The Mentor Initiative

Devoted to reducing Malaria deaths & suffering in humanitarian crises
Genetically Modified Mosquitoes

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CURRENT MALARIA INTERVENTIONS

- Indoor residual spraying
- Insecticide treated bed nets
- Larval controls
MOSQUITO RELEASE

- Mosquitoes are bred to express certain traits
- These bred mosquitoes are released into the wild
- The released mosquitoes mate with wild mosquitoes
- The next generation of wild mosquitoes is altered
GOALS OF GENETICALLY MODIFIED MOSQUITO INTERVENTIONS

• Reduction of malaria incidence
  – Population reduction
  – Population replacement
POPULATION REDUCTION

• Sterile Insect Technique
  – Irradiation
  – Chemosterilization
  – Cytoplasmic incompatibility
  – Trangenic sterilization
POPULATION REDUCTION

- Successes in Anopheles
  - El Salvador, Anopheles albimanus
    - Chemosterilization
POPULATION REDUCTION

• Failures
  – El Salvador
  – WHO & Indian Council of Medical Research
• Introduction of genes that induce lethality in the offspring of mosquitoes
POPULATION REPLACEMENT

• Induce plasmodium resistance in anopheles mosquitoes
ANIMAL STUDIES

- Rodent
  - Proteins prevented parasite from leaving the midgut

- Avian
  - Antibodies attack parasite in hemolymph before entering salviary glands
ENDOGENOUS PROMOTERS

• Genes inherent in mosquitoes that will promote the production of engineered proteins
• Bloodmeal-triggered
  – Also utilizes genes already present in mosquito to enhance immunity
DRIVE SYSTEMS

- Mechanisms that would help the exogenous gene spread through the population
DRIVE SYSTEMS

• Transposable Elements
  – Replicate within single host’s genome
  – Many obstacles
DRIVE SYSTEMS

- Medea
  - Offspring lethality
TRANSGENIC FUNGI

• *Metarhizium anisopliae*
  – Induce malaria resistance
  – Antibody production
  – Peptide production
FITNESS CONCERNS

• Study using plasmodium resistant, plasmodium susceptible, and control
  – Plasmodium resistant showed less population growth
  – Fitness most dependent on larval survival and gravid female survival
    • Plasmodium resistant performed lower than other groups
ADVANTAGES

• Human compliance
• Sustainability
DISADVANTAGES

• Ethical Concerns
• Biosafety
• Sustainability
• Scale
ETHICS

- Religious issues
- Consent
BIOSAFETY

• Cartagena Protocol
  – Precautionary Principle
  – Least harmful alternative
SUSTAINABILITY

- Gene drive success
- Natural Selection
- Mosquito Release Numbers
LOOKING TO THE FUTURE

• More research needs to be done
• Each study has its own drawbacks and advantages