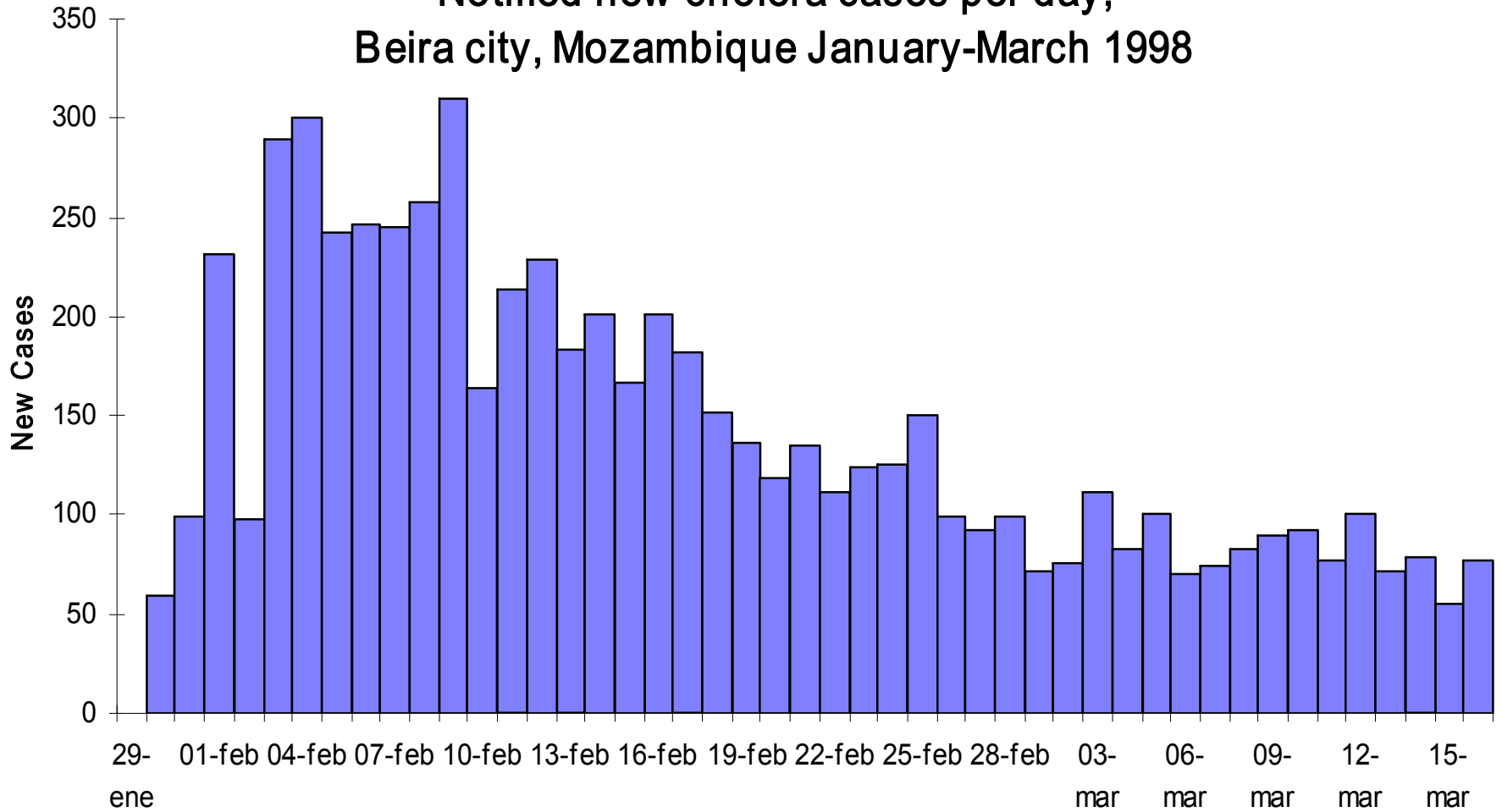


## Notified new cholera cases per day, Beira city, Mozambique January-March 1998



## Cholera total cases and attack rates per borough, Beira city, 2/3/98

<b>BOROUGH</b>	<b>ATTACK RATE</b>	<b>CASES</b>
<b>Highest attack rates</b>		
Munhava Central	4.42 %	1406
Mananga	4.01 %	776
Mungassa	3.74 %	146
Vaz	3.20 %	195
<b>Lowest attack rates (boroughs with 0 cases excluded)</b>		
Inhamizua	0.40 %	60
Nhangau	0.41 %	13
Matadouro	0.54 %	61
Mascarenha	0.66 %	139
Muavo	1.05 %	69

## Measles outbreak in Germany

How many of the following cases are secondary cases of the first one?

Periods: from infection to rash 14 to 21 days  
Infective one week before to 4 days after rash

Cases by age and day of onset of rash

	1	2	3	4	5	6	7	8	9	10	11	12	13
Family 1							7			8		9	
Family 2	12					7				10			

\* 7 years old cases are classmates at the school,  
there is no other contact between the cases of both families

# Introduction to infectious disease epidemiology

Fernando Simón

# Infectious disease

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- Infectious agent or its toxins

- Transmission



- Epidemic risk

# Specific issues

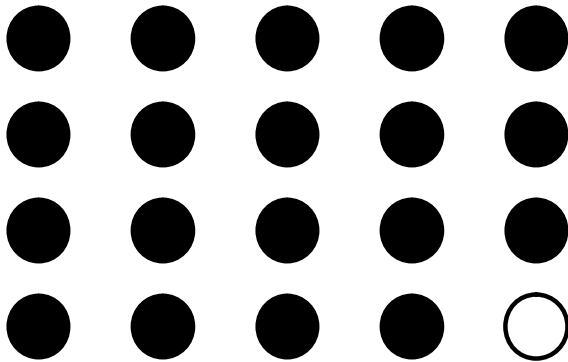
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- A case can be an exposure  
**Cases at T0 determine cases at T1**  
(together with other factors)
- Infection  $\Rightarrow$  Immunity (not always)  
Partial or complete  
Temporal or permanent

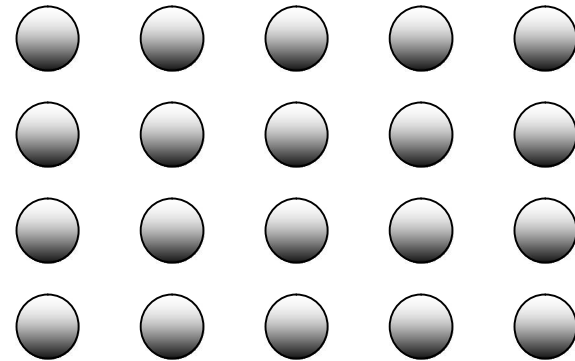
# Immunity

---

A



B



95% population immune ¿two scenarios?

# Exposure and disease

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- Exposure to agent  $\Rightarrow$  risk of infection

Exposure  $\Rightarrow$  Infection

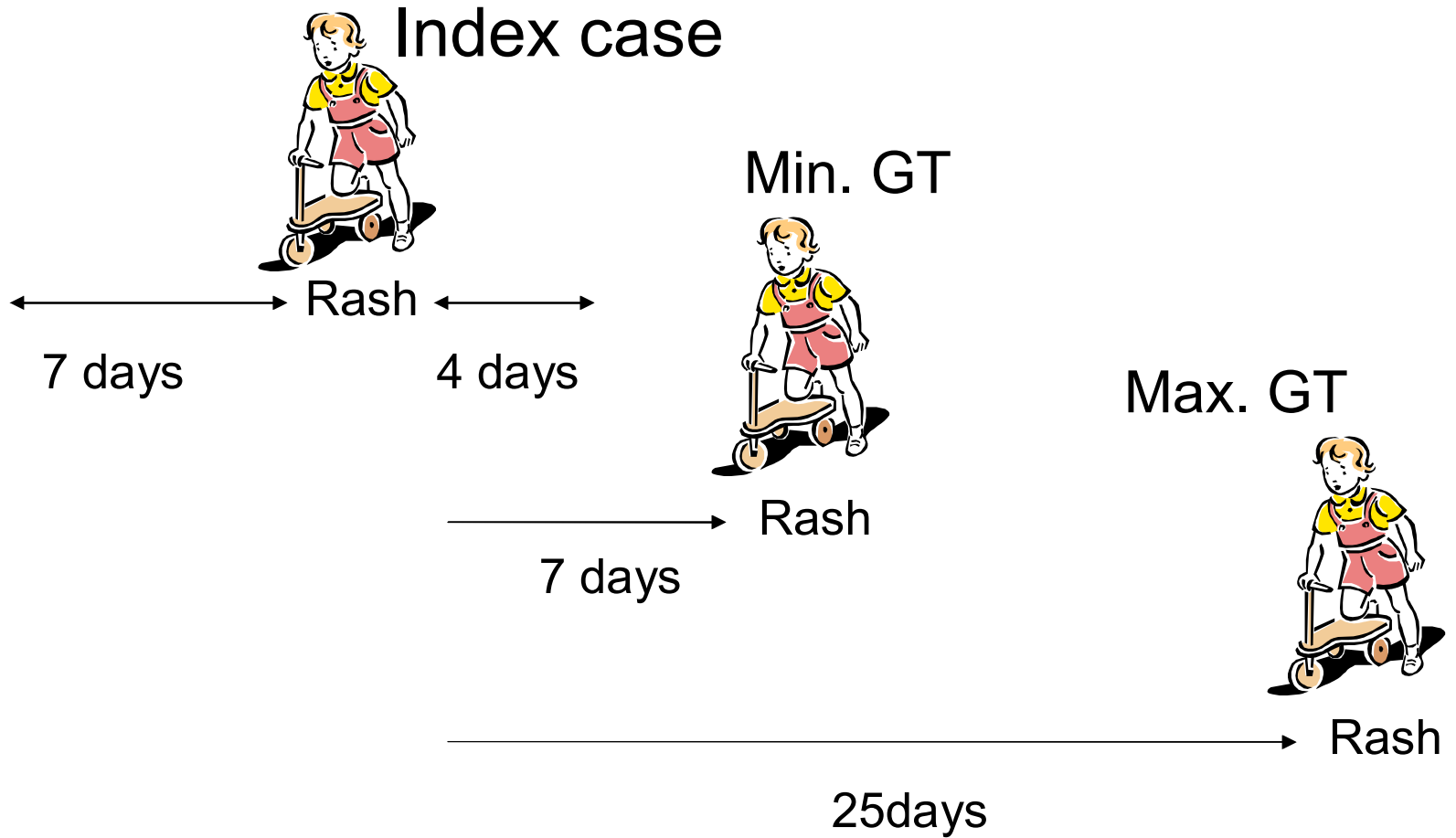
Infection  $\nRightarrow$  Disease

- Unknown exposures
  - Asymptomatic carriers
  - Incubation period



# Generation time

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# Exposure and transmission

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Susceptible	Incubation	Symptoms	
	Latency	Infectivity	

- **Generation time / Serial interval**

Relates cases with a potential infection source

Helps identifying index cases or sources

## Measles outbreak in Germany

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# Source / mode of transmission

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- Communicable disease  $\Rightarrow$  epidemic risk
- Epidemic dynamics
  - Infection source and mode of transmission
  - Incubation period
  - Transmissibility
    - Social factors
    - Immunity

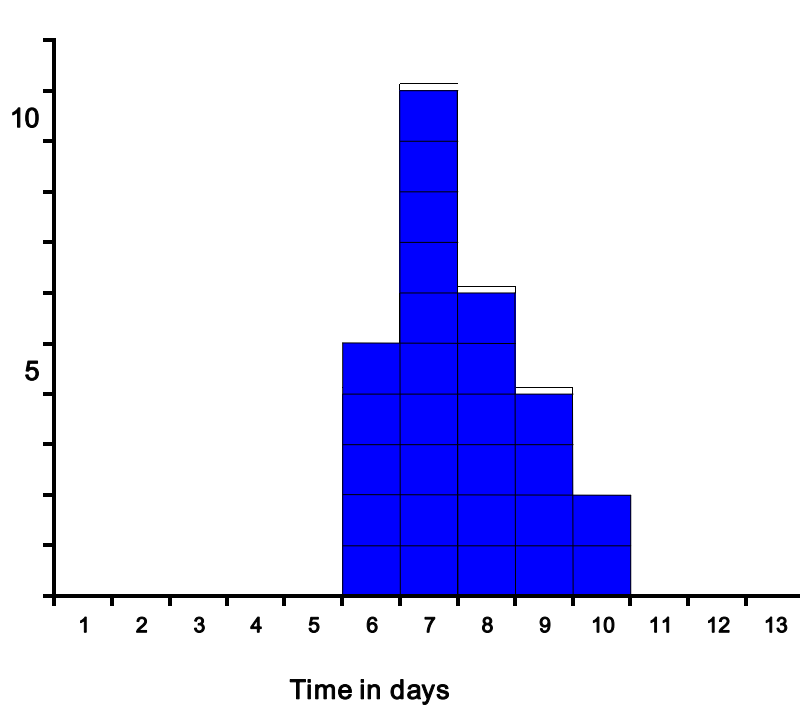
# Interpretation of the epidemic curve

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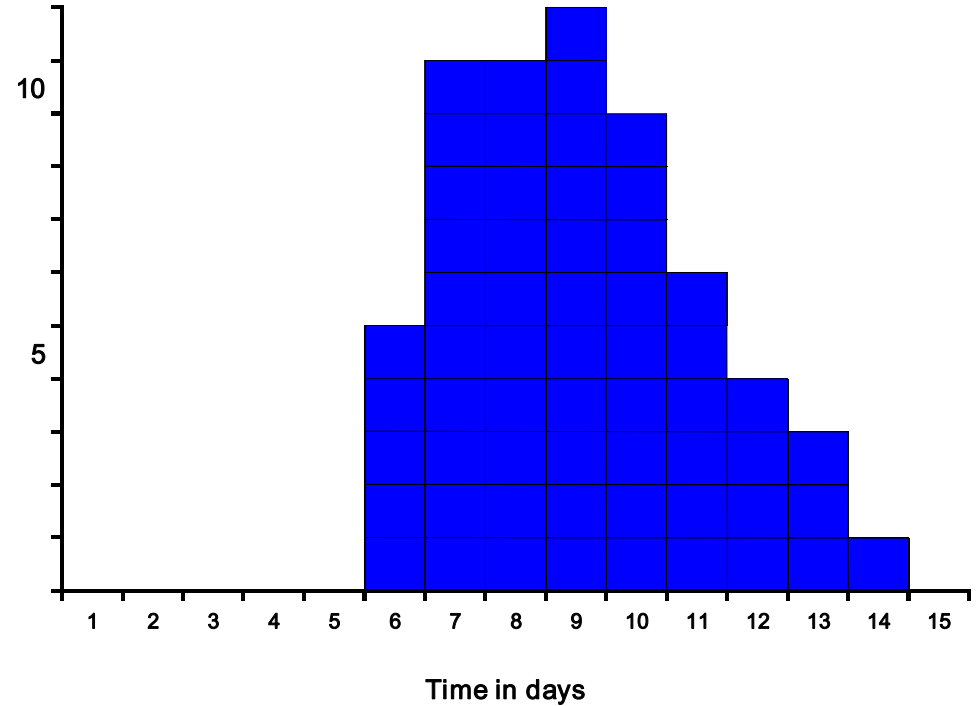
- Hypothesis type of outbreak
- Confirm maximum and minimum IP
- Identify probable moment and duration of exposure
- Identify IP of unknown agents if the moment of exposure is known

# Interpretation of the epidemic curve

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**Point source**

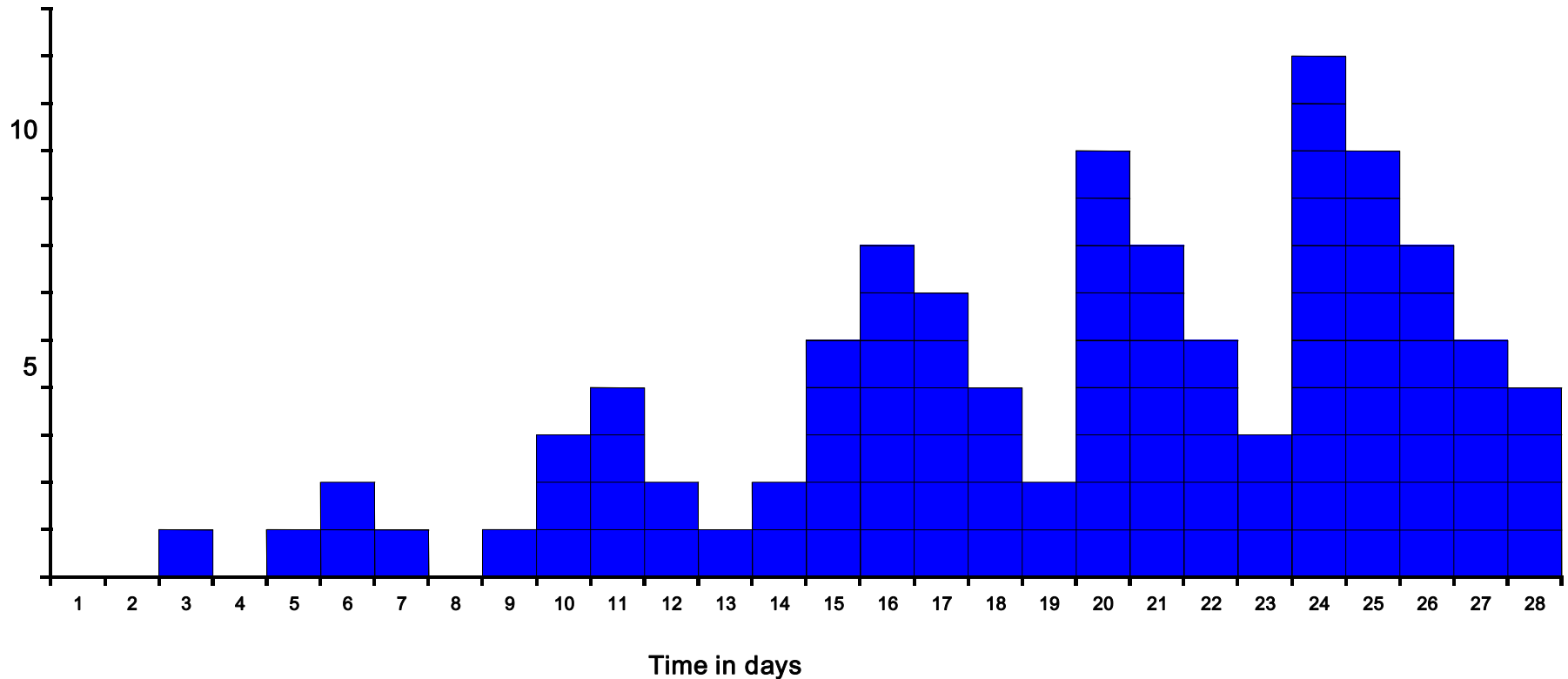


**Extended source**

**Distribution of the incubation period**

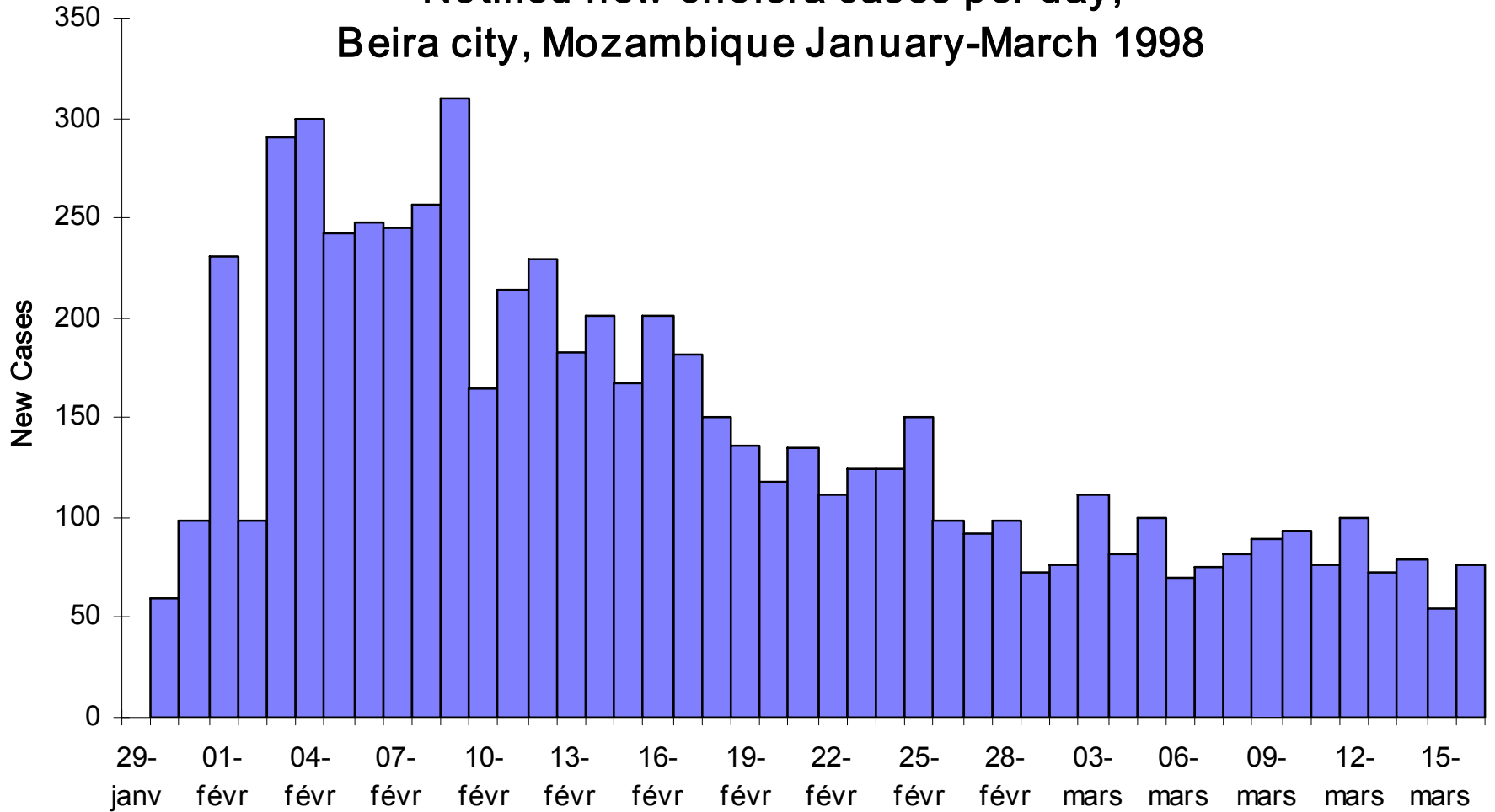
# Interpretation of the epidemic curve

---



**Serial / progressive source , person to person**

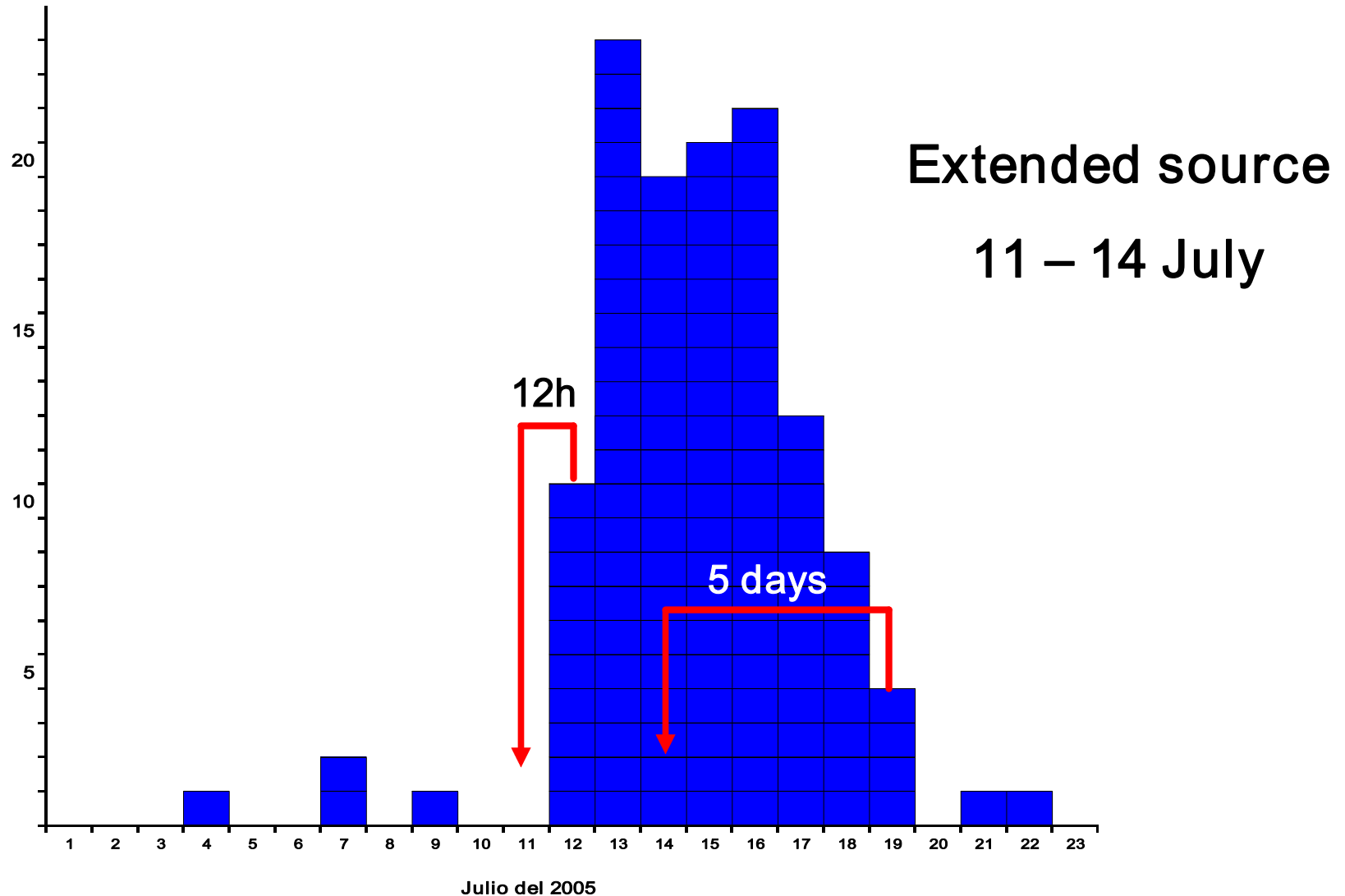
## Notified new cholera cases per day, Beira city, Mozambique January-March 1998





# Interpretation of the epidemic curve

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# Transmissibility

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- Direct (person to person)  
or
  - Indirect (multiple means)
- 

- Biological factors  
and
- Social factors

# Transmissibility

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- **Secondary attack rate**  
% cases among contact of 1 index case  
Depends on social interaction and the age of cases (inverse)
- **Reproduction number ( $R_0$  and  $R$ )**  
Average of secondary cases  
Transmissibility  
Contact pattern and intensity  
Proportion of immunes

# Utility of $R_0$

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- $R_0 > 1$  epidemic disease
- $R_0 = 1$  endemic disease
- $R_0 < 1$  elimination of disease

Herd immunity threshold

$$\frac{R_0 - 1}{R_0} = 1 - \frac{1}{R_0}$$

Problem: Super-spreaders

# Indirect transmission

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## Malaria

Average of infective bits per day after introduction of a case

$R_0 = \text{vectorial capacity} * \text{duration of infection}$

# Concepts

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- Case = exposure
- Immunity
- Latency period / asymptomatics
- Transmissibility (secondary attack)
- Contact patterns
- Epidemic threshold
- % 2<sup>o</sup> cases infected before control of index case