Military Repellent Testing

CPT(P) Kendra Lawrence

WRAIR

Material has been reviewed by the Walter Reed Army Institute of Research. There is no objection to its presentation and/or publication. The opinions or assertions contained herein are the private views of the author, and are not to be construed as official, or as reflecting true views of the Department of the Army or the Department of Defense.

Our Customer

Our Criteria

- **Disease prevention**
  - Vector-borne disease = lost manpower = decreased combat effectiveness; cost of treatment/evacuation from theater
- **Efficacy and duration**
  - Efficacy against a wide range of vectors
  - Duration of at least 8 hours, preferably 12
- **We are not your typical repellent customer**

Testing

- **Laboratory screening**
  - *In vitro*: mosquitoes (working on sand fly assay)
  - *In vivo*: K&D module - multiple repellents simultaneously; less exposure to bites

- **Field testing***
  - Culicoides, ticks, sand flies, mosquitoes
  - Collaboration with overseas laboratories

Field Testing

- **Candidate repellents tested against 33% DEET (Ultrathon® or EDTIAR)**
- **Repellency measure endpoint = relative protection (RP)**
  - Number landing in 20 minute challenge
    - Approx. 1 mosquito per minute
  - Treated vs. Untreated leg
  - Challenge at 2, 4, 6, 8, 10, and 12 hours post application

- **Relative Protection (RP)**

- **Percentage reduction in probes/bites**
  - Time to first confirmed bite (TFCB)
  - Landing with intent to bite (LIB)

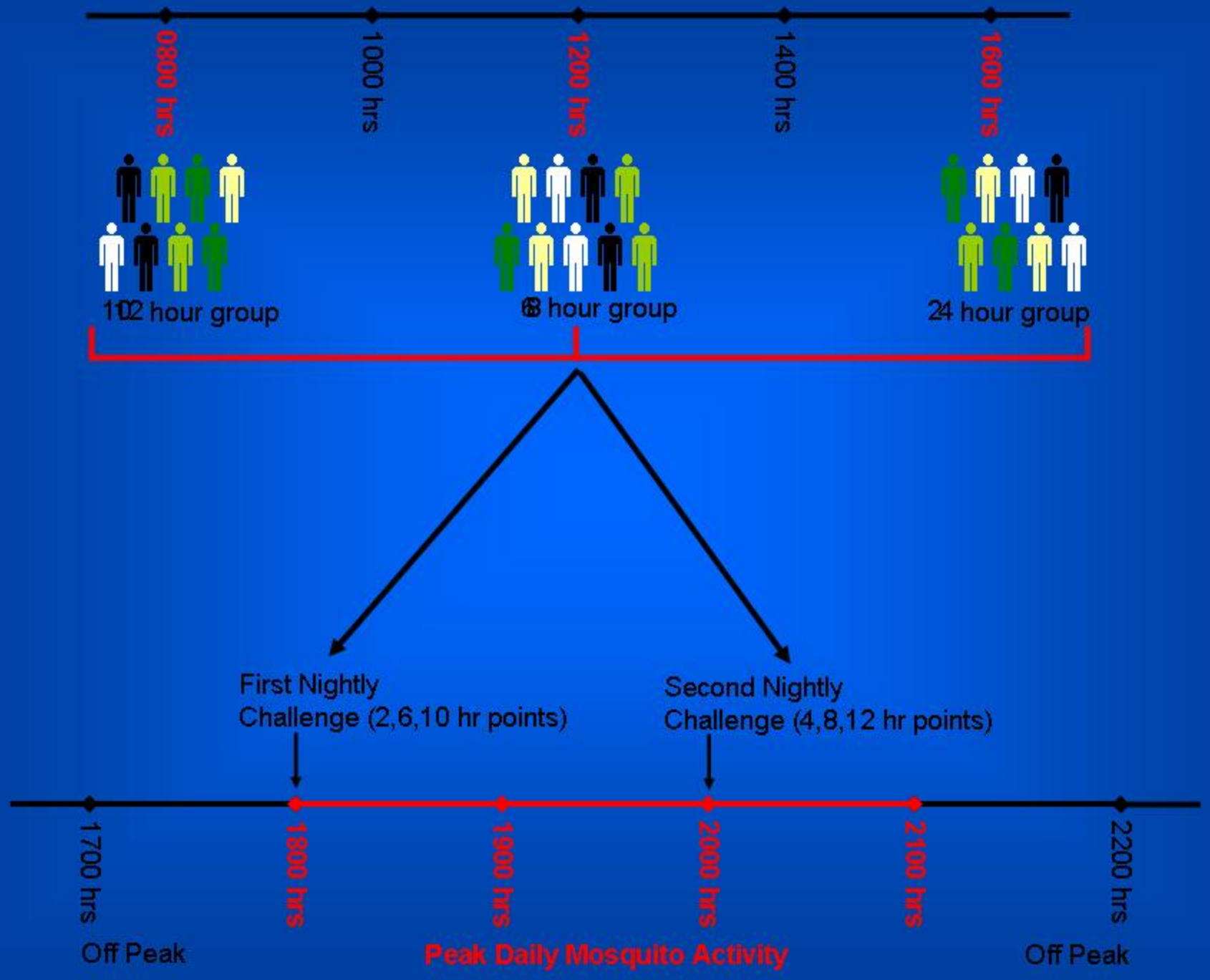
- **Percentage reduction in landings****

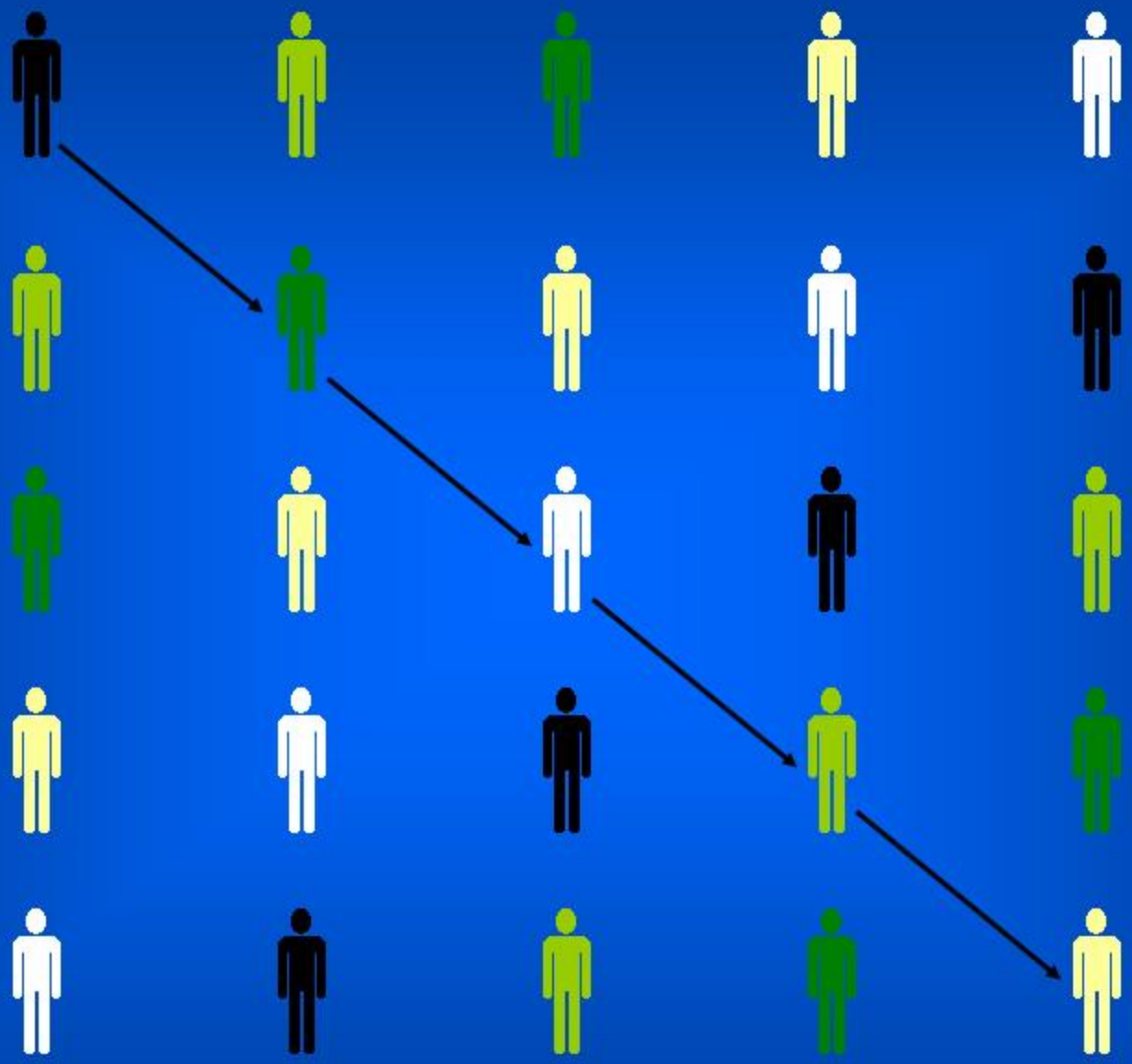
- **Assumptions**
  - DEET has 95% efficacy
  - Candidate is no more than 20% less efficacious
  - 1 mosquito landing per min. (20 min. challenge)
  - With this kind of data, even with a large sample size, you won't get normally distributed data
  - Variability: subject, location, date, time

Belize Feb. 07

Belize Sept. 07

- **4 candidate repellents plus EDTIAR**
- **6 volunteers per treatment**
  - Each volunteer wears the same repellent each day
- **Tested at 6 post-application time points**
- **Peak activity: 1800-2100**
  - Challenge at 1800, 2000
- **Staggered treatment during the day**
  - 0800, 1200, or 1600


0800 hrs
1000 hrs
1200 hrs
1400 hrs
1600 hrs
12 hour group
8 hour group
24 hour group
First Nightly
Challenge (2,6,10 hr points)
Second Nightly
Challenge (4,8,12 hr points)
1700 hrs
1800 hrs
1900 hrs
2000 hrs
2100 hrs
2200 hrs
Off Peak
Peak Daily Mosquito Activity
Off Peak



Analysis

- **Calculate**

$$PP = 100 \times [(ARC-ARP) / (ARC)]$$

  - ARC = attack rate for control
  - ARP = attack rate for repellent
- **Data transformation**
- **GLMM**
  - With and without interaction (repellent x duration)

Our Bias

- **95% is a desirable goal but there is much variability**
- **Better to design it this way to have greater power**
- **Not 'perfect' design but field studies = limitations**
  - # of volunteers
  - # of days required (peak activity)
  - Compensation
  - Minimizing risk
  - Weather

Our Bias

- **Compare against EDTIAR**
- **Each person needs to serve as own control**
  - Positive controls: cannot establish biting pressure
  - One control (sentinel): artificially reduces inherent variability
- **Landing counts**
  - Volunteers can easily collect from themselves
  - Possibly reduces actual exposure

Our Bias

- **Negative (true) controls are necessary**
  - Clear risk communication to volunteer
  - Covered except for treated area
  - Adequate follow-up
- **Alternative – putting out a product that doesn't really do what it claims**
  - Unreliable data
  - What is the greater good?

Questions?