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A Comparative Study of Two Mosquito Control Techniques Implemented in Three States

Christina Spoons, Ph.D.

Problem

A review of literature revealed a gap in research on the use of the sterile insect technique and genetically modified *Aedes aegypti* mosquitoes to reduce the number of biting females in the United States. This case study used purposeful sampling of key informants who are experts on mosquito abatement and public health to compare the effectiveness of these two mosquito abatement strategies.

- The sterile insect technique involves infecting male mosquitoes with the Wolbachia bacteria, which prevents an insect from reproducing. Eggs will not hatch.
- Genetically modified mosquitoes contain a gene that causes offspring to die in the first 2-3 days of life.

According to the Centers for Disease Control and Prevention, 222 cases of local mosquito-borne transmission of the Zika virus have been reported in the continental United States, and 36,361 presumed local mosquito-borne transmission cases have been reported in US territories since 2015 (CDC, 2017).

Although the World Health Organization downgraded the Zika outbreak to a “dangerous mosquito-borne disease” from a world health emergency in December, 2016, the CDC expects the virus to continue to spread to additional regions in the U.S. The female *Aedes aegypti* mosquito can transmit not only Zika, but also Dengue and Chikungunya. Communities in California, Florida, and Texas (three of the four states that had the most confirmed cases of Zika in 2016) have implemented two distinct strategies in limited regions to see how effective the techniques would be in reducing the number of biting *Aedes aegypti* mosquitoes.

Purpose

The purpose of this case study was to analyze the effectiveness of the sterile insect and genetically modified mosquito techniques implemented in three U.S. states to reduce the number of biting female *Aedes aegypti* mosquitoes.

Research Questions

- How is each mosquito control technique effective?
- What are the benefits of each technique?
- What are the risks to each technique?

Theory or Framework

This study was examined through the lens of Charles Lindblom’s theory of incrementalism, which is used in both public policy and health care. The projects analyzed in this study were built upon from previous smaller projects in each of the communities. They are using incremental changes to add to and expand the projects slowly rather than taking large leaps each time.

Significance

Findings from the study could inform other communities of strategies to reduce the number of biting female mosquitoes in those regions. This in turn can help reduce the spread of mosquito-borne illnesses, such as Zika, Dengue, and Chikungunya.

Relevant Scholarship

Much has been written about

- the spread of the Zika virus (Ali, Gugliemini, Harber, Harrison, Houle, & Ivory, 2017; CDC, 2017; Shacham, Nelson, Hoft, Schootman, & Garza, 2017),
- the health risks associated with mosquito bites (CDC, 2017; Eisen & Moore, 2013; Leta et al, 2018; Powell & Tabachnik, 2013),
- basic precautions people can take to limit their chances of contracting the virus (CDC, 2017), and
- mosquito abatement (Adler, 2016; Benedict & Robinson, 2003; Ramsey, et al., 2014; Sinkins & Gould, 2006).

However, research on the effectiveness of the sterile insect technique and the use of genetically modified mosquitoes specifically for the purpose of reducing the number of biting female *Aedes aegypti* mosquitoes in the U.S. is lacking.

Limitations

Limitations include time and open and honest responses from participants, and the small number of key informant interviewees. Information from the experiences in California, Florida, and Texas may not be generalizable to other locations.

Social Change Implications

This study provides insight into the benefits and challenges regarding the use of two mosquito control strategies for the purposes of limiting the number of biting female mosquitoes. Results of the study provide considerations for other regions with similar concerns about the spread of the *Aedes aegypti* mosquito and the viruses it can carry.

Participants and Procedures

Purposeful sample of nine key informant interviewees (experts on mosquito abatement, public health, and the specific program being implemented in that community), with three participants from each state.

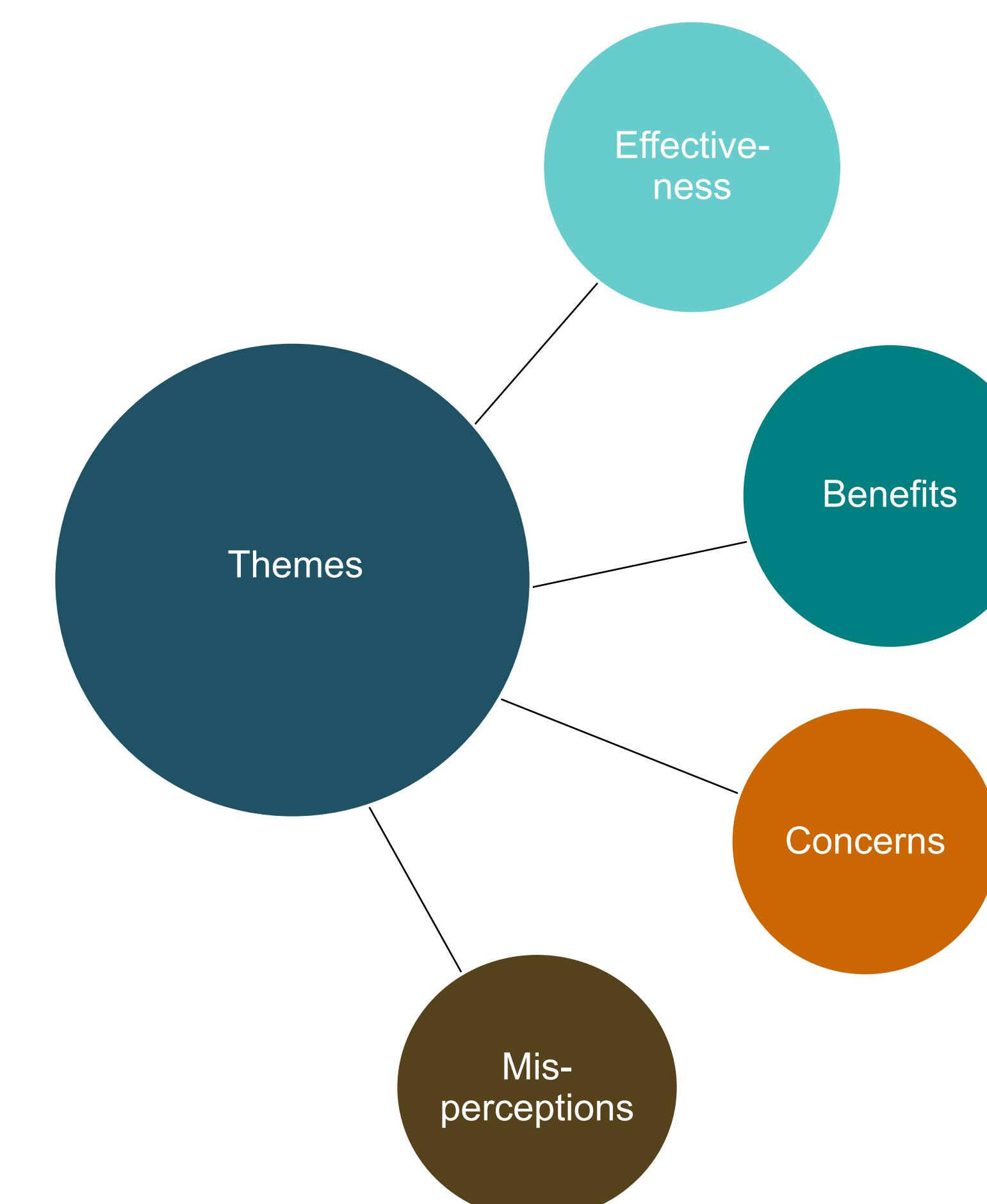
General interview guide with open ended questions allowed for follow-up questions and clarification.

Data Analysis

Qualitative data from semi-structured interviews with participants were analyzed both inductively and through coded outlines to look for patterns regarding the benefits and risks of using each of the mosquito control techniques, as well as local attitudes about the use of these strategies.

Identification and analysis of themes.

NVivo 10 was used for data organization and coding.



Findings

Effectiveness

- Small-scale testing has resulted in an 80-90% reduction in population of *Aedes aegypti* mosquitoes.
- Biting female population dropped by two-thirds in some communities.

Benefits

- Potentially reduce spread of mosquito-borne illnesses.
- Safer, cheaper, more precise than traditional pesticides.

Concerns

- Funding.
- Environmental concerns.
- Health concerns regarding genetic modification.
- Scalability.
- It is not known whether an overall 80-90% reduction in *Aedes aegypti* mosquito population would be sufficient to eliminate virus transmission.
- More community concern/dissent was noted in regions that used genetically modified mosquitoes rather than the sterile insect technique

Misperceptions

- Some do not understand how the technology works.
- Some fear genetic modification spreads the illness rather than helps to limit the spread

Interpretation

The use of the sterile insect technique and genetically modified mosquito technology seem promising on many fronts. They can help control the mosquito population, are more precise than traditional pesticides, and are safer for the environment than traditional pesticides.

Recommendations

Results of this study suggest that the mosquito reduction strategies could be explored in additional communities, with the sterile insect technique so far being the less controversial option.