Ukraine Biological Threat Reduction Program (BTRP)

Program (BTRP) Phase IIb

HDTRA1-08-D-0007-0004

CDRL A017

Country Science Plan (CSP)

Prepared for:

Prepared by:

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in collaboration with Metabiota, Inc.

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Contents

I. REVISION TABLE

Date of Modification	Modification	Person Responsible for Modification
03/02/2012	Initial submittal Revision 07 (Phase IIa)	M.C. Guttieri
03/07/2013	Revision 01	M.C. Guttieri
02/03/2014	Revision 02	M.C. Guttieri
06/30/2017	Revision 03	M.C. Guttieri
06/29/2018	Revision 04	M.C. Guttieri
07/25/2018	Revision 05	M.C. Guttieri
06/27/2019	Revision 06	D. Mustra

II. EXECUTIVE SUMMARY

A. Purpose

Massive increase in land use change and global human and animal connectivity, combined with persistent risks associated with political instability, water scarcity, food insecurity, bioterrorism and bio-error, have significantly increased risk to global health security. Working with partner countries, the U.S. Department of Defense (DoD) Defense Threat Reduction Agency's (DTRA's) Biological Threat Reduction Program (BTRP) seeks to deploy sustainable strategies to build indigenous scientific capacity and capability for conducting biologically safe and secure surveillance of especially dangerous pathogens (EDPs), including new and emerging diseases, as a means to mitigate the global impact of biological threats; natural, accidental, or intentional. Through transparent and health-based engagements that foster compliance with World Health Organization (WHO) International Health Regulations and World Organization for Animal Health (OIE) best practices, BTRP efforts promote rapid iteration, coordinated intelligent networking, and the ability to positively leverage scientific and technical advancement, tangible and intangible, which are critical to limiting the threat of infectious disease. In accordance with these guiding principles, the BTRP Ukraine Country Science Plan (CSP, CDRL A017) summarizes activities for advancement of sustainable Ukraine-owned and -developed One Health initiatives that support mitigation of disease risk. The pursuits outlined in the CSP serve as a conduit for achievement of BTRP objectives in Ukraine by fostering the collaborative dynamic necessary to address One Health concerns and by equipping the country with the capacity and capability to sustain effective and efficient disease detection and diagnosis.

B. Scope

A robust program for scientific engagement should integrate partner country scientists into the international research community, with the aim of fostering opportunities for sustainable enhancement of human and animal health. To this end, training and mentorship are universal requirements on the path leading to scientific excellence and are critical components of a strategic approach necessary to build a cadre of skilled professionals. Additionally, solutions to global health challenges require collaboration. For this, effective assimilation and communication of scientific information is essential to drive networking and optimal engagement within the scientific arena.

The BTRP Ukraine CSP offers a roadmap for engaging the country's science community in activities that synergistically link training and mentorship to research. Through enhanced communication, networking, and funded engagements, this serves as a conduit for regional and international collaboration, a key feature to biorisk mitigation. Initiatives are founded on developing strategic research partnerships between Ukrainian scientists and Subject Matter Experts (SMEs), forging relationships that integrate the ongoing and future life science research in Ukraine with the world community of scientists. To further this objective, the CSP is linked to the objectives and activities included in the BTRP Ukraine

Training Implementation Plan (TIP, CDRL A023), and lead international collaborators supporting BTRP Ukraine-funded Collaborative Biological Research (CBR) projects are synergistically tied to the development and delivery of in-country training activities. Through these connections, active research projects bolster the generation and understanding of modern concepts and approaches across the entire Government of Ukraine participating (GoUP) scientific community. In addition, the Science Writing Mentorship (SWM) Program, a keystone activity within BTRP Ukraine, further solidifies the relationship between the CSP's roadmap and the TIP's vision. The SWM Program serves as a vital conduit for GoUP scientists to receive expert mentorship that fosters scientific knowledge transfer, communication of research objectives, and networking, which collectively promote access to funding opportunities while also reinforcing training objectives.

C. Research Projects

The CSP describes research pursuits that aim to inform proactive and responsive One Health strategies for ethical, safe, secure, and sustainable biosurveillance. Immediate return on investment is realized through project objectives that address real-time health threats impacting the country and the region, such as African swine fever (ASF) and highly pathogenic avian influenza (HPAI). Projects are targeted to efforts that:

- Enhance the country's biosurveillance system.
- Promote understanding of the ecology, epidemiology, and/or biology of pathogens posing a risk to global health security and considered a priority for addressing DTRA's threat reduction mission.

Initiatives supportive of the latter are captured in CBR projects, which are generally hypothesis-driven multi-year engagements (12-18 month base, with 2-3 option years); whereas, pursuits associated with the former are typically one year in length and, historically, have been designated Threat Agent Detection and Response Activity (TADR) Projects (TAPs). By offering a lens into disease baseline, knowledge gaps relevant to risk mitigation, and other factors that compel further study, TAPs often serve as a springboard for future CBR projects.

The CSP summarizes the desired outcome and resources needed to achieve objectives for each of BTRP-Ukraine's CBR Projects and TAPs. The CSP is reviewed and adjusted no less than yearly to capture new initiatives and offer an update on existing and planned projects. As the disease landscape is continually evolving, the CSP is considered a living document that can flex to meet the demands of a robust health security agenda; locally, nationally, and globally.

As a vehicle for enhanced understanding of perceived gaps in regional biosurveillance or of biological risks posed to Ukraine and regional partners, CSP-related activities compel development of research topics for future project proposals. Newly identified pursuits

can be prepared in collaboration with the GoU for funding consideration, with support requested from either DTRA or other sponsors (e.g., Horizon 2020). Currently, for the animal health community, the threat posed by lumpy skin disease serves as one such example of a potential research effort, engaging Ukrainian partners as well as scientists from the bordering countries of Moldova, Poland, and Belarus. Similarly, within the human health community, zoonotic diseases such as tularemia, and other biological threats warrant further investigation.

D. Sustainment

Training, mentorship, and research are key elements to sustaining an effective biosurveillance system. Importantly, each is intertwined with the other and is made vital and functional through accessible technology that can be utilized and maintained locally for an extended duration. The framework underpinning the projects described herein applies each of these elements in a manner that complements or augments additional BTRP Ukraine initiatives, which collectively drive comprehensive and consistent country-wide participation in achieving a sustainable and effective biosurveillance system. Furthermore, each project seeks collaboration with regional and international experts, who, through their interaction with the country's scientists, serve as inspirational role models and compel pride and motivation within the Ukraine scientific community. These collaborations offer a window to regional and international networks that support global engagement in the joint quest to offset disease risk. In addition, project collaborators also serve as internationally recognized SMEs for both the Biological Threat Reduction Integrating Contract (BTRIC) Ukraine training program and SWM Program. As a result, collaborators further contribute to capacity building for project participants by linking them to additional training courses, promoting them to serve as Train-The-Trainer (T3) candidates, and providing them mentorship through SWM-P on the development of manuscripts for submission to peer-review journals, as well as for project proposals and grants. For BTRP Ukraine, coordinated, integrated, and collaborative research provides an avenue for promoting innovative approaches, which, ideally, contribute to a paradigm shift sparked by cultural and political adaptation to new standards supportive of long term biorisk management.

III. BACKGROUND

In accordance with mandates set forth in the August 2005 Biological Threat Reduction Implementation Agreement (BTRIA) between the U.S. DoD and the GoU, DTRA has tasked the BTRP to implement three integrated project areas in Ukraine: Biosafety and Biosecurity (BS&S), Biosurveillance (historically designated TADR), and CBR, inclusive of TAPs. Since the inception of the BTRIC in 2008, 9 TAPs and 10 CBR project proposals have been developed and submitted to DTRA for consideration and approval. Of these, 7 TAPs were approved for implementation and have been completed. To date, 5 CBR projects have received full approval, while 4 others achieved conditional approval but were not further pursued due to political challenges in the country. In addition, 3 of the 5 fully-approved projects have continued into option years, which were awarded via a formal proposal review process. Of note, research was reinvigorated in 2015 following restart of

the BTRIC, which was suspended in 2014. Efforts to implement approved CBR activities continued, and in 2016, the first project implemented under the BTRIC was completed, with tangible success realized through more than 9 international peer-reviewed publications. The list of CBR projects and TAPs is presented in Tables 1 and 2, respectively, with additional description provided in Sections IV – IX.

IV. CBR OBJECTIVES

The BTRP Ukraine CSP serves as a comprehensive One Health strategy to support an operational biosurveillance system for effective disease detection and reporting, which can optimally inform and implement disease risk mitigation strategies. Collectively, research focuses on building the national capacity of GoUP to:

- Maintain the biosurveillance system and the operational readiness of Recipient facilities.
- Facilitate the adoption and implementation of internationally accepted guidelines for BS&S.
- Develop networks and partnerships (cooperative and collaborative) for long term scientific engagements, which advance the potential of the country's scientists to access funding for peaceful pursuits (ethical and responsible) in support of global health security.

Through coordinated planning, project-related training is synergized with activities outlined in the BTRP TIP to support cost- and time-effective strategies for technical skill enhancement. Additionally, the CSP embodies the core values described in the BTRP Sustainment Plan.

V. KEY GoU STAKEHOLDERS

A. Ministry of Defense (MoD) of Ukraine

1. MoD of Ukraine

The MoD is the central executive body of Ukraine responsible for the management of territorial defense, military development, mobilization in the case of war, and combat readiness. The Ministry's primary objectives are preventing hostility, structuring the military, and repelling all types of aggression (both domestically and internationally).

2. State Sanitary Epidemiological Service (SSES) of the MoD of Ukraine

The SSES MoD is the unit responsible for sanitary-hygienic and anti-epidemic measures.

B. Ministry of Health (MoH) of Ukraine

1. MoH of Ukraine
The MoH is the main body of the Ukrainian healthcare system and coordinates all Oblast Laboratory Centers (OLCs).

2. State Institution Public Health Center of Ukraine (PHC) of the MoH of Ukraine
The PHC was established in 2015 to protect and promote the health of the population of Ukraine through the development and implementation of evidence-based programs for the transformation of public health in Ukraine.

C. National Academy of Agrarian Sciences of Ukraine (NAAS)

1. The NAAS is a state scientific organization with the main objective of scientific support for the development of the agro-industrial complex of Ukraine.

D. National Academy of Sciences of Ukraine (NASU)*

1. The NASU is the largest state research center in Ukraine.

E. State Service of Ukraine for Food Safety and Consumer Protection (SSUFSCP)

1. The SSUFSCP became the central body of executive authority in 2014 as a result of the reorganization of the Veterinary Service of Ukraine.

F. Ministry of Education and Science of Ukraine (MESU)*

1. The MESU is the main executive body ensuring the implementation of state policy in the sphere of education, science, innovation, and intellectual property.

*NASU and MESU are potential Recipients. Resources of the NASU and MESU may promote greater interagency cooperation and standardization.

For the complete GoU BTRP recipient list, please refer to Appendix Two.

Table 1. CBR Projects: Status

Project Designation	Project Title	Planned	Ongoing	Completed	Not Pursued
CBR UP-1	Ecological-Epidemiological Evaluation of Prevalence of Natural Focal Infections Caused by Rickettsia spp. and *Coxiella burnetii* (*C. burnetii*) in Different Landscape Zones of Ukraine				✔
CBR UP-2	Incorporating GIS, Remote Sensing, and Laboratory Diagnostics into Human and Veterinary Disease Surveillance for Tularemia and Anthrax in Ukraine (In Ukraine: Development of the Epidemiological Forecasting System for Zoonotic Diseases Employing GIS Technology)			✔	
CBR UP-3	Epidemiologic Algorithms and Molecular Approaches for Differential Diagnosis of Severe Febrile Illness of Unknown Etiology in Ukraine				✔
CBR UP-4	Risk assessment of selected Especially Dangerous Pathogens potentially carried by migratory birds over Ukraine		✔		
CBR UP-5	Ecological-Epizootological Surveillance for Identifying the Prevalence and Genetic Diversity of Crimean Congo Hemorrhagic Fever Virus, Hantaviruses, Tick-Borne Encephalitis Virus, Pseudorabies Virus, and *Leptospira* spp. in Ukraine				✔
CBR UP-6	Ecological and Epizootiological Evaluation of the Prevalence of Natural Focal Infections Caused by *Rickettsia* spp. and *Coxiella burnetii* in Different Landscape Zones of Ukraine				✔
CBR UP-7	Surveillance capacity building and determination of disease baseline for brucellosis in domestic and wild animal populations of Ukraine				✔
CBR UP-8	Prevalence of Crimean Congo hemorrhagic fever virus and hantaviruses in Ukraine and the potential requirement for differential diagnosis of suspect leptospirosis patients		✔		
CBR UP-9	The spread of African swine fever virus (ASFV) in domestic pigs and wild boar in Ukraine – Building capacity for insight into the transmission of ASFV through characterization of virus isolates by genome sequencing and phylogenetic analysis.		✔		
CBR UP-10	Regional Field-to-Table Risk Assessment of the spread of African swine fever virus (ASFV) across Ukraine in wild fauna and via consumer trade routes – insight into the development of effective ASFV quarantine strategies and public policy		✔		

Table 2. TAPs: Status

Project Designation	Project Title	Planned	Ongoing	Completed	Not Pursued
T01 Human TAP-1	Implementation of Cell Culture and Nucleic Acid Sequencing Capabilities at the Ukrainian Research and Anti-Plague Institute (URAPI) in Order to Foster and Improve Viral Diagnostics				✔
T01 Veterinary TAP-2	Development and Use of the Express Method for Avian Influenza Virus (AIV) Diagnostics Based on Reverse Transcription-Loop-Mediated Isothermal Amplification (RT-LAMP)			✔	
T01 Veterinary TAP-3	Analysis of the Threat of Spread of African Swine Fever (ASF) and Classical Swine Fever (CSF) in Wild Boar Populations in Ukraine			✔	
TO4 Veterinary TAP-1	Molecular Characterization of Highly Pathogenic Avian Influenza Virus (HPAIV) and Virulent Newcastle Disease Virus (vNDV) Isolated in Ukraine			✔	
TO4 Veterinary TAP-2	Serological Monitoring of Glanders in Ukraine and Evaluation of Serological Methods for Laboratory Diagnosis of Glanders			✔	
TO4 Veterinary TAP-3	Analysis and Review of Ukrainian Legislation and Guidelines for Veterinary Laboratory Diagnostics Quality Assurance, Biological Safety, and Biological Security for Specified EDPs, with the Aim of Identifying Potential Enhancements to the Veterinary System of Ukraine			✔	
TO4 Veterinary TAP-4	Community Outreach to Support Understanding of ASF Ecology and Epidemiology in Eastern Europe: Training and Implementation for Methods and Strategies for Control and Prevention			✔	
TO4 Veterinary TAP-5	Grantsmanship in Action: Development and Submission of a National Science Foundation (NSF) Grant Application for Avian Influenza Research in Ukraine		SWM-P		
TO4 Veterinary TAP-6	Analysis of the threat of spread of African swine fever and classical swine fever in wild boar populations in Ukraine: Improving diagnosis, surveillance, and prevention			✔	

VI. RESOURCES

Successful achievement of BTRP objectives requires both human and technical resources, which can be defined according to the following core functional areas:

A. Outreach: Access to SMEs and networks is key to achieving facile acquisition and sharing of insights, learnings, and recent scientific and technical advances by which collective understanding and experience can form the basis of directed action. Essential change is enacted through the creation of a scientific, clinical, and public health community that supports integrated and collaborative communications and development within a One Health context. BTRP research seeks to afford Ukrainian scientists access to expertise and international, multi-cultural networks to foster a sustainable network of health experts at local and national levels who are integrated into the global health community. A sampling of the numerous scientific collaborators and networks engaged through BTRP-Ukraine is presented in Figure 1.

B. Capacity: The merits and contributions of a well-informed science community require technology to transform knowledge into actionable results. For this, scientists must have access to a tool kit that can support basic and advanced methodologies in a manner that is cost-effective, sustainable, and tailored to address specific needs of a given study. In this regard, careful analysis is ascribed to the preparation of equipment, materials, and consumables lists for each BTRP CBR project and TAP. Cost, local sourcing, and other data points factor into the decision-making process. Equipment either to be purchased, or already procured, to support existing or planned BTRP research projects in Ukraine is summarized in Table 3.

C. Capability: Enhancements driven by capacity-building are realized through training, both general and specialized, theoretical and practical. Access to experts in the global arena provides a conduit by which to attain necessary skills and, via a feedback loop, further foster integration into the international scientific community. As a resource, training is a vital linkage between capacity and capability. BTRP training for CBR projects and TAPs is driven by the study design and its correlation to the targeted pathogen(s). Additionally, project training is synergized with activities outlined in the BTRP TIP, thereby driving rational cost-effective solutions to establish cadres of skilled professionals. A list of training topics for projects, either planned or underway, is presented in Table 4.

Figure 1. Sampling of Ukrainian Scientific Collaborator Network

Table 3. DTRA-Furnished Equipment Associated with Science Projects

Distribution of DTRA---Furnished Equipment to Ukraine Research Project Participants Correlated to Projects, Functional Areas, and Quantity									
Functional Area	**Ukraine Research Project Participating Organizations**								
	IECVM: UP4 UP9 UP10	**IVM:** UP4 UP9 UP10	**SSRILDVSE:** UP4 UP9 UP10	**PHC:** UP8	**RIEH:** UP8 (base year)	**UAPRI:** UP-4	**MoD:** UP8	**SSCIBSM:** UP-10	**SSUFSCP:** UP-10
ELISA/IFA:									
Plate Reader							1 (*P)		
Plate washer							1 (P)		
Thermoshaker							1(P)		
Fluorescent microscope							1(P)		
GIS:									
GPS Trimble receivers	1(**D)	1(D)	1(D)	1(P)		1(D)			
Digital camera (Ricoh WH-5 GPS)		1(D)	1(D)						
Digital camera (Canon EOS 6D kit)	1(D)		1(D)			1(D)			
Quad Core Desktop Server									
IT:									
Laptop	1(D)	1(D)	2(D), 2(P)	1(D)	1(D)	1(D)	1(P)	1(P)	1(P)
Laptop (for hospitals)				2(P)					
Rugged Laptop	1(D)	1(D)							
Quad Core Desktop Computer			1(D)						
SuperMicro Server		1(D)							
PCR/sequencing:									
Vortex Genie with adapter						1(D)			
Centrifuge-vortex Combi Spin			1(D)						
Mini-Centrifuge			1(P)				1(P)		
Micro-Centrifuge				1(P)					
LCX-200/100 Centrifuge				1(P)					
Centrifuge (for hospitals)							1(P)		
Rotor-Gene 6000				1(D)					
ProFlex PCR System				1(D)					
Sequencing: MinION	1(D)	1(D)	1(D)						
Qubit fluorometer	1(P)			1(D)					
E-Gel System				1(D)					
ChemiDoc XRS+ imaging system			1(D)						
Horizontal Electrophoresis System			1(D), 1(P)						
BioAnalyzer Electrophoresis Instrument			1(D)						
Spectrophotometer			1(P)						
Other equipment									
Celestron Cavalry 7x51	1(D)	1(D)	1(D)						
Zeiss Conquest HD 10X42						1(D)			
Dry Shipper	1(D)		1(D)			1(D)			
BMP71 Label Printer and Reader	1(D)		1(D)			1(D)			
Freezer, -86°C							1(P)		
Chest freezer (for hospitals)				2(P)					
Homogenizer				1(P)					
Thermomixer				1(P)					

Notes: * D – Delivered; ** P --- Planned

Table 4. Training Associated with Science Projects

	Research Projects					
	Project Title:	**UP-4**	**UP-8**	**UP-9**	**UP-10**	**TAP-6**
Research Training: Focus Areas	**Bioinformatics Data Analysis and Interpretation**	Nov 2018 June 2019	Sep 2018	Apr 2018 Nov 2018 May 2019		August 2017
	Portable DNA sequencers (Oxford Nanopore Technologies) and data administration to develop genome sequencing capabilities	Nov 2018, May 2019, June 2019 and TBD		Apr 2018, Nov 2018, Dec 2018, Mar 2019 May 2019, June 2019		July 2017
	Practical ELISA training to improve capability for diagnostics		TBD			
	Collaborative Institutional Training Initiative (CITI) Human Subjects Training		Oct-Nov 2018			
	Immunofluorescence assay (IFA)		May 2018, Jul-Aug 2018 Nov-Dec 2018			
	Next-generation sequencing techniques	June 2019	TBD	Apr 2018, Nov 2018, Dec 2018, Mar 2019		
	Phylogenetics	TBD	TBD	Apr 2018, Nov 2018 May 2019		July-Aug 2017
	RT-PCR: Theoretical and hands-on training on negative-sense, single-stranded RNA viruses		Nov 2017, Jul-Aug 2018			
	qRT-PCR: Theoretical and hands-on training for discovery of prevalence of hemorrhagic fever viruses		Mar 2018, May 2018, and TBD			
	Practical PCR training/mentorship to improve capability for diagnostics	Apr 2017 and TBD	Jul-Aug 2018, Nov-Dec 2018	December 2017		

	Research Projects					
	Project Title:	**UP-4**	**UP-8**	**UP-9**	**UP-10**	**TAP-6**
Research Training: Focus Areas	**Risk assessment, biosecurity and genomic-based biosurveillance**	Nov 2018		May 2019 and TBD		
	Field sample and data collection training	Sep 2017, Oct 2018 and TBD	TBD	TBD	Apr 2018	
	GIS Basic training					
	Global Information Systems (GIS): Advanced techniques	Sep 2017, Oct 2018 and TBD	Nov 2017, March 2018	TBD		July 2017
	KAP Survey				Mar 2019 June 2019	

VII. CURRENT PROJECTS

Key aspects of each CBR project are outlined below.

A. UP-4 Option Year (OY)2: Risk assessment of selected Especially Dangerous Pathogens potentially carried by migratory birds over Ukraine

- **Purpose:** Comprised of a base year and two option years (OY1 and 2), the UP-4 research project aims to assess the ecologic, epizootic, and epidemiologic risk of infectious diseases transmitted by migratory birds associated with major flyways in Ukraine.
- **Engaged:** University of Alaska Anchorage (UAA)
- **Primary Collaborators:**
  - Dr. Eric Bortz, Assistant Professor, Dept. of Biological Sciences, UAA, Anchorage, AK, USA
- **Reginal Partners:**
  - Dr. Otar Parkadze, Director (Avian Diseases), Laboratory of the Ministry of Agriculture, Tbilisi, Georgia
  - Dr. Levan Ninua, Research associate, Institute of Ecology, Ilia State University, Tbilisi, Georgia
- **Ukrainian Collaborating Institutes:**
  - National Scientific Center "Institute of the Experimental and Clinical Veterinary Medicine" (NSC IECVM), Kharkiv, Ukraine
  - State Scientific Research Institute of Laboratory Diagnostics and Veterinary and Sanitary Expertise (SSRILDVSE), Kyiv, Ukraine
  - Institute of Veterinary Medicine (IVM), Kyiv, Ukraine
  - SI (State Institution) "Ukrainian I.I. Mechnikov Anti-Plague Research Institute" (UAPRI) of the Ministry of Health of Ukraine, Odesa, Ukraine
- **Primary Ukrainian Collaborators:**
  - Dr. Borys Stegniy (NSC IECVM): Ukraine Project Manager
  - Dr. Anton Gerylovych (NSC IECVM): Ukraine Leader on Molecular Epidemiology
  - Dr. Denys Muzyka (NSC IECVM): Ukraine Leader on Field Collection
  - Dr. Andrii Mezhenskyi (SSRILDVSE): Participating Institution Manager
  - Dr. Sergiy Nychyk (IVM): Participating Institution Manager
  - Mr. Maksym Bezymennyi (IVM): GIS Leader
  - Dr. Oksana Yurchenko (UAPRI): Principal Investigator (TBD)
- **Regions Targeted:** Three distinct ecoregions in northern and southern Ukraine along major avian migratory flyways, including Odesa, Kherson, and Chernihiv Oblasts
  Target Pathogens: Avian EDPs (AIV, HPAIV, and NDV)
- **Field Collection Activities:** In selected regions of Ukraine, bird specimens will be collected in field expeditions according to the field schedule organized by NSC IECVM, closely mirroring the fieldwork activities in the UP-4 base year and OY1. Sampling will be organized to include ornithological observations recorded in an

ornithological database based on that used by project ornithologists in Ukraine to target key sentinel sites for wild bird migrations, recent incidence of avian EDPs, and proximity to domestic poultry. All field activities will be performed according to biosafety procedures and standard operating procedures (SOPs) established in the UP-4 base year and OY1 for specimen collection. Samples will be collected from selected bird species described in the base year and OY1 reports, with focus on 15 predominant Anatidae (duck) species, particularly mallard duck (*Anas platyrhynchos*), white-fronted and graylag geese (*Anser* spp.), shelducks (*Tadorna* spp.), whooper, Bewick's, mute swans (*Cygnus* spp.), and other duck species including Eurasian wigeon (*Anas penelope*). These species were selected as the focus of surveillance because they are known carriers of HPAIV.

- **Direct Cost (approved):** $550,000
- **Project Aims:** With a 12-month period of performance, UP-4 OY2 focuses on the following aims and tasks:
  - **AIM 1.** Conduct longitudinal biosurveillance of EDPs in migratory birds and domestic poultry at key interface sites in Ukraine and countries connected by migratory flyways.
    - Task 1.1. Longitudinal avian surveillance and detection of avian EDPs.
    - Task 1.2. Data capture for data sharing and Avian Virus Risk Mapping analysis.
    - Task 1.3. Tracking and analysis of bird migrations and transit of avian EDPs.
    - Task 1.4. Engage regional partners though protocol and data sharing and workshops.
  - **AIM 2.** Deploy PCR diagnostics, virus genome sequencing, and GIS data sharing resources to build a collaborative Avian Virus Risk Map for Ukraine and countries the region.
    - Task 2.1. PCR diagnostics and sequencing analysis of avian samples for AIV, NDV, and HPAIV.
    - Task 2.2. Full genome sequencing of selected high-risk AIV and NDV strains.
    - Task 2.3. Build an integrated, GIS-based Avian Virus Risk Map for Ukraine and the region.
- **Start Date:** 31 January 2019
- **Summary:** The viruses that cause HPAI and ND are currently eradicated in poultry in Ukraine. However, there is continued risk of the re-emergence of HPAIV and NDV through zoonotic spillover from infected wild birds into the country's poultry population. Emergence is further supported by the viruses' intrinsic genetic and antigenic variability, which can facilitate host jumping and switching. In addition, local and regional environmental impacts of climate change may increase the potential for viral transmission among reservoir and non-reservoir hosts. Based on results of the base year and OY1 studies, an expanded investigation continues in OY2 in order to gain maximum scientific value from the momentum generated by UP-4 project activities and to gain deeper biological insight into avian EDP threats in Ukraine and countries in the region. A key goal is to engage researchers in

regional partners; including Georgia, Armenia, and Belarus; with scientists in Ukraine to share expertise and data, increase diagnostics and virus sequencing capacity, and build partnerships to develop an Avian Virus Risk Map for better understanding of avian EDP emergence in wild birds and poultry in the region.

TO4 CBR Project UP-4 OY2: FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	31 January 2019 -30 January 2020
Estimate total direct cost of the project (US $)	$549,991
Including:	
Remuneration to FSU participants	$102,880
Equipment, materials and supplies	$145,168
Other Direct Costs (subcontracts and services)	$232,660
Travel	$69,283

[1]Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

B. UP-8 OY1: Prevalence of Crimean Congo hemorrhagic fever virus and hantaviruses in Ukraine and the potential requirement for differential diagnosis of suspect leptospirosis patients

- **Purpose:** To determine the potential threat of Crimean Congo hemorrhagic fever virus (CCHFV) and hantaviruses, which are high priority pathogens that cause, often severe, febrile illnesses and are believed to be circulating in Ukraine but are not effectively detected or diagnosed.
- **Engaged:** University of Tennessee Health Sciences Center (UTHSC), University of Florida (UOF), University of New Mexico (UNM), and Labyrinth Global Health, Inc.
- **Primary Collaborators:**
  - Dr. Colleen B. Jonsson, Professor, UTHSC, Memphis, TN USA
  - Dr. Gregory E. Glass, Professor, UOF, Gainesville, FL, USA
  - Dr. Gregory J. Mertz, MD, UNM, Albuquerque, NM, USA
- **Ukrainian Collaborating Institutes:**
  - State Institution Public Health Center of the Ministry of Health of Ukraine (PHC)
  - State Institution Volyn' Oblast Laboratory Center of the Ministry of Health of Ukraine (VOLC)
  - State Institution Lviv Oblast Laboratory Center of the Ministry of Health of Ukraine (LOLC)
  - State Institution Zakarpattia Oblast Laboratory Center of the Ministry of Health of Ukraine (ZOLC)
  - State Institution Dnipropetrovsk Oblast Laboratory Center of the Ministry of Health of Ukraine
- **Primary Ukrainian Collaborators:**
  - Dr. Iryna Demchyshyna (PHC): Ukraine Project Manager and Science Leader on testing samples to be collected in the project (rodent and tick samples, as well as human samples from hospitalized patients)
  - Dr. Ihor Nebogatkin (PHC): Ukraine Lead on environmental sampling efforts
  - Dr. Oksana Semenyshyn (Lviv OLC): Lead on human sample processing at Lviv OLC
  - Dr. Nataliia Yanko (Volyn OLC): Lead on organization of field efforts in Volyn Oblast
  - Dr. Serhiy Lytovka (MoD): Ukraine Project Manager for MoD-related efforts
- **Regions Targeted:** In OY1, project collaborators plan to analyze environmental samples (ticks) and rodents from routine collections made by OLC laboratories and expand activities to surveillance of hospital patients in Kyiv and Lviv for the potential misdiagnosis of hemorrhagic fever diseases, while also conducting a seroprevalence study of healthy soldiers from four regions of Ukraine: Lviv, Kharkiv, Odesa, and Kyiv.
- **Target Pathogens:** CCHFV and hantaviruses, with primary focus on Dobrava virus (DOBV) and Puumala virus (PUUV)

- **Field Collection Activities**: Trained personnel will collect human samples from hospitalized patients at selected hospitals in Lviv and Kyiv, and from volunteers recruited from MoD facilities in Lviv, Kharkiv, Odessa, and Kyiv.
- **Direct Cost (approved):** $772,000
- **Project Aims:** With a 12-month period of performance, UP-8 OY1 focuses on the following Aims and Tasks:
  - **AIM 1.** Provide in-country training on clinical research methodologies, conduct a prospective evaluation of the incidence, differential diagnosis, and misdiagnosis of CCHF and hantavirus infections in patients hospitalized with suspected or confirmed leptospirosis, or unexplained febrile illness, in two major hospitals in Ukraine, and screen sera from MoD personnel for antibodies against CCHFV and hantaviruses.
    - Task 1. Complete Institutional Review Board (IRB) approval in Ukraine and the U.S. for the minimal risk protocol, develop an electronic data entry platform, provide clinical research and protocol training in Ukraine, and initiate the protocol at hospitals in Lviv and Kyiv. Conduct site visits; revise protocol, as necessary, and submit to IRBs; assess potential for future expansion to other hospital sites; and preform data analysis.
    - Task 2. Determine the seroprevalence of antibodies to DOBV/PUUV/CCHFV among 4,000 normal volunteers recruited from MoD facilities in Lviv, Kharkiv, Odessa, and Kyiv and correlate seroprevalence with past medical history as well as facility location.
  - **AIM 2.** Enable continued development of capacity and capabilities to diagnose CCHFV and hantaviruses in human sera, rodents, and ticks (CCHFV only) using collected samples.
    - Task 3. Prepare and use diagnostic microscope slides for an indirect IFA diagnostic for screening of human or mammal specimens for antibodies specific to hantaviruses and use commercial ELISA screening of human specimens for antibodies specific to CCHFV.
    - Task 4. Use modern molecular diagnostic tools (RT-qPCR, RT-PCR) for detection of CCHFV and hantaviruses in environmental and human samples.
    - Task 5. From positive samples identified by the Ukraine MoH obtain sequence data for CCHFV and hantaviruses from positive human, rodent, and tick samples by Sanger and MinION approaches.
    - Task 6. Create a database that includes all findings and work within AIMs 1 and 3 in the analyses of the results.
  - **AIM3.** Develop a proactive surveillance and hotspot detection system for CCHF and hantavirus risk in targeted oblasts.
    - Task 7. Project collaborators will expand GIS training to incorporate RS software and methods for environmental monitoring and statistical analyses.
    - Task 8. Evaluate current surveillance, data collection, and management practices performed by Oblast MoH field workers. Protocols for small mammal and tick surveillance will be reviewed for the four Oblast region.

  - Task 9. Use environmental data gathered from GIS/RS and link with sites associated with infectious ticks and mammals.
  - Task 10. Expand the GIS/RS training sessions to meet identified specific needs of Ukrainian MoD public health agencies. This training will use previously developed approaches and software, as well as specifically identified, targeted tasks proposed by the client.
- **Start Date:** 18 February 2019
- **Summary:** Hospitalized patients with severe febrile illness represent the most serious spectra of infections occurring in any community. Determining the etiology of these infections is often difficult based only on clinical signs and symptoms, and routine laboratory testing, as patients often present with overlapping signs and symptoms and with non-specific laboratory abnormalities early during illness. The prevalence of undiagnosed febrile illness in Ukraine, along with limited surveillance efforts, suggest several high priority EDPs circulate but are not effectively detected or diagnosed. The lack of diagnostic reagents has made it challenging to diagnose cases of febrile illness originating from hemorrhagic fever viruses (HFVs) in Ukraine. Discussions of case reports suggest that unidentified febrile illnesses associated with hemorrhage may include CCHFV and hantaviruses. The Base Year focused on establishing laboratory capacity and capabilities within the MoH to facilitate diagnosis of febrile illnesses. These new capabilities were used to survey current repositories of small mammals, ticks, and human sera for the presence of CCHFV and two species of hantaviruses, DOBV and PUUV. These viruses are the primary causative agents of hemorrhagic fever diseases in Europe. In OY1, project activities will be expanded to surveillance of hospital patients in Kyiv and Lviv, as well as healthy soldiers from four regions of Ukraine. These studies will define the potential risk of CCHFV and hantavirus infection within Ukraine, reinforce Base Year training, and inform development of appropriate diagnostics and countermeasures. Additionally, the Team's basic clinical research studies will provide an algorithm for clinical diagnosis of selected EDPs with an emphasis on disease caused by *Leptospira* spp. Modern molecular methods will be used to detect and sequence CCHFV, DOBV, and PUUV in environmental and human samples. Diagnosis of leptospirosis will be confirmed by MoH staff in accordance with existing MoH-directed policies and procedures. Also, basic Geographic Information Systems (GIS) tools will be used for database development and creation of high-quality maps of disease distribution. Various GIS statistical methods will predict additional regions that are likely to be at risk for CCHFV and hantaviruses.

TO4 CBR Project UP-8 OY1: FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	18 February 2019 – 17 February 2020
Estimate total direct cost of the project (US $)	$771,884
Including:	
Remuneration to FSU participants	$84,042
Equipment, materials and supplies	$252,616
Other Direct Costs (subcontracts and services, including US Collaborators' budget)	238,726
Travel	196,500

[1]Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

C. UP-9 OY1: The spread of African swine fever virus (ASFV) in domestic pigs and wild boar in Ukraine – Building capacity for insight into the transmission of ASFV through characterization of virus isolates by genome sequencing and phylogenetic analysis

- **Purpose:** To comprehensively study genomes of ASFV associated with outbreaks in Ukraine (2012-2020) and to understand the epidemiological patterns of these outbreaks. The overall goal of the project is to investigate the genetic diversity, distribution, and spread of ASFV in Eastern Europe, with focus on Ukraine, as well as to inform transboundary forecasting and control strategies to reduce the risk of ASF outbreaks.
- **Engaged:** Genomics Division & DOE Joint Genome Institute (JGI), UAA, UA Fairbanks (UAF), National Veterinary Research Institute (NVRI), Metabiota Inc.
- **Primary Collaborators:**
  - Dr. Eric Bortz, Assistant Professor, UAA, USA
  - Dr. Devin Drown, Assistant Professor, UAF, USA
  - Dr. Inna Dubchak, Senior Scientist, Berkeley, CA, USA
  - Dr. Grzegorz Wozniakowski, National Veterinary Research Institute (NVRI), Puławy Poland
  - Dr. Christian E. Lange, Metabiota Inc., San Francisco, CA, USA
- **Ukrainian Collaborating Institutes:**
  - SSRILDVSE, Kyiv, Ukraine
  - NSC IECVM, Kharkiv, Ukraine
  - IVM, Kyiv, Ukraine
- **Primary Ukrainian Collaborators:**
  - Dr. Andrii Mezhenskyi (SSRILDVSE): Ukraine Project Manager
  - Dr. Anton Gerylovych (NSC IECVM): Ukraine Leader on Molecular Epidemiology
  - Dr. Oleksandr Tarasov (IVM): Principal Investigator from IVM
- **Regions Targeted:** Archived samples will be selected from regions affected by ASF outbreaks in 2012-2019.
- **Target Pathogens:** ASFV
- **Field Collection Activities:** Samples will be collected through the existing veterinary infrastructure and outbreak sample management system in Ukraine.
- **Direct Cost (approved):** $640,000
- **Project Aims:** With a 12-month period of performance, UP-9 OY1 focuses on the following Aims and Tasks:
  - **AIM 1.** Understand genotypes of ASFV in Ukraine and track the spread of virus by genotypic signatures.
    - Task 1.1. Trace the origin and spread of ASF outbreaks in Ukraine (2014-2020) by genomic signature and full genome sequencing analyses of ASFV using nanopore sequencing (ONT MinION) technology.

        - Task 1.2. Understand ASFV virulence and co-infections in wild boar and domestic pigs by genomics and evolutionary analysis of ASFV pathogenicity genes and detection of co-infecting pathogens in swine.
    - **AIM 2.** Undertake investigation into the epidemiology of ASF in Ukraine to understand exposure, incidence, and prevalence for mapping the disease.
        - Task 2.1. Estimate the roles of environmental risk factors on incidence, persistence, and geographic distribution of ASF outbreaks.
        - Task 2.2. Understand ASFV exposure and prevalence in ASF outbreak zones by serological surveillance of domestic pigs and wild boar.
    - **AIM 3.** Scientific Advancement: Bioinformatics capacity-building and data sharing.
        - TASK 3.1. Advance scientific capacity for pathogen genomics analysis through bioinformatics and sequence analysis workshops.
        - TASK 3.2. Advance ASF data sharing, reporting, and international collaboration through workshops, communication among institutes in Ukraine and SMEs, and scientific presentations and publications.
- **Start Date:** 1 April 2019
- **Summary:** ASF is a serious viral disease of swine, characterized by high mortality and significant economic losses. ASF spread rapidly in Eastern Europe in 2007-2019, starting in the Caucasus from Georgia, Azerbaijan, and Armenia, then crossing the southern European region of the Russian Federation into Ukraine and Belarus (2012 and 2013), Poland and the Baltic States (2014), Romania (2017), Czech Republic (2017), and Hungary (2018). From 2012-2018, the number of laboratory-confirmed ASF outbreaks in Ukraine reached 478 as of 31 May 2019, spreading throughout the country. Thus, Ukraine remains in the geographic center of the European ASF epidemic and is under threat of long-term endemic disease. The threat of ASF becoming established as an endemic disease or reintroduction via transboundary ASF transmission from countries in Eastern Europe and the Caucasus poses tremendous risk to commercial and backyard swine operations in Ukraine. The ongoing spread of the etiological agent of ASF, a virulent lineage of ASFV that emerged in Georgia in 2007 and spread throughout Eastern Europe, highlights the need to identify and characterize the ASFV genotypes circulating in Ukraine. Current knowledge gaps include limited understanding of susceptibility and transmission patterns, the role of domestic pigs and wild boar in the ASFV transmission cycle, the relative virulence of circulating isolates, and the potential role of carrier animals and the pork industry. The epidemiology and evolution of ASFV, including the source and location of virus introduction for individual outbreaks, the rate of spread within the country, and the rate of evolutionary change, are poorly understood. In OY1, UP-9 collaborators will continue to advance critical scientific capacity for genomics-based biosurveillance of emerging ASFV strains in Ukraine and the region. Collectively, the findings of the UP-9 Base Period and OY1 will contribute significantly to the region's preparedness and potentially aid in multinational efforts to stem the spread of ASF.

TO4 CBR Project UP-9 OY1: FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	01 April 2019 – 31 March 2020
Estimate total direct cost of the project (US $)	$639,983
Including:	
Remuneration to FSU participants	$47,020
Equipment, including shipping	$184,746
Other Direct Costs (services and subcontracts including US Collaborators' budget)	$247,215
Travel	$161,002

[1]Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

A. UP-10: Regional Field-to-Table Risk Assessment of the spread of African swine fever virus (ASFV) across Ukraine in wild fauna and via consumer trade routes – insight into the development of effective ASFV quarantine strategies and public policy

- **Purpose:** To assess the relationship between anthropogenic, socio-economic and environmental risk factors, their contribution to and impact on ASFV distribution/spread in Ukraine and develop public policy/communications that will reduce the rate of ASFV spread to new areas and across international borders.
- **Engaged:** Kansas State University (KSU), University of Florida (UOF), Helmholtz Centre for Environmental Research – UFZ, SAFOSO AG, and Labyrinth Global Health, Inc.
- **Primary Collaborators:**
  - Dr. Stephen Higgs, Director, Biosecurity Research Institutes, KSU
  - Dr. Kenneth Burton, Director, Director National Agricultural Biosecurity Center, KSU
  - Dr. Dana Vanlandingham, Associate Professor, Diagnostic Medicine and Pathobiology, KSU
  - Dr. Jason Blackburn, Associate Professor, UOF
  - Dr. Hans-Hermann Thulke, Helmholtz Centre for Environmental Research – UFZ
  - Dr. Marco De Nardi, Consultant, SAFOSO AG
  - Dr. Manon Schuppers, Director, SAFOSO AG
  - Dr. Karen Saylors, CEO, Labyrinth Global Health, Inc.
- **Ukrainian Collaborating Institutes:**
  - State Service of Ukraine on Food Safety and Consumer Protection (FSCP)
  - SSRILDVSE
  - NSC IECVM
  - IVM
  - State Scientific Control Institute of Biotechnologies and Strains of Microorganisms (SSCIBSM)
  - State Forest Resources Agency of Ukraine (SFRA)
  - National University of Life and Environmental Sciences (NULES)
- **Primary Ukrainian Collaborators:**
  - Dr. Andrii Mezhenskyi (SSRILDVSE)
  - Dr. Anton Gerylovych (NSC IECVM)
  - Dr. Andrii Mezhenskyi (SSRILDVSE)
  - Dr. Sergiy Nychyk (IVM)
  - Dr. Anatolii Holovko (SSCIBSM)
  - Dr. Andrii Shelepylo (SFRA)
  - Dr. Volodymyr Polischuk (NULES)
  - Mr. Mykola Sonko (FSCP)
- **Regions Targeted:** Targeted regions will include Zakarpattia, Rivne, Kharkiv, and Odesa Oblasts

- **Target Pathogens:** ASFV
- **Field Collection Activities:** Collection of samples will be accomplished through surveillance activities, which include collection of samples at unlicensed markets and street vendors who are points of distribution for products from small stakeholder and backyard holdings. Samples targeted for study will include pork products, unprocessed pig meat and organs (spleen, lymph nodes, liver, tonsil, heart, lung, and kidney). All samples will be handled according to established protocols and in line with Ukrainian requirements for the handling of materials potentially contaminated with ASFV, as well as in accordance with international standards for biosafety and biosecurity.
- **Direct Cost (approved):** $850,000
- **Project Aims:** With a 14-month period of performance, UP-10 focuses on the following Aims and Tasks:
  - **Aim 1.** Define geographical and environmental factors associated with establishment and spread of ASFV through wild boar movements.
    - Task 1.1. Perform spatial modeling of existing data on wild boar occurrence to be provided from the historical records of SFRA and NULES, habitat landscape structure, and seasonal movement across Ukraine in order to project the size and location of effective quarantine zones and inform geographical factors contributing to the spread of ASFV in Ukraine.
    - Task 1.2. Support capacity building for spatially explicit computational methodologies within the participating Ukrainian organizations. Consider advanced system dynamics modelling to explore future options in translating the data-based findings into predictive intervention options.
  - **Aim 2.** Track anthropogenic and socio-economic factors.
    - Task 2.1. Ensure proper protocol and biosecurity throughout sample collection, shipping, and testing.
    - Task 2.2. Collect biological samples of pork products from small-stakeholders and backyard holdings, local butchers and slaughter houses, unlicensed markets and street vendors (blood; samples of organs, including spleen, lymph nodes, lungs, kidneys) to test for ASF.
    - Task 2.3. Conduct laboratory investigations of collected specimens to determine presence of ASFV.
    - Task 2.4. Perform analysis of results.
    - Task 2.5. Document anthropogenic factors contributing to the spread of ASF in Ukraine and implement effective biosecurity and control measures for preventing farm-to-farm and farm-to-wildlife spread. Assess the relative risk of ASFV spread within Ukraine and across regional borders via commercial trade routes of pigs and pig products, the illegal distribution and transport of pigs and pig products, and wild boar movements.
  - **Aim 3.** Public policy and communications through training, education, and outreach.
    - Task 3.1. Establish a GIS and Computational Modeling Fellow.

  - Task 3.2. Develop training curricula for GIS and computational modeling and perform outreach to inform local, regional, and national policy development.
  - Task 3.3. Develop audience-appropriate materials to support education and public outreach strategies designed to improve local, regional, and national biosecurity and lessen anthropogenic factors contributing to the spread of ASF.
  - Task 3.4. Educate and perform outreach to inform local, regional, and national policy development.
  - Task 3.5. Produce a minimum of two, Ukrainian-recipient led, high-impact peer-reviewed publications on this work.
- **Start Date:** 8 January 2019
- **Summary:** UP-10 seeks to expand upon research and biosurveillance efforts currently underway within Ukraine in order to inform effective biosecurity strategies and the development of public policy for controlling the spread of ASFV within Ukraine. Through connecting biosurveillance findings and policy development, the overall outcome of this program will be recommendations for the development of policy and public outreach designed to limit the potential for ASFV transmission via consumer trade routes and/or across regional borders through human activities. Furthermore, due to the imperative to quickly resolve the growing ASF crisis in Ukraine, this project will link Ukrainian officials with regional researchers and ASFV control programs in order to build upon best practices and lessons learned for blocking the spread of ASF further into European Union countries. Implementing the findings of this project will contribute to the economic sustainability and stability of agricultural markets within Ukraine and contribute to Ukraine's further integration and alignment with EU trade and policy. As such, the project consists of three focus "Project Pillar" areas that will be undertaken in parallel: A) Defining Geographical and Zoonotic Factors, B) Tracking Anthropogenic and Socio-Economic Factors, and C) Public Policy/Communications.

TO4 CBR Project UP-10: FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	08 January 2018 – 07 March 2020
Estimate total direct cost of the project (US $)	$849,971
Including:	
Remuneration to FSU participants	$87,295
Equipment, materials and supplies	$188,213
Other Direct Costs (services and subcontracts including US Collaborators' budget)	$396,662
Travel	$177,801

[1] Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

VIII. PLANNED PROJECTS

N/A

IX. COMPLETED PROJECTS

Key aspects of each proposed project are outlined below.

A. TAP-6: Analysis of the threat of spread of African swine fever and classical swine fever in wild boar populations in Ukraine: Improving diagnosis, surveillance, and prevention

- **Purpose:** To support continued surveillance and forecasting of the ASF and Classical Swine Fever (CSF) epizootic situation among wild pig populations inhabiting regions of Ukraine, which border the Russian Federation (RF), Belarus, and Poland, and to evaluate the risk of transmission to domestic pigs in the country.
- **Engaged:** Orion Integrated Biosciences, Inc. (OIB; Larchmont, NY, USA)
- **Primary Collaborators:**
  - Dr. Willy Valdivia (OIB)
- **Ukrainian Collaborating Institutes**
  - SSRILDVSE, FSCP
  - IVM, NAAS
- **Primary Ukrainian Collaborators:**
  - Dr. Oleg Nevolko (SSRILDVSE)
  - Dr. Sergiy Nychyk (IVM)
- **Region Targeted:** Administrative geographic regions chosen for these studies are Vinnytsa, Volyn', Dnipropetrovsk, Donetsk, Zhytomyr, Zakarpattia, Kyiv, Lugansk, Lviv, Odesa, Poltava, Rivne, Sumy, Kharkiv, Cherkassy, and Chernihiv Oblasts.
- **Target Pathogens:** ASF and CSF viruses
- **Field Collection Activities:** Samples were collected from wild boar during the state-specified hunting season.
- **Direct Cost:** $132,000
- **Project Length and Aims:** 12 months (1 September 2016 – 31 August 2017)
  - **AIM 1.** Sampling.
    Collect georeferenced biological specimens (e.g., blood and organ samples, including: Spleen, lymph nodes, lungs, and kidneys) from wild boar to test for ASF and CSF.
  - **AIM 2.** Laboratory Diagnostics for ASF and CSF.
    Perform laboratory investigations, personnel training, and capacity building to improve capability for ASF and CSF diagnostics.
  - **AIM 3.** Pathogen Characterization.
    Determine pathogen diversity by sequence analysis of ASFV- or CSFV-positive specimens.

- **AIM 4.** Genomic-Based Biosurveillance and Data Analysis.
  Utilize genomic-based biosurveillance technologies to analyze and map project-acquired data and to generate situational awareness reports.
- **AIM 5.** Training and Reporting.
  Conduct training, develop training materials, and present scientific findings.

- **Period of Performance:** 1 September 2016 – 31 August 2017
- **Summary:** TAP-6 focused on laboratory diagnostic studies to assess the risk of transboundary transfer into Ukraine of these extremely challenging swine diseases. Samples were collected and tested at SSRILDVSE using PCR and ELISA. Additionally, scientists performed ASFV-amplicon-based sequencing of 10 samples from swine and wild boar using the MinION sequencing device. A detailed protocol for amplicon-based sequencing of ASFV using MinION platform was produced. The project demonstrated the feasibility of using portable sequencing for ASFV and the integration of GIS. Sequence data analyses of 12 samples suggested ASFV linkage to a Malawi strain of the virus, which will require confirmation by Illumina sequencing.

TO4 Veterinary TAP-6: AWARD FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	Month Day Year-Month Day Year **1 September 2016 – 31 August 2017**
Estimate total direct cost of the project (US $)	$132,000
Including:	
Remuneration to FSU participants	$ 0
Equipment, materials and supplies including shipping	$ 97,500
Other Direct Costs (services and subcontracts)	$ 25,000
Travel	$ 9,500
Overhead for Ukrainian organizations participating on the project	$ 0

[1]Direct costs exclude IC indirect costs and potential award fee.

B. UP-2: Incorporating GIS, Remote Sensing, and Laboratory Diagnostics into Human and Veterinary Disease Surveillance for Tularemia and Anthrax in Ukraine (In Ukraine: Development of the Epidemiological Forecasting System for Zoonotic Diseases Employing GIS Technology)

- **Purpose:** To develop disease baseline for anthrax and tularemia, using historical as well as newly-acquired data and GIS software.
- **Engaged:** Arizona State University (ASU), Johns Hopkins Bloomberg School of Public Health (JHSPH), Kansas State University (KSU), Walter Reed Army Institute of Research (WRAIR), and the University of Florida (Gainesville)
- **Primary Collaborators:**
  - Dr. Jason Blackburn (University of Florida, UOF): US Lead Project Manager
  - Dr. Jason Farlow (WRAIR): US Co-Investigator
  - Dr. Doug Goodin (KSU): US Co-Investigator
  - Dr. Sabra Klein (JHSPH): US Co-Investigator
  - Dr. Mikeljon Nikolich (WRAIR): US Co-Investigator
- **Ukrainian Collaborating Institutes:**
  - Ukraine Center for Disease Control and Monitoring (UCDC) of the MoH of Ukraine
  - IVM, NAAS
  - VOLC
- **Primary Ukrainian Collaborators:**
  - Dr. Sergiy Nychyk (IVM): Ukraine Lead Project Manager
  - Dr. Nataliia Vydaiko (UCDCM): Principal Investigator from UCDCM
  - Dr. Maksym Bezymennyi (IVM): Ukrainian Lead on GIS efforts
- **Regions Targeted:** Volyn' Oblast of Ukraine
- **Field Collection Activities:** Ticks and small mammals were collected 2X per year in 2012-2013 within regions targeted by the project
- **Direct Cost (2012-2016):** $1,922,207
- **Project Length and Tasks:** The project was performed in 2012-2015. Under the mentorship of the US collaborators, generally all tasks were completed successfully.
  - **Task 1**. Historical GIS Analyses
    - Task 1.1. Create Anthrax databases.
      a. Historical records of anthrax outbreaks were collected using available sources of information.
      b. Records were linked to an administrative division database of the Ukrainian Parliament (rada.gov.ua) so that sites were located according to the most detailed geographic location (=geocode).
      c. GIS was used to map locations of outbreaks.
      d. Statistical analyses were performed for regions having excess rates of outbreaks (hotspot analysis) using kernel density estimators and k-function analyses.

- Task 1.2. Create Tularemia databases.
  a. Historical records of tularemia outbreaks were collected using available sources of information.
  b. Records were linked to an administrative division database of the Ukrainian Parliament (rada.gov.ua) so that sites were located according to the most detailed geographic location (=geocode).
  c. GIS was used to map locations of outbreaks.
  d. Statistical analyses were performed for regions having excess rates of outbreaks (hotspot analysis) using kernel density estimators and k-function analyses.

- **Task 2.** Active Surveillance Tularemia
  - Task 2.1. Survey small mammals as possible *Francisella tularensis* reservoirs in Volyn' Oblast.
    a. Small mammals were collected in at least 20 sites within Volyn' Oblast 2x each year. At least four sites were previously sampled to ensure longitudinal recording of data.
    b. Recorded local environment biotope and photographed sites where animals were captured.
    c. Recorded geographic location of each site.
    d. Delivered euthanized small mammals to VOLC for necropsy and data generation.
    e. At VOLC, necropsy forms were completed (recording species, sex, reproductive condition, size), ectoparasites were removed, and specimens were stored frozen. The following organs were removed and stored individually at -80^{o}C: spleen, salivary gland, kidney, and lung.
    f. Frozen tissues and associated necropsy data forms were delivered to UCDCM for testing.
    g. At UCDCM, individual necropsy records were confirmed and entered into spreadsheets with test results.
    h. SOPs were utilized for quantitative PCR using SYBR Green assay to detect *F. tularensis*.
    i. PCR-positive specimens were tested by microbiological culture on FT-agar plates for colony growth.
    j. Spatial distribution maps for potential distributions of the six most commonly sampled small mammals were generated using spatial statistical modeling (co-kriging) of captured mammals and environmental data (elevation and land cover derived from RS data) for all of Volyn' oblast.
  - Task 2.2. Arthropod surveys for *F. tularensis* in Volyn' Oblast.
    a. Questing blood feeding arthropods (ixodid ticks) were collected by flagging near locations where small mammals were surveyed.
    b. A 1 sq m of light-colored cloth was dragged through the environment for one hour. Every five minutes the cloth was checked for attached ticks. Collected ticks were removed and placed in vials. Individual vials were

used for each site and were labeled with the collection date and site name.

c. Collected ticks were kept cool and sent to VOLC with small mammals.
d. At VOLC, ticks were separated by species, site of collection, and date, then stored in vials, with no more than 20 ticks per vial. Multiple vials were used for one species, sex, site, and date if needed.
e. Ticks were frozen at -80°C and delivered to UCDCM along with collection information.
f. Ticks were homogenized according to SOPs and tested by PCR and culture methods for *F. tularensis* according to SOPs.

- **Task 3.** Active Surveillance Anthrax.
  - Task 3.1. IVM passively monitored reports of anthrax in domestic or wild animals through the national veterinary service.
  - Task 3.2. Reports were investigated.
  - Task 3.3. Confirmed reports were geographically located and added to the historical database of cases.
  - Task 3.4. Sites in Volyn' and Kherson Oblasts were visited, and soil near burial sites was sampled. Soil samples were subsequently tested for the presence of viable *B. anthracis* spores using microbiological assays and PCR at IVM laboratories.
- **Task 4.** GIS Analysis.
  - Task 4.1. Space-time analysis of historical and prospective surveys for *F. tularensis* and *Bacillus athracis* were performed.
    a. Historical data for anthrax and tularemia outbreak locations were used and spatial statistical analyses performed to identify the times and places with excess rates of disease across the nation. This identified regions likely to experience higher than average risk of disease.
    b. Prospective surveillance for *F. tularensis* and *B. anthracis* was used to identify, at local levels, the clustering of pathogen presence using spatial statistical methods to identify local clustering of infections.
  - Task 4.2. ENM
    a. Sites of *F. tularensis* or *B. anthracis* outcomes were mapped in combination with environmental data to model the likelihood of occurrence of pathogens in sites that have been not sampled based on their similarities with sites with outbreaks. State of the art ENMs (e.g., MaxEnt) was used or other appropriate models to create predictions.
    b. Predictions from ENMs were evaluated by test sampling at additional sites, and the likelihood of pathogen presence was determined.
  - Task 4.3. Remote Sensing
    a. Commercially available moderate resolution satellite imagery (Landsat) was acquired.
    b. Imagery for Volyn' region using commercially available software was processed.

c. Land use classification algorithms were performed to characterize the region.
d. Field surveys were conducted to compare the classification scheme with observations. Results were evaluated and modifications were pursued as necessary.
e. RS data were incorporated with other spatial data layers related to infection to generate databases for ENM and output.

- **Summary:** The primary goals of this project were to develop both explanatory and predictive, spatially-explicit models to explore the geography and ecology of EDPs; specifically, *F. tularensis,* the causative agent of tularemia, and *B. anthracis,* the causative agent of anthrax; across Ukraine at multiple spatial scales. Historical data were used to characterize the distribution and seasonality of the zoonoses at the national scale, while active surveillance and field efforts concentrated on local scale patterns of land cover change in relation to disease agent, host, and/or vector distributions. This project was defined by four specific objectives:
  1) Analyses of historical tularemia and anthrax data sets, including pathogen passports, field collection records, and field responses at the national level.
  2) Present-day active surveillance for *F. tularensis* in ticks and small mammal host populations, with the integration of appropriate culture and PCR-based lab analyses for pathogen detection.
  3) Surveillance of livestock herds and environemental sampling for *B. anthracis*, with integration of appropriate PCR-based detection assays in the laboratory.
  4) Forecasting of pathogen outbreak conditions using advanced spatial analyses GIS, and Remote Sensing (RS) approaches to define the geographic extent of the pathogens and landscape dynamics that effect those distributions.

  UP-2 was originally developed and implemented under the BTRIC in 2012-2014. However, in February 2014, BTRIC Ukraine, including all ongoing research efforts, was terminated, and UP-2 project implementation continued under another contract, the Academic Engagement Partnership (AEP) program. With restart of BTRIC-Ukraine in February 2015, the project was transitioned in October 2015 from AEP back to Integrating Contractor Black & Veatch Special Projects Corp. (BVSPC), who was tasked with implementing UP-2 through completion of the project's aforementioned objectives.

TO4 CBR Project UP-2: FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	1 February 2012 - 31 May 2016
Estimate total direct cost of the project (US $)	$1,922,207
Including:	
Remuneration to FSU participants	$ 310,160
Equipment, including shipping	$ 399,015
Materials, including shipping	$ 211,648
Other Direct Costs (services and subcontracts including US Collaborators' budget)	$ 632,929
Travel	$ 368,455

[1] Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

C. UP-4 (Base Year): Risk assessment of selected Especially Dangerous Pathogens potentially carried by migratory birds over Ukraine

- **Purpose:** To assess the ecologic, epizootic, and epidemiologic risk of infectious diseases transmitted by migratory birds associated with major flyways in Ukraine.
- **Engaged:** UAA
- **Primary Collaborators:**
  - Dr. Eric Bortz, Assistant Professor, Dept. of Biological Sciences, UAA, Anchorage, AK, USA
- **Ukrainian Collaborating Institutes:**
  - NSC IECVM
  - SSRILDVSE
  - IVM
  - UAPRI
- **Primary Ukrainian Collaborators:**
  - Dr. Borys Stegniy (NSC IECVM): Ukraine Project Manager
  - Dr. Anton Gerylovych (NSC IECVM): Ukraine Leader on Molecular Epidemiology
  - Dr. Denys Muzyka (NSC IECVM): Ukraine Field Collection and GIS Leader
  - Dr. Oleg Nevolko (SSRILDVSE): Participating Institution Manager
  - Dr. Sergiy Nychyk (IVM): Participating Institution Manager
  - Dr. Olena Yegorova (UAPRI): Participating Institution Manager
- **Regions Targeted:** Three distinct ecoregions in northern and southern regions of Ukraine, including Odesa, Kherson and Chernihiv Oblasts
- **Target Pathogens:** Highly pathogenic avian influenza (HPAI) and Newcastle disease (ND) viruses
- **Field Collection Activities:** Collection was conducted with consideration given to the ecologic-epizootic risk of disease as ascertained through current and historical monitoring of bird populations and avian diseases. Additionally, specific study sites were selected based on spatial factors, such as flyways, proximity to farms, land use, etc., and temporal conditions, such as seasonality and climate change. Sampling correlated to migration resting sites and wintering grounds. All sampling was conducted according to local standards and practices, and no project collaborator trapped birds or participated in any actions that brought harm to any subject. As such, fecal samples were collected from the ground as directed by observation of resting migratory flocks. Tissue and other biological samples were provided to the project collaborators from birds collected under the Sate sponsored monitoring surveillance program by licensed hunters in accordance with the National Surveillance Plan. Expeditions were arranged to permit autumn/winter and winter/spring collections.
- **Direct Cost:** $529,502
- **Project Aims:** The UP-4 Base Year study focused on the following aims and tasks:
  - **AIM 1.** Review and adjust SOPs as necessary to ensure safe and effective implementation of project activities.

        - Task 1.1. Create/update SOPs and other documents to standardize. methodologies and improve relevance and credibility of results.
        - Task 1.2. Develop standardized data collection and management procedures.
        - Task 1.3. Develop protocols to establish molecular diagnostic capabilities.
    - **AIM 2.** In selected regions of Ukraine, collect and analyze bird specimens for the presence of HPAIV and NDV.
        - Task 2.1. Migratory birds targeted for study.
        - Task 2.2. Collection of bird specimens in the South and North.
        - Task 2.3. Analysis of bird specimens for HPAIV and NDV.
    - **AIM3.** Utilize geographic information systems (GIS) technologies to map and analyze data obtained within the project.
        - Task 3.1 Develop protocols, standardize data entry, and format data for use with GIS.
        - Task 3.2. Develop protocols for integrating handheld Global Positioning System (GPS) receivers into field specimen collection.
        - Task 3.3. Improve capacity to produce high-quality analyses, maps, and graphics for reports and scientific publications.
- **Period of Performance (Base Year):** 1 December 2016 – 30 November 2017
- **Summary (Base Year):** The UP-4 project was developed in order to support assessment of the ecologic, epizootic, and epidemiologic risk of infectious diseases transmitted by migratory birds associated with major flyways in the country. Comprised of a base-year study with two OYs, DTRA approved the Base Year, which was implemented from 1 December 2016 – 30 November 2017. In the Base Year, project scientists surveyed regions of Ukraine for AIV and NDV, respectively, in wild waterfowl located within proximity of the country's major northern and southern migratory flyways. Flyways and resting grounds most frequently visited by wild bird species hypothesized to be vectors for EDPs, particularly waterfowl species known to carry avian influenza and paramyxoviruses, were targeted for ornithological evaluation, sampling, and laboratory analysis. Bird observations, viral detection data, and GIS techniques were assessed for use in analyzing ecological and anthropogenic impacts on virus prevalence and genotypes. During UP-4 Base-Year implementation, 4790 biological samples (fecal) were obtained in southern (Odesa, Kherson, and Zaporizhzhya Oblasts) and northern (Chernihiv Oblast) regions of Ukraine from wild waterfowl and shorebirds. Based on PCR results, the influenza A virus genome was detected in 74 samples (including ten H5 positive samples) and the avian paramyxovirus (APMV) genome in 5 samples. This analysis suggested that approximately 1.5% of samples were positive for AIV. As noted, an expanded investigation was proposed, which resulted in DTRA's approval of UP-4 OY1.

TO4 CBR Project UP-4 Base Year: FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	1 December 2016 -30 November 2017
Estimate total direct cost of the project (US $)	$529,502
Including:	
Remuneration to FSU participants	$114,280
Equipment, including shipping	$ 52,187
Materials, including shipping	$192,584
Other Direct Costs (subcontracts and services)	$127,253
Travel	$ 43,198

[1]Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

D. UP-4 OY1: Risk assessment of selected Especially Dangerous Pathogens potentially carried by migratory birds over Ukraine

- **Purpose:** Conduct biosurveillance of migratory birds at key sites identified in the base year, expanding surveillance to sentinel sites for nesting colony birds and domestic backyard poultry, with focus on the following objectives:
  - Develop virus genome sequencing and GIS mapping resources for deeper scientific analysis of risk dynamics of avian viruses and their hosts in Ukraine.
  - Assess the ecologic, epizootic, and epidemiologic risk of infectious diseases transmitted by migratory birds associated with major flyways in Ukraine.
- **Engaged:** UAA
- **Primary Collaborators:**
  - Dr. Eric Bortz, Assistant Professor, Dept. of Biological Sciences, UAA
- **Ukrainian Collaborating Institutes:**
  - NSC IECVM
  - SSRILDVSE
  - IVM
  - UAPRI
- **Primary Ukrainian Collaborators:**
  - Dr. Borys Stegniy (NSC IECVM): Ukraine Project Manager
  - Dr. Anton Gerylovych (NSC IECVM): Ukraine Leader on Molecular Epidemiology
  - Dr. Denys Muzyka (NSC IECVM): Ukraine Field Collection and GIS Leader
  - Dr. Andrii Mezhenskyi (SSRILDVSE): Participating Institution Manager
  - Dr. Sergiy Nychyk (IVM): Participating Institution Manager
  - Dr. Olena Yegorova (UAPRI): Participating Institution Manager
- **Regions Targeted:** Three distinct ecoregions in northern and southern Ukraine, including Odesa, Kherson, and Chernihiv Oblasts
- **Target Pathogens:** HPAIV and NDV
  Field Collection Activities: Collection continued at sites selected from key regions previously studied in the UP-4 Base Year, while expanding biosurveillance efforts to new territories. Additional study sites were selected, taking into consideration high densities of migratory birds that represent landing sites in migratory flyways observed during the Base Year and based on spatial factors such as flyways, proximity to farms, land use, etc., as well as temporal conditions such as seasonality and climate change. Investigation of additional sites at the interface of wild birds and domestic backyard poultry; as well as prevalence studies in resident nesting colony birds (e.g., gulls, terns), tufted ducks and waders; provided better understanding of the risk of interspecies transmission of highly pathogenic AIV and NDV, and long-term prevalence dynamics in sentinel sites. Four field expeditions were conducted for collection of environmental feces during winter, spring, late summer/early autumn, and late autumn migrations (an Institutional Care and Use Committee [IACUC] exempt activity). All field activities were performed according to biosafety procedures established in UP-4 Base Year SOPs for specimen

collection. Samples were collected from selected bird species described in the Base Year, with focus on recent carriers of HPAIV (*Anser, Anas*, and *Cygnus* spp.), while also targeting new species of wild birds frequently observed in close proximity to carriers of EDPs.

- **Direct Cost:** $689,350
- **Project Aims:** The UP-4 OY1 study focused on the following aims and tasks:
  - **AIM 1.** Conduct biosurveillance of migratory birds at key sites identified in the base year of UP-4, expanding surveillance to sentinel sites for nesting colony birds and domestic backyard poultry.
    - Task 1.1. Obtain long term data regarding AIV and NDV prevalence in wild bird species at key observation sites in Ukraine.
    - Task 1.2. Expand biosurveillance to nesting colony birds and waders as sentinels for measuring prevalence of AIV and APMV, as well as for determining risk of virus transmission to migratory birds.
    - Task 1.3. Expand biosurveillance at the interface of domestic backyard poultry and wild birds to understand the risk of AIV and NDV spillover from migratory birds.
    - Task 1.4. Laboratory analysis of bird samples for HPAIV and NDV.
  - **AIM 2.** Develop virus genome sequencing and GIS mapping resources for deeper scientific analysis of risk dynamics of avian viruses and their hosts in Ukraine.
    - Task 2.1. Build protocols for full genome sequencing of selected high-risk AIV and NDV strains, leveraging expertise in virus sequence analysis, next-generation sequencing, and nanopore sequencing.
    - Task 2.2. Build an accessible, integrated GIS-based Avian Virus Risk Map for key regions of Ukraine based on virus genome, PCR diagnostics, avian host, and environmental data from biosurveillance.
- **Period of Performance (OY1):** 31 January 2018 – 30 January 2019
- **Summary (OY1):** EDPs that cause HPAI and ND have continue to threaten wild birds and poultry in Ukraine and other countries in Eurasia. Looking forward, there is continued risk of the emergence of HPAI and NDV, respectively, and zoonotic spillover from infected wild birds into the commercial and backyard poultry populations of Ukraine. Emergence is further supported by the viruses' intrinsic genetic and antigenic variability, which can facilitate host jumping and switching. In addition, local and regional environmental impacts of climate change may increase the potential for viral transmission among reservoir and non-reservoir hosts. DTRA approved the extension of UP-4 project for OY1, which was implemented from 31 January 2018-30 January 2019, to support long-term surveillance, detection, and scientific study of avian EDPs, and to assess risk of avian EDP outbreaks. Bird observations, viral detection data, and GIS methods were used to analyze ecological impacts on virus prevalence and genotypes. Collectively, 111 avian EDPs were identified by diagnostic PCR and sequencing in the base year and OY1, including 98 AIV and 13 NDV strains, with an overall prevalence of 2.3% detection. In OY1, a total of 17 AIV genomes from wild birds and poultry were sequenced, of

which 9 were sequenced in Ukraine using new nanopore sequencing technology. These viruses are being provisionally analyzed for their genetic relationships to AIV found in wild bird and poultry populations in Eurasia. Elements of two APMV-1 genomes (a name given to NDV when it occurs in wild birds) were also partially sequenced in Ukraine. A salient finding of the UP-4 project has been that both HPAI and NDV emerge from a background reservoir of viruses that exists in Ukraine but is linked with wild bird migratory patterns from countries in the region. Based on results of the Base Year and OY1 studies, an expanded investigation was proposed for UP-4 OY2 in order to gain maximum scientific value from the momentum generated by UP-4 project activities and to gain deeper biological insight into avian EDP threats in Ukraine and countries in the region.

TO4 CBR Project UP-4 OY1: FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	31 January 2018 -30 January 2019
Estimate total direct cost of the project (US $)	$689,350
Including:	
Remuneration to FSU participants	$118,175
Equipment, materials and supplies	$250,818
Other Direct Costs (subcontracts and services)	$191,763
Travel	$128,594

[1]Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

E. UP-8 (Base Year): Prevalence of Crimean Congo hemorrhagic fever virus and hantaviruses in Ukraine and the potential requirement for differential diagnosis of suspect leptospirosis patients

- **Purpose:** To determine the potential threat of CCHFV and hantaviruses, which are high priority pathogens that cause, often severe, febrile illnesses and are believed to be circulating in Ukraine but are not effectively detected or diagnosed.
- **Engaged:** UTHSC, UOF, and UNM
- **Primary Collaborators:**
  - Dr. Colleen B. Jonsson, Professor, UTHSC, Memphis, TN USA
  - Dr. Gregory E. Glass, Professor, UOF, Gainesville, FL, USA
  - Dr. Gregory J. Mertz, MD, UNM, Albuquerque, NM, USA
- **Ukrainian Collaborating Institutes:**
  - PHC
  - Danylo Halytskyi Lviv National Medical University (LNMU)
  - VOLC
  - LOLC
  - ZOLC
  - State Institution Dnipropetrovsk Oblast Laboratory Center of the MoH
  - Danylo Halytsky Lviv National Medical University (LNMU)
- **Primary Ukrainian Collaborators:**
  - Dr. Iryna Demchyshyna (PHC): Ukraine Project Manager and Science Leader on testing rodent and tick samples that were previously collected under CBEP-funded CBR Project UP-2
  - Dr. Ihor Lozynskyi (LNMU): Principal Investigator of the Research Institute of Epidemiology and Hygiene of LNMU and Ukraine Leader on serological analysis of human samples that were previously collected under CBEP-funded Project Development Grant (PDG) UP-1 project
  - Dr. Olena Zubach (LNMU): Ukraine Leader on developing algorithms to facilitate diagnosis of febrile illnesses due to EDPs in Ukraine
- **Regions Targeted:** For the Base Year, the project proposed to survey current repositories of small mammals and ticks that were collected in Volyn' Oblast of Ukraine and human sera that were collected in Yavoriv and Novoyavoriv rayons of Lviv Oblast
- **Target Pathogens:** CCHFV and hantaviruses; DOBV, Hantaan virus (HTNV), Seoul virus (SEOV), or PUUV
- **Field Collection Activities:** No collection activity was planned for the base year.
- **Project Aims:** The UP-8 Base Year focused on the following Aims and Tasks:
  - **AIM 1.** Develop algorithms to facilitate diagnosis of febrile illnesses due to EDPs in Ukraine and establish clinical research capacity for collection of de-identified clinical specimens linked to de-identified epidemiologic and clinical data.
    - Task 1. Complete FWA registration for Ukrainian IRB, develop a research protocol, consent and CRFs for collection of de-identified clinical samples,

clinical and epidemiological data and gain approval (exempt status approval for task 4 and minimal risk approval for the research protocol) from US and Ukrainian IRBs. Identify clinical investigators for collaborative development of the research protocol and provide in country training on the research protocol as well as human subjects research training in Russian through the CITI training program.

- **AIM 2.** Establish capacity and capabilities to diagnose CCHFV and hantaviruses in human sera, rodents, and ticks (CCHFV only) using previously collected samples**.**
  - Task 2. Preparation of diagnostic reagents for screening of humans or mammals for hantaviruses or CCHFV (IFA).
  - Task 3. Training of Ukrainian scientists in modern molecular diagnostic tools (RT-PCR) for detection of CCHFV and hantaviruses, respectively.
  - Task 4. Screening of previously collected rodent and tick samples for detection of hantaviruses and CCHFV, respectively, using qRT-PCR.
  - Task 5. RT-PCR amplification of amplicons from RNA isolated from positive rodent and tick samples for sequencing of hantaviruses and CCHFV, respectively, for sequencing and phylogenetic analyses.
  - Task 6. Serological analysis of hantavirus antibody prevalence in healthy Ukrainians from Yavoriv rayon of Lviv Oblast - Diagnostic testing using assays developed in Subtasks 2.2 and 2.3.
- **AIM3.** Develop and implement GIS mapping tools to inform assessment of CCHF and hantavirus risk.
  - Task 7. Develop an integrated software system that creates a decision-making system for policy makers in this region of Ukraine.

- **Period of Performance (Base Year and 3-month No Cost Extension):**
  02 October 2017 – 01 January 2019
- **Summary (Base Year and 3-month No Cost Extension)**: Basic research studies focused on developing an algorithm for diagnosis of CCHFV and hantaviruses (Aim 1) and on molecular approaches/tools to enhance detection and accurate identification of these pathogens (Aim 2). Researchers used basic GIS tools for database development and creation of high-quality maps (Aim 3). Special attention was paid to conducting research according to international standards. US SMEs assisted with establishing laboratory capacity and capabilities within the MoH to facilitate diagnosis of febrile illnesses. These new capabilities were used to survey current repositories of small mammals, ticks, and human sera for the presence of CCHFV and two species of hantaviruses, DOBV and PUUV. Positive human sera were identified for all three viruses. Identified hantavirus seropositive rodent samples indicated circulation of hantaviruses in Ukraine's Volyn Oblast. Based on project findings, optional follow-on work was pursued to expand activities to additional regions, permit further assessment of the potential risk of infection caused by HFVs within Ukraine, reinforce training, and inform development of appropriate countermeasures. In this regard, UP-8 OY1 was awarded by DTRA.

TO4 CBR Project UP-8 Base Year: FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	2 October 2017 – 01 January 2019
Estimate total direct cost of the project (US $)	$866,236
Including:	
Remuneration to FSU participants	$79,380
Equipment, materials and supplies	$221,485
Other Direct Costs (subcontracts and services, including US Collaborators' budget)	$360,499
Travel	$204,872

[1]Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

F. UP-9 (Base Period): The spread of African swine fever virus (ASFV) in domestic pigs and wild boar in Ukraine – Building capacity for insight into the transmission of ASFV through characterization of virus isolates by genome sequencing and phylogenetic analysis

- **Purpose:** To comprehensively study genomes of ASFV associated with 2012-2017 outbreaks in Ukraine.
- **Engaged:** Genomics Division & DOE Joint Genome Institute (JGI), University of Alaska Anchorage (UAA), National Veterinary Research Institute (NVRI), Orion Integrated Biosciences Inc. (OIB), Metabiota Inc.
- **Primary Collaborators:**
  - Dr. Eric Bortz, Assistant Professor, UAA, Anchorage, AK
  - Dr. Inna Dubchak, Senior Scientist, Joint Genome Institute, Berkeley, CA, USA
  - Dr. Grzegorz Wozniakowski, ScD, National Veterinary Research Institute (NVRI), Puławy Poland
  - Dr. Willy A. Valdivia, Chief Executive Officer (OIB), Larchmont, NY, USA
  - Dr. Christian E. Lange, PhD/DVM, Metabiota Inc., San Francisco, CA, USA
- **Ukrainian Collaborating Institutes:**
  - SSRILDVSE
  - NSC IECVM
  - IVM
- **Primary Ukrainian Collaborators:**
  - Dr. Andrii Mezhenskyi (SSRILDVSE): Ukraine Project Manager
  - Dr. Anton Gerylovych (NSC IECVM): Ukraine Leader on Molecular Epidemiology
  - Dr. Mykola Sytiuk (IVM): Principal Investigator from IVM
- **Regions Targeted:** Archived samples were selected from western (Ternopil, Rivne, Khmelnytskyi), eastern (Zaporizhia, Kharkiv, Luhansk), southern (Mykolaiv, Odesa), or north/central (Sumy, Chernihiv, Kyiv) Oblasts affected by ASF outbreaks in 2012-2018.
- **Pathogens:** ASFV
- **Field Collection Activities:** Samples were collected through the existing veterinary infrastructure and outbreak sample management system in Ukraine.
- **Direct Cost:** $1,171,280
- **Project Aims:** The UP-9 Base Period focused on the following Aims and Tasks:
  - **AIM 1.** Development of ASFV genome sequencing capabilities in Ukraine and regional partners.
    - Task 1.1. Development of protocols for PCR amplification of genomic signature regions of the ASFV genome.
    - Task 1.2. Nanopore sequencing of critical conserved and differential variable regions of the ASFV genome to analyze Ukraine outbreak samples from 2012-2018.

        - Task 1.3. Full length next-generation sequencing of selected ASFV genomes to understand virus variation and emergence in Ukraine.
    - **AIM 2.** Scientific advancement and mentorship in laboratory, sequencing, and data analysis protocols.
        - Task 2.1. Development of laboratory expertise for ASFV sequencing to improve diagnostics and surveillance of ASFV genotypes and pathotypes.
        - Task 2.2. Enhance expertise of project participants in advanced sequencing techniques and bioinformatics analysis including genome alignment, comparative genomics, and phylogenetics for characterization of ASFV.
    - **AIM 3.** Data sharing, dissemination, and publication of results.
        - TASK 3.1. Improving Reporting: Managing and sharing ASFV sequence data and protocols.
        - TASK 3.2. ASF-STOP and networking: improving outbreak diagnostics and regional control of ASF.
- **Period of Performance (Base Period):** 2 October 2017 – 31 March 2019
- **Summary (Base Period):** ASF is a serious viral disease of swine, characterized by high mortality and significant economic losses. The ongoing circulation and spread of ASFV throughout Ukraine, coupled with the threat of transboundary disease in countries in Eastern Europe and the Caucasus, and the associated risks posed to the region's large swine operations, highlights the need to identify and characterize the ASFV genotypes circulating in Ukraine. During the Base Period, the UP-9 team developed ASFV genome sequencing expertise, resources, and capacity centered at SSRILDVSE, and through these efforts, the partial sequence of an isolate from a wild boar (in Luhansk) was determined and submitted to the National Center for Biotechnology Information (NCBI) GenBank (Gallardo, Fernandez-Pinero et al. 2014) (GenBank Accession no. 612065690). Additional studies, which examined short diagnostic DNA sequences of ASFV isolates from Ukraine (p72 encoded by gene B646L and the Central Variable Region [CVR] in gene B602L) confirmed that ASFV strains circulating in Ukraine are derived from the virulent ASFV Georgia/2007 lineage (Valdivia, W., TAP-6 project; SSRILDVSE, unpublished data). The UP-9 team has sequenced 3 full ASFV genomes and 9 partial ASFV genomic signatures (PCR amplicons that span specific loci in the virus genome) using long-read nanopore technology. Protocols for ASFV DNA extraction, quality analysis, and sequencing were developed in SSRILDVSE labs. PCR amplicon sequencing of ASF outbreak #243 (strain ASFV/Zakarpattia/2017/243) and an additional 8 samples from ASF outbreaks (#2, 7, 15, 38, 102, 170, 196, and 203) have provided genomic signature data regarding ASFV genome variation in Ukraine, which will be used for outbreak tracing. Full genome sequencing and genomic signature data were performed on ASF outbreak sample #7 (strain ASFV/Chernihiv/2014/7) and an additional 2 outbreak samples (#356, 398). By the conclusion of the UP-9 Base Period, the genomic signature analysis of PCR amplicon loci for 11 distinct Ukrainian ASF outbreaks, 2 full ASFV genomes with high coverage, and 1 genome with partial coverage have been completed. Combined with insight into the epidemiological context of ASF outbreaks in

Ukraine, UP-9 research has generated the first deployable genotyping approach for ASFV in Ukraine, holding promise for providing scientific data for ASF control measures and outbreak response. Importantly, the full genome of ASFV circulating in Ukraine was sequenced for the first time using aforementioned Oxford Nanopore Technologies (ONT) MinION portable deep sequencing platform and protocols developed by the UP-9 team for ASFV DNA extracted from clinical samples. In collaboration with the University of Alaska and the National Veterinary Research Institute (NVRI) in Puławy, Poland, laboratory and bioinformatics expertise have been developed to engage in a comprehensive phylogenetic analysis of Ukraine ASFV isolates and to build similar capacity in regional partner laboratories.

TO4 CBR Project UP-9 Base Period: FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	2 October 2017 – 31 March 2019
Estimate total direct cost of the project (US $)	$1,170,809
Including:	
Remuneration to FSU participants	$59,760
Equipment, including shipping	$301,645
Other Direct Costs (services and subcontracts including US Collaborators' budget)	$623,653
Travel	$ 185,751

[1]Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

X. CLOSED PROJECTS

To date, two project proposals have been officially closed. Key aspects of the proposed studies are provided below.

A. UP-1 re-scoped to project UP-6: Ecological and epidemiological evaluation to establish the prevalence of natural focal infections caused by *Rickettsia* spp. and *Coxiella burnetii* in different landscape zones of Ukraine

- **Purpose:** To conduct molecular and serological analyses that investigate rickettsial and *C. burnetii* pathogens transmitted by arthropods within ecologically distinct locations.
- **Engaged:** CDC and the NMRC
- **Primary Collaborators:**
  - Dr. William Nicholson (CDC): US Co-Lead Investigator
  - Dr. Allen Richards (Naval Medical Research Center, NMRC): US Co-Lead Investigator
- **Ukrainian Institutes:** SSRILDVSE, IVM, UAPRI, LRIEH, Regional State Laboratories of Veterinary Medicine (RSLVMs)
- **Primary Ukrainian Collaborators:**
  - Dr. Oleg Nevolko (SSRILDVSE), Ukraine Project Manager
  - Dr. Serhiy Nychyk (IVM), Participating Institution Manager
  - Dr. Liudmila Maruschak (SSRIDVSE), Ukraine PCR Leader
  - Dr. Olena Yegorova (UAPRI): Participating Institution Manager
  - Dr. Ihor Lozynskyi (LRIEH): Participating Institution Manager
- **Regions Targeted:** Lviv Oblast (the forest-steppe zone), Odesa Oblast (steppe zone), and Zakarpattia oblast (mountain zone).
- **Field Collection Activities:** Tick and ruminant collection activities, with at least three 7-day field trips per year (spring, summer, and fall) during all years of the project.
- **Direct Cost:** $2,461,994
- **Project Length and Aims:** With a proposed 3-year period of performance, the first year aimed to provide training in study techniques and to initiate field collection activities. The subsequent 2 years focused on environmental assessment employing GIS, PCR, ELISA, and IFA technology. The project would achieve BTRP objectives through execution of the following Aims.
  - **AIM 1.** Analysis of pathogen antibody prevalence in healthy Ukrainians:
    - Task 1.1. Titrate rickettsial antibodies in ELISA positive samples (TGR, SFGR. *C. burnetii*) identified during the project development grant (PDG)
    - Task 1.2. Conduct serosurveys in human populations in the selected regions of Ukraine.
    - Task 1.3. Confirm by indirect IFA the samples that test positive by ELISA for antibodies specific to TGR, SFGR, and *C. burnetii* (for both previously and newly collected samples).

- Task 1.4. Perform data analysis and summarize epidemiologic and serologic data (for both previously and newly collected samples).
- Tasks 1.5. Draft and submit a manuscript(s) for publication.

- **AIM 2.** Refine SOPs as necessary for *Coxiella* and rickettsial investigations in order to ensure safe and effective implementation of project activities.
  - Task 2.1. Create/update SOPs and other documents to standardize methodologies and improve relevance and credibility of the results.
  - Task 2.2. Develop standardized field collection procedures for tick and animal specimens.
  - Task 2.3. Develop protocols to establish molecular diagnostic capabilities.
- **AIM 3.** Conduct training in *Coxiella* and rickettsial laboratory techniques, field collection methods, and GIS tools and methods, which will be performed in conjunction with project activities (please refer to AIM 4 and AIM 5).
  - Task 3.1. Conduct refresher training on serologic methods.
  - Task 3.2. Train scientists in appropriate molecular diagnostic techniques at laboratories in the United States (NMRC, CDC) and at LRIEH/URAPI/SSRILDVSE in order to develop skills needed for PCR, molecular analysis, and phylogenetic analyses of amplified sequences.
  - Task 3.3. Conduct tick and animal collection procedures, training, and mentorship, including parasitological research (identification of tick species, age, sex, degree of blood engorgement, etc.).
  - Task 3.4. Train and mentor scientists in GIS tools and methods for data collection, spatial analysis techniques, and ENM.
  - Task 3.5. Train on methods for statistical analyses of results.
- **AIM 4.** Conduct surveillance and environmental sampling for *Rickettsia* species and *C. burnetii* in ticks and livestock from selected regions of Ukraine.
  - Task 4.1. Select collection sites for both ticks and livestock based on careful analysis of historical records, veterinary knowledge, access to investigators, and habitat characteristics.
  - Task 4.2. Select sampling periods for collections in two seasons across each year;
  - Task 4.3. Collect tick specimens for laboratory analysis.
  - Task 4.4. Collect biological specimens from livestock for laboratory analysis.
  - Task 4.5. Conduct laboratory analysis for evidence of pathogen DNA (molecular testing) or antibodies (serologic testing) on specimens (previously and newly collected samples).
  - Task 4.6. Consolidate project specimens in a secure biorepository.
- **AIM 5.** Determine the diversity of pathogens by sequence analysis of organisms identified in the field investigation:
  - Task 5.1. Develop techniques for PCR, molecular analysis, and phylogenetic analysis of amplified sequences.
  - Task 5.2. Conduct sequence analysis of any PCR-positive material to determine specific identification and characterize diversity of *Rickettsia* spp.

        - Task 5.3. Conduct sequence analysis of any PCR-positive material to determine specific identification and characterize diversity of *C. burnetii*.
        - Task 5.4. Develop a contemporary listing of pathogens and other related agents in the three biomes of Ukraine.
    - **AIM 6.** Utilize GIS technologies to map and analyze historical and contemporary data:
        - Task 6.1. Create a GIS database of historical survey data, map the data, and generate summary statistics by geographic areas.
        - Task 6.2. Develop protocols, standardizing data entry and formatting for use with GIS.
        - Task 6.3. Develop protocols for integrating handheld GPS receivers into field specimen collection.
        - Task 6.4. Improve capacity to produce high-quality analysis, maps, and graphics for reports and scientific publications.
        - Tasks 6.5. Assess the potential predictive value of various geospatial modeling applications for characterizing spatial and temporal dynamics of *C. burnetii* and *Rickettsia* spp. in Ukraine.
- **Proposed Start Date:** N/A
- **Summary:** This project aimed to conduct molecular and serological analyses of rickettsial and *C. burnetii* pathogens transmitted by arthropods within ecologically distinct locations. Regions of potential study included the forest-steppe zone (Lviv oblast), steppe zone (Odesa oblast), and mountain zone (Zakarpattia oblast), which were selected on the basis of historical data analysis of veterinary experts conducted in previous years. The study proposed to analyze various samples, including humans (serum), environment (ticks), and animals (blood, serum, milk, attached ticks), and GIS techniques, such as Hot Spot analysis, were to be employed for mapping and analyzing historical and contemporary data collected during the project. Summary statistics were to include prevalence per region(s). The study aimed to provide current information on the prevalence of infection in important vertebrate and invertebrate reservoirs for *C. burnetii* and *Rickettsia* spp.

TO4 UP-6 (3 years): FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	Month Day Year-Month Day Year TBD-pending execution of option
Estimated total direct cost of the project (US $)	$2,461,994
Including:	
Payments to FSU participants	$ 392,685
Equipment, including shipping	$ 242,686
Materials, including shipping	$1,260,916
Other direct costs, including institutional support STCU/CRDF administrative fee	$ 141,879
Travel (including IC travel)	$ 423,828

[1]Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

B. UP-7: Surveillance capacity building and determination of disease baseline for brucellosis in domestic and wild animal populations of Ukraine

- **Purpose:** To perform a comprehensive epidemiological and ecological investigation of the distribution of *Brucella* spp. pathogen circulating in wildlife or harbored in livestock reservoirs, within different geographic and ecological zones of Ukraine.
- **Engaged:** UOF, USA; EU Independent Consultant.
- **Primary Collaborators:**
  - Dr. Jason K. Blackburn, Director & Associate Professor, Spatial Epidemiology & Ecology Research Laboratory, Department of Geography & Emerging Pathogens Institute, UOF
  - Dr. Wojciech Iwaniak, SME, EU Independent Consultant
- **Ukrainian Collaborating Institutes:**
  - NSC IECVM (Lead Ukrainian Institute)
  - SSRILDVSE (Participating Institute)
  - IVM (Participating Institute)
- **Primary Ukrainian Collaborators:**
  - Dr. Anton Gerylovych (NSC IECVM): Ukraine Project Manager
  - Dr. Andrii Mezhenskyi (SSRILDVSE): Participating Institution Manager
  - Dr. Oleksandr Tarasov (IVM): Participating Institution Manager
- **Regions Targeted:** Central Ukraine (Kirovohrad, Poltava, and Cherkasy Oblasts), Southern Ukraine (Mykolaiv and Kherson Oblasts), Eastern Ukraine (Kharkiv and Dnipropetrovsk Oblasts), Western Ukraine (Ternopil and Khmelnitsyi Oblasts), as well as in the North (Zhytomyr Oblast)
- **Target Pathogens:** *Brucella* spp.
- **Field Collection Activities:** The project proposed serological analysis of existing samples stored at the repositories of the collaborating Ukrainian Institutes. In addition to analyzing existing samples from livestock and wildlife, blood samples from wild fauna (~1,500 samples from wild boars [*Sus scrofa*] and ~250 samples from deer species) were to be obtained from specialists within RSLVMs, who would collect the specimens as part of their regular duties under the SVPS State monitoring program.
- **Direct Cost:** TBD
- **Project Length and Aims:** With a 12-month period of performance, the project proposed the following Aims and Tasks:
  - **Aim 1.** Evaluate and expand diagnostic capabilities across Ukrainian institutions to improve brucellosis detection and assess prevalence using available serum banks.
    - Task 1.1. Review protocols used by the Ukrainian Institutes and adjust SOPs as necessary to ensure safe and effective implementation of project activities.
    - Task 1.2. Develop standardized data collection, data entry, and management procedures.

- **Aim 2.** Assess the prevalence of *Brucella* circulation using available biological samples (serum banks and clinical materials) and diagnostic tools including serological and molecular methods.
  - Task 2.1. Verify the diagnostic sensitivity of different serological techniques and integrate FPA into laboratory practice at Ukrainian institutes.
  - Task 2.2. Detect Brucella-specific antibodies among wild ungulates fauna populations using FPA.
  - Task 2.3. Establish PCR (RT and conventional) for detection of *Brucella* spp. in diagnostic samples.
- **Aim 3.** Epidemiological and spatial analysis of serological results.
  - Task 3.1. Estimate and map the disease baseline of *Brucella* spp. from livestock and wildlife populations in Ukraine.
  - Task 3.2. Develop a spatially explicit risk model of brucellosis in Ukraine from serological screening of wildlife and livestock.
  - Task 3.3. Enhance understanding of risk factors associated with *Brucella* spp. in Ukraine.
  - Task 3.4. Conduct advanced epidemiological and spatial analyses training to refine risk intensity (prevalence) and the distribution of risk (mapping).

- **Start Date:** TBD
- **Summary:** In recent years, cases of human brucellosis have been registered annually in Ukraine. Additionally, results of serological investigation of wild boar serum conducted by SSRILDVSE confirmed active circulation of brucellosis in wild animals throughout Ukraine. This study proposed to (a) provide better understanding of risk factors associated with *Brucella* spp. in Ukraine; (b) assess the general prevalence of *Brucella* spp. in targeted territories; and (c) identify the structure of the ecological-geographical system supporting pathogen circulation. By incorporating GIS into proposed data collection, management, analysis, and reporting processes, disease data would be integrated with other forms of geographic information, such as historic case data, data from animal surveys, agricultural animal density, land use, human populations, as well as remotely-sensed imagery and remotely-sensed data products. The project proposed to improve Ukraine's ability to determine the risk of *Brucella spp.*, enhance diagnostic accuracy with focus on serological testing, and inform the necessity and development of follow-on studies in OYs (e.g., survey of new territories, additional potential reservoir species, assessment of other wild-domestic interfaces, *etc.*). Collectively, these proposed efforts would improve the efficacy of brucellosis surveillance at the wildlife/livestock interface. This study would introduce to Ukraine (1) the US DTRA-approved Fluorescent Polarization Assay (FPA), a highly sensitive and rapid test, and (2) improved ELISA capabilities. These techniques will enhance diagnostic capabilities and increase capacity across Ukrainian institutes to detect the disease.

TO4 CBR Project UP-7 (1 year): FINANCIAL SUMMARY (BTRIC SUPPORT ONLY)[1]

Effective Period	TBD
Estimate total direct cost of the project (US $)	$631,594
Including:	
Remuneration to FSU participants	$ 78,865
Equipment, materials and supplies	$188,710
Other Direct Costs (services and subcontracts including US Collaborators' budget)	$271,492
Travel	$ 92,527

[1]Direct costs exclude IC and IC-subcontractor indirect costs and potential fee.

XI. SUSTAINMENT AND TRANSITION

The resources described in Section VI establish the foundation for long term engagement of the Ukrainian science community in safe, peaceful, and relevant scientific pursuits. Continued success is fortified by access to (1) experts who, through mentorship, can serve as a gateway to advancement; (2) cost-effective and readily sourced technologies by which to realize objectives; and (3) training to ensure the utility of provided tools. Collectively, these features support collaborative dialogue and serve as the conduit by which a sustainable community of internationally-engaged scientific professionals can flourish.

Throughout the life cycle of BTRP-Ukraine science, initiatives are continually assessed to identify assets that can support sustainable approaches for effective transition at the end of the BTRP period of performance. Follow-on studies are discussed at the onset of initial project development and are often captured as concepts suggested for option years. Additionally, participation in networking events (e.g., conferences) and the BTRP SWM Program provide forums by which ideas can be tested, discussed, and perhaps lead to new funding opportunities. A flexible dynamic of mentorship and international collaboration is sought to guide Ukraine's scientists toward future donors, including various U.S., German, Swiss, and other European funders. These efforts serve to secure DTRA's desired end state for the country.

XII. APPENDICES

List of Appendices:

APPENDIX ONE: ACRONYMS

Acronym	Full Text
AEP	Academic Engagement Partnership
AI	Avian Influenza
AIV	Avian Influenza Virus
ASF	African Swine Fever
ASFV	African Swine Fever Virus
ASU	Arizona State University
BS&S	Biological Safety & Security
BTRP	Biological Threat Reduction Program
BTRIC	Bio Threat Reduction Integrating Contract
BVSPC	Black & Veatch Special Projects Corporation
CBEP	Cooperative Biological Engagement Program
CBR	Cooperative Biological Research
CCHFV	Crimean Congo Hemorrhagic Fever Virus
CDRL	Contract Data Request List
CDC	Centers for Disease Control and Prevention
CEM	Contagious Equine Metritis
CISA-INIA	Centro de Investigacion en Sanidad Animal
CSF	Classical Swine Fever
CSP	Country Science Plan
DOBV	Dobrava Virus
DTRA	Defense Threat Reduction Agency
DVM	Doctor of Veterinary Medicine
EDP	Especially Dangerous Pathogen
EIDSS	Electronic Integrated Disease Surveillance System
ELISA	enzyme-linked immunosorbent assay
FPA	Fluorescent Polarization Assay
FSCP	Ukrainian State Service for Food Safety and Consumer Protection

Acronym	Full Text
GIS	Geographic Information Systems
GoU	Government of Ukraine
GoUP	Government of Ukraine Participants
GPS	Global Positioning System
HPAI	Highly pathogenic avian influenza
HTNV	Hantaan Virus
IFA	Immunofluorescence Assay
IVM	Institute of Veterinary Medicine
JGI	DOE Joint Genome Institute
JHSPH	Johns Hopkins Bloomberg School of Public Health
KSU	Kansas State University
LNMU	Danylo Halytsky Lviv National Medical University
LRIEH	Lviv Research Institute of Epidemiology and Hygiene
LOLC	State Institution Lviv Oblast Laboratory Center of the Ministry of Health of Ukraine
MESU	Ministry of Education and Science of Ukraine
MoD	Ministry of Defense of Ukraine
MoH	Ministry of Health of Ukraine
NAAS	National Academy of Agrarian Sciences of Ukraine
NASU	National Academy of Science of Ukraine
ND	Newcastle Disease
NGS	Next-Generation Sequencing
NSC IECVM	National Scientific Center “Institute of the Experimental and Clinical Veterinary Medicine”
NMRC	Navy Medical Research Center
NVRI	National Veterinary Research Institute
OIB	Orion Integrated Biosciences, Inc.
OIE	World Animal Health Organization
OLC	Oblast Laboratory Center
PCR	Polymerase Chain Reaction

Acronym	Full Text
PHC	Public Health Center
PUUV	Puumala Virus
RF	Russian Federation
qRT-PCR	Quantitative Reverse Transcription Polymerase Chain Reaction
SME	Subject Matter Expert
SOEV	Seoul Virus
SOP	Standard Operating Procedure
SSRILDVSE	State Scientific Research Institute of Laboratory Diagnostics and Veterinary and Sanitary Expertise
SWM-P	Science Writing Mentorship Program
TADR	Threat Agent Detection and Response
TAP	TADR Project
TO4	Task Order 4
UAA	University of Alaska Anchorage
UOF	University of Florida
UOT	University of Tennessee
UAPRI	State body I.I. Mechnikov Ukrainian Anti-Plague Research Institute
UCDCM	Ukrainian Center for Disease Control and Monitoring
UKrSCES	Ukrainian Scientific Centre of Ecology of the Sea
UNM	University of New Mexico
UP	Ukraine Project
USA	United States of America
VOLC	State Institution Volyn' Oblast Laboratory Center of the Ministry of Health of Ukraine
WHO	World Health Organization
WNV	West Nile Virus
WRAIR	Walter Reed Army Institute of Research
ZOLC	State Institution Zakarpattia Oblast Laboratory Center of the Ministry of Health of Ukraine

APPENDIX TWO: GoU BTRP RECIPIENT LIST*

I. State Service of Ukraine for Food Safety and Consumer Protection (FSCP):

1. State Scientific Research Institute of Laboratory Diagnostic and Veterinary Sanitary Expertise
2. State Scientific Control Institute of Biotechnology and Strains of Microorganisms (SSCIBSM)
3. Dnipropetrovsk Regional State Laboratory of Veterinary Medicine
4. Lviv Regional State Laboratory of Veterinary Medicine
5. State Scientific Research Institute of Laboratory Diagnostic and Veterinary Sanitary Expertise Odesa Branch
6. Regional State Laboratory of Veterinary Medicine in Poltava Oblast
7. Tsenkovskyi Kherson Regional State Laboratory of Veterinary Medicine
8. Khmelnytskyi Regional State Laboratory of Veterinary Medicine
9. Cherkasy Regional State Laboratory of Veterinary Medicine
10. Chernihiv Regional State Laboratory of Veterinary Medicine

II. National Academy of Agrarian Sciences of Ukraine (NAAS)

1. Institute of Veterinary Medicine NAAS of Ukraine
2. National Scientific Center “Institute of Experimental and Clinical Veterinary Medicine” NAAS of Ukraine

III. Ministry of Health (MoH)**

1. State Institution Public Health Center of the Ministry of Health of Ukraine
2. State Institution Vinnytsia Oblast Laboratory Center of the Ministry of Health of Ukraine
3. State Institution Volyn’ Oblast Laboratory Center of the Ministry of Health of Ukraine
4. State Institution Dnipropetrovsk Oblast Laboratory Center of the Ministry of Health of Ukraine
5. State Institution Zakarpattia Oblast Laboratory Center of the Ministry of Health of Ukraine
6. State Institution Lviv Oblast Laboratory Center of the Ministry of Health of Ukraine
7. State Institution Ternopil Oblast Laboratory Center of the Ministry of Health of Ukraine
8. State Institution Kharkiv Oblast Laboratory Center of the Ministry of Health of Ukraine
9. State Institution Kherson Oblast Laboratory Center of the Ministry of Health of Ukraine
10. State Institution Mechnikov Ukrainian Research Anti-Plague Institute of the Ministry of Health of Ukraine

IV. Ministry of Defense of Ukraine (MoD)

1. Central Sanitary and Epidemiological Department of the Ministry of Defense of Ukraine
2. 10 Regional Sanitary and Epidemiological Department of the Central Sanitary and Epidemiological Department of the Ministry of Defense of Ukraine;
3. 27 Regional Sanitary and Epidemiological Department of the Central Sanitary and Epidemiological Department of the Ministry of Defense of Ukraine;
4. 28 Regional Sanitary and Epidemiological Department of the Central Sanitary and Epidemiological Department of the Ministry of Defense of Ukraine;
5. Regional Sanitary and Epidemiological Department 108 of the Central Sanitary and Epidemiological Department of the Ministry of Defense of Ukraine.

***Recipient List effective April 2019**
****MoH list may change with ongoing reorganization**

APPENDIX THREE: HUMAN TADR PATHOGEN INFORMATION IN UKRAINE

Human pathogen/diseases	TADR Pathogen	MoH Reportable	Last Reported Outbreak
Bacillus anthracis (anthrax)			2018
Borrelia spp. (borreliosis)			2019
Brucella spp (brucellosis)			2017
Burcholderia mallei (glanders)			Not yet reported in Ukraine
Clostridium botulinum toxin (botulism)			2018
Coxiella burnetii (Q fever)			2017
Fevers of unknown origin			Constant
Francisella tularensis (tularemia)			2018
Influenza-like illnesses requiring hospitalization			Constant
Leptospira spp. (leptospirosis)			Constant
Pox viruses (e.g. smallpox)			Eradicated
Rabies virus (rabies)			2018
Rickettsia prowazekii (typhus)			1984
Rickettsia rickettsia (ricketsiosis)			2013
Tick-borne encephalitis virus			Constant
Vibrio cholera (cholera)			2018
Viral hemorrhagic fevers (hantavirus, CCHF, others)			2018
Yersinia pestis (plague)			Eradicated
Measles viruses (measles)			2019
Rubella viruses (rubella)			Constant
Plasmodium species (malaria)			2018
Highly pathogenic influenza viruses (influenza)			2018
Key:			
Green signifies reportable or Program Pathogen			
Red signifies not reportable or not Program pathogen			
White signifies absence of natural foci			

APPENDIX FOUR: VETERINARY TADR PATHOGEN INFORMATION IN UKRAINE

(*according to OIE: http://www.oie.int/wahis_2/public/wahid.php/Countryinformation/Animalsituation)

Veterinary EDP (disease)	TADR Pathogen	OIE Reportable	Last Reported Outbreak
Bacillus anthracis (Anthrax)			2018
Brucella species (Brucellosis)			2008
Burkholderia mallei (formerly *Pseudomonas mallei*) (Glanders)			Unknown
Burkholderia pseudomallei (formerly *Pseudomonas pseudomallei*) (Melioidosis)			Unknown
African Swine fever virus (ASF)			Disease present
Avian influenza virus (highly pathogenic) (Avian influenza)			2017
virus (exotic) (Bluetongue)			Never reported
Classical swine fever virus (CSF)			2015
Foot-and-mouth disease virus (FMD)			1988
Goat pox virus (Goat pox)			Never reported
Lumpy skin disease virus (LSD)			Never reported
Rinderpest virus (Cattle plague)			Never reported
Sheep pox virus (Sheep pox)			Never reported
Virulent Newcastle disease virus (Newcastle disease)			2006
Coxiella burnetii (Q fever)			Never reported
Crimean-Congo haemorrhagic fever virus (Crimean-Congo haemorrhagic fever)			Never reported
Francisella tularensis (Tularemia)			Never reported
Yersinia pestis (Plague)			Eradicated
Bovine spongiform encephalopathy (BSE)			Never reported
Rabies virus (Rabies)			Disease present
Leptospira (pathogenic species) (Leptospirosis)			Disease present
Key:			
Green signifies reportable or Program Pathogen			
Red signifies not reportable or not Program pathogen			
White signifies absence of natural foci			