Descriptive Spatial Analysis of the Cholera Epidemic in Harare

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Zimbabwe

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Harare in 2008
Socioeconomic chaos
Environmental Risk Factors

Crisis 2008, Hyperinflation

Source: www.weathdaily.com

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Cholera Epidemic in Zimbabwe

100,000 cases   4,000 deaths

Source: The Guardian and The Nytimes

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Chitungwiza: Index Case

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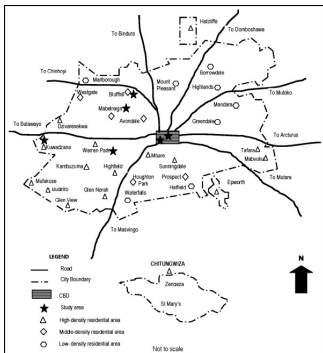Harare in 2008
Socioeconomic chaos
Environmental Risk Factors
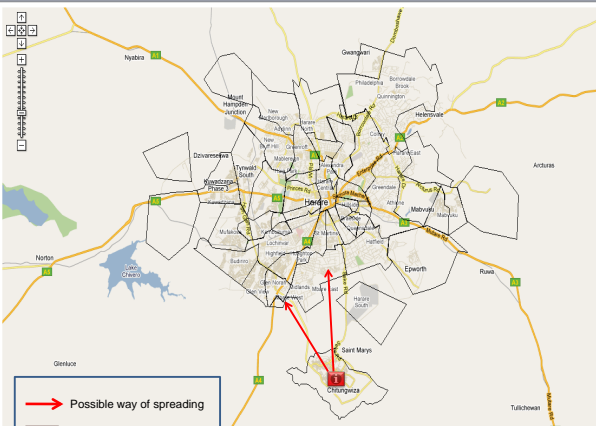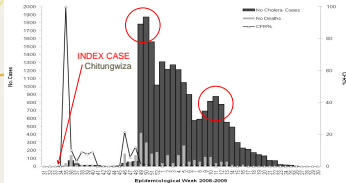
Environmental Risk Factors

Chiremba Primary School, Ruwa, Zimbabwe
Raw sewage flowing past the school

Source: Médicins Sans Frontières (MSF)
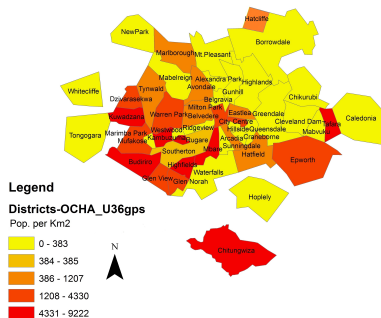http://www.zimbabwesituation.com

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Harare Pop Density by Suburbs: Triangulation

Source Unknown

OCHA DATA 2008

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Environment Risk Factors: Housing

Mbare House

Mount Pleasant House

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Environment Risk Factors: Population mobility and Sanitation

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hypothesis and Objectives

Hypothesis

The distribution of cholera cases by suburb in Harare during the epidemic of 2008-2009 followed an identifiable spatial pattern related to the topographical elevation, the active population movements and high density population areas as markets and bus stations.

Objectives

To describe the spatial distribution of the cholera epidemic in Harare and Chitungwiza and identify factors that influenced the spatial pattern of the outbreak spread that may explain mechanism of transmission and, to analyze the association between topographic elevation and the distribution of cholera cases.

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Data and Methods

Cholera data and Population Figures

- Cholera data were drawn from the registry of cholera treatment centers and oral rehydration points functioning during the cholera epidemic in Harare and Chitungwiza implemented and managed by MSF in collaboration with the Department of City Health of the Ministry of Health & Child Welfare.

- Population figures by suburb were calculated from the 2008 official census of Harare and Chitungwiza.

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Cholera Treatment Center

An emergency, makeshift cholera treatment centre in Kadoma, Zimbabwe.

Picture courtesy of MSF

Source: Medécins Sans Frontières (MSF)

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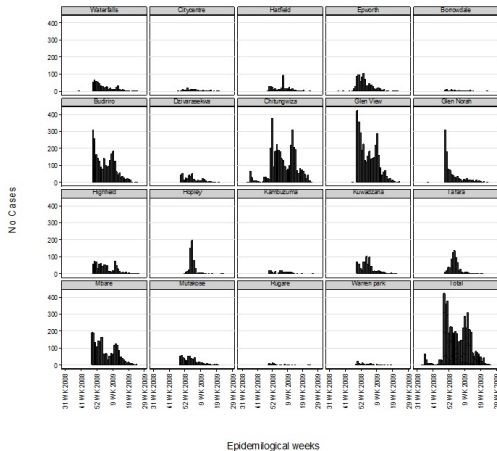**Methods**
Results
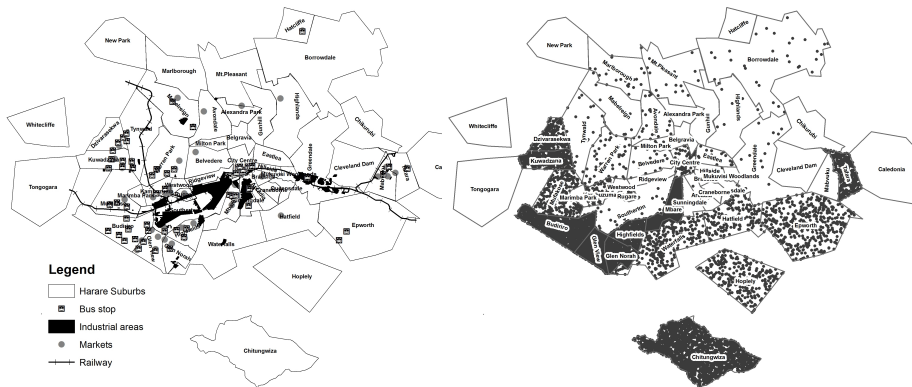Conclusion

Data and Methods

Spatial Data

- A high resolution satellite image of Harare (2008) was geometrically corrected to fit a set of control points surveyed in the field with a GPS.

- Information from Harare's topographic map (Produced by the Surveyor General of Zimbabwe), was digitalized on top of the satellite image using ArcMap software.

- Vector polygon information about Harare suburbs was obtained from OCHA, Harare.

- Average ground elevation and the distance between each suburb centroid to Chitungwiza were measured for each polygon.

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Distribution of Cholera cases by sex and age in the CTCs in Harara, 2008-2009, (n= 19,422).

Variables	n(%)
Sex	
Males	10071(51.9)
Females	9272(47.7)
Age in years	
≤ 5	3542(18.2)
6-14	1932(9.9)
15-24	3811(19.6)
25-34	4828(24.9)
35-44	2682(13.8)
≥ 45	2627(13.5)
Children ≤ 5 years	
0-2	2356(66.5)
3-5	1186(33.5)

Children ≤ 2 years old and active population were the most affected

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Epidemiological weeks

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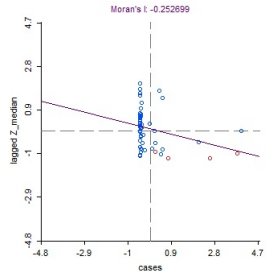Conclusion

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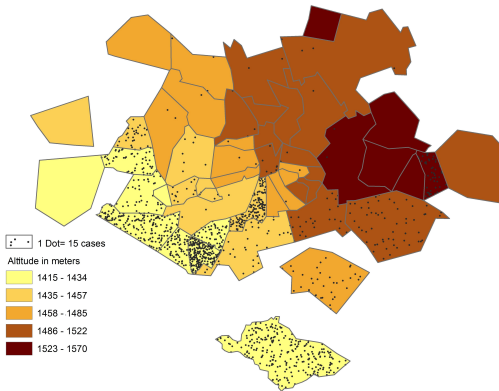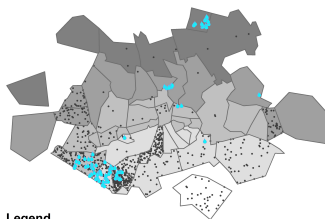
Pearsons Coefficient of Correlation $= $ 0.31

Source: Luque Fernndez M,et al. Descriptive spatial analysis of the cholera epidemic 20082009 in Harare, Zimbabwe: a secondary data analysis. Trans R Soc Trop Med Hyg (2010)

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Legend
Smoothed rates ratios

0.0 - 1.0
1.1 - 2.4
>2.5

Source: Luque Ferrndez M,et al. Descriptive spatial analysis of the cholera epidemic 20082009 in Harare, Zimbabwe: a secondary data analysis.
Trans R Soc Trop Med Hyg (2010)

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Elevation and Cholera

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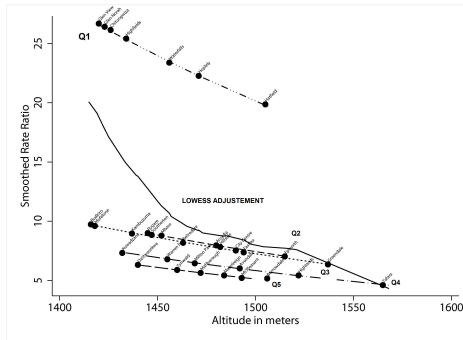Methods
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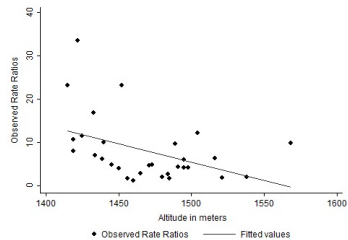
Suburbs Smoothed Rates Ratios of cholera risk by elevation

$ln(\text{cases}_{ij}) = ln(\text{population}_{ij}) + \beta_0 + \beta_1 \times (\text{elevation in meters}_{ij}) + Q_j \ (\text{Random effect:(five clusters)})$

$ln(\text{cases}_{ij}) - ln(\text{population}_{ij}) = ln(\frac{Cases}{Population}) = \beta_0 + \beta_1 \times (\text{elevation}_{ij}) + Q_j$

An increase in 100 meters in elevation yields 30% lower cholera risk with a Rate Ratio of 0.70; (95%CI=0.66-0.76)

Source: Luque Fernandez et al. BMC Public Health 2012

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Conclusion

- The distribution of cholera cases by suburb in Harare followed an identifiable spatial pattern.

- The pattern in the spread of cholera cases was related with the active population movements and high density population areas.

- The pattern in the spread of cholera cases was characterized by low risk in low density residential housing, and higher risk in high density south west suburbs and Mbare.

- The pattern in the spread of cholera cases was characterized by a lower cholera risk when the average elevation in meters increases by 100 meters.

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Thanks

Thanks for your attention and time

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