

## Cholera in Bangladesh

BoundarySeer™ software tracks possible new pandemic



Photo courtesy of the Evangelical Lutheran Church of America.

### Information

While not always fatal, cholera can lead to death through dehydration and shock. In areas without adequate medical facilities for quick diagnosis and treatment, cholera can be deadly in a few days after infection.

Cholera is caused by an infection of *Vibrio cholerae* bacteria. In the 1960s, a new strain, cholera El Tor, spread rapidly across the world, causing a pandemic, an outbreak of a global scale. Another new form of cholera has emerged in Bangladesh, cholera O139.



Scientists at the Centre for Health and Population Research have been tracking the occurrence of cholera El Tor and O139 in an area with endemic cholera, Matlab Bangladesh.

### Analysis

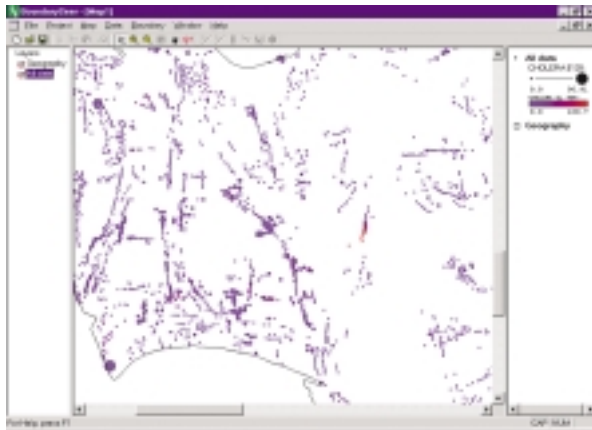
Field researchers compiled extensive information on cholera infection by each strain and by factors such as education, use of the river embankment, socio-economic status, migration, population density, and sanitation in the area. They then turned to BoundarySeer to find pattern in the data. For more information, see BoundarySeer Analysis Details on the reverse side.

### Insight

BoundarySeer found strong spatial relationships between the two strains of cholera. They seem to be inversely related—areas high in one strain are low in the other. The boundaries for each strain showed statistically significant overlap. Cholera O139 seems to be replacing the El Tor strain in Matlab.

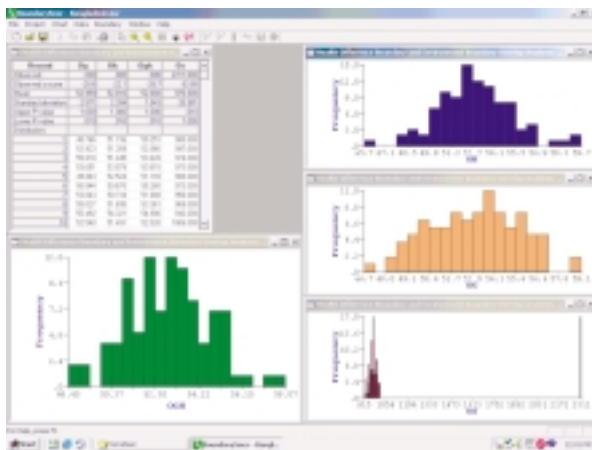
Patterns for both strains of cholera were strongly associated with environment (sanitation and use of the embankment) and population variables (density, migration and education). These results suggest that cholera O139 is replacing cholera El Tor, and raises the possibility of a pandemic of the new strain. The Centre for Health and Population Research in Dhaka, Bangladesh, is monitoring the outbreak.

# BoundarySeer™ Analysis Details



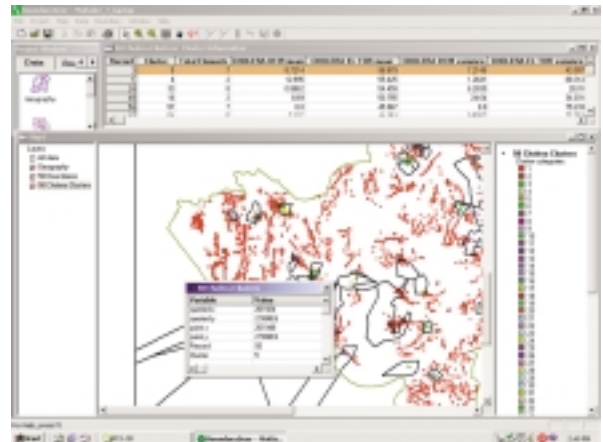
## 1) Exploratory Visualization

BoundarySeer produced histograms, scatterplots, and maps of the distributions of all variables. This map shows the incidence of the two strains. Incidence of 0139 determines circle size. Small circles are low in 0139 while large circles are high in 0139. Incidence of El Tor determines circle color. Red circles are high in El Tor while blue circles are low in El Tor. All of the large circles are blue, suggesting 0139 is replacing El Tor.



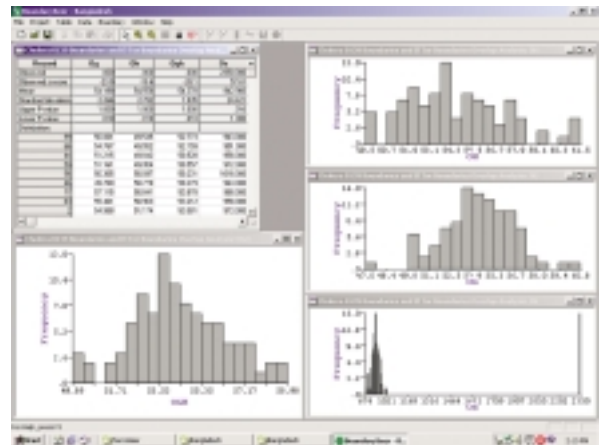
## 3) Overlap Analysis-1

Boundaries in environmental variables significantly overlapped with boundaries in cholera incidence, so that changes in environment and cholera tend to happen in the same places.



## 2) Boundary Delineation

BoundarySeer detected clusters in the incidence of both cholera strains (shown) as well as population, and environmental variables (not shown).



## 4) Overlap Analysis-2

The overlap analysis showed more overlap between the boundaries for the two strains of cholera than would be expected by chance. This analysis confirms the earlier observation that the two strains showed opposite spatial patterns.

For additional background, see: Ali, M., M. Emch, M. Yunus, and R. B. Sack. in prep "Are the environmental niches of *Vibrio cholerae* O139 different from that of *Vibrio cholerae* El Tor?"

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