aline Souza (Universidade Federal do Rio de Janeiro), and Dr Ulisses de Padua Pereira (Universidade Estadual de Londrina). This provides us access to a large and diverse GBS and SAU isolates collections.

From the results generated in this project, we plan to publish a total of 12 manuscripts in high impact scientific journals. These publications will foster the advancement of my career as a young women post-doctoral scientist based in a LMIC by strengthening my curriculum vitae and enhancing my chances of pursuing a permanent position in a research/academic institution in Brazil. Already, the fellowship increased my potential to achieve a permanent position as Associate Professor and/or Researcher at Brazilian institutions, to obtain funding for future projects, and the confidence to start my own research line. In 2021, I applied for a position as associated professor at the Universidade Federal Fluminense (UFF), located at the Niteroi city, Rio de Janeiro state, and was classified in the 4<sup>th</sup> position from 100 candidates. Although there were only two vacancies available, this final classification gave me the confidence that I am in the right path to pursue this goal in my career. Furthermore, in 2021 I was awarded a 4-year post-doctoral fellowship by the Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro – FAPERJ. This was a very competitive application, and the fellowship will allow me to move forward with the developments of the IVVN's project.

This fellowship has helped me to overcome scientific limitations usually experienced by low- or middle-income country scientists when establishing a scientific career because it helped me to improve my subject-specific and transferable knowledge and skills in a manner that could not be achieved in Brazil alone. My future plans include to train Brazilian graduate students, foster the development of Master's and PhD theses of Brazilian students, publish scientific papers in high-ranking (Quartile 1) international peer-reviewed journals, keep pursuing a permanent position as Associate Professor and/or Researcher at Brazilian institutions, obtain funding for future projects, keep developing my research and transferable skills, and strengthen my confidence to start my own research line in near future. This research line will focus on the study of the molecular epidemiology, antimicrobial resistance, and virulence potential of gram-positive bacteria isolated from human and animal hosts to improve the diagnosis, control, and prevention of infectious diseases in the human and veterinary medicine settings.

## **Project Outputs**

Outputs from the three fellowships are detailed in Annex 1



## **Problems and challenges**

Fellows were provided with opportunities during meetings, the dissemination event and in their final reporting to detail some of the challenges they faced:

- Work was disrupted due to Covid-19, however they appreciated that no cost extensions were implemented where necessary to allow all fellows to complete their fellowships.
- Procurement delays were a problem, particularly in African research institutions, and so this should be considered by research funders when determining the length of fellowships.
- Fellows felt the duration (9-11 months) of the fellowships were not long enough and that projects should last at least 12 months.

## Overall assessment and recommendations

Recommendations from the fellows on what could be improved were:

- Fellowships should be longer than the 9-11 month duration and could be for 1-2 years.
- Fellows would have appreciated more opportunities to network and would have benefited from an in-person meeting, for example, if the dissemination event could have been hosted face-to-face, this would have been of value.
- Fellows would value the opportunity to interact with previous IVVN/IDRC programme fellows. As this was the first year of this particular programme, this could be implemented in future years.
- Opportunity to access IVVN or IDRC training opportunities during their fellowships. Several fellows attended some of the online training opportunities provided by IVVN in 2021, however generally fellows felt there are limited training opportunities available to them.
- IVVN/IDRC could provide more support to better support challenges faced by women ECRs in LMICs including having a higher percentage of salary covered by the fellowship and maternity policies/clauses in fellowship terms and conditions.

IVVN are very supportive of these suggestions and would further develop the fellowship programme to include more facilitated meetings between fellows, access to training courses (either provided by IVVN or other organisations), opportunities to interact with previous fellows and revision of fellowship terms and conditions, for example, to extend the duration of the fellowships provided.

## **Annex 1: Project Outputs**

### **1) *Surveying Salmonella antigens for use in a bacteriophage-based vaccine enabling homologous and heterologous protection and colonization-inhibition effect in poultry***

**Mentee: Dr Angela Makumi (International Livestock Research Institute, Kenya)**

**International Mentor: Dr Andrea McWhorter (University of Adelaide, Australia)**

**Local Mentor: Dr Nicholas Svetik (ILRI, Kenya)**

#### **Publications**

- Short communication: Angela Makumi and Nicholas Svetik: Salmonella poultry vaccines and the need for improved vaccines. Concepts of Dairy & Veterinary Sciences. Lupine Publishers, LLC. Progress: in edit
- Book Chapter: Angela Makumi, Nicholas Svetik and Andrea McWhorter : Chapter title: How dynamics of farming in LMIC's can contribute to Salmonella Evolution. Book Title: Salmonella - Past, Present and Future. Publisher: IntechOpen. Progress: In writing

#### **Further/Follow-on funding**

- Apply for the next open Bactivac call to be able to continue with research finding we have so far obtained.

#### **Staff promotions**

- I am in the process of applying for a Junior Scientist position at ILRI.

#### **Engagement activities**

- Angela Makumi, A. Mhone, Linda Guantai, Josiah Odaba, Sylvain Moineau, Nicholas Svetik. Potential Phage based Vaccine for the Control of Salmonella in Poultry. The KEMRI-IPR Symposium - Status of Bacteriophage Research in Kenya. 21st March 2022. Oral presentation
- Angela Makumi, Andrea McWhorter, Nicholas Svetik. Bacteriophage based salmonella vaccines. International Viruses of Microbes conference. Guimaraes, Portugal . 18th-22nd July 2022. Poster presentation

#### **Trainings attended**

- IVVN Grant Writing by Scriptoria on 29 April & 6 May 2021 (0.5-day sessions)
- IVVN Project Management by Scriptoria on 25 & 27 May 2021 (0.5-day sessions)
- IVVN Ethics, Experimental Design and the 3Rs in Animal Infectious Disease Research by University of Nottingham on 8, 9 & 10 June 2021 (0.5-day sessions)

### **2) *Identification and characterization of circulating coronaviruses and host receptor diversity in non-human primates***

**Mentee: Dr Mercy Yvonne Akinyi (Institute of Primate Research, Kenya)**

**International Mentor: Prof George Warimwe (University of Oxford, UK)**

**Local Mentor: Dr Lucy Ochola (Institute of Primate Research, Kenya)**

#### **Equipment support**

A nanopore sequencer was procured to screen for viruses detected during pathogen screening. Though our results were negative for SARS-CoV-2 and other coronaviruses, we were able to test the machine and train other research scientists at my home institute (Institute of Primate Research) on how to use it and this we achieved using human positive COVID-19 samples obtained during the pandemic. This sequencer is housed at the IPR One Health Centre whose main focus now is on pathogen surveillance using a one health approach.

It is also available for other scientists working in various departments at the institute that conduct research on infectious diseases, microbiome characterization, reproductive health, conservation biology and other lifestyle diseases. To address the shortage of storage space at IPR, we also procured a new fridge/freezer combo to facilitate sample storage of both samples and procured reagents. This equipment is also shared by a couple of other scientists who have ongoing projects.

### **Student mentorship**

We recruited two research interns, Cedrick Shikoli and Griphin Ochola to the project, who were offered a research fellowship position supported by the IVVN project. We trained both students on various laboratory techniques including DNA and RNA extraction, PCR amplification and purification of amplicons, sequence analysis and nanopore sequencing. To foster peer to peer training and build further research capacity at IPR, two undergraduate student interns were also recruited to assist in the research and laboratory tasks. Both research interns were able to secure research jobs and this was as a result of them acquiring prerequisite molecular biology skills while attached to my lab.

### **Nanopore sequencing training**

My international mentor's home institution (KWTRP) organized a two-week training course in nanopore technology wet lab and computational analysis and both my research fellow and I attended this training. Having received this training, we also held an in-house nanopore sequencing training for IPR staff in April this year. We then went on to host another joint nanopore sequencing training workshop at IPR in collaboration with one of my research partners in June this year. The workshop had participants from IPR and two other research institutions in Kenya. Through this we were able to provide both wet lab and computational skills to the participants.

### **Presentations**

I presented the results from this study at two workshops; 1) The 1st Bioinformatics and Molecular Biology conference which was held from 11th-13th April 2022 at the Mount Kenya University, in Kenya and 2) The IVVN and IDRC fellowship programme dissemination seminar held on 21st June 2022, virtually.

### **3) Use of Molecular epidemiology of bovine *Staphylococcus aureus* and *Streptococcus agalactiae* to guide vaccine development and improved control measures for contagious mastitis in Brazil**

**Mentee:** Dr Laura Oliveira (Federal University of Rio de Janeiro, Brazil)

**International Mentor:** Prof Ruth Zadoks (University of Sydney, Australia)

**Local Mentor:** Dr Tatiana Pinto (Federal University of Rio de Janeiro, Brazil)

### **Publications**

I have submitted/presented three abstracts in international and national conferences that occurred in 2021 or will be held in 2022:

- Abstract accepted for poster presentation in the World Microbe Forum conference organized by the American Society for Microbiology (ASM) and the Federation of European Microbiological Societies (FEMS), which took place online from 20-24 June 2021.

**Title:** CRISPR1-RFLP and MALDI-TOF MS as Alternative Typing Methods for Serotype III Group B *Streptococcus* Strains of Veterinary Origin.

**Authors:** LMA Oliveira<sup>1</sup>, LC Simões<sup>1</sup>, CAG Leal<sup>2</sup>, RF Rabello<sup>3</sup>, TCA Pinto<sup>1</sup>, RN Zadoks<sup>4</sup>.

<sup>1</sup>Instituto de Microbiologia Paulo de Góes, Universidade Federal do Rio de Janeiro, Brazil

<sup>2</sup>Escola de Veterinária, Universidade Federal de Minas Gerais, Brazil

<sup>3</sup>Instituto Biomédico, Universidade Federal Fluminense, Brazil

<sup>4</sup>Sydney School of Veterinary Science, University of Sydney, Australia

- Abstract accepted for poster presentation in the Brazilian Congress of Microbiology, organized by the Brazilian Society for Microbiology, which was held online from 22-24 October 2021.

**Title:** CRISPR1-RFLP as an Alternative Method for Molecular Typing of Serotype III Group B *Streptococcus* from bovine and human origins.

**Authors:** Oliveira, L.M.A.<sup>1</sup>; Simões, L.C.<sup>1</sup>; Rabello, R.F.<sup>2</sup>; Teixeira, L.M.<sup>1</sup>; Pinto, T.C.A.<sup>1</sup>; Zadoks, R.N.<sup>3</sup>

<sup>1</sup>Instituto de Microbiologia Paulo de Góes, Universidade Federal do Rio de Janeiro, Brazil

<sup>2</sup>Instituto Biomédico, Universidade Federal Fluminense, Brazil

<sup>3</sup>Sydney School of Veterinary Science, University of Sydney, Australia

- Abstract accepted for poster presentation in ASM Microbe conference, organized by the American Society for Microbiology, which will take place in-person from 9-13 June 2022.

**Title:** Genomic analysis of Group B *Streptococcus* from bovine origin reveals the circulation of antimicrobial resistant and multi-host adapted lineages over a period of 34 years in Brazil

**Authors:** LMA Oliveira<sup>1</sup>, LC Simões<sup>1</sup>, JCF Pantoja<sup>2</sup>, RF Rabello<sup>3</sup>, Teixeira LM<sup>1</sup>, Jamroz D<sup>4</sup>, Bentley S<sup>4</sup>, TCA Pinto<sup>1</sup>, RN Zadoks<sup>5</sup>.

<sup>1</sup>Instituto de Microbiologia Paulo de Góes, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brasil

<sup>2</sup>Faculdade de Medicina Veterinária e Zootecnia, Universidade Estadual Paulista Júlio de Mesquita Filho, Botucatu, Brasil

<sup>3</sup>Instituto Biomédico, Universidade Federal Fluminense, Niterói, Brasil

<sup>4</sup>Wellcome Trust Sanger Institute, Hinxton, Cambridgeshire, United Kingdom

<sup>5</sup>Sydney School of Veterinary Science, University of Sydney, Camden, NSW, Australia

We are finalising a manuscript entitled “The landscape of antimicrobial resistance in the multi-host pathogen Group B *Streptococcus* as seen from a One Health perspective”, which will be submitted as a perspective article to the research topic “Drug resistance in maternal and Paediatric Bacterial and Fungal infections: is COVID-19 changing the landscape” of the journal *Frontiers in Microbiology*.

**Authors:** Laura M. A. Oliveira, Leandro C. Simões, Natalia S. Costa, Ruth N. Zadoks, Tatiana C. A. Pinto.

Additional manuscripts using results from the IVVN project have been planned, both as first author and as co-author.

#### **Further/follow-on funding**

At the end of 2021, I was awarded with a 4-year post-doctoral fellowship (£ 50,000) by the Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro – FAPERJ, which is a scientific funding agency that belongs to the Rio de Janeiro state’s government. This fellowship began in 2022 and will cover my salary, consumables, attendance at conferences and professional development courses. The project covered in this fellowship represents a continuation of the IVVN’s project that was extended to include GBS strains from human origins (carriage and disease; pregnant women, neonates, and adult hosts). Dr Tatiana Pinto, my local mentor, collaborates in the JUNO project, led by scientists of the Wellcome Sanger Institute, which allowed us to sequence the whole genome of 500 human GBS

strains. The overarching objective of this fellowship is to gather unprecedented genomic and proteomic data on GBS strains circulating in different hosts in Brazil; to study the molecular epidemiology and population structure of this species in the country; to evaluate the applicability of alternative methodologies for diagnostics and strain-typing based on MALDI-TOF MS and CRISPR1-RFL; and to inform vaccine design within the scope of human and veterinary vaccinology. Because this fellowship is closely aligned with the original IVVN project, I will be able to continue to work on manuscripts from the IVVN project, with a further 4 first-author publications anticipated.

### **New collaborations and partnerships**

Since the beginning of the project, we have established a research network in Brazil that is much larger than we have anticipated, which gathered renowned scientists of different universities in the country through the scientific network of Dr Ruth and Dr Tatiana with Brazilian scientists. The Brazilian scientific network includes the following scientists: Dr Lucia Teixeira (Universidade Federal do Rio de Janeiro), Dr Renata Rabello (Universidade Federal Fluminense), Dr Carlos Pantoja (Universidade Estadual Paulista), Dr Carlos Leal (Universidade Federal de Minas Gerais), Dr Aline Souza (Universidade Federal do Rio de Janeiro), and Dr Ulisses de Padua Pereira (Universidade Estadual de Londrina). This provided us access to larger and diverse GBS and SAU isolates collections that enriched the project's sampling. In addition, the collaboration established by Dr Ruth with the Wellcome Sanger Institute through the JUNO project provided us an opportunity for whole genome sequencing (WGS) of the GBS collections, which enhanced our access to genomic data and bioinformatic support and strengthens our project. Moreover, Dr Ruth introduced Dr Tatiana and I to Prof. Claudia Daubenberger (Swiss Tropical and Public Health Institute, Basel, Switzerland) and Dr Valentin Pflüger (Mabritec AG, Riehen, Switzerland), which are specialists on MALDI-typing of bacterial pathogens and led us to establish a collaboration with them so that MALDI-typing of GBS in Brazil is part of a global MALDI-typing effort and database for GBS. Another collaborator included in our research network is Dr Chiara Crestani (Institut Pasteur, Paris, France), who offered me a professional development training on bioinformatics.

### **Continuing professional development**

During the past year, I attended several online professional development courses to improve my bioinformatic and MALDI-TOF MS-related skills to analyze the genomic and proteomic data generated in the project. I was awarded a place to attend the following training courses offered by IVVN for early-career researchers in low-and-middle income countries (LMICs):

- The Essential Bioinformatics course offered by Edinburgh Genomics, University of Edinburgh, UK, which took place on the days 13, 14, 20, 21, and 22 April 2021 (Five 0.5 day sessions) and whose content was to introduce participants to Linux and command line tools for biology, and the R basics, vectors, loading data, data frames and iteration and data visualization;
- The Project Management Course offered by Scriptoria, UK, which took place on the days 25 and 27 May 2021 (two 0.5 day sessions) and whose content was to provide researchers who are leading projects and/or collaborations with critical skills and tools for managing projects, resources, and teams.

Other professional development courses attended in 2021:

- Bioinformatics Training Course (<https://lp.biouni.com.br/lista-de-espera-curso-de-bioinformatica>) led by a Brazilian researcher/bioinformatician that works at the Federal University of Viçosa, Brazil. This was an 8-week online course (64h in total) whose content includes the basics of Linux and command lines most used to analyze genomic data, sequencing data quality analysis, genome assembling and annotation, comparative genomics, and phylogenetic analysis.
- MALDI-TOF MS – Mass Spectrometry Applied to the Clinical Microbiology course offered by the Brazilian Society for Microbiology from May 25 and June 29, 2021. The course covered

since the basics of mass spectrometry technique and equipment to practical applications for species identification (bacteria and fungi), strain-typing, and to determine AMR mechanisms.

- Applications of MALDITOF Mass-Spectrometry in Clinical Microbiology course offered by ESCMID (European Society of Clinical Microbiology and Infectious Diseases), which took place from 19-20 October 2021. This course aimed to provide participants with the tools to do their best with their MALDI instruments: methodology for new MALDI applications and analytical tools for spectra analysis. The attendees will have the opportunity to interact with leading researchers in the field of MALDI-TOF mass spectrometry applications in clinical microbiology and discuss recent breakthroughs and new applications. The workshop will include theoretical presentations and practical training and will represent an excellent chance for networking between clinical microbiologists, basic researchers, MALDI experts, bioinformaticians and others.

Moreover, I've been trained by Dr Chiara Crestani, which was mentored by Dr Ruth Zadoks on her PhD, on bioinformatic tools to develop my skills on analyzing the GBS and SAU genomes regarding multi-locus sequence types, AMR genes, virulence genes and capsular types, alignment, and comparative genomics, and phylogenetics. We have had 5 online meetings to date in which she taught me command lines and how to install and run bioinformatic programs, and we plan to have additional online meetings in March-April 2022.

## Engagement

In 2021 I was featured on the website

(<https://www.microbiologia.ufrj.br/portal/index.php/pt/destaques/novidades-sobre-a-micro/1069-pos-doutoranda-do-ppg-microbiologia-laura-oliveira-e-contemplada-com-fellowship-internacional-para-jovens-doutoras-na-area-de-vacinologia-veterinaria>) and Instagram of the Microbiology Institute of the UFRJ, the location where I work and developed the IVVN's project, as a promising early-career researcher in my local academic community.



I was also featured on the LinkedIn ([https://www.linkedin.com/posts/faperjoficial\\_faperj-carreira-saaeqde-activity-6899701309142827008-v5CI](https://www.linkedin.com/posts/faperjoficial_faperj-carreira-saaeqde-activity-6899701309142827008-v5CI)) of the Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro – FAPERJ, the funding agency that is affording my current fellowship, and on the website (<https://sbmicrobiologia.org.br/bolsistas-da-faperj-sao-eleitos-embaixadores-da-sociedade-americana-de-microbiologia/>) of the Brazilian Society for Microbiology.

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**Bolsistas #FAPERJ são nomeados Embaixadores da Sociedade Americana de Microbiologia!**

O biólogo Felipe Neves, professor do Departamento de Microbiologia e Parasitologia do Instituto Biológico da Universidade Federal Fluminense e Cientista do Nosso Estado da FAPERJ, e a Doutora em Microbiologia pela UFRJ - Universidade Federal do Rio de Janeiro e bolsista do programa de Pós-Doutorado Nota 10, da FAPERJ, Laura Oliveira foram nomeados pela Sociedade Americana de Microbiologia (American Society for Microbiology/ASM) como embaixador e jovem embaixadora da Ciência no Brasil.

«Felipe Neves integra o Conselho Fiscal da Sociedade Brasileira de Microbiologia e participa do projeto "P-Carriage", iniciativa da Organização Mundial da Saúde (OMS) para avaliar o impacto global das vacinas pneumocócicas conjugadas. Ele ainda faz parte da Rede BioSaúde-UFF, que auxilia no diagnóstico do SARS-CoV-2, e é Topic Editor na revista "Frontiers in Microbiology".

Já Laura Oliveira é pós-doutoranda no Instituto de Microbiologia Paulo de Góes (IMPG) da UFRJ e já foi contemplada com o "Fellowship For Early-Career Women from LMIC" da International Veterinary Vaccinology Network (IVVN). Atualmente, faz parte do projeto "Juno", uma iniciativa global liderada pelo Wellcome Sanger Institute do Reino Unido para sequenciar 10 mil genomas de Streptococcus do grupo B, uma bactéria associada com morbidade e mortalidade perinatal. A pesquisadora também se dedica à popularização da ciência e à divulgação científica pelo projeto DivulgaMico.

«Sinto-me muito honrado e motivado para cumprir o enorme desafio de representar em nosso país a maior e mais antiga sociedade relacionada às Ciências da Vida no mundo», afirma Felipe Neves.

«Laura Oliveira também ressalta a alegria e honra de representar o Brasil na ASM. "Minha missão é trabalhar para o avanço da Microbiologia no âmbito nacional e internacional e contribuir para o desenvolvimento profissional de outros jovens cientistas brasileiros, e a FAPERJ tem um papel muito importante como a principal apoiadora da minha carreira como cientista", diz Laura.

«Parabéns aos pesquisadores fluminenses!



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O biólogo Felipe Neves, professor do Departamento de Microbiologia e Parasitologia do Instituto Biológico da Universidade Federal Fluminense (UFF), Cientista do Nosso Estado (CNE) da FAPERJ, foi nomeado pela Sociedade Americana de Microbiologia (American Society for Microbiology/ASM) "Country Ambassador of Science to Brazil", até 2024. Além disso, a Doutora em Microbiologia pela Universidade Federal do Rio de Janeiro (UFRJ) e bolsista do programa de Pós-Doutorado Nota 10, da FAPERJ, Laura Oliveira, também foi eleita pela mesma organização "Young Ambassador of Science to Brazil". Com pós-doutorado na School of Public Health da University of California (EUA), Felipe Neves integra o Conselho Fiscal da Sociedade Brasileira de Microbiologia e participa do projeto "P-Carriage", iniciativa da Organização Mundial da Saúde (OMS) para avaliar o impacto global das vacinas pneumocócicas conjugadas. Ele ainda faz parte da Rede BioSaúde-UFF, que auxilia no diagnóstico do SARS-CoV-2, e é Topic Editor na revista "Frontiers in Microbiology". Pós-doutoranda no Instituto de Microbiologia Paulo de Góes (IMPG) da UFRJ, Laura já foi contemplada com o "Fellowship For Early-Career Women from LMIC" da International Veterinary Vaccinology Network (IVVN) e atualmente faz parte do projeto "Juno", uma iniciativa global liderada pelo Wellcome Sanger Institute do Reino Unido para sequenciar 10.000 genomas de Streptococcus do grupo B, uma bactéria associada com morbidade e mortalidade perinatal. A pesquisadora também se dedica à popularização da ciência e à divulgação científica pelo projeto DivulgaMico.

Fonte: <http://www.faperj.br/?id=4421.2.0>

Furthermore, I could not fail to mention the publications on the IVVN website that featured the IVVN's fellowship awardees and their projects (<https://www.intvetvacnet.co.uk/blog/bridging-the-career-advancement-opportunity-gap-for-women-researchers-in-lmics>; <https://www.intvetvacnet.co.uk/fellowships/funded-fellowships/use-of-molecular-epidemiology-of-bovine-staphylococcus-aureus-and>).

#### Use of Molecular epidemiology of bovine Staphylococcus aureus and Streptococcus agalactiae to guide vaccine development and improved control measures for contagious mastitis in Brazil

##### Project summary

Brazil is one of the largest milk producers worldwide, but its dairy industry has suffered great economic losses due to contagious bovine mastitis (CBM), an infectious disease caused mainly by the bacterial species Streptococcus agalactiae (GBS) and Staphylococcus aureus (SAU). CBM control in Brazil is difficult because most dairy farms run small family farms with limited professional training. Farmers often use antibiotics for treatment and prevention of mastitis without proper guidance. This practice contributes to the risk of antimicrobial resistance in the bacteria, which can infect people as well as cows. Not all GBS and SAU are equal. There is variability in certain bacterial structures, including those that are present on their outer surface (e.g. carbohydrates and proteins). These polymorphic cell surface structures allow the classification of SAU and GBS strains into different types. Knowledge of the distribution of these types is essential for development of disease control tools, such as vaccines and management strategies. Currently, there is a lack of knowledge on CBM-causing SAU and GBS in Brazil, partly because current diagnostic and typing methods are expensive and usually restricted to research laboratories. There is an urgent need for the development of faster and cheaper methods, improved surveillance, better CBM control measures and vaccine development studies. We aim to collect unprecedented information on SAU and GBS types on Brazilian dairy farms, to evaluate new diagnostic and typing methods, and to inform future studies for vaccine design. Our analysis of SAU and GBS strains from Southeastern and Northern Brazil will provide better understanding of their potential to cause CBM, and it will guide mastitis control policies, public health recommendations, including the rational use of antimicrobials, and inform vaccine design. Moreover, our international scientific collaboration will foster the scientific and professional development of a promising young LMIC-based female scientist.

##### Researchers involved in this project

Dr Laura Oliveira  
Federal University of Rio de Janeiro, Brazil

Dr Tatiana Pinto  
Federal University of Rio de Janeiro, Brazil

Professor Ruth Zadoks  
University of Sydney, Australia

#### The IVVN Fellowship Programme

The recently launched IVVN Fellowship Programme directly addresses the mentorship opportunity gap and aims to provide a boost to the careers of the six female researchers in LMICs who were selected as fellows. Each Fellow can receive up to £50,000 to work on a project that addresses key bottlenecks to developing vaccines against animal diseases. This funding can be used towards the research – for example for laboratory equipment or bench fees – and towards professional development, including attending conferences and workshops, or as a stipend for the fellow.



The six 2021 IVVN Fellows. Top row (L-R): Dr Mercy Yvonne Akinyi, Dr Amany Hassan and Dr Sreeja Lakshmi; bottom row (L-R): Dr Angela Makumi, Dr Laura Oliveira and Dr Tanja Smith.

**Dr Laura Maria Andrade de Oliveira, Universidade Federal do Rio de Janeiro, Brazil**

"I was recently awarded the IVVN Fellowship, which is a life-changing opportunity for my professional career as a scientist. The IVVN Fellowship will foster my professional development, strengthen my international network and improve my research skills as a promising young LMIC-based female scientist. I will have the opportunity to start my first international collaboration with a renowned researcher in my field, Professor Ruth Zadoks, and her collaborators at the Universities of Sydney and Glasgow. The fellowship will increase my potential to achieve a permanent position as Associate Professor and/or Researcher at Brazilian institutions, without losing sight of future projects, and to acquire the confidence to start my own research line. In addition, this is a unique opportunity that will aid to overcome scientific limitations usually experienced by LMIC scientists when establishing a scientific career, since during the fellowship I will be able to improve subject-specific and transferable knowledge and skills in a manner that I could not achieve in Brazil alone. Lastly, the IVVN Fellowship will be of huge importance for the advancement of mastitis research in Brazil and provide essential information on Streptococcus agalactiae and Staphylococcus aureus strains and serotypes for mastitis vaccine development, mastitis control guidance and diagnostic improvements tailored to an LMIC scenario."

In November 2021 I participated together with Dr Ruth in the Australia–Brazil Virtual Research Collaboration (VRC) event (<https://aas.eventsair.com/QuickEventWebsitePortal/aus-brazil-vrc/info-page>). This event included a limited number of promising early-career researchers that were invited to participate to meet and get to know potential new collaborators from both countries and discuss future possibilities of funding.

## New research databases and IP

In this project we sequenced the whole genomes of 156 GBS and 140 SAU isolates from animal origins, which will be made available for public use through public data repositories. The databases of genomes sequenced as part of the JUNO project (bovine and piscine GBS;



<https://www.sanger.ac.uk/collaboration/juno-global-genomic-survey-streptococcus-agalactiae/>) will be made available via the Wellcome Sanger Institute Hinxton, UK. Instead, the databases of genomes sequenced by MicrobesNG, Birmingham, UK, will be available via GenBank (<https://www.ncbi.nlm.nih.gov/genbank/>) or ENA (<https://www.ebi.ac.uk/ena/browser/home>), and the metadata via MicroReact (<https://microreact.org/>).

The proteomic databases generated from MALDI-TOF MS analysis will be shared as supporting information files of the corresponding papers published, as there is not a public repository available for this kind of data yet. This data can also be made available through peer-reviewed journals dedicated to publishing new methods of data in science. The proteomic database generated from the surfome analysis of GBS and SAU isolates will be made available via UniProt (<https://www.uniprot.org/>).

In addition, we intend to patent our MALDI-ToF MS-based strain-typing method, without commercial purposes. Patent deposition is highly valued in Brazil nowadays as the scientists have been stimulated to translate basic scientific knowledge into applied science. In addition, our intention is to get recognition by the development of this new method through a patent because this is something highly valued in terms of curriculum evaluation in Brazil, like in the application process for a position as associate professor.

#### **Awards/Recognition**

At the beginning of 2022, I was awarded a place at the Future Leaders Against AMR programme, funded by the PAR Foundation (<https://futureleadersagainstamr.org/>). The Future Leaders Against AMR is an international and interdisciplinary programme for students and early-career professionals, designed to support their development as future leaders in the work against antimicrobial resistance (AMR). The programme has been taking place virtually since January 2022, running for 10 weeks in total.

