# HOW YOU CAN GET FOOD POISONING FROM OYSTERS WITHOUT EATING ONE!

## MODELLING THE EPIDEMIOLOGY OF NOROVIRUS.

### Introduction

Norovirus is a single stranded RNA virus responsible for an estimated total of 2.65 million infectious intestinal disease cases in the UK per year.

The epidemiology of this virus is complicated. Able to spread via contaminated food, water, surfaces and through contact with people, it is a highly contagious disease.

Oysters (filter feeders) are able to concentrate norovirus from contaminated waters. When someone eats a contaminated oyster the virus can be passed on to other people, without them consuming any oysters themselves.

### Aims

The aims of this research is to develop a model of the epidemiology of Norovirus and gain a better understanding of the key sources of infections and the causes of outbreaks.

### Methods

The epidemiology of Norovirus was deconstructed into it's different modes of transmission and key contributing factors that may affect its distribution (Figure 1). Using data from published literature a microsimulation model of the Norovirus was created in R.

### Susceptibility

People have different susceptibility to contracting Norovirus. ~20% of the population have a nonsense mutation in the FUT2 gene which reduces the likelihood of infection. People with blood type B also have a reduced risk. Those of lower social class and at the extremes of ages are at higher risk of becoming ill.

### Person-to-Person Transmission

Virus particles present within vomit and faeces can spread between people when they are inhaled. They can survive outside of the body for several days and spread via contaminated surfaces. People who are in close proximity with others, such as those within schools, hospitals, nursing homes, etc., have a higher risk of becoming infected.

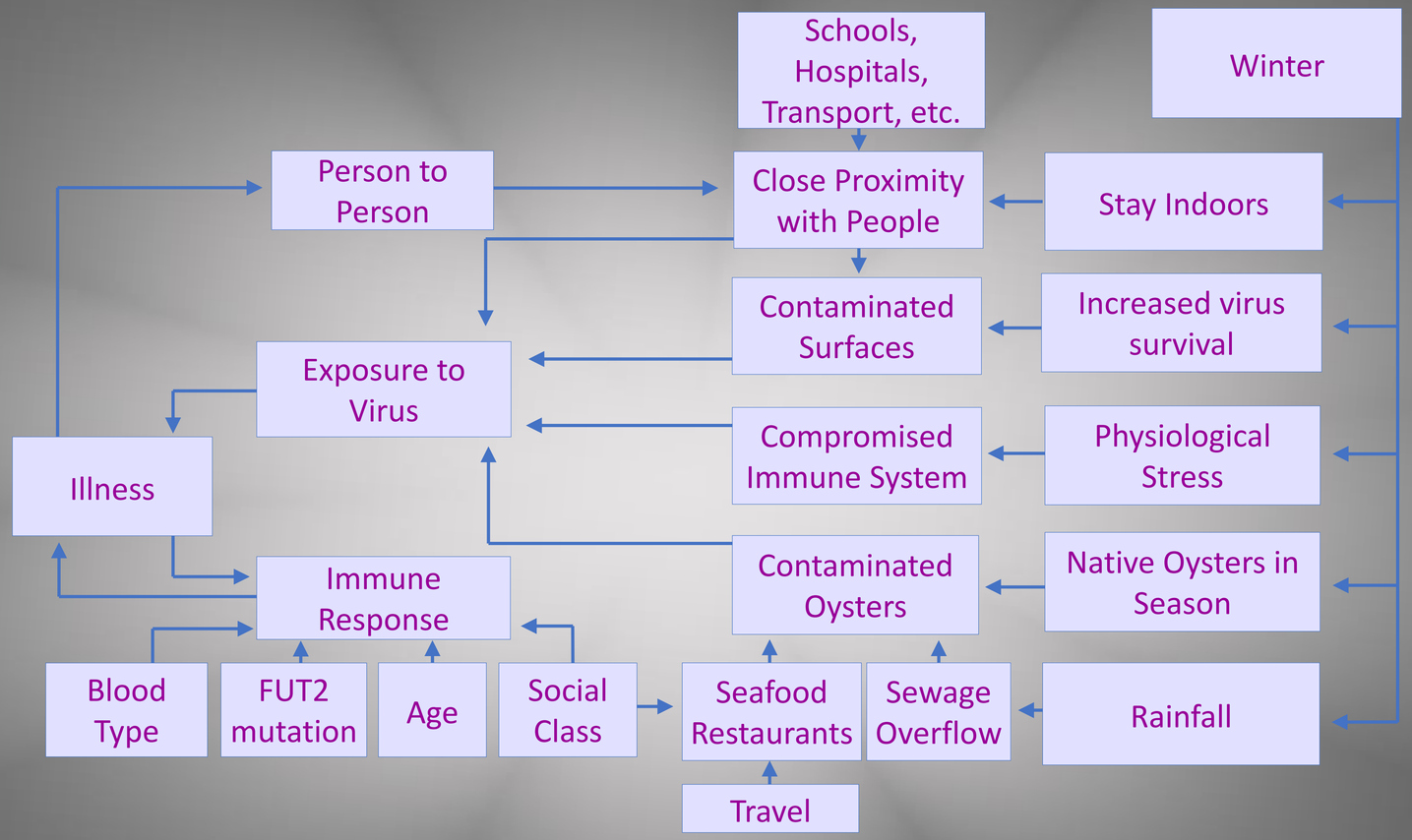


Figure 1: Model of the transmission of Norovirus

### "Winter Vomiting Bug"

The peak time for Norovirus in the UK is between December and March.

During winter:

- The human immune system is compromised due to increased physiological stress. People are more susceptible to infection.
- The Norovirus survives for longer outside the body. Surfaces will be contaminated for longer.
- People are more likely to stay indoors and be in close proximity with other people. There is an increase in person-to-person transmission and contaminated surfaces.

There was a significant difference in the average amount of shellfish eaten (g) between the different age groups ($t=2.848$, $p < 0.05$) (Figure 6).

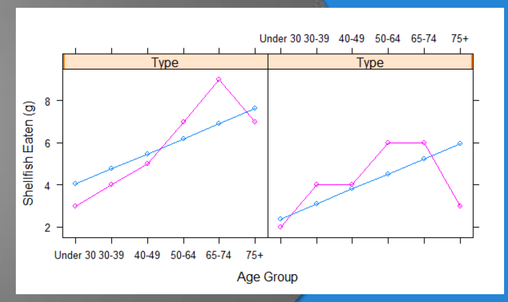


Figure 6: Amount of shellfish (g) eaten by age group. Fresh shellfish (left), frozen shellfish (right).

### Results

There was a significant difference in the average amount of shellfish eaten (g) between the age groups at which people left education ($t = 1.206 \times 10^{15}$, $p < 0.001$ ) (Figure 2) and between the equivalised income groups. ($t=5.097$, $p < 0.001$) (Figure 3).

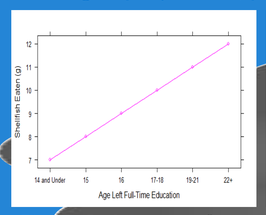


Figure 2: Amount of shellfish (g) eaten by education level

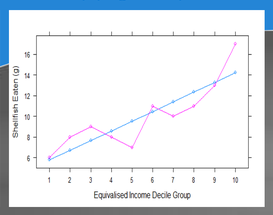


Figure 3: Amount of shellfish (g) eaten by household income

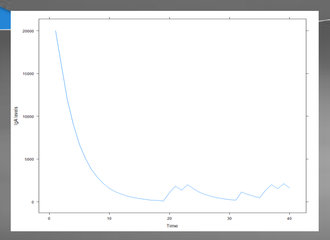


Figure 4: IgA levels in response to Norovirus Challenges over time

### Immunity

When challenged with Norovirus the immune system responds by increasing the levels of IgA. This allows for short-term resistance to infection. Over time IgA levels decrease until challenged again by Norovirus causing a peak in IgA levels (Figure 4).

### Sewage & Shellfish

Increased rainfall can cause sewage systems to overflow and pollute waters and shellfish beds. ~75% of British Oysters are contaminated with Norovirus. During the winter, shellfish are is season and there is increased rainfall. More people are ill during this period (Figure 5).

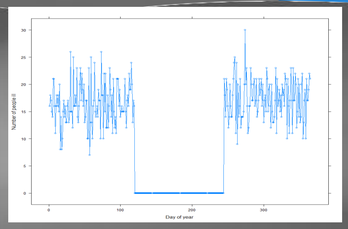


Figure 5: Number of people ill with Norovirus each day of year

### Discussion

Shellfish consumption plays a small but key part in the transmission of Norovirus. It is responsible for the infection of ~16-28 people during the winter months. It is difficult to attribute outbreaks to oysters alone due to how contagious and easily spread the virus is through person-to-person transmission.

Future work will involve continuing to model other factors involved in its transmission such as variation in susceptibility of people, and transmission between people and combining all factors to get an overall model.


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References : Robilotti et. al. (2015) Norovirus. American Society for Microbiology 28: 134-164