**The Epidemiology of Unmitigated Epidemic Cholera in 19th Century Denmark**

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**Background:** Cholera epidemics devastated 19th century European cities in multiple outbreaks during 1830-1900. Due to an effective quarantine policy, most Danish cities experienced only a single epidemic in 1853 for which detailed data are available. This setting uniquely allows the study of unmitigated epidemic cholera in a fully susceptible population. These insights can be used for empirical parameterization of mathematical models of cholera transmission. Here we describe the Danish cholera experience and provide a detailed examination of the transmission and impact of cholera outbreaks in three cities including Copenhagen.

**Methods**: We accessed cholera surveillance data and contemporary descriptions by physicians of the outbreaks from Danish archives. We also accessed census data and annual mortality time series data available by cause and age, and used statistical modeling to attribute age-specific cholera mortality burden. The basic reproductive number, R0, was estimated from the early epidemic weeks using an exponential growth and maximum likelihood method. Narratives of individual case clusters were used to estimate the serial interval.

**Results**: The outbreaks typically occurred in late summer months of 1853. Physicians recorded only patients with severe cholera (rice water diarrhea and severe dehydration). The case fatality ratio (CFR) ranged from 54%-68% and the overall mortality impact ranged from 3.4% to 7.5% of the population. Seniors aged 70+ years in Copenhagen had the highest mortality rates (16% died) whereas only 2.7% of children under five died. We derived point estimates for R0 at 1.5-2.2. Narratives of index patients and their contacts were used to compute the generation interval to be 3.1 days (1.9 - 4.5).

**Discussion**: Detailed data of cholera outbreaks in historical Danish pre-sanitation cities allowed assessment of key epidemiological parameters needed to parameterize dynamic disease models used to gage the likely effect of interventions in contemporary disaster settings. This low-income pre-sanitation historical setting may serve as a proxy for populations in contemporary resource-poor urban settings.

**Bio:** Matthew is a PhD Fellow in epidemiology at the University of Copenhagen’s Department of Public Health. His focus is on cholera transmission models in both historic and contemporary outbreak settings. Previously he worked as a community health agent in rural Cameroon and at USAID’s sexual and reproductive health division in Washington DC. He received his Masters of Public Heath in Epidemiology from Yale University in 2014 and his Bachelor’s in History from Purdue University in 2007.