



OriGen

Whole Genome Sequencing  
Source tracking for the  
food industry



## The Burden of Foodborne Disease

Foodborne disease constitutes a major public health burden, both in the UK and globally, and is responsible for tens of thousands of GP visits and hospitalisations each year. Models covering the UK in 2011–12 suggest that there were around 280,000\* cases of *Campylobacter* causing 38,000 subsequent GP visits, while *Salmonella* led to around 2500 hospitalisations.

Such a huge number of outbreaks inevitably results in high costs on an industry level as well as a personal one. In a survey by the Grocery Manufacturers Association, 77% of large food manufacturers estimated that the cost of a product recall as a result of disease outbreak would be up to \$30m, with the remaining 23% estimating even higher. Five percent estimated the cost to be over \$100m.

The costs to business are not only financial. Product recalls can also damage the brand of a company and its relationship with suppliers, as well as complicating insurance policies. To reduce the risk of recall, therefore, is to reduce the potential costs to which a company can be exposed.

## Next Generation Sequencing

When it comes to sequencing DNA, the last five to ten years have seen rapid technological advancements, with cost falling even as capacity rises. The highest throughput Next Generation Sequencing (NGS) platform is now able to sequence 18,000 human genomes in a single year, and at the cost of one thousand dollars per genome.

The number of providers and platforms offering this sequencing service has also grown, with each platform based on a different chemistry with its own advantages and drawbacks. Choosing the appropriate sequencing platform depends largely on the particular application, and whether the genome is long or complex or comparatively short.

These advances have been adopted across fields ranging from medical microbiology to plant and livestock breeding, from population genetics to the diagnosis and epidemiology of infectious diseases. Indeed, considering that a human genome is approximately 600 times longer than a typical bacterial genome, the benefits of this technology are particularly evident when it comes to microbiology.

## Whole Genome Sequencing for Tracing Outbreaks

Foodborne disease is therefore a problem which DNA sequencing is well-positioned to tackle –thanks to the increasing availability of sequence data and the simultaneous decreasing cost of generating new data, whole genome sequencing (WGS) has become an important tool for outbreak investigation.

Whereas molecular epidemiology traditionally relied on using a subset of markers within the genome to determine how closely related different strains of bacteria were, WGS techniques look at variation across the entire genome. This makes them the most discriminative tools possible for distinguishing strains, which is crucial when linking foodstuffs to outbreaks or detecting connected cases at an early stage in an outbreak.



How is all this accomplished? The US FDA's GenomeTrakr programme has been uploading DNA sequence data to the National Center for Biotechnology Information's Sequence Read Archive since 2013. When bacterial sequences from food samples are uploaded and compared to similar data from clinical patients, it becomes possible to rapidly detect outbreaks of foodborne disease at an early stage when they are small and not geographically clustered. Outbreaks can also be traced back to their source, from the scale of a general foodstuff and geographical origin to individual processing plants.

A recently published report by the FSA Chief Scientific Adviser argues that WGS techniques are the way forward for industry when it comes to preventing outbreaks, because of their extremely high discriminatory power for understanding the links between microbial samples, as well as their reducing costs and turnaround time.

## A WGS Service for the Food Industry

Based on the increasing accessibility of WGS data, policy decisions by regulators such as FDA and FSA, and interest from the food industry, Fera have developed a dedicated WGS service for the food industry. We are combining our expertise in food microbiology, DNA sequencing and analysis to provide an end-to-end service that will help the industry to rapidly identify and understand sources of contamination.

Briefly, we will receive samples of a customer's bacterium of choice from their existing sampling regime (though we can also supply sampling materials and protocols if desired), grow them in pure culture and perform DNA extraction. The DNA will then be sequenced, and the relatedness of the samples determined. Based on this relatedness, and the associated information supplied about the origins of the samples, we would then aim to provide some explanation to the customer about what these relationships mean from a practical point of view.

We are maintaining a flexible approach as to how this service might be used. Positive environmental samples are likely to be rare in a food manufacture environment. Building up a library of positive samples, and then sequencing when a sufficient number have been received, would be a useful way to inform the customer about how their contaminants are changing over time. The sort of information this would provide could include whether a plant has been continuously contaminated with a single type, or whether new types are being introduced. Alternatively, this service could be useful in the aftermath of a recall or other large-scale contamination event, where information about the source of contamination is required rapidly to demonstrate due diligence, and prevent repeat occurrences.

## Benefits to Industry

There are a number of reasons that we think this service will be of benefit to the food industry

- **Prevent future outbreaks and recalls**
- **Demonstrate due diligence to customers after any event**
- **Fewer audits**
- **Identify or suggest external sources of contamination**
- **Easily compare across multiple events from different time periods**





## Want to know more?

To find out more about how Fera can be your partner with regards to improving understanding of emerging risks and issues, ultimately aiming to reduce your business risk and likelihood of product recall, please contact;

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