Optimized Oral Cholera Vaccine Distribution Strategies to Minimize Disease Incidence

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Introduction

Cholera Worldwide
1.4-4.3 million cases of cholera per year, leading to 28,000-142,000 deaths (WHO, 2014)

Cholera Transmission
Oral-Fecal Pathway

Cholera Outcomes
Severe diarrhea, dehydration, and potentially death

Cholera Prevention
- Improved water, sanitation, and hygiene (WASH) strategies
- Vaccination with an oral cholera vaccine (OCV)

Currently, there is no systematic method for finding the best OCV distribution strategy under limited resources.

Methods

For systematic distribution of OCVs over multiple populations and multiple years:
- Mixed integer programming model
- Distribution strategy analysis, considering groups by:
  - Age
  - Region
  - Age & region
- Investigation of age & region strategy with:
  - Varying supply
  - Complete vaccination (best coverage)
  - Partial vaccination
  - Varied vaccine efficacy
- Cost-effectiveness analysis

Results

Targeting groups by age and region is the best strategy.

Cost-Effectiveness Analysis of Distribution Strategies

Cost-effective if ≤ $830 (2013 constant 2013 GDP)

Priority is given to groups receiving the most vaccine benefit:
- Vaccine benefit = (base incidence rate) * (vaccine efficacy)

Partial Vaccination (1 or 2 doses per vaccinated person)
Two doses are recommended per vaccinated person unless a single dose is at least 51% as effective as two doses. In that case, a single dose is recommended for some individuals in order to vaccinate more people.

Varied Vaccine Efficacy

Cost effective if ≤ $830 (2013 constant 2013 GDP)

No strategy is cost effective if CFR is 0.5%
- Age and region and age only strategies are cost effective over 8 years at 0.5% CFR if:
  - investment in OCV vaccination for 7 years or less or
  - at most 15 million doses/year
- The region only strategy is cost effective for 0.5% CFR if maximum price of 5.90/dose
- Strategies may be more cost effective if we consider herd immunity

Case Study: Bangladesh

Population & Risk in Bangladesh
(International Vaccine Institute, 2013)

Vaccination priorities:
1. High risk 1-4 year-olds
2. Medium risk 1-4 year-olds
3. Low risk 1 year-olds and/or high risk 5-14 year-olds
4. Other groups in order of risk (if vaccine remaining)

For additional details: