Incentivizing Multiples Objectives in Active Surveillance for Urban Disease Vectors

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Introduction

Large-scale vector control campaigns have successfully reduced infectious disease incidence around the world. These campaigns produce a wealth of information about the distribution of insect vectors, which can be incorporated into risk maps, and presented directly to surveillance personnel in the field. Nonetheless, achieving optimal use of complex spatio-temporal information in risk maps hinges on the behavior of the technicians tasked with the job. We carried out a series of rolling trials in which we evaluated risk map use under different incentive schemes in the context of a Chagas disease vector control campaign in Arequipa, Peru.

Incentive Schemes

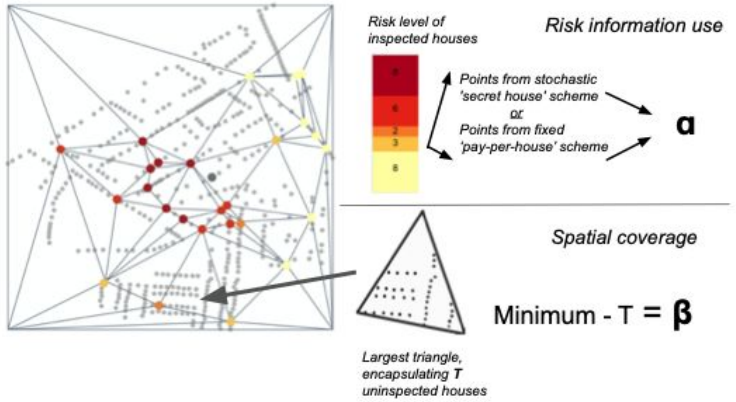

Figure 1. Representation of incentive schemes. A search area of N households. A colorimetric risk estimate, based on historical data. **α** is the reward for risk information utilization, which can be stochastic or fixed. **β** represents the reward for spatial coverage which is calculated from the Minimum expected coverage (N *.05) and T, the maximum number of uninspected houses bounded by Delaunay triangles formed between the inspected houses. In the first three trials, the total reward is a weighted average of **α** and **β**. In the final trial values of **α** and **β** are taken together to form hierarchical 'poker hands'.

Poker Incentive

Poker analogy	Hands	Points	Additional Points
Wild Card		500+	+50 if they find another infested house
Straight Flush		300+	+5/triangle + 5/highest risk, 4/high risk, 3/medium risk, 2/low risk, 1/lowest risk
Flush		100+	5/highest risk, 4/high risk, 3/medium risk, 2/low risk, 1/lowest risk
Straight		100+	+5/triangle
High Card		0-100	+1 if they inspect a house

Socabaya Trial

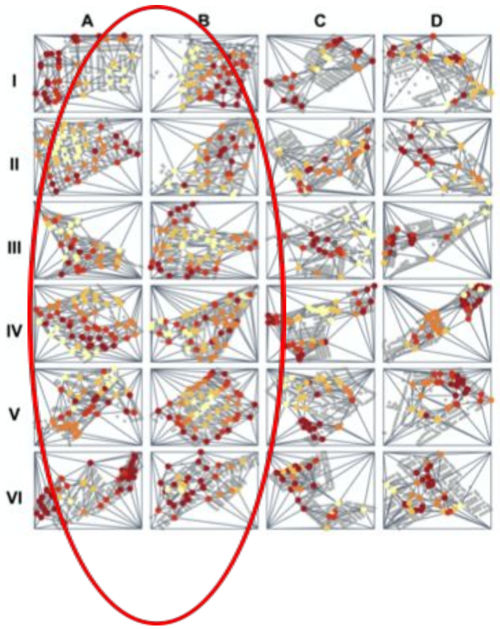

Figure 3. Scoabaya Trial Maps show spatial coverage. Columns represent arms: A) Incentives for spatial coverage and stochastic incentive for inspecting higher risk houses; B) Incentive for spatial coverage and an increased payout of the stochastic incentive for inspecting higher risk houses; C) No incentives; and, D) A large incentive for finding infested houses. Arms A and B both had significantly higher spatial coverage than Arms C and D (paired t-test, p= 0.0029, p=0.0005).

Cayma Trial

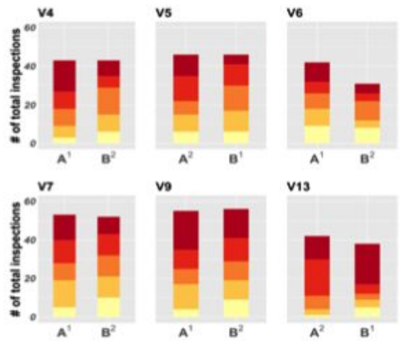

Figure 4. Cayma Trial. Distribution of household risk quintile, as displayed on a risk app.. Each set of two bars represents one technician, and each bar a study arm. A was stochastic while B was fixed. Arm A had significantly higher risk information utilization, (proportional odds logistic regression, OR 1.45, 95% CI 1.08-1.96, p- value= 0.014).

JLByR Trial

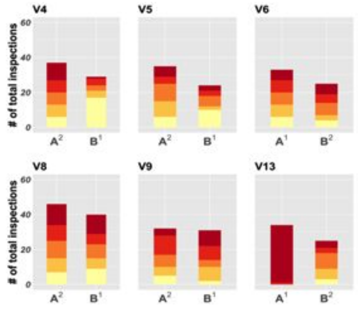

Figure 5. Jose Luis Bustamante y Rivero (JLBR) Trial. Distribution of household risk quintile, as displayed on a risk app. Each set of two bars represents one vector control specialist, and each bar a study arm. A (10 soles per risk: 1 sol per spatial coverage), B (payment per infested house).

Miraflores Trial

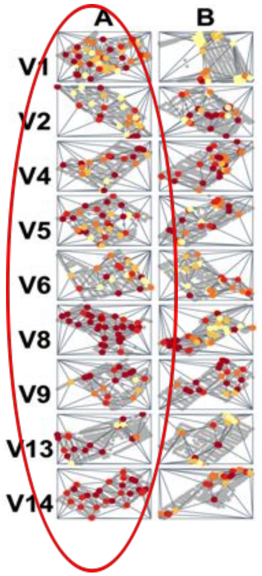

Figure 5. Spatial coverage Columns represent arms: A) poker incentive B) pay per detection. Arm A had significantly had a higher spatial coverage than Arm B (paired t-test, p<0.005).

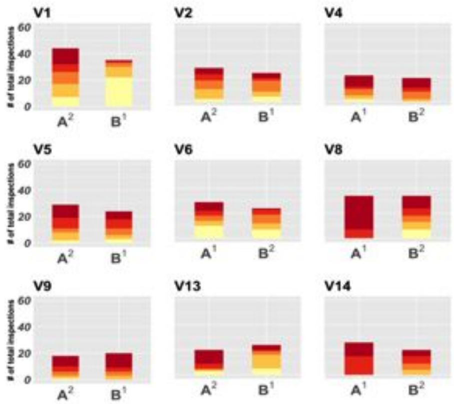

Figure 7. Miraflores Trial. Distribution of household risk quintile, as displayed on a risk app. Each set of two bars represents one vector control specialist, and each bar a study arm. A: Poker arm while B is pay per detection. Poker arm or Arm A had significant differences for risk information utilization (POLR model, OR 2.11, CI 95% 1.52-2.93).

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