PMI 214 Notes - Final Review with Greg Lanzaro

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- Lec. 11
  - EIR: entomological innoculation rate
    - EIR $= ma\phi\theta$ where
      - m - How many mosquitoes out there? mosq/person
      - a - How many bites? bites/day
      - ϕ - How many bites are on humans (how anthropophilic)? human-bites/all-bites
      - θ - How many vectors are infected? transmitting-vectors/all-vectors
  - Vectorial Capacity - number of infective vector bites that would arise from all the mosquitoes that bite a single host on a single day $C = \frac{ma^2b}{-\ln p}p^n$
    - a - bites/person/day (not the same a as in EIR)
    - b - vector competence
    - n - extrinsiv incubation period
    - p - vector daily survival rate
  - Basic Reproductive Rate (R_0) - avg. # of future host infections that will arise following introduction of a single infectious host in a susceptible population $R_0 = C/r$ where
    - r - host recovery rate 1/infectious-perioud
- Lec 12
  - Integrated Vector Control (IVM) - think about all the availble tools for the specific vector and situation - "a rational decision-making process for the optimal use of resources for vector control"
  - Behavioral Insecticide Resistance - ex: mosquitoes feeding over a range of times, kill all the ones who feed at night, going to select for ones who don't feed at night, bed nets stop being effective.
  - Source reduction - getting rid of some feature of the environment which the mosquito needs - filling potholes, getting rid of standing water, covering drainage systems, getting rid of carbohydrates, unneeded vegetation, draining swamps
- Lec 13
  - GMM for vector control
  - population suppression vs. population replacement
    - suppression - reduce fecundity of the population by killing them or getting rid of all the females
    - replacement - introduce mosquito resistance to malaria through gene drive (turn the vectors into nonvectors)
  - transgene (in the lab)
    - need to have an effector gene (affects the phenotype that kills parasite)
    - need to have a promoter (turns the gene on at the right time (larval stage, adult stage) in the right place (salivary gland, epidermis lining the stomach, , sex specific, etc))
  - transgene in nature
    - all of the above, and a gene drive (not normal Mendelian inheritance)
  - How does a gene drive work?
    - progeny has one copy of transgene and one copy of wild type.

    - gene drive cuts the wild type gene and repairs it with the transgene.
    - heterozygote turns to homozygote
    - ALL future progeny carries the transgene

- Lec 14
  - Ecology of Rickettsiaceae
  - hard and soft tick feeding behavior
    - hard ticks feed once per stage
    - hard ticks have different hosts for each stage
    - hard ticks feed for a week at a time - they cement themselves to the host, until it gets completely full
    - soft ticks feed for 20 min at a time
  - Rickettsiaceae
    - bacteria
    - live inside the cell - not exposed to the host immune system
  - How do horses get infected with Neorickettsia?
    - acquatic insects on wet grass (Carter: "I think it's... wet food?")

- Lec 15
  - Wolbachia
    - Wolbachia is very common bacteria in insects - often symbiotic
    - transmitted maternally (vertical transmission)
    - also horizontally transmitted (between different species) - mechanism not understood - but good be good for mosquito control, but could cause problems (evolution people say horizontal transmission is between species, not necessarily within species)
  - Cytoplasmic incompatibility - uninfec/infec female with uninfec/infec male different results.
    - infected female with whoever, all infected, normal progeny numbers
    - infected male with uninfected female, all uninfected, reduced progeny numbers
  - How are Wolbachia spread?
  - Bartonian vs. Fisherian waves
    - Fisherian (1937) - pulled - more robust spreading
    - Bartonian (1979) - threshold - bistable, pushed - easily stopped by barriers to dispersal

- Lec 16
  - genome evolution in malaria vectors in response to vector control
  - what is a sibling species?
  - "genomic island of speciation" - in these islands are genes responsible for reproductive isolation
  - adaptive introgression is one gene moving into another which imparts a fitness advantage
  - shows up in Anopheles coluzii and An. gambiae
    - movement of a good (adaptive) gene from one species to another, or one diverged population to another
    - what was the gene that moved from coluzii to gambiae? insecticide resistance.
  - selective sweep
    - if selection is operating on a gene, there is a loss of heterozygosity around that gene

- Lec 17
  - Leishmaniasis
  - visceral, cutaneous, mucocotaneous
  - sand flies
  - makes the sand flies regurgitate, making it feed more
  - sand fly saliva induces blood flow, preventing coagulation, and suppresses the immune system

- Lec 18
  - mechanisms of arbovirus emergence
    - 1992-93 vs 1996 outbreaks of VEEV
      - 92-93 - mutation in the virus that changed the pathogenicity to the horses
      - 1996 - caused a switch in the vector making it a really good vector
    - common causes of alphavirus outbreaks?
      - either alter pathongenicity, or
      - alters the vector
    - what determines how frequently these outbreaks occur? environmental conditions
    - competitive fitness assays?
      - co-infect a host with a mixture and see which one wins in the individual
      - if one is over-represented, it is more fit.