Operational Entomology in the Department of Defense (DoD): Implications on Clinical Practice

LCDR Michael Kavanaugh

Clinical Communities Speaker Series

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Presenter

LCDR Michael Kavanaugh, M.S.
Armed Forces Pest Management Board (AFPMB)

Office of the Assistant Secretary of Defense for Sustainment

LCDR Michael Kavanaugh, M.S.

- LCDR Kavanaugh earned the United States Navy Health Services Scholarship Collegiate Program in 2006 and attended the University of North Texas. He achieved a Master's of Science and was commissioned as a Medical Entomologist at the rank of Lieutenant Junior Grade.
- After commissioning in 2008, he was selected to go to the Navy Entomology Center of Excellence (NECE) and deployed to Afghanistan with the 2nd Marine Expeditionary Brigade's first wave into the Helmand Province during Operation Khanjar. He then became the Assistant Officer in Charge (AOIC) of the Preventive Medicine Unit and one of a 12-member medical team that forward deployed to assist in building Camp Dwyer. During his deployment, he led a range of preventive medicine tasks, theater wide entomological support by providing vector surveillance and control and assisted the Shock Trauma Platoon with patient movement. Upon his return to CONUS, he deployed on Continuing Promise 2010 aboard the USS IWO JIMA (LHD7) as the AOIC of the Preventive Medicine Directorate, working with the Ministries of Health in South and Central American countries in best preventive medicine strategies.
- LCDR Kavanagh reported to Navy Environmental Preventive Medicine Unit FIVE where he was the Director for the Forward Deployable Preventive Medicine Unit in 2010. He ensured teams' readiness for deployment in worldwide operations as the Division Officer (DIVO) for Education and Training. He implemented the Catalog of Navy Training Courses (CANTRAC) and just-in-time training for deploying units.
- In 2013, LCDR Kavanaugh was selected for Duty Under Instruction for the World Health Organization Collaborative Center at the Entomology Branch of the Centers for Disease Control and Prevention (CDC), at which time he was awarded a Deployed Warfighter Protection Program grant of $116k. He also developed the first prototype non-destructive permethrin test kit for military uniforms in response to a request from MARCOSYSCOM. While at the CDC, he became the Deputy DoD Liaison Officer to the CDC, during the Dugway Proving Grounds anthrax investigation. He also led the surveillance and insecticide resistance testing in Puerto Rico in response to the Zika outbreak, in preparation for future emergency response with the CDC and Puerto Rican Health Department.
- LCDR Kavanaugh is currently stationed at the Armed Forces Pest Management Board where he is the Chief, Strategy and Information Division.

Disclosures

- LCDR Kavanagh has no relevant financial or non-financial relationships to disclose relating to the content of this activity.
- The views expressed in this presentation are those of the presenter and do not necessarily reflect the official policy or position of the Department of Defense, nor the U.S. Government.
- This continuing education activity is managed and accredited by the Defense Health Agency, J-7, Continuing Education Program Office (DHA, J-7, CEPO). DHA, J-7, CEPO and all accrediting organizations do not support or endorse any product or service mentioned in this activity.
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- Commercial support was not received for this activity.

Overview

- Role of DoD Entomology
- Entomology and Public Health
- Operational Entomology

Learning Objectives

1. Analyze the role of entomology in DoD public health programs
2. Identify the components of the DoD Arthropod Repellent System
3. Outline emerging issues in vector-borne disease

The Role of DoD Entomology

CDR Steven E. Rankin, MSC, USN; AFPMB Historical Records

Historical Perspective

- Prior to WWII many more deaths were caused by disease than by combat
- MAJ Walter Reed and Carlos Finlay discovered that yellow fever was vectored by mosquitoes
- Surgeon General William Gorgas established the Sanitary Corps in 1917

National Museum of Health and Medicine online archive. Retrieved 20 May 2020 https://www.medicalmuseum.mil/index.cfm?p=about.directors.reed

(Ginn, 1997.)

Historical Perspective

- Entomologists were first commissioned into the Sanitary Corps after WWI.
- **1944:** General George C. Marshall established **Army Committee for Insect and Rodent Control** to coordinate pest control efforts
- **1979:** Renamed **Armed Forces Pest Management Board** (AFPMB) - Directorate in the **Office of the Under Secretary of Defense for Acquisition and Sustainment**, OUSD(A&S)

USDA ARS AgResearch Online Magazine. 2005. 53(9). https://agresearchmag.ars.usda.gov/ar/archive/2005/sep/vector0905.pdf. Retrieved 20 May 2020.

(Ginn, 1997.)

Our Mission

- Ensure environmentally sound & effective pest management programs are in place to prevent pests and disease vectors from adversely affecting DoD operations

- Ensure deployed forces have effective capabilities to prevent vector-borne diseases and optimize readiness of deployed forces

https://www.defense.gov/observe/photo-gallery/igphoto/2002244372/
Retrieved 26 May 2020

Our Customers

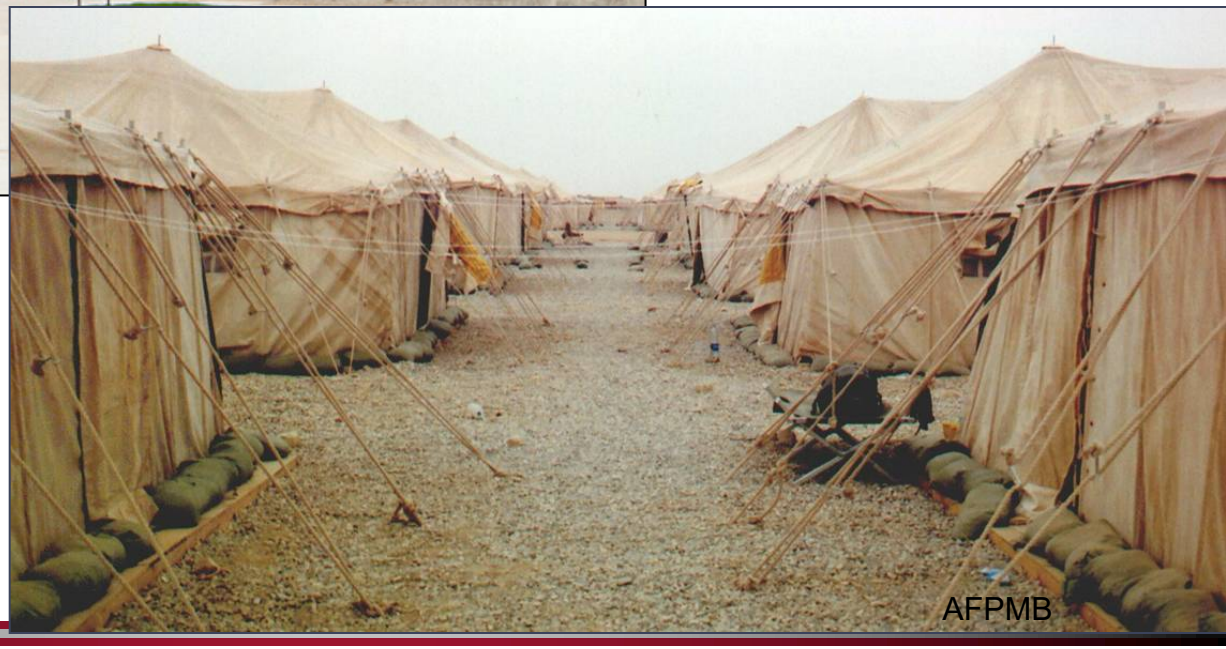
AFPMB

Retrieved on 21 May 2020
https://www.defense.gov/observe/photo-gallery/igphoto/2002301977/

Retrieved 21 May 2020
https://www.defense.gov/observe/photo
gallery/igphoto/2002254798/

Home and Abroad

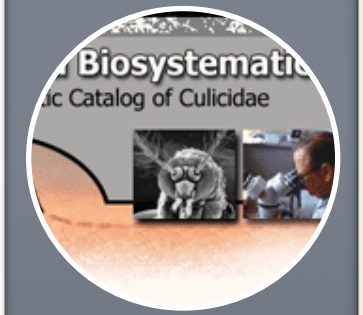
Retrieved 21 May 2020
https://www.mortenson.com/federal-government/projects/jblm-wa-ueph-whole-barracks-renewal



AFPMB

Entomology Capability Areas

Vector Surveillance



Vector ID

Pathogen Detection

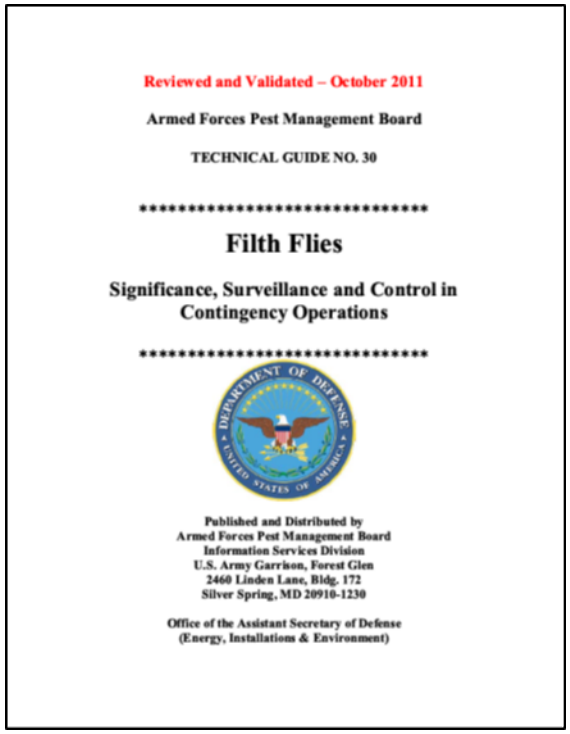
Bite Prevention & Personal Protective Measures

Vector Control

Mapping, modeling & risk assessment

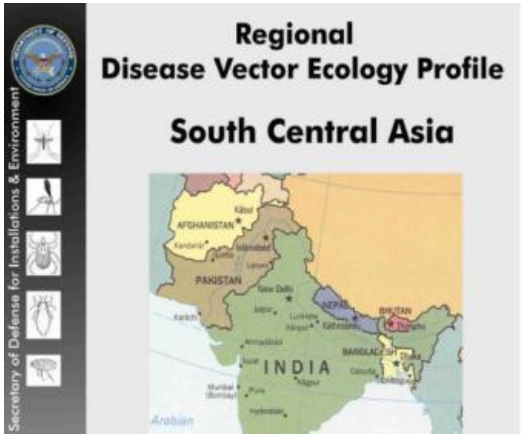
DoD Entomology Products

Personal Protective Equipment



Technical Guides (TG)

Pest Surveillance, Identification, & Control Tools



Medical Planning & Decision Support Tools

Policy

https://www.acq.osd.mil/eie/afpmb/

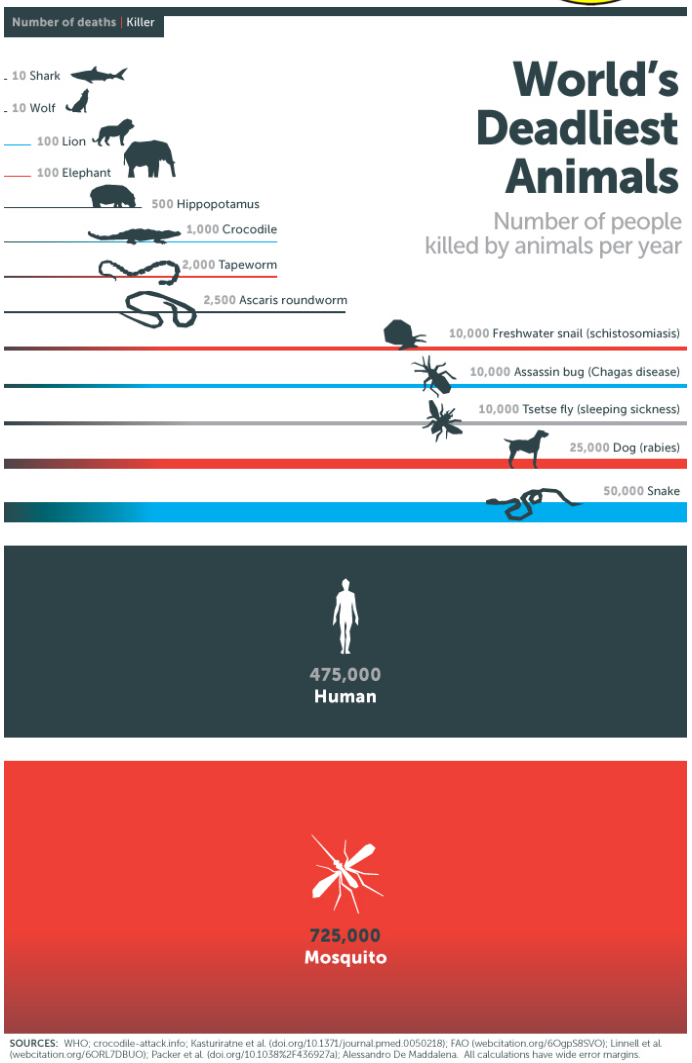
Photos from AFPMB, APHC, and USDA

Entomology and Public Health

Jim Gathany-CDC The Public Health Image Library phil.cdc.gov/phil Retrieved 28 May 2020

Pathogens Vectored by Arthropods

- A massive amount of human suffering and economic loss is caused by arthropod-borne diseases



https://www.gatesnotes.com/Health/Most-Lethal-Animal-Mosquito-Week
Retrieved 26 May 2020

Diseases from Vectored Pathogens

- Parasites
  - Malaria
  - Leishmaniasis
  - Filariasis
  - Babesiosis
  - African and American trypanosomiasis
- Bacteria
  - Lyme
  - Plague
  - Spotted fever group (SFG) Rickettsiosis
  - Anaplasmosis
  - Epidemic typhus
- Viruses
  - Dengue fever
  - Yellow fever
  - Powassan
  - Sand fly fever
  - Ross River
  - West Nile Virus (WNV)
  - Eastern Equine Encephalitis (EEE)

Service, M. W. (2008).

Mechanical Transmission of Pathogens

- Insects can pick up pathogens on surfaces
- Those pathogens can make us sick if the insect then crawls or lands on us or our food

LTJG Tim Ciarlo, NEPMU 5
AFPMB

Pathogens Mechanically Transmitted

- *Salmonella*
- *Shigella*
- *Entamoeba*
- *Giardia*
- *Toxoplasma gondii*
- *Francisella tularensis*

Graczyk, T. K., Knight, R., & Tamang, L. (2005).
Higley, L. G., Karr, L. L., & Pedigo, L. P. (1989).

Other Health Concerns

- Parasitism
  - Scabies
  - Myiasis
  - Lice
  - Bed bugs
- Envenomation
  - Arachnids
  - Hymenoptera
  - Hairy caterpillars
- Allergies
  - Hymenoptera
  - Cockroach infestations
- Phobias
  - Extreme fear of arthropods
  - Delusory parasitosis

Service, M. W. (2008).

Vaccines and Therapeutics

- Vaccines:
  - Yellow Fever
  - Lyme (withdrawn from market)
- Therapeutics:
  - Malaria prophylactics
  - Anti-parasitics (Ivermectin)
- **The vast majority have no specific treatment or vaccine**

Nigrovic, L. E., & Thompson, K. M. (2006).

Operational Pest Management

https://www.luke.af.mil/News/Article-Display/Article/641038/entomology-keeping-food-base-pest-free/ Retrieved 1 June 2020

DoD Insect Repellent System

- Topical repellent
- Repellent treated uniform
- Proper wear of uniform
- Bed net
- Malaria chemoprophylaxis
- Coming soon: Spatial repellents

Army Public Health Center. Retrieved January 2020. https://phc.amedd.army.mil/topics/envirohealth/epm/Pages/DoD-Insect-Repellent-System.aspx

Uniform Treatment

- Factory treatment
  - Permethrin
  - Etofenprox
- 2-gallon Hand Can
- Individual Dynamic Absorption Kit
- Aerosol can
  - Civilian clothing can be treated too!

https://www.southcom.mil/MEDIA/NEWS-ARTICLES/Article/1058014/usns-spearhead-set-to-deploy-continuing-promise-2017-begins/
Retrieved 26 May 2020

Integrated Pest Management

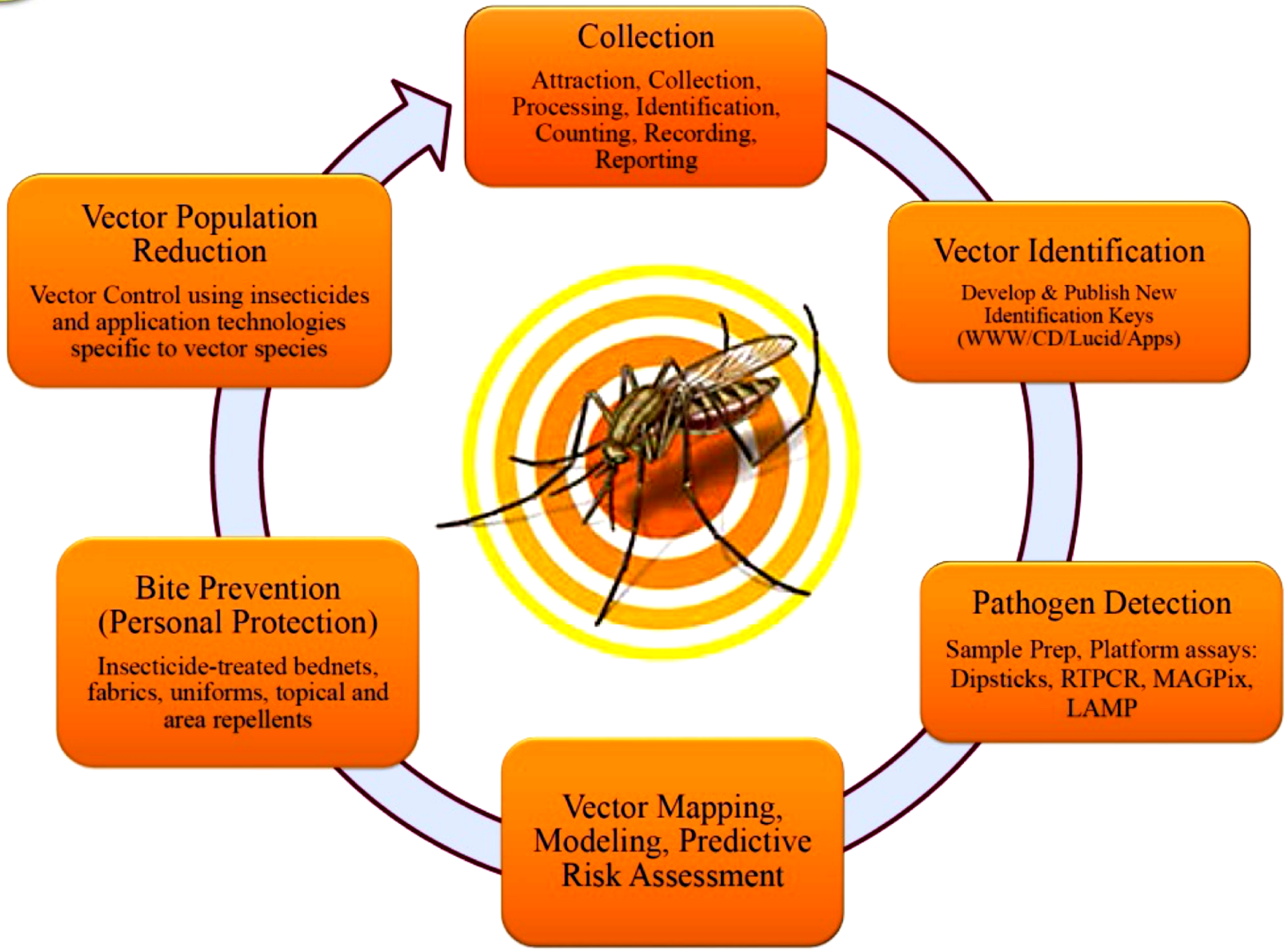
- Comprehensive program to reduce the impact of pests below a certain level of acceptability
- Required by DoD policy
- Types of control
  - Mechanical
  - Physical
  - Biological
  - Regulatory
  - Cultural
  - Chemical

Pedigo, L.P. & Rice, M.E. (2014).

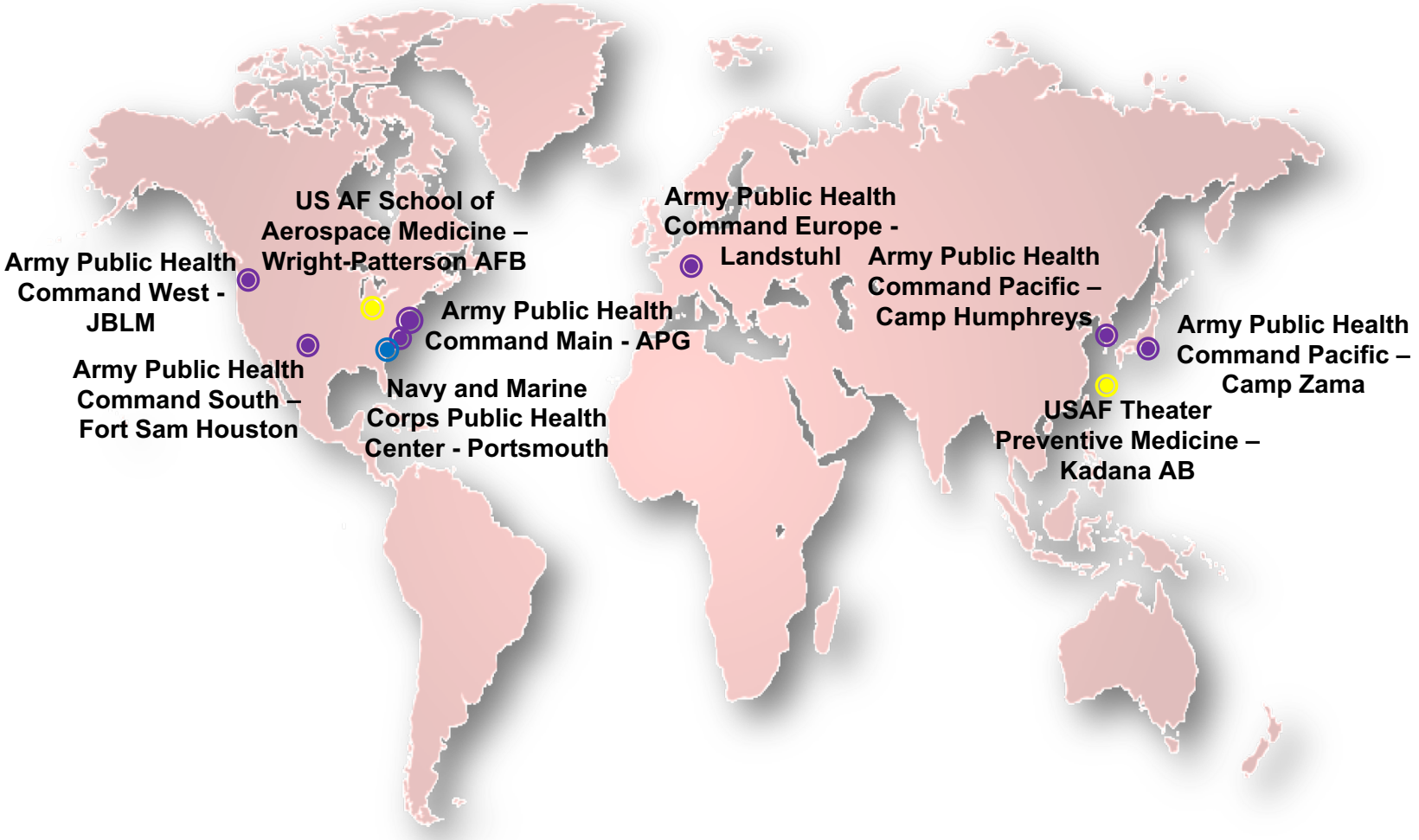
Under Secretary of Defense for Installations and Environment. (2005, March 19).

Under Secretary of Defense for Acquisition and Sustainment. (2019, December 26).

Vector Surveillance and Control



DoD Public Health Activities



Army Public Health Center (APHC)

Mission: The mission of Entomological Sciences Division is to advance the readiness and health of Army personnel and communities by monitoring legacy, current, and emerging environmental public health threats; provide vector-borne disease prevention/surveillance, consultative expertise, and programmatic support to optimize the Army's Public Health Enterprise.

APHC Resources:

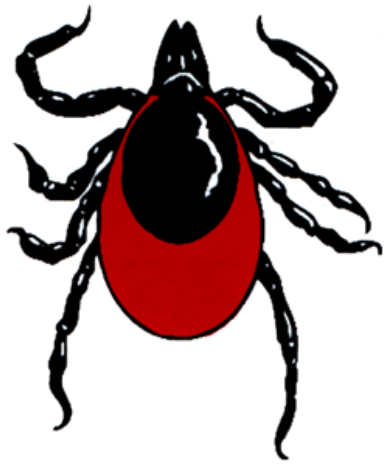
- Deployment pest management guidance
- DoD Pesticide Hotline
- Training aids and public health educational materials
- Disease fact sheets
- Identification and analysis of surveillance samples
- Surveillance data analytics

Entomological Sciences Division. (n.d.).

TICK TEST KIT

ARMY PUBLIC HEALTH CENTER
DOD Human Tick Test Kit Program

- Tick Identification
- Analysis for Tick-Borne Diseases



Directions:

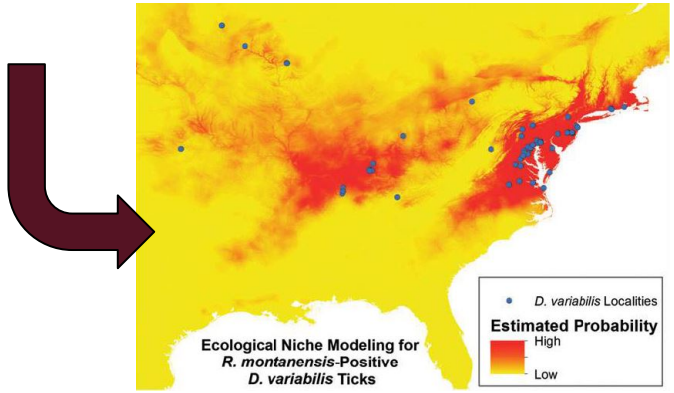
1. Place tick in plastic screw cap vial.
2. Place vial in plastic ziploc bag.
3. Fill out LIDS 850, enclosed.
4. Place plastic bag and LIDS 850 in the mailing envelope and send without delay to:

Army Public Health Center
ATTN: Human Tick Test Kit Program
5158 Blackhawk Road
BLDG E5800
Aberdeen Proving Ground, MD 21010-5403
(410) 436-5421

- **Free clinical support for DoD beneficiaries, DoD health care providers and their tick-bite patients**
- **Tick identification provided**
- **Testing available for agents of**
  - **Lyme disease**
  - **Human granulocytic anaplasmosis**
  - **Babesiosis**
  - **Human monocytic ehrlichiosis**
  - ***Ewingii* ehrlichiosis**
  - **Panola mountain ehrlichiosis**
  - **Tidewater spotted fever**
  - **Rocky Mountain spotted fever**
  - **Powassan/deer tick virus**
- **3000+ ticks tested annually**

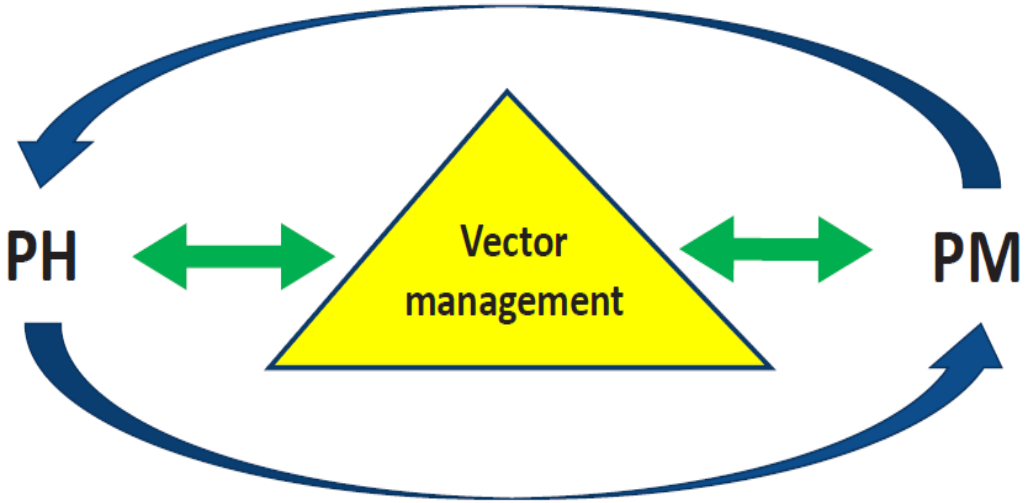
What is the DoD Human Tick Test Kit Program?

- DoD clinics and individuals submit ticks removed from DoD personnel to the Tick Test Kit by mail using kits they request
- The Tick-Borne Disease (TBD) Lab identifies the tick to species, and tests it for the appropriate suite of pathogens using polymerase chain reaction (PCR) assays
- Results are reported back to the clinic and tick-bite victim
- The results from the Tick Test Kit can be used to guide medical treatment decisions for the tick-bite victim
- The Tick Test Kit produces valuable long-term passive surveillance data on tick distributions and risk of tick-borne diseases at each submitting installation



US Air Force School of Aerospace Medicine (USAFSAM) & 18 AMDS Theater Preventive Medicine

- Public Health (PH) Airmen do tick drags or use CO_2 tick traps
- Other collected ticks are also sent
- Ticks that attached to a human are sent to the Army
- Ticks are shipped dry to USAFSAM and identified to species



Navy and Marine Corps Public Health Center (NMCPHC)

Mission: NMCPHC is the Navy and Marine Corps' center for public health services. NMCPHC provides leadership and expertise to ensure mission readiness through disease prevention and health promotion in support of the National Defense Strategy.

Field Activities:

- Navy Environmental Preventive Medicine Units (2,5,6 and 7)
- Navy Entomology Center of Excellence

Navy and Marine Corps Public Health Center. (n.d.).

Emerging Issues in Operational Entomology

https://www.cdc.gov/lyme/signs_symptoms/index.html Retrieved 1 June 2020

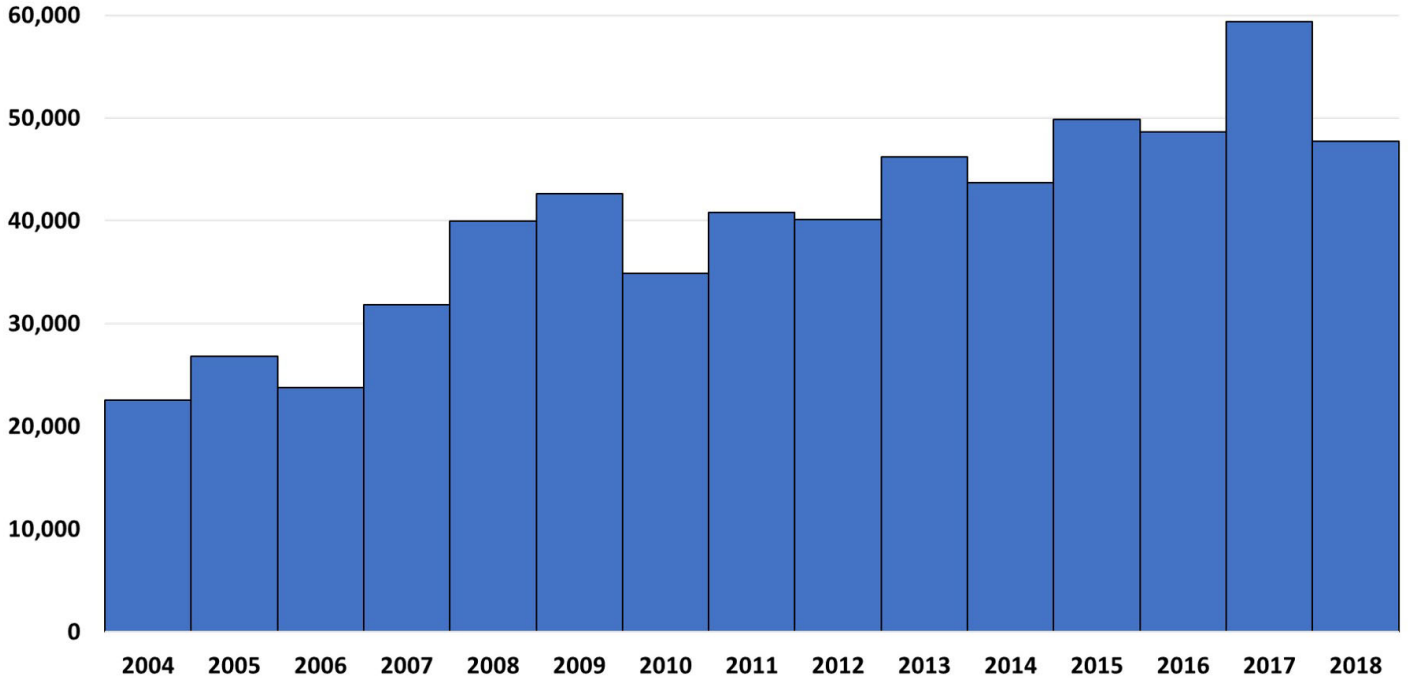
Emerging Issues

- Insecticide Resistance

- Invasive vectors and emerging diseases
  - Climate change
  - Globalization
  - Shifts in habitat use

Tick-borne Disease in the US

Total Reported Cases of Tickborne Disease, 2004-2018
Centers for Disease Control and Prevention



Tickborne Disease Surveillance Data Summary. (2019, November 4).

Tick-borne Disease in the US

Seven new TBD in the past 20 years

- Lyme disease (*B. burgdorferi*)
- *Borrelia miyamotoi*
- *Borrelia mayonii* (also Lyme)
- Tick-borne relapsing fever
- *Rickettsia parkeri* rickettsiosis
- Rocky Mountain Spotted Fever (RMSF)
- 364D rickettsiosis
- Tularemia
- Anaplasmosis
- Babesiosis
- *Erlichia ewingii*
- *Erlichia muris*
- Powassan virus
- Heartland virus
- Colorado tick fever
- Bourbon virus
- Southern tick-associated rash illness (STARI)

Non-pathogenic concerns:

- Alpha-gal meat allergy
- Tick-bite paralysis

Lyme and Other Tickborne Diseases Increasing. (2019, April 22).
Alpha-gal Allergy. (2019, March 28).
Diseases Transmitted by Ticks. (2020, April 2).

Invasive Ticks

https://www.cdc.gov/ticks/longhorned-tick/index.html
Retrieved 28 May 2020

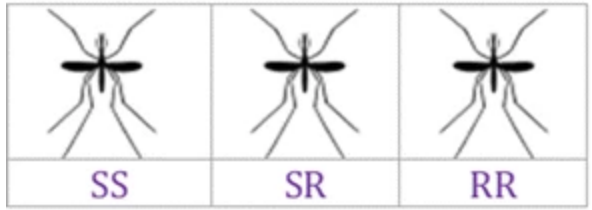
- Asian Longhorned Tick (ALT) (*Haemaphysalis longicornis*)
- Parthenogenic
- Severe Fever with Thrombocytopenia Syndrome (SFTS), RMSF
- Exsanguination

Stanley, H.M., Ford, S.L., Snellgrove, A.N., & et al. (2020, April 27).

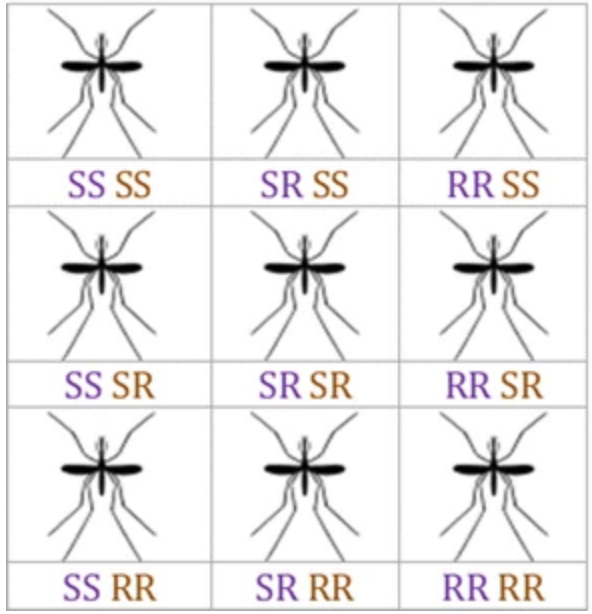
Insecticide Resistance (IR)

- A population of vectors can evolve the ability to overcome pesticide exposure
- Variable across time and space
- Variable mechanisms (genetic, metabolic, behavioral)

a Single insecticide, 3 potential genotypes :



b Two insecticides, 9 potential genotypes :

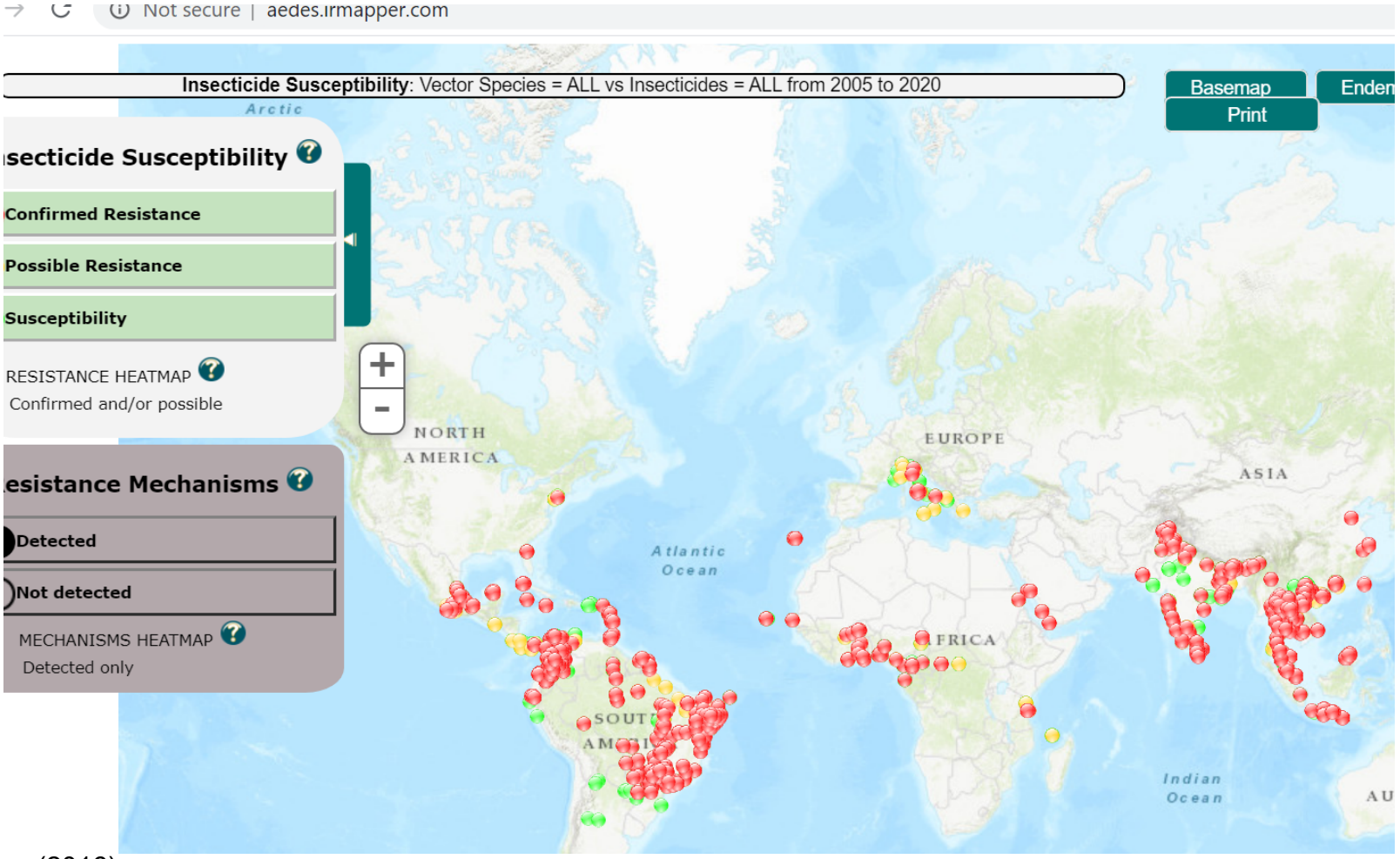


South, A., & Hastings, I.M. (2018).

Why is IR an Issue?

- DoD only has two classes of insecticides.
- Without the tools to eliminate vectors we have to use other methods to protect personnel. These usually rely on personal compliance (repellents, bed nets, uniform usage)

Example: *Aedes* Pyrethroid Resistance



IR Mapper. (2016).

How Are We Combatting IR?

- Deployed Warfighter Protection Program has competitive funding to develop novel insecticides to combat IR issues.
- New tools being evaluated that do real time testing so personnel can make force health protection recommendations in hours vs. days.

Key Takeaways

- Entomology and pest management are integral components of an effective public health program
- Personal protective measures and pest management are the only means of prevention and control of most vector-borne diseases
- Insecticide resistance and tick-borne diseases are important emerging issues in operational entomology

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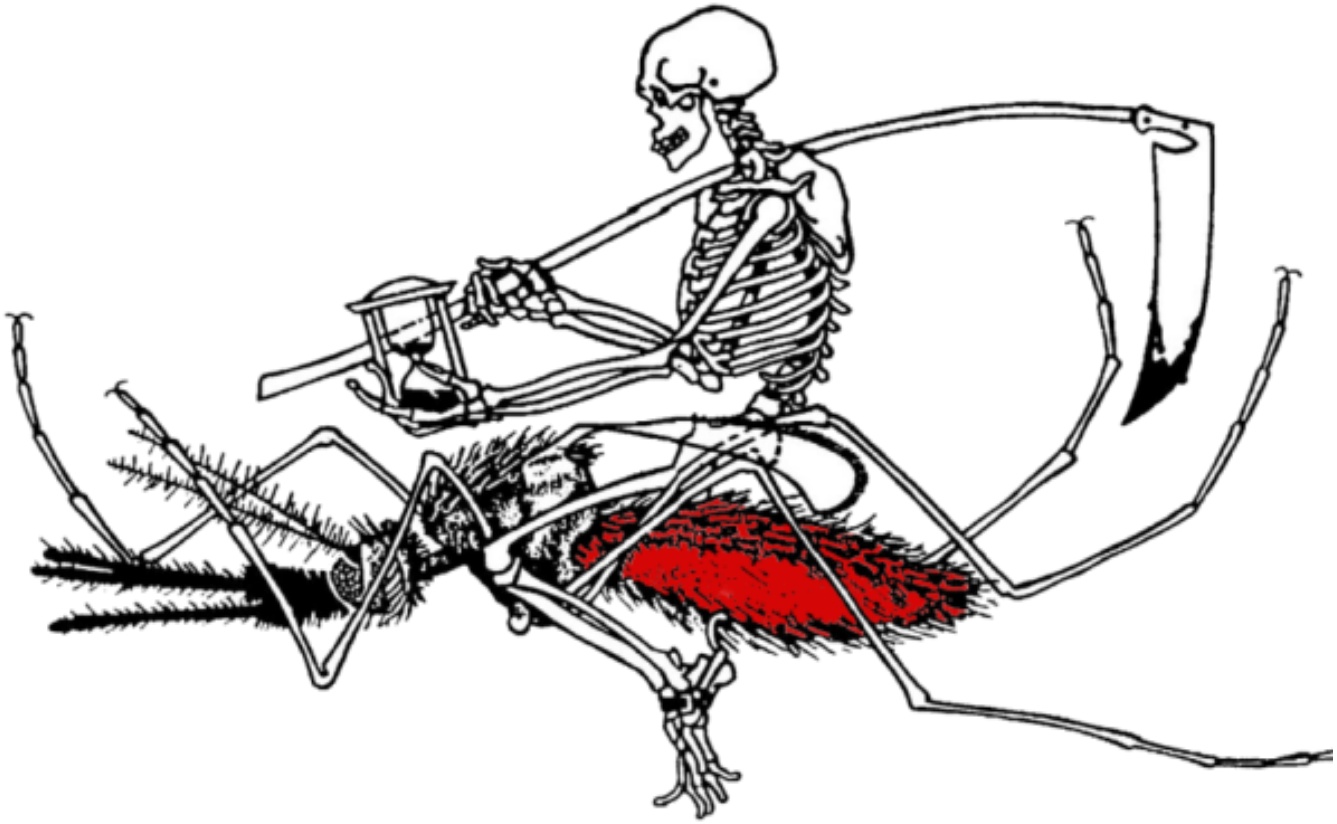
Questions?



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To receive CE/CME credit, you must register by 0745 ET on 24 July 2020 to qualify for the receipt of CE/CME credit or certificate of attendance. You must complete the program posttest and evaluation before collecting your certificate. The posttest and evaluation will be available through 6 August 2020 at 2359 ET. Please complete the following steps to obtain CE/CME credit:

1. Go to URL: https://www.dhaj7-cepo.com/content/clinical-communities-speaker-series-health-innovations-and-promising-practices-jul-2020
2. Click on the REGISTER/TAKE COURSE tab.
   a. If you have previously used the CEPO CMS, click login.
   b. If you have not previously used the CEPO CMS click register to create a new account.
3. Follow the onscreen prompts to complete the post-activity assessments:
   a. Read the Accreditation Statement
   b. Complete the Evaluation
   c. Take the Posttest
4. After completing the posttest at 80% or above, your certificate will be available for print or download.
5. You can return to the site at any time in the future to print your certificate and transcripts at https://www.dhaj7-cepo.com/
6. If you require further support, please contact us at dha.ncr.j7.mbx.cepo-cms-support@mail.mil