

Measles Epidemics in Vaccinated Populations

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Standard epidemiologic theory tells us that there is a vaccination threshold ($V_c = 1-1/R_0$) above which the infection should be eradicated but below which outbreaks can occur. For measles, which has a very high $R_0=17$, vaccination levels with the highly successful MMR vaccine need to reach around 95%. However, many regions of the UK fall below this threshold and hence are expected to suffer from epidemics.

One such epidemic hit South Wales (and also Liverpool) in 2013; the area around Swansea has historically had very low uptake of the MMR vaccine. Thanks to our strong collaborative links with Public Health Wales, we are able to access data on this outbreak in unparalleled detail. Available data ranges from the location, ages and contacts of cases, to population level demography and historical vaccine uptake.

This project provides an ideal opportunity to work with public-health researchers, and to address a range of questions that this outbreak poses. Suitable questions for the MSc include:

- 1) An understanding of the role of contact-tracing in this outbreak; how informative were these measures of the local transmission networks?
- 2) What roles did schools play in this outbreak? Did they act as amplifiers of infection?
- 3) Why did the outbreak occur when it did? Had the population recently passed some threshold, or was this a stochastic event?
- 4) What does this tell us for other areas with low vaccine uptake.

This project can be readily extended into a PhD, and can potentially draw on data from other areas including the on-going outbreak in California. This project brings together a range of disciplines (model development, parameter inference, statistical analysis, network theory, epidemiology etc etc) to address a substantial challenge for modern public-health.

Suitable Reading:

- The Lancet 2013.
<http://www.sciencedirect.com/science/article/pii/S0140673613609083>
- The BMJ 2013 <http://www.bmj.com/content/346/bmj.f2545.full>
- J Epidemiol Community Health. 2000
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1731691/>
- Science 1997 <http://www.sciencemag.org/content/275/5296/65.short>
- Trends in Microbiology 1997
<http://www.sciencedirect.com/science/article/pii/S0966842X97011475>