WRAIR'S INVESTIGATOR'S DISPATCH

DEFEATING INFECTIONS TO **MAXIMIZE HUMAN POTENTIAL** IN MULTI DOMAIN OPERATIONS

WRAIR Walter Reed Army Institute of Research

WRAIR PROTECTS YOUR SIX

Protecting your brain - the most important six inches on the battlefield

CENTER FOR MILITARY PSYCHIATRY AND NEUROSCIENCE

- Blast Induced Neurotrauma and Neuroprotection
- Sleep & Resilience
- Team Performance and Mental Fitness
- Military Psychiatry

Protecting the most important six microns between you and the threat of disease

CENTER FOR INFECTIOUS DISEASE RESEARCH

- Vaccines & Entomology
- Viral & Bacterial Diseases
- Military HIV Research Program
- Experimental Therapeutics & Emerging Infectious Diseases

WHETHER YOU'RE AT HOME STATION OR SIX THOUSAND MILES AWAY

WALTER REED ARMY INSTITUTE OF RESEARCH'S MISSION

Discover, design, and develop solutions for military relevant infectious disease and brain health threats through innovative research protecting and optimizing warfighter lethality.

LIKE AND FOLLOW WRAIR

- WRAIROfficial
- @WRAIR
- https://www.wrair.army.mil
- WalterReedArmyInstituteOfResearch

PROMOTED HASHTAGS

#WRAIRProtectsYourSix
#DefeatInfections #WorldHealth
#OptimizeHumanPotential
#ForgeTheFuture #SoldierHealth

WALTER REED ARMY INSTITUTE OF RESEARCH IS A SUBORDINATE COMMAND OF MRDC

usarmy.detrick.medcom-wrair.mbx.public-affairs@mail.mil

MILITARY MEDICINE'S
CONTRIBUTION TO THE DEVELOPMENT OF
DISEASE COUNTERMEASURES

1. WRAIR and its global research sites played a role in developing nearly half of the vaccines.

2. One key aspect of WRAIR's vaccine program is partnership and collaboration across U.S. Army Medical Research and Development Command, U.S. Army Medical Materiel Development Activity, and our nearly 400 academic and industry partners.

3. WRAIR's contributions to countermeasure development include disease surveillance, discovery, small batch vaccine production, phase I-III clinical trials, and phase IV post-licensure clinical trials.

1900
YELLOW FEVER
Demonstrated that the etiologic agent was a filterable virus transmitted by *Aedes aegypti* mosquitoes, leading to disease control through vector eradication and, eventually, vaccination.

1945
PNEUMOCOCCUS
Tested first multivalent polysaccharide vaccine at the Sioux Falls Army Air Base, S.D., which reduced incidence of pneumonia and the pneumococcal carrier state.

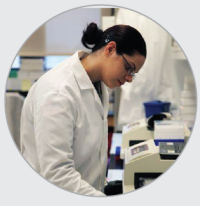
1957
INFLUENZA
Described how the influenza virus evolved from year to year and developed a vaccine minimizing the impact of a major pandemic in the United States.

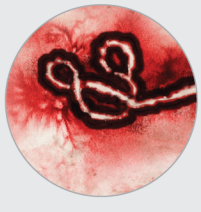
1961
RUBELLA
First isolation of rubella virus; identification led to development of a safe and effective vaccine.

1952
ADENOVIRUS
Isolated the causative agent, described the epidemiology and clinical spectrum, and developed a vaccine to prevent adenovirus infection. Subsequent manufacturing concerns led to the development of a new vaccine in the 1970s.

1908
TYPHOID
Developed the first American typhoid vaccine at WRAIR's predecessor, the Army Medical School.

Table of Contents





1966-1972
MENINGOCOCCAL DISEASE
Described the immune response to meningococcal disease, developed the first polysaccharide immunogen against it and proved the preventive's efficacy in clinical trials.

1980-1990
HEPATITIS A
Investigated safety and immunogenicity of inactivated vaccines and directed a pivotal efficacy study among 40,000 Thai children.

1995
CHOLERA
Developed a live oral cholera vaccine candidate derived from C6709, a Peruvian strain of *V. cholerae* O1, biotype El Tor.

2010
ANTHRAX
Evaluated a new vaccine delivery route from subcutaneous to intramuscular that decreased dosing.

2018
DENGUE
Evaluated the safety and immunogenicity of three different formulations of a dengue vaccine.

2019
EBOLA
Conducted six Ebola vaccine studies testing three candidates; current Ebola vaccine being used in the DRC has been shown to be 97% effective, conducting a Marburg vaccine study (VRC) and another Ebola Sudan vaccine trial in Uganda.

2009
ADENOVIRUS
Ad4 and Ad7 vaccines were approved by the U.S. FDA and vaccination resumed in 2011 at all military recruiting centers.

1980-2009
JAPANESE ENCEPHALITIS
Contributed technology, preclinical studies, pilot-scale manufacturing, clinical studies, and additional field studies for final FDA approval of a vaccine against Japanese encephalitis.

1970-1980
HEPATITIS B
Demonstrated antibodies from individuals infected with hepatitis B are protective, allowing for an immunoglobulin preventive.

2019
MERS COV
Completed the first-in-human, and still only, phase I trial of a MERS vaccine candidate intended for use in humans.

2019
RTS,S/MALARIA
WRAIR's Controlled Human Malaria Infection model showed safety and efficacy of this malaria vaccine in humans. Currently being used by WHO in three countries in Africa to decrease childhood deaths.

2016-2017
ZIKA
Moved from an initial concept of a Zika vaccine to clinical studies within nine months.

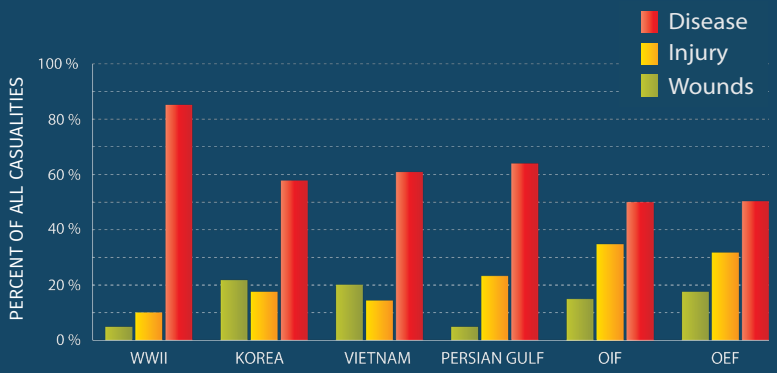
Dis-integrating Deployment Related Infectious Diseases

.....Page 10

Disease Priorities & Partnerships

.....Page 11

Disease Causes More Casualities Than Enemy Action



Source:
1. https://www.medscape.com/viewarticle/482869_2
2. Hauret KG, Pacha L, Taylor BJ, Jones BH. Surveillance of Disease and Nonbattle Injuries During US Army Operations in Afghanistan and Iraq. US Army Med Dep J. 2016 Apr-Sep;(2-16):15-23.

PROLONGED FIELD CARE IMPLICATIONS FOR INFECTIOUS DISEASES

CHALLENGE

- During near-peer competition, air superiority diminishes, limiting availability to evacuate Soldiers from the point of injury limiting Warfighter sanitation, treatment and resupply capabilities.
- During the penetrate, dis-integrate, and exploit phases of MDO, when casualty rates are elevated and MEDEVAC is limited, there will be a corresponding rise in wound infection rates; complicated by growing resistance to existing antibiotics, wound infection is an increasingly devastating source of mortality.
- During OIF and OEF, when we had the benefit of the Golden Hour, 10-30% of casualties experienced a serious wound infection.
- When we are in a near-peer competition, wound infections could be the signature wound of MDO.
- The most lethal Soldiers on the MDO battlefield will be the ones durably protected against infectious diseases by countermeasures delivered prior to entry into theater that are not dependent upon a battlefield medical logistics system, which is highly vulnerable to enemy interdiction.

1hr GOLDEN HOUR EVACUATION

52,352[1]
wounded in action

On average 45 - 90[2] **minutes from injury to field hospital**

49%[3]
of those wounded had bacteria in their wounds

34%[4]
combat casualties develop infections during their initial hospitalization

27%[5]
deep infection rate for type III open tibia fractures

24hr How many infections will we have when we extend to the Golden Day+?

1. United States Department of Defense. OIF/OEF Casualty Status. www.defense.gov/casualty.pdf (Last accessed October 13, 2017).

2. Kotwal RS1, Howard JT2, Orman JA2, Tarpey BW2, Bailey JA3, Champion HR4, Mabry RL2, Holcomb JB5, Gross KR3. The Effect of a Golden Hour Policy on the Morbidity and Mortality of Combat Casualties. JAMA Surg. 2016 Jan;151(1):15-24. doi: 10.1001/jamasurg.2015.3104.

3. MAJ Clinton K. Murray, MC USA*; MAJ Stuart A. Roop, MC USAF, LTC(P) Duane R. Hospenthal, MC USA*; COL David P. Dooley, MC USA*; CPT Kimberly Wenner, MC USA|; MAJ John Hammock, MC USA|; CPT Neil Taufen, MC USA|; MAJ Emmett Gourdine, MS USA Bacteriology of War Wounds at the Time of Injury. MILITARY MEDICINE, 171, 9:826, 2006

4. Weintrob AC1,2,3, Murray CK4, Xu J5, Krauss M5, Bradley W1,2, Warkentien TE3, Lloyd BA6, Tribble DR1. Early Infections Complicating the Care of Combat Casualties from Iraq and Afghanistan. Surg Infect (Larchmt). 2018 Apr;19(3):286-297. doi: 10.1089/sur.2017.240. Epub 2018 Jan 19.

5. Travis C. Burns, MD, Daniel J. Stinner, MD, Andrew W. Mack, MD, Benjamin K. Potter, MD, Rob Beer, MD, Tobin T. Eckel, MD, Daniel R. Possley, DO, Michael J. Beltran, MD, Roman A. Hayda, MD, Romney C. Andersen, MD, John J. Keeling, MD, Harold M. Frisch, MD, Clinton K. Murray, MD, Joseph C. Wenke, PhD, James R. Ficke, MD, Joseph R. Hsu, MD, and the Skeletal Trauma Research Consortium, Fort Sam Houston, Texas Microbiology and injury characteristics in severe open tibia fractures from combat, J Trauma Volume 72, Number 4

WHAT WE'RE DOING ABOUT IT

WRAIR is investigating new far-forward therapeutic interventions to extend the Golden Hour to the Golden Day, which is required to sustain a lethal and responsive force during high-intensity combat.

Advances in Wound Infection Therapeutic Development

Due to the unique nature of combat injuries, wound contamination frequently results in bacterial infection by multidrug-resistant (MDR) organisms. WRAIR is developing novel solutions through:

- Small and large preclinical infection models with clinically relevant multidrug-resistant bacteria
- Preclinical models of bacteriophage therapy leading to human proof-of-concept studies
- Monoclonal antibody therapeutic development
- Home to the Army's only structual biology center for drug discovery and vaccine development

Maximizing Joint Force Generation

- Immunize for vaccine preventable disease
- Disease surveillance information from OCONUS labs inform disease risk to guide preventive countermeasures (vectors/pathogens)

Safer Blood Supply

The need to develop a safe, effective, rapidly-acting, and durable product that minimizes or eliminates the ongoing issues with non-compliance, medication side effects, and host genetics restriction remain a critical goal– a "fire and forget" solution.

Fielded Solutions

BinaxNow
Point of care testing for rapid diagnosis and treatment of malaria infection.

Future Solutions

Topical Paromomycin
Showed efficacy as treatment for ulcerative cutaneous leishmaniasis in FDA regulated study

FORGING THE FUTURE

- WRAIR, in partnership with other MRDC and DOD organizations, are creating new far-forward therapeutic interventions to prevent and treat bacterial wound infections and extend the Golden Hour to the Golden Day+.
- WRAIR is investigating novel, small molecule antibiotics, monoclonal antibodies and bacteriophage solutions to overmatch this threat.

INFECTIOUS DISEASES IN DENSE URBAN AND SUBTERRANEAN ENVIRONMENTS

Challenge

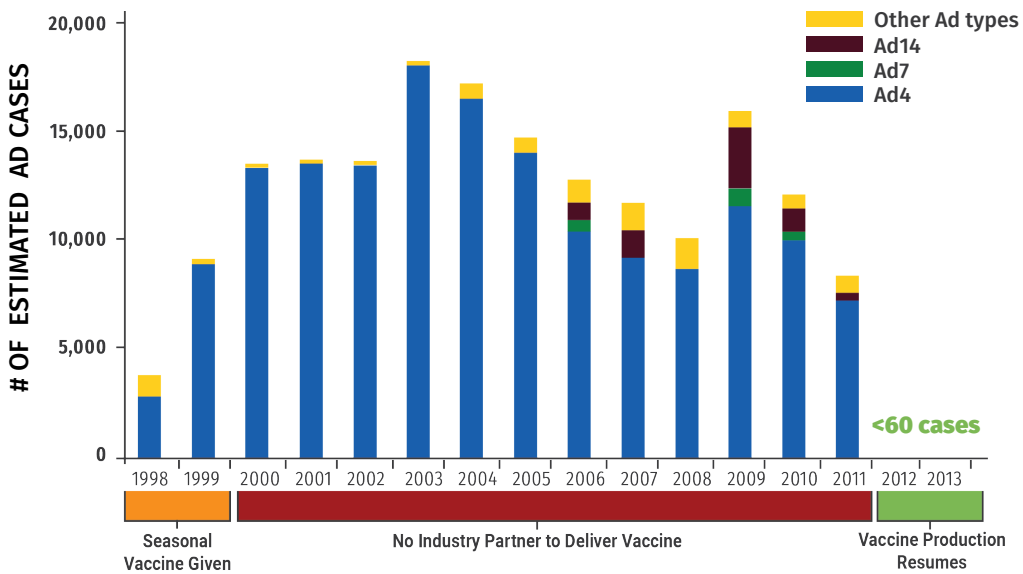
- In dense urban environments, diseases spread by human contact will increase. War will disrupt infrastructure in urban environments (sewage, water) presenting additional risks capable of defeating the most lethal and combat effective troops.
- Environmental and infectious disease threats not routinely seen in the U.S present health risks to Warfighters.
- Large troop movements introduce threats due to diarrheal disease and airborne pathogens.
- MRDC has taken a global lead to develop the next generation of infectious disease countermeasures against diseases of military relevance.

SUCCESS STORY **ADENOVIRUS (AD)**

15,000 cases per year
in the military between 2000-2011 when vaccine was unavailable.

Adenovirus types 4&7
infections affect up to 8 of 10 Service Members during basic training.

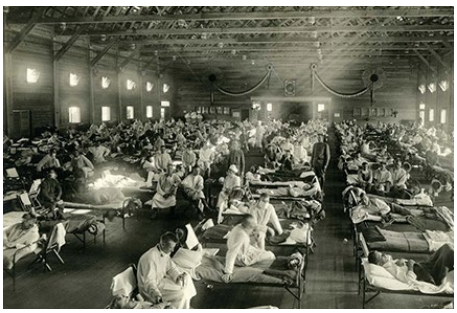
to 60 cases per year
since reintroduction of the vaccine which WRAIR led with USAMMDA and industry partners.



"Infectious disease threats have the potential to endanger lives and disrupt economies, travel, trade, and the food supply. Outbreaks do not respect national boundaries and can spread rapidly jeopardizing the health, security, and prosperity of the United States. It is in the national security interest of the United States to strengthen global health security and manage the risk of infectious disease outbreaks."

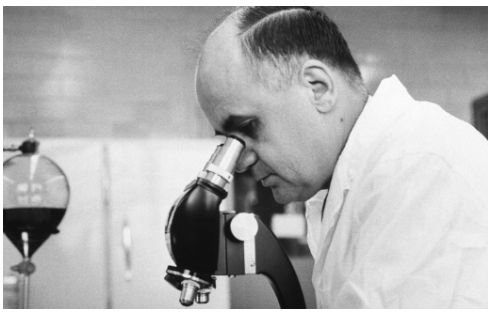
— United States's Government
Global Health Security Strategy, 2019

INFLUENZA, AN ENDURING THREAT



More than 43,000
U.S. sailors and soldiers died of flu and pneumonia in 1918.

1945
WRAIR helped develop first influenza vaccine.



1957
Maurice Hilleman at WRAIR isolated new strain of flu that led to improved vaccines.

"U.S. Army's Medical Research and Development Command (MRDC) product development mission and research platforms serve to protect DOD personnel from infectious disease threats, by supporting the National Defense Strategy, the National Military Strategy and is nested in the President's National Security Strategy. It achieves this by operating a global research network to detect and mitigate outbreaks to contain the spread of disease."

WRAIR CONTINUES TO

In partnership with Global Emerging Infectious Surveillance (GEIS), WRAIR informs annual flu vaccine development through global surveillance.

Evaluate human and environmental factors that can be used to predict and prevent influenza transmission in close-quarter settings.

Model and study the risk of vaccine failure in highly vaccinated DOD populations.

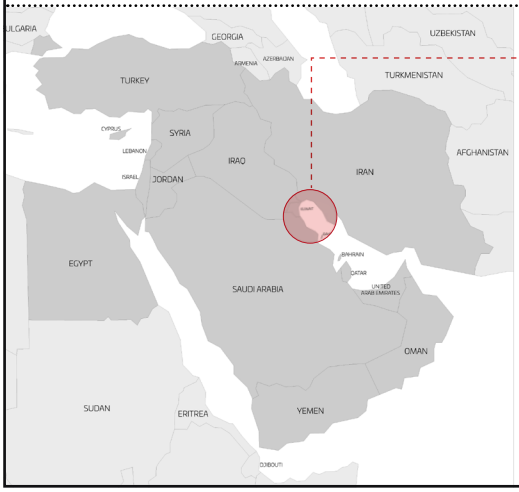
NOROVIRUS, OPERATIONAL IMPACT OF COMMUNICABLE DISEASE

is the leading cause of acute gastrointestinal illness outbreaks in military settings.

is spread by infected:

- Food & Beverages
- Fomites
- Feces
- Direct Contact
- Aerosols

Symptoms begin within 12-48 hours of exposure and include vomiting, nausea and diarrhea.



Camp Arifjan, Kuwait

- There were approximately 14,000 Service Members at Camp Arifjan, 3,000-4,100 were in transit and 10,000 were permanently assigned there.
- A Soldier with symptoms of nausea, vomiting, and diarrhea was treated and released to his unit.
- Over 14 days, more than 90 Soldiers experienced symptoms of nausea, vomiting, and diarrhea, resulting in the shutdown of Camp Arifjan for about 10 days.

EMERGING INFECTIOUS DISEASES DEGRADING COMBAT EFFECTIVENESS

CHALLENGE

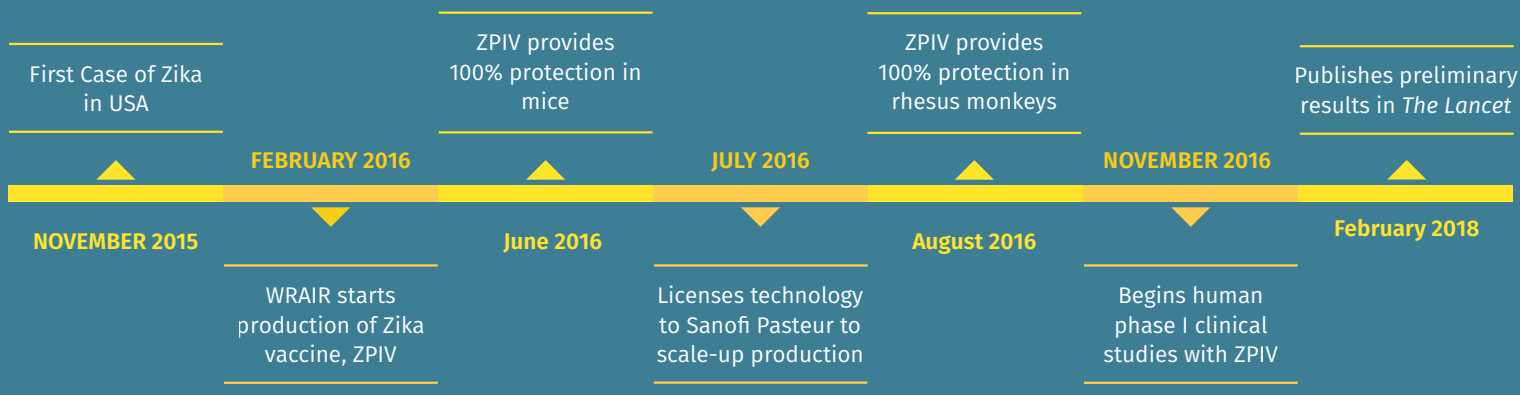
Emerging infectious disease threats have the potential to overwhelm U.S. and partner capacity; this can significantly threaten political and economic stability, supporting an environment conducive to transnational crime and violent extremism. Emerging infectious disease disrupts strategic goals in the compete phase of MDO and limits the ability to consolidate gains during the re-compete phase of MDO.

WHAT WE'RE DOING ABOUT IT

WRAIR's extensive international research infrastructure and capabilities allow its scientists to anticipate and develop countermeasures against emerging infectious disease (EID) threats. The Institute's longstanding capabilities, which include subject matter expertise, in-house manufacturing, a broad network of international sites and public-private partnerships, enable the Emerging Infectious Diseases Branch (EIDB) to respond rapidly to outbreaks, through an accelerated cycle of countermeasure development: from conception to human clinical trials.

ZIKA

Due to senior Army leadership support, WRAIR was able to move an initial Zika purified inactivated virus (ZPIV) vaccine concept through pre-clinical studies into first-in-human clinical testing within nine months. This usually takes four years.



MILITARY RELEVANCE

GEOGRAPHIC REGIONS OF POTENTIAL EXPOSURE TO ZIKA CASES

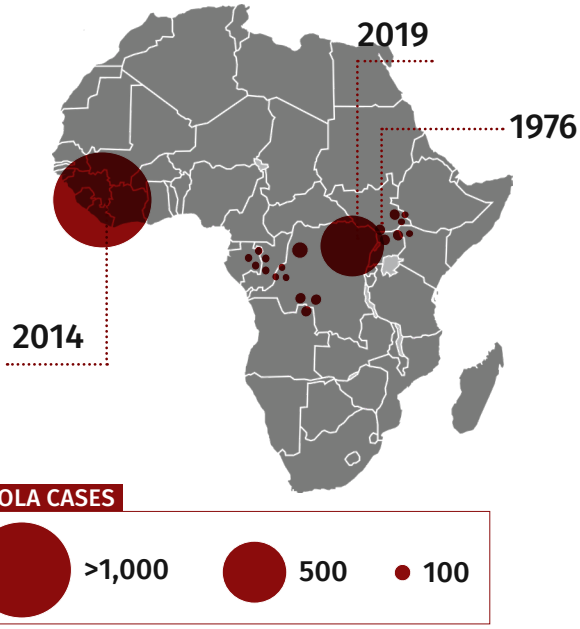
Zika spread to nearly 50 countries and terrritories within a 17-month period.

CASES IN SERVICE MEMBERS BETWEEN JAN TO NOV 2016

Among affected Service Members, the Army reported the most Zika cases.

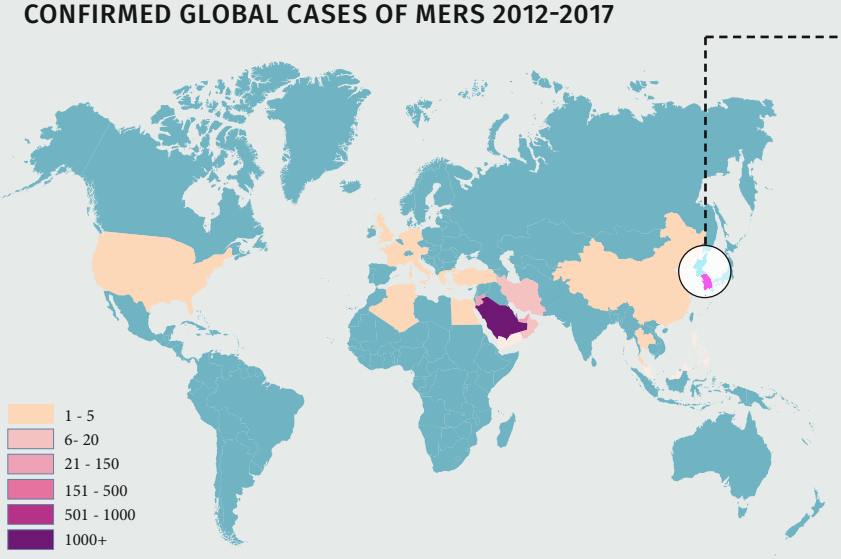
EBOLA OUTBREAK

- Leveraging partners and clinical trial capabilities, WRAIR pivoted to advance an Ebola Zaire vaccine candidate during the 2014 West Africa outbreak into first-in-human clinical trials in just 11 weeks.
- The vaccine showed efficacy when used less than a year later during an outbreak later in Guinea.
- The Ebola Zaire vaccine efficacy is estimated at 97% based on a WHO meta analysis of its use in the current Ebola outbreak in the Democratic Republic of Congo.
- To date, WRAIR has conducted six Ebola vaccine studies testing three candidates; is conducting a Marburg vaccine clinical trial at WRAIR currently and another Ebola Sudan vaccine trial in Uganda.



MIDDLE EAST RESPIRATORY SYNDROME (MERS)

CONFIRMED GLOBAL CASES OF MERS 2012-2017



Republic of Korea

- The 2015 Korea outbreak of MERS involved 186 cases, including 38 fatalities.
- A total of 83% of transmission events were due to five superspreaders.
- The government quarantined 16,993 individuals for 14 days, and the economic loss was estimated at 9.311 trillion Korean won (8.5 billion US dollars).

MILITARY RELEVANCE

- MERS is a growing global concern due to its high fatality rate of nearly 40%.
- Given deployments to the Middle East and South Korea—where large outbreaks have occurred—coupled with close living quarters in those situations, military personnel are at increased risk for exposure to MERS.
- There are currently no approved countermeasures for MERS.

FORGING THE FUTURE

- WRAIR initiated and now has completed the first-in human, and still only, phase I trial of a MERS vaccine candidate intended for use in humans.
- The study, conducted at the WRAIR Clinical Trials Center, evaluated a candidate DNA vaccine co-developed with industry.
- The promising results from this study, published in, July, 2019, in *The Lancet Infectious Diseases*, have prompted advancement to a second phase I/IIa trial in South Korea and a phase II study in the Middle East.

DIS-INTEGRATING DEPLOYMENT RELATED INFECTIOUS DISEASES

Challenge

- Each year we send Soldiers to 140 countries where they not only face the threat of the enemy but the threat of diseases.
- Historically, disease non-battle injury (DNBI) has resulted in greater loss of combat strength and combat efficacy than the enemy. Attrition from DNBI disrupts the ability of the Army to penetrate, dis-integrate, and exploit the MDO battlefield.
- Although emerging technologies like artificial intelligence, hypersonics, machine learning, nanotechnology, and robotics are driving a fundamental change in the character of war, the nature of war remains a human endeavor. The Soldier remains the most essential weapon system to ensure success in MDO.
- In conflicts occurring on battlefields in the enemy's backyard. U.S. forces could find themselves more susceptible to endemic diseases than our opponents because of protection stemming from previous exposure.
- These pathogens are often highly contagious, they may spread within a unit of Warfighters and not just decrease the efficacy of the individual but remove entire combat units from the battlefield.
- Just as the joint force must dis-integrate the enemy's anti-access and area denial systems, countermeasures created by MRDC and WRAIR must provide a convergence of effort to stop the spread of disease; thus providing a foundation for combat effectiveness.

WHAT MILITARY MEDICINE IS DOING ABOUT IT

CONTROL THE THREAT

- Picaridan and IR3535 are proven, effective repellents
- Treated bed nets
- Permethrin-treated uniform

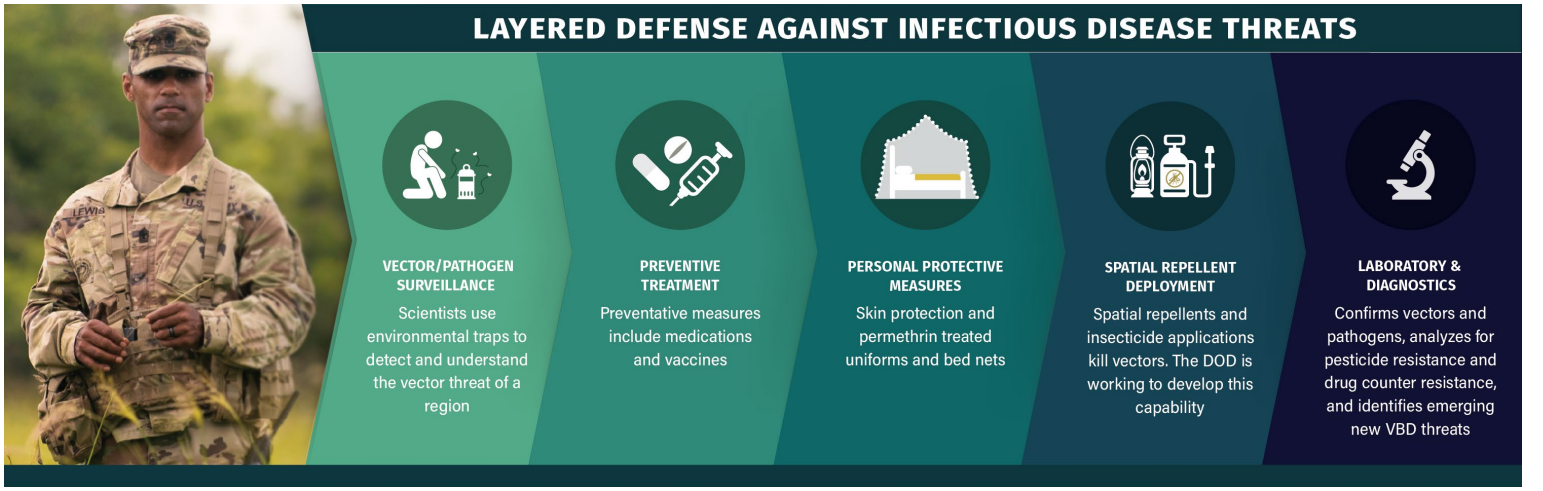
WRAIR evaluated in partnership with the Armed Forces Pest Management Board and USAMMDA

COUNTERMEASURE DEVOLOPMENT

- In 2019, FDA approved Dengvaxia in dengue endemic areas (restricted for use of local populations)

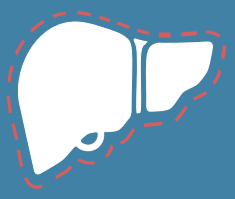
WRAIR'S CURRENT TARGETS

- Dengue
- Malaria
- Chikungunya
- Leptospirosis
- Acute Respiratory, Viral
- Diarrhea
- Multidrug-Resistant Organisms



SUCCESS STORY HEPATITIS A VIRUS (HepA)

A liver infection that is highly contagious



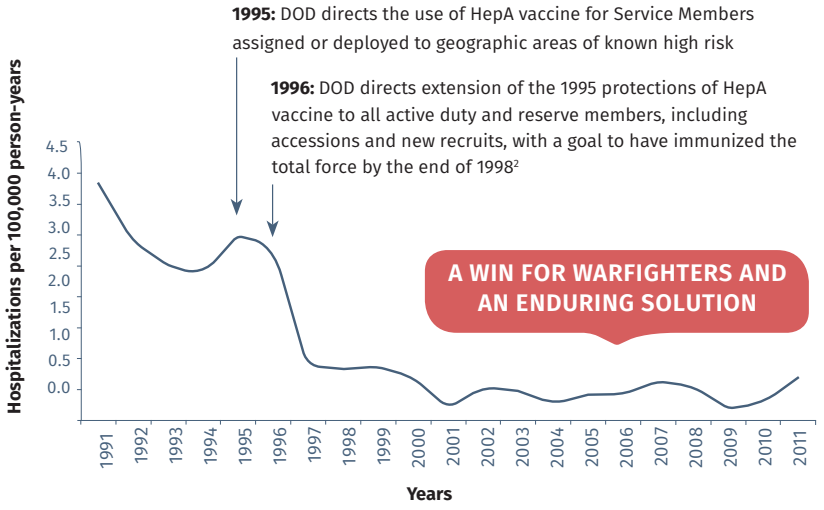
is spread by infected:

1.4 Million Cases Reported World-Wide Each Year

HepA VACCINE MILITARY RELEVANCE

- Biologic solution that maintains combat effectiveness
- HepA is highly contagious and a concern of the U.S. military as outbreaks can spread quickly through a unit and sideline a Soldier for a few weeks to several months
- The youngest age group of Service Members are most at risk for HepA exposure
- HepA vaccine provides life-long immunity; only 237 incidents of acute HepA were reported between 2007-2016

TREND OF INCIDENT HOSPITALIZATIONS FOR HEPATITIS A, ACTIVE COMPONENT, U.S. ARMED FORCES, 1991-2011

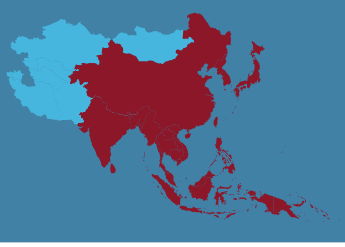


SUCCESS STORY JAPANESE ENCEPHALITIS VIRUS (JEV)

is spread by infected:

JEV virus is transmitted to humans through bites from infected *Culex* mosquitoes.

JEV is the most common cause of encephalitis in Asia.



20% to 30%

reported case fatality rate, with 30–50% of the survivors having long-term medical issues that often lead to an early death.

JEV MILITARY RELEVANCE

- Based on our innovation, the Republic of Korea implemented mandatory childhood vaccination (1967), which reduced incidences from 2500 cases (695 deaths) in 1966 to 0-7 cases 1984-2007.
- JEV vaccine reduces exposure risk to U.S. Service Members deployed to the Republic of Korea.
- The continued presence of JEV in the Republic of Korea poses a potential threat to over **29,000 U.S. personnel and greater than 13,000 beneficiaries.**
- INDOPACOM implemented JEV vaccine in force protection policy for TDY/PCS to endemic area of >30 days.

WRAIR'S INFECTIOUS DISEASE TARGETS

ACUTE RESPIRATORY, VIRAL	CHIKUNGUNYA	DENGUE	DIARRHEA, BACTERIAL	DIARRHEA, VIRAL	INFLUENZA	LEPTOSPIROSIS	MALARIA	MULTDRUG-RESISTANT ORGANISMS

REGIONAL TARGETS

KEY PARTNERSHIPS

Our robust partnerships, especially our MIL-MIL partnerships, provide a competitive advantage and help build strategic depth during all phases of MDO. Partnerships with biotech and pharmaceutical companies in the development of drugs and vaccines, allows for cost sharing, sped up timelines and takes advantage of robust development platforms in the civilian sector.

U.S. GOVERNMENT & DEPARTMENT OF DEFENSE	• DHA-AFHSC • AFPMB • CCCRP • CHAMP • CBER/FDA	• CDC • DARPA • DEPARTMENT OF STATE • DHA • DTRA	• FDA • MIDRP • MOMRP • NIH (NIAD, NCI, NCATS, NIDDK, VRC)	• NMRC • OGAC • PVC • USAID • USDA	• USAMMDA • USMMVP • USUHS
ACADEMIA	• ARKANSAS STATE UNIV. • BETH ISRAEL DEACONESS • BROAD INSTITUTE • CALVIN COLLEGE • CASE WESTERN RESERVE UNIV. • CHULALONGKORN UNIV. • COLUMBIA UNIV. • DUKE UNIV.	• EMORY UNIV. • HARVARD UNIV. • JOHN HOPKINS UNIV. • KAROLINSKA INSTITUTET • LEIDEN UNIV. MED. CENTER • LONDON SCHOOL OF MED. • MAKERERE UNIV. • MAHIDOL UNIV. • MASSACHUSETTS GEN. HOSP.	• MIT • NORTHEASTERN UNIV. • OREGON HEALTH AND SCI. UNIV. • OXFORD UNIV. • PORTLAND STATE UNIV. • RAGON INST. • SOUTHWEST RES. INST. • OHIO STATE UNIV.	• UNIV. OF ALABAMA • UNIV. OF BUFFALO • UNIV. OF COLORADO • UNIV. OF ESSEN • UNIV. OF HAWAII • UNIV. OF IOWA • UNIV. OF MARYLAND • UNIV. OF MIAMI • UNIV. OF MISSISSIPPI	• UNIV. OF NOTRE DAME • UNIV. OF PENN. • UNIV. OF SOUTH FL • UNIV. OF VIRGINIA • UNIV. OF WASHINGTON • UNIV. SOUTHERN FL • UNIV. TEXAS MED. BRANCH • VIRGINIA MILITARY INST. • VANDERBILT UNIV.
INDUSTRY	• 60 DEGREES PHARMACEUTICALS • ABBOTT LABORATORIES • ACUITAS THERAPEUTICS • ALPHA-O-PEPTIDE • ANTIGEN DISCOVERY • BECTON DICKINSON	• CRUCELL • DAFRA PHARMA • EMERGENT BIOSOLUTIONS • ENTASIS THERAPEUTICS • FRAUNHOFER BIOLOGICALS • FREQUENCY THERAPEUTICS • GENEONE LIFE SCIENCE	• GSK • INOVIO PHARMACEUTICALS • IOGENETICS • JANSSEN, J&J • LYNDRA THERAPEUTICS • MESO SCALE DIAGNOSTICS • MERCK	• MICROBIOTIX • MILTENYI BIOTEC • NOVARTIS • NOVADIGM • PFIZER • PRECISION BIOSERVICES • SANARIA	• SANOFI PASTEUR • TAKEDA • TITAN PHARMACEUTICALS • THEMIS • VLP THERAPEUTICS
FOREIGN GOVERNMENT & MILITARY	• ARMED FORCES OF LIBERIA • ARMED FORCES OF THE PHILIPPINES • AUSTRALIAN DEFENCE FORCE	• BUNDESWEHR • BRAZIL MINISTRY OF HEALTH • GHANA ARMED FORCES • ISRAEL DEFENSE FORCES • JORDANIAN ARMED FORCES	• JORDAN MINISTRY OF HEALTH • KENYA MEDICAL RESEARCH INSTITUTE • KENYA DEFENCE FORCES • NATIONAL INSTITUTE OF	HEALTH MOZAMBIQUE • NIGERIAN ARMED FORCES • ROYAL CAMBODIAN ARMED FORCES • ROYAL THAI ARMY	• TANZANIA MIN OF HEALTH AND SOCIAL WELFARE • TANZANIA PEOPLE'S DEFENCE FORCE • THAI RED CROSS SOCIETY
NONPROFIT & NON-GOVERNMENTAL ORGANIZATION	• ASTMH • BILL & MELINDA GATES FOUNDATION • BURNET INST. • DRUGS FOR NEGLECTED	DISEASE INITIATIVE • HJF • INTERNATIONAL VACCINE INSTITUTE • ISGLOBAL	• JENNER INST. • MEDICINES FOR MALARIA VENTURE • PATH • POISON CONTROL CENTER	• SRI INT. • TEXAS BIOMED • TRUDEAU INSTITUTE • WHO	THIS IS A SUBSET OF WRAIR'S MORE THAN 400 PARTNERSHIPS