In-depth Epidemiological Study of Cholera in Zimbabwe – *A Study of Cholera Hotspots*

(…epidemiological basins in East and Southern Africa – Unicef, WHO & MOH)

A Presentation to the Global Taskforce for Cholera Control 15 April 2019

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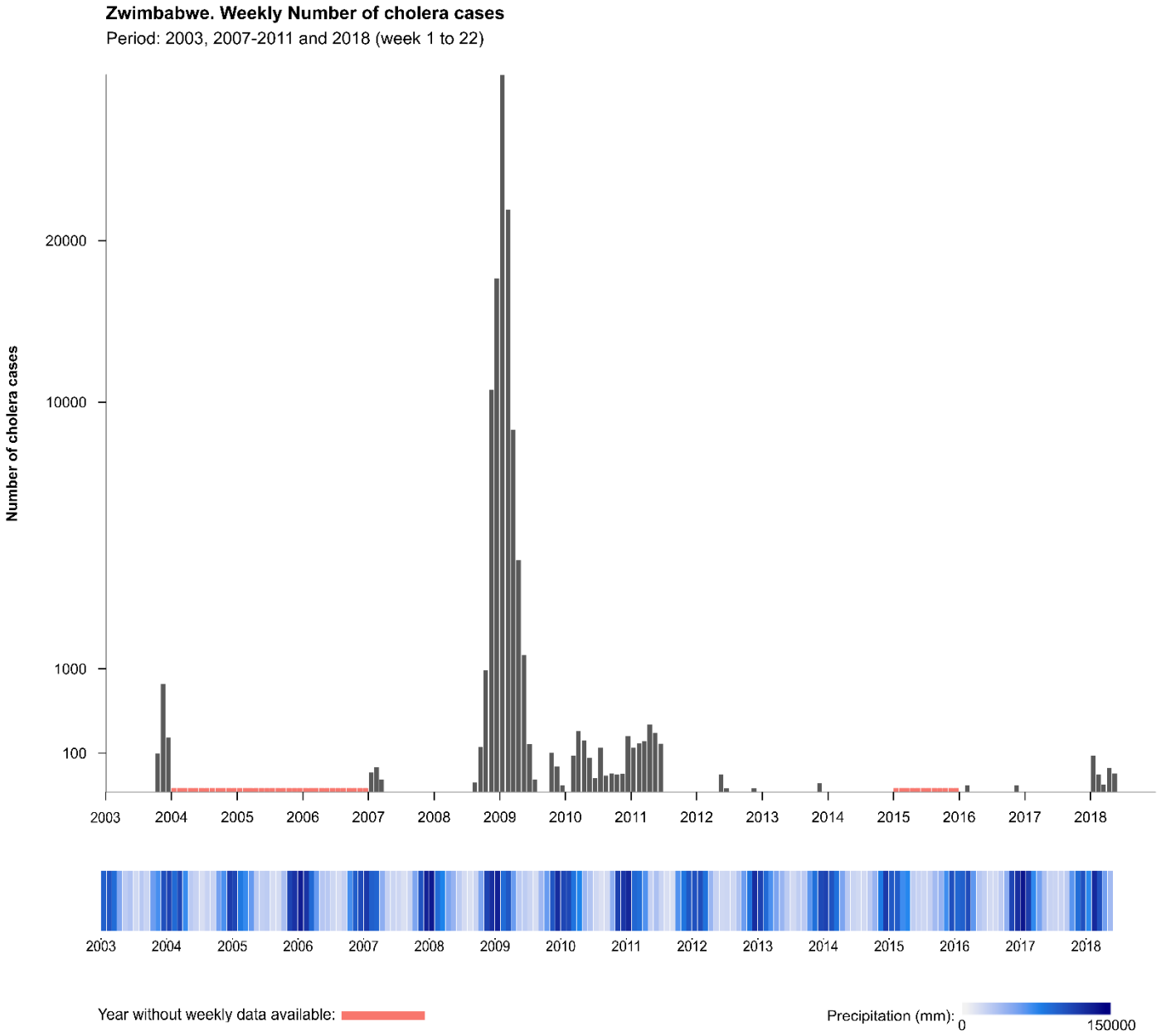
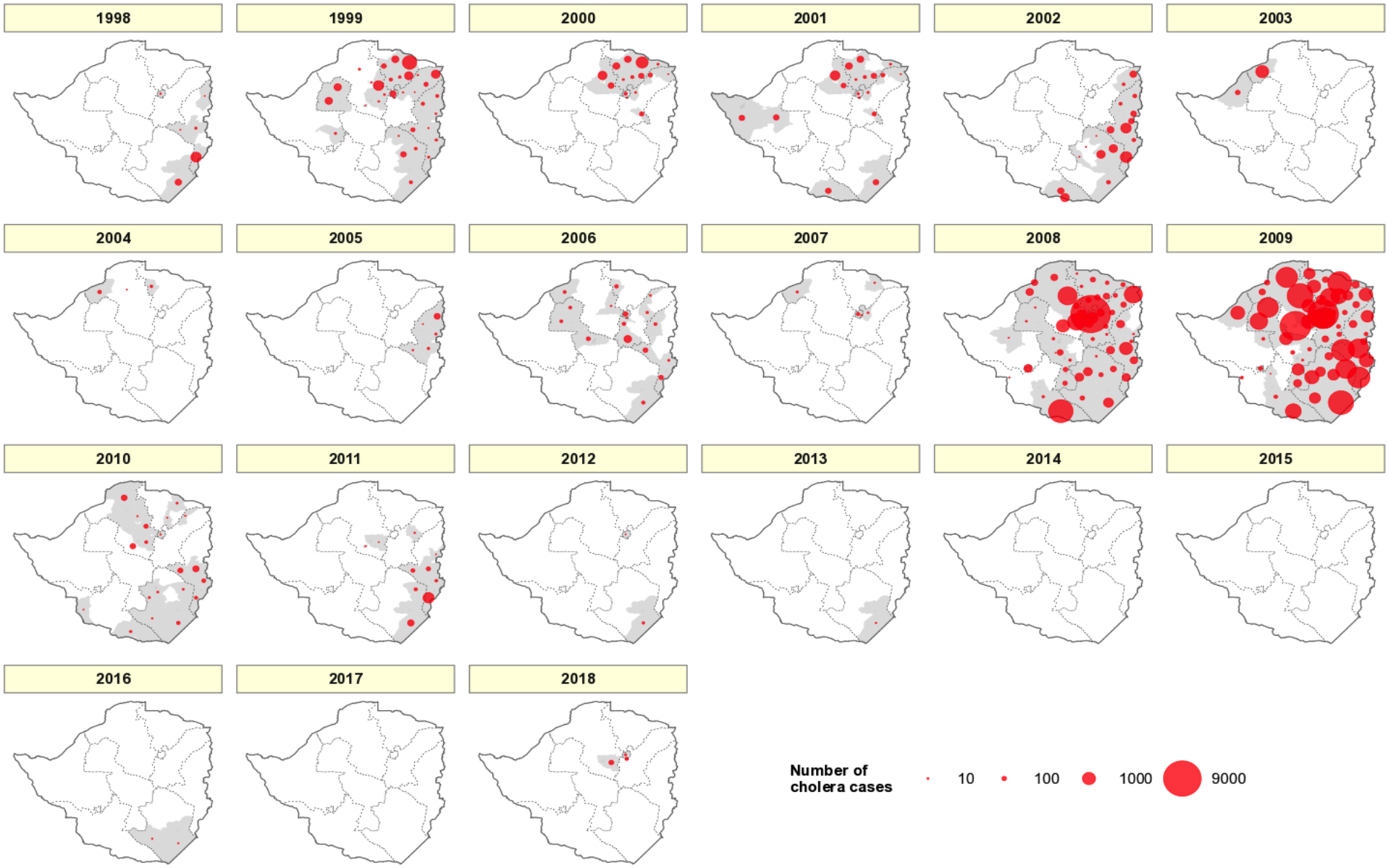
Cholera Hotspot Definition

- A geographically limited area where environmental, cultural and/or socioeconomic conditions facilitate transmission of the disease and where cholera persists or re-appears regularly. Hotspots play a central role in the spread of the disease to other areas; (Source: Interim Guidance Document on Cholera Surveillance, Global Task Force on Cholera Control (GTFCC) Surveillance Working Group, June 2017 http://www.who.int/cholera/task_force/GTFCC-Guidance-cholera-surveillance.pdf
- To better understand the local dynamics of cholera at a national *and regional level*
  - Apply an approach combining field research, epidemiology and genetic analysis of clinical isolates of *Vibrio cholerae*
- To identify cholera hotspots as well as high-risk populations and practices for targeted emergency and prevention programs
- To establish effective strategies to combat cholera in Zimbabwe *and neighboring countries*

Dynamics of recent cholera outbreaks



Dynamics of recent cholera outbreaks

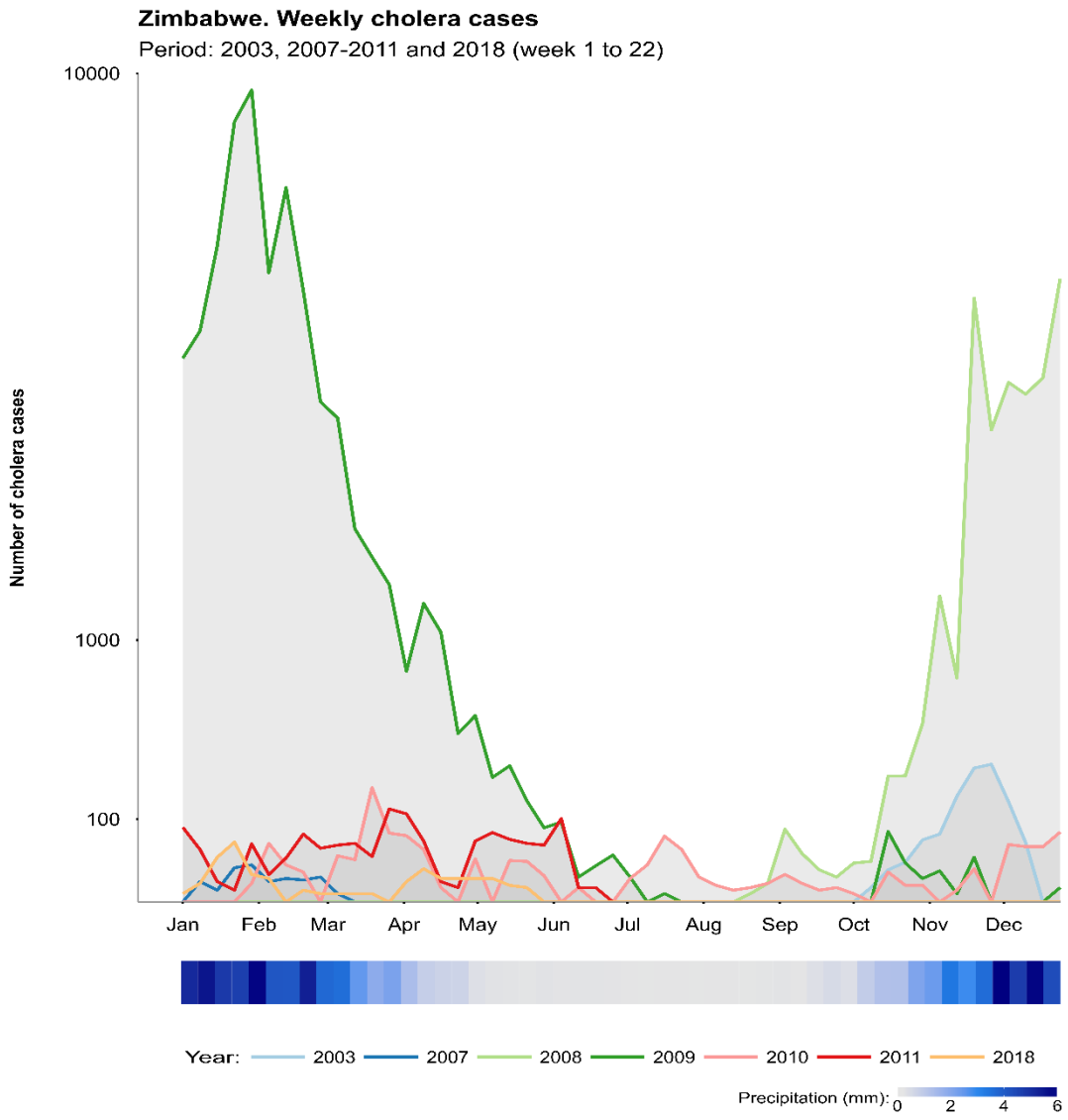


Cholera Seasonality

Median outbreak start week

Week W45 – W51
(November – mid December)

STATE / COUNTY	Median onset week [min-max]
MASHONALAND WEST	47 [37-11]
HARARE	48 [33-13]
MANICALAND	50 [28-27]
MASHONALAND CENTRAL	51 [43-20]
MASVINGO	51 [32-23]
MASHONALAND EAST	51 [40-20]
MIDLANDS	48 [40-05]
MATABELELAND SOUTH	47 [44-05]
MATABELELAND NORTH	47 [41-01]
BULAWAYO	45 [45-45]



Methods (1/2)

- Cholera case definition
- Suspected case: In a patient age five years or more, severe dehydration or death from acute watery diarrhea in an area where there is no cholera.
  - In the context of a cholera epidemic, a suspected case is any person age two years or more with acute watery diarrhea, with or without vomiting.

  Confirmed case: A suspected case in which *Vibrio cholerae* serogroups O1 or O139 has been isolated from stool samples.
- Cholera cases and deaths (Ministry of Health, WHO)
  - Total number of cases/deaths per district for 1998-2002 and 2004-2006
  - Weekly time series of cholera cases and deaths per district for 2003 and 2007-2018 (missing weekly data for 2015).
- GIS shape files, background layers (UNOCHA)
- Population data from ZIMSTAT 2012 census with a population growth factor derived from the National Health Profile 2014
- Rainfall data estimated from daily TRMM Multi-Satellite Precipitation Analysis remote sensing products

Methods (2/2)

- Data Analysis Process
  - Data cleaning and quality assessment, including missing data and outlier detection
  - Smoothing and interpolation procedure
  - Patterns of sporadic cases were removed (e.g., a single case or two to three cases without reported cases during the two weeks before and after).
  - Two successive outbreaks separated by an inter-epidemic period equal to or greater than six weeks were considered as two separate events.
  - Outbreak: extraction of the key epidemiological features per outbreak event (onset, peak, duration, incidence, case fatality rate, inter-epidemic period)
  - Hotspot classification according to recurrence, duration and intensity of cholera outbreaks
  - Interpretation of the results according to local contexts (literature and national expertise)

Hotspot classification

Type	Interpretation	Frequency (Percentile of distribution)	Frequency outbreaks	Duration (Percentile of distribution)	Duration (number of weeks)	Intensity (Percentile of distribution)	Intensity Median Indicende over time
T1	Highest Priority	>90	>6	≥40	≥13.5		
T2	High Priority	>70 and <90	>4 and<6	≥40	≥13.5		
T3	Med. Priority	>90	>6	<40	<13,5	≥40	>0,9
T4	Low Priority	>70 and <90	>4 and ≤6	<40	<13,5	≥40	>0,9

Table 1: Frequency and duration of cholera outbreak thresholds per hotspot type

Hotspot classification

admin1	admin2	Sum_ca	case_su	case_pr	Freq	Freq_tal	Classif_F	Med_Du	Classif_D	Median	Med_OE	Classif_I	Min_sta	Max_sta	HotSpot
Manicaland	Chipinge	5652,7	5655	4,8	8	8	5	19	5	13,71	0,87	2	2	6	T.1
Masvingo	Chiredzi	5272,6	5283	4,5	10	10	5	17,3	4	2,05	0,19	0	9	8	T.1
Manicaland	Mutare	4386,3	4398	3,7	6	6	5	16,35	4	5,6	1,16	3	3	45	T.1
Mashonaland Central	Guruve	1715,1	1718	1,5	6	6	5	15,7	3	16,05	2,28	4	18	45	T.1
Manicaland	Chimanimani	1634	1646	1,4	6	6	5	14,3	3	3,07	0,29	0	4	45	T.1
Mashonaland West	Kariba	1557,3	1564	1,3	6	6	5	11	2	11,98	1,44	3	6	40	T.3
Manicaland	Buhera	4225,2	4242	3,6	7	7	5	10,35	0	3,71	0,45	0	8	9	.
Harare	Harare Urban	16211,6	16229	13,8	8	8	5	7	0	0,3	0,05	0	1	9	.
Mashonaland West	Zvimba	2231,5	2238	1,9	5	5	4	16,5	4	7,56	1,22	3	46	48	T.2
Mashonaland Central	Centenary	1037,8	1038	0,9	5	5	4	15,85	3	21,9	0,77	2	4	45	T.2
Mashonaland Central	Shamva	2346,6	2348	2	5	5	4	15,65	3	14,05	4,01	5	7	43	T.2
Mashonaland Central	Mazowe	683,8	684	0,6	5	5	4	14,3	3	1,85	0,86	2	8	44	T.2
Masvingo	Bikita	3104,1	3111	2,6	5	5	4	13,15	2	11,97	1,36	3	4	52	T.4
Mashonaland Central	Bindura	2541	2544	2,2	5	5	4	13,05	2	3,58	5,28	5	7	48	T.4
Mashonaland West	Makonde	7394,9	7398	6,3	4	4	3	20	5	35,41	6,15	5	37	40	T.2
Mashonaland East	Mudzi	3687,6	3692	3,1	4	4	3	19,7	5	27,62	3,05	4	1	40	T.2
Mashonaland East	UMP	752,8	771	0,7	4	4	3	17	4	7,51	1,21	3	5	44	T.2
Mashonaland Central	Mt Darwin	[illegible]	[illegible]	[illegible]	4	4	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Manicaland	Nyanga	1156,5	1158	1	4	4	3	11,85	2	10,78	2,53	4	1	12	T.4
Matabeleland South	Beitbridge	5526,9	5527	4,7	4	4	3	10,4	2	25,38	2,74	4	44	5	T.4
Manicaland	Makoni	749,3	751	0,6	4	4	3	10,4	2	1,7	0,45	0	3	46	.
Midlands	Gokwe North	3035	3039	2,6	4	4	3	7	0	8,29	0,36	0	4	51	.
Manicaland	Mutasa	229,6	251	0,2	4	4	3	6	0	1,8	0,39	0	7	4	.

- To be classified as Hotspot, a district must have Frequency of outbreaks > 4
- To be classified as Hotspot T1, Frequency > 6 & Duration > 13.5 weeks
- To be classified as Hotspot T3, Frequency > 6 & Duration < 13.5 weeks but Intensity >0.9
- To be classified as Hotspot T2, Frequency > 4 & Duration > 13.5 weeks
- To be classified as Hotspot T4, Frequency > 4 & Duration < 13.5 weeks but Intensity >0.9

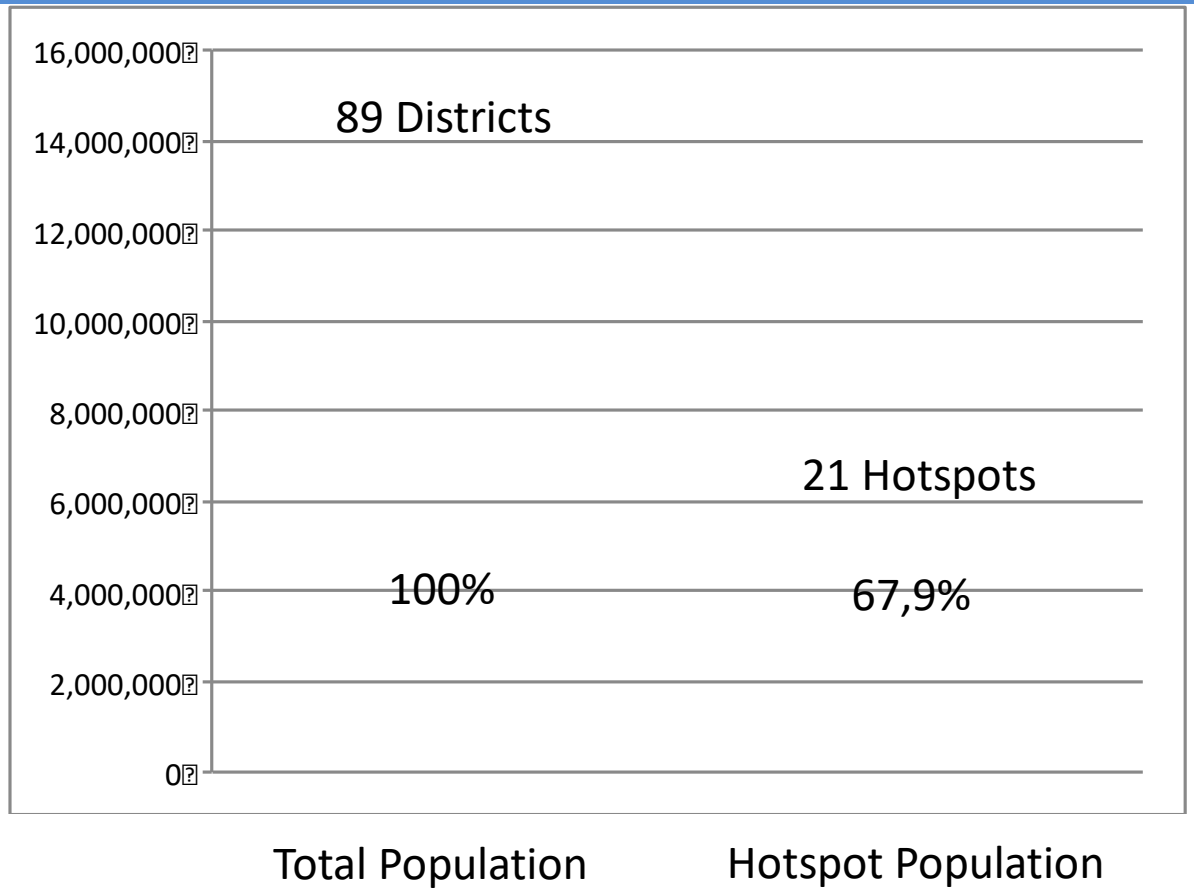
NB: Other Potential Areas of Interest: Buhera – Harare Urban – Makoni, Gwokwe North, Mutasa

Hotspot classification

PROVINCE	DISTRICT	POP	CASES	PROP	DEATHS	FREQ	DUR	INT	HOTSPOT
Masvingo	Chiredzi	292305	5283	4,5	194	10	17,3	0,19	T.1
Manicaland	Chipinge	316771	5655	4,8	150	8	19,0	0,87	T.1
Manicaland	Mutare	277851	4398	3,7	321	6	16,4	1,16	T.1
Mashonaland Central	Guruve	131483	1718	1,5	66	6	15,7	2,28	T.1
Manicaland	Chimanimani	143036	1646	1,4	117	6	14,3	0,29	T.1
Mashonaland West	Zvimba	278801	2238	1,9	130	5	16,5	1,22	T.2
Mashonaland Central	Centenary	130158	1038	0,9	43	5	15,9	0,77	T.2
Mashonaland Central	Shamva	131069	2348	2	65	5	15,7	4,01	T.2
Mashonaland Central	Mazowe	247457	684	0,6	29	5	14,3	0,86	T.2
Mashonaland West	Makonde	162752	7398	6,3	209	4	20,0	6,15	T.2
Mashonaland East	Mudzi	141247	3692	3,1	275	4	19,7	3,05	T.2
Mashonaland East	UMP	119368	771	0,7	69	4	17,0	1,21	T.2
Mashonaland Central	Mt Darwin	225489	5602	4,7	180	4	15,1	3,51	T.2
Harare	Harare Urban	1574345	16229	13,8	502	8	7,0	0,05	T.3
Manicaland	Buhera	260631	4242	3,6	164	7	10,4	0,45	T.3
Mashonaland West	Kariba	43851	1564	1,3	51	6	11,0	1,44	T.3
Masvingo	Bikita	172097	3111	2,6	205	5	13,2	1,36	T.4
Mashonaland Central	Bindura	132732	2544	2,2	52	5	13,1	5,28	T.4
Manicaland	Nyanga	134195	1158	1	95	4	11,9	2,53	T.4
Matabeleland South	Beitbridge	84888	5527	4,7	159	4	10,4	2,74	T.4
Midlands	Gokwe North	254773	3039	2,6	148	4	7,0	0,36	T.4

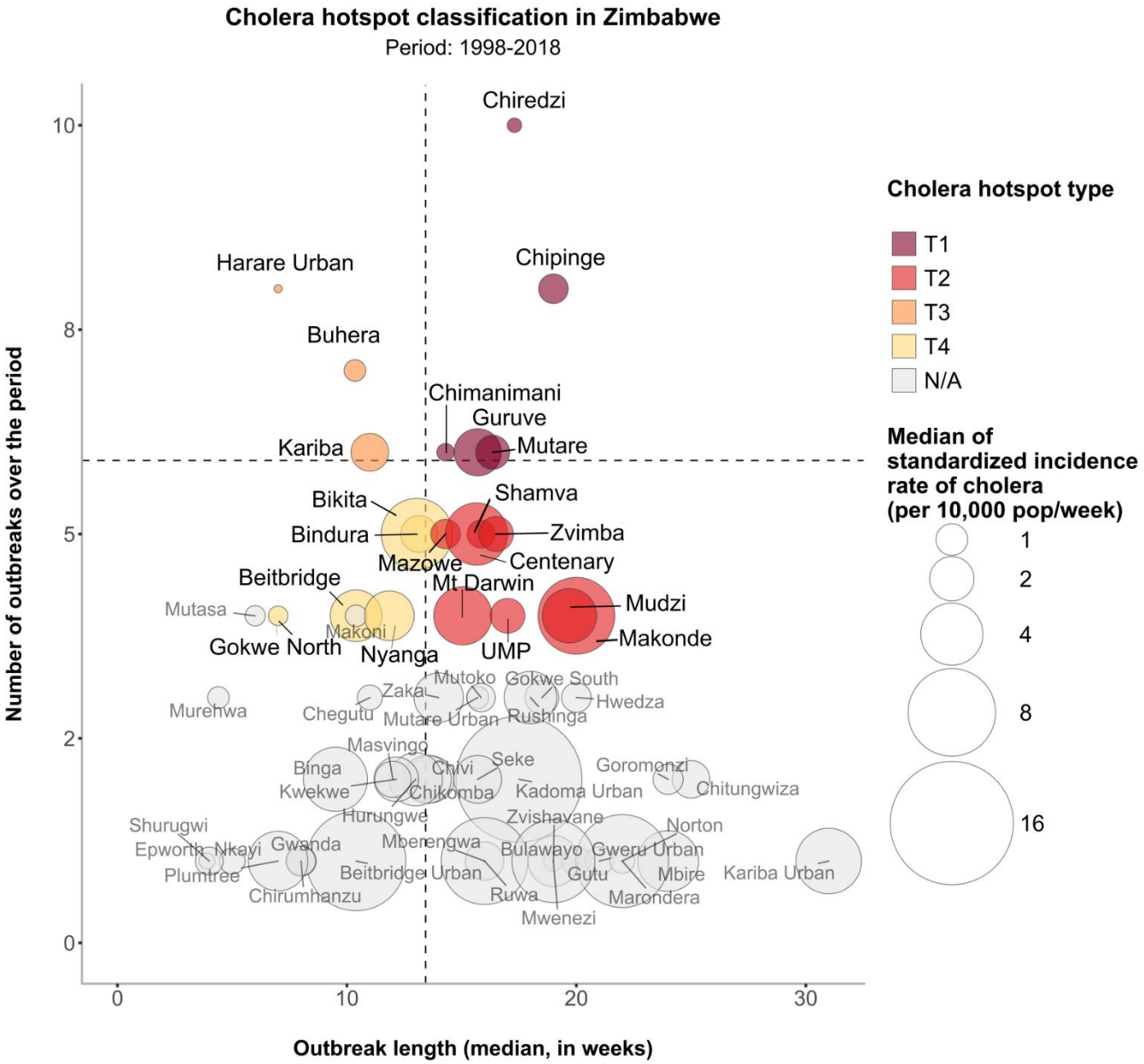
- Total priority areas (21 Hotspots) represent 67.9% of cases (Incl. Harare, Buhera, Gokwe North)
- 5 highest-priority hotspots (T1) = 15.9%
- 13 high-priority hotspots (T1+T2) = 36.1% of cases

Hotspot classification



- Total population in 89 districts is 13,7 million people
- Target population in 21 Hotspots is 5,2 million people, and carry 67.9% of cholera cases
- Target population in 13 High priority Hotspots is 2,5 million people

Hotspot classification



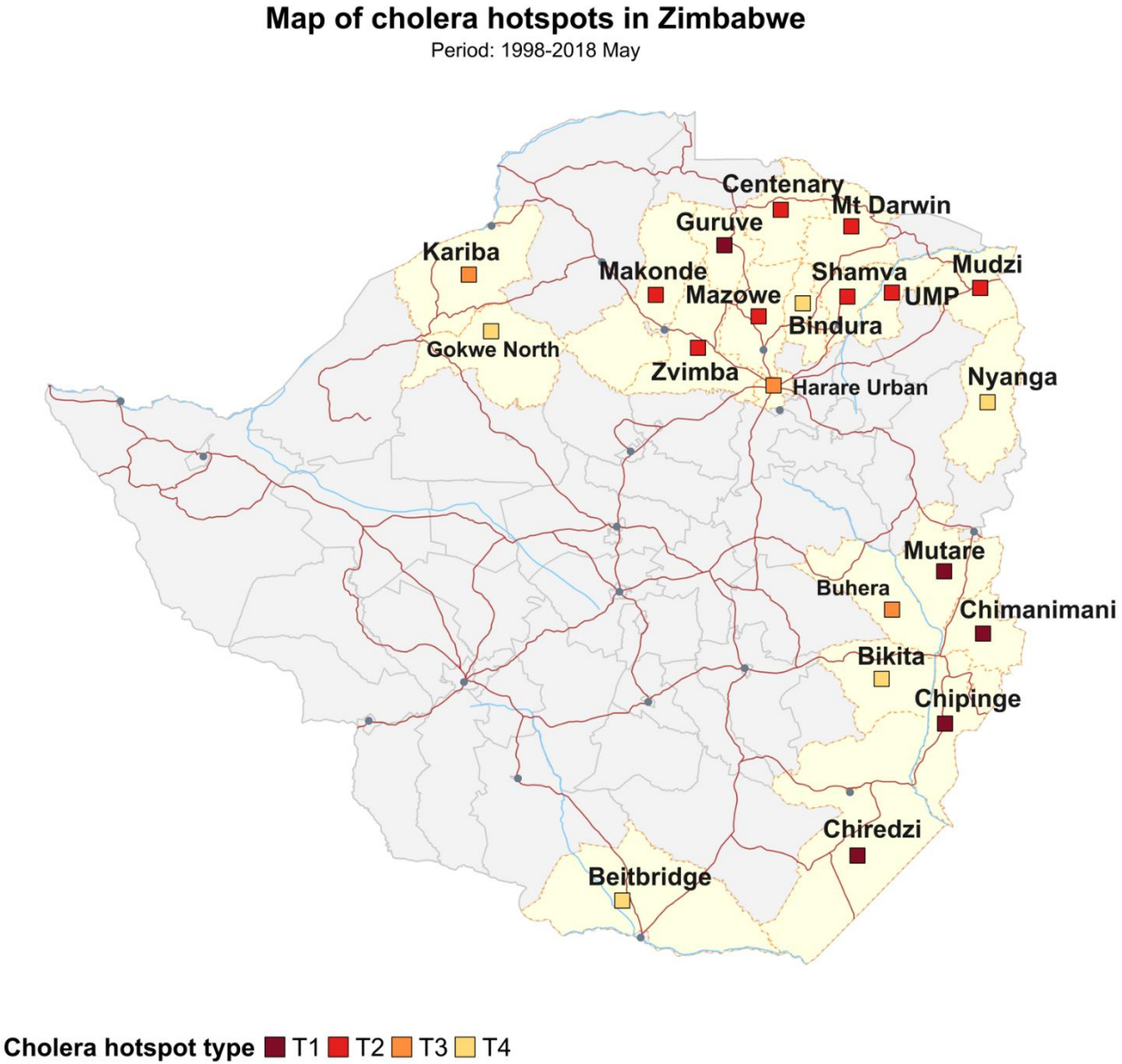
T1: Highest-priority area with cholera outbreaks of high frequency (>90th percentile) and extended duration (≥40th percentile)

T2: High-priority area with cholera outbreaks of moderate frequency (between 60th and 90th percentile) and extended duration

T3: Medium-priority area with cholera outbreaks of high frequency and short duration (<40th percentile)

T4: Low-priority area with cholera outbreaks of moderate frequency and short duration.

Hotspot classification



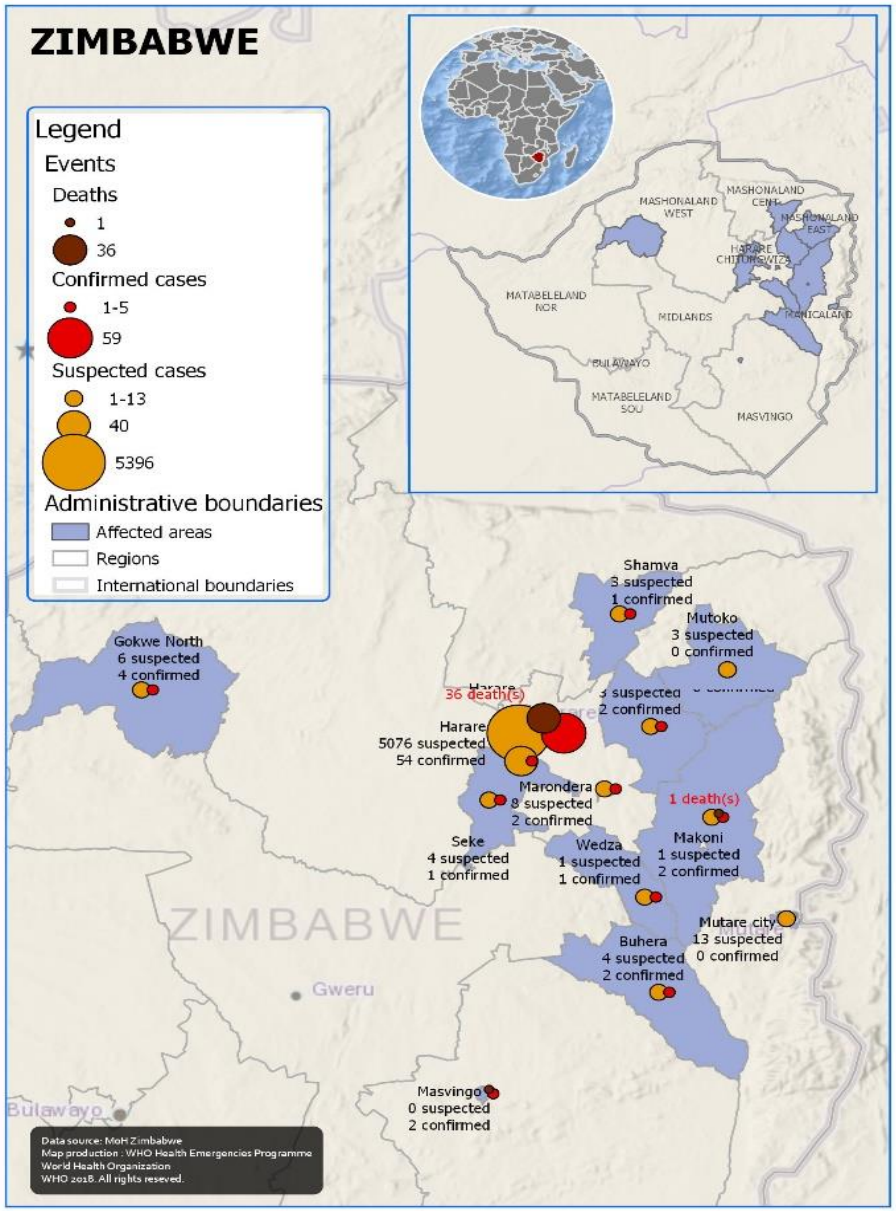
T1: Highest-priority area with cholera outbreaks of high frequency (>90th percentile) and extended duration (≥40th percentile)

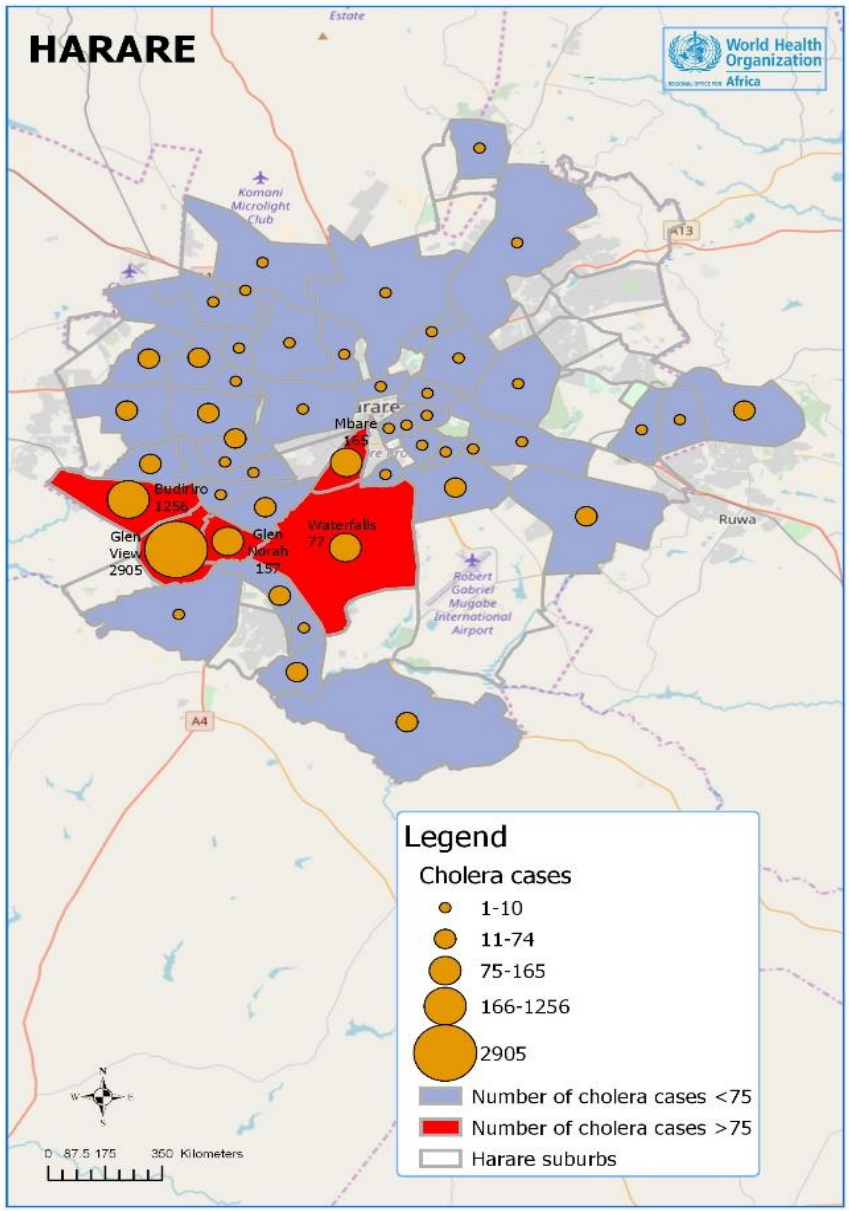
T2: High-priority area with cholera outbreaks of moderate frequency (between 60th and 90th percentile) and extended duration

T3: Medium-priority area with cholera outbreaks of high frequency and short duration (<40th percentile)

T4: Low-priority area with cholera outbreaks of moderate frequency and short duration.

Cholera in Harare and Beyond - September 2018





Use of Study Results (before / during an outbreak)

Justification for a targeted intervention in Cholera hotspots (even if not yet affected)

- ✓ Cholera hotspots are at higher risk (probability) of being affected
- ✓ Once affected, cholera hotspots are more vulnerable to cholera transmission (higher intensity and duration of cholera outbreaks)
- ✓ Cholera hotspots may be responsible for the spread of cholera to other districts

Targeting cholera hotspots to increase preparedness/prevention in high-risk areas.

- ✓ Increase cholera awareness & prevention at the community level
- ✓ Early detection & referral of suspected cholera cases – through community-based surveillance
- ✓ Increase the readiness of the health system (training of health workers, stocks, identification of location for CTCs, CTUs, ORPs, etc.)
- ✓ Targeting with vaccination
- ✓ Inform the National cholera elimination roadmap, National Clean-up, WASH modernization
- ✓ Engage resistant groups

Acknowledgements

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