The Emergence of a new *Salmonella* Typhimurium phage type associated with pigs

L.R. Ward, E.J. Threlfall

Laboratory of Enteric Pathogens, Central Public Health Laboratory, 61 Colindale Avenue, London N.W.9 5HT Phone: +44(0)2082004400, Fax: +44(0)2089059929, E-mail: lward@phls.nhs.uk

Abstract: A new phage type of *Salmonella enterica* serovar Typhimurium has been identified that appears to have a strong epidemiological link with pigs and pig products used for human consumption. In 1997 a strain emerged that was resistant to all the *S.* Typhimurium typing phages; this resulted in a new phage being adapted to type this strain. The type defined by this phage has been given the provisional type designation U310 and the majority of isolates are resistant to tetracyclines (R-type T).

Keywords: Salmonella, phage type, pigs, drug resistance

Introduction: Phage typing has proved invaluable as a rapid and accurate method of distinguishing between strains of a range of *Salmonella*. In the case of *Salmonella Typhimurium* over two hundred and sixty phage types can be defined using 37 typing phages, (Anderson et al 1977). A major value of the current phage-typing scheme in use in the Laboratory of Enteric Pathogens (LEP), Public Health Laboratory Service, England and Wales, is to follow the development of epidemic infections and also to identify new phage types that are associated with human infections. One such type, provisional phage type U310 (PT U310) has been found to be associated with pigs and pig products.

Epidemiology: In 1997 a number of *S.* Typhimurium isolates examined by the LEP were found to be untypable with the *S.* Typhimurium phage-typing scheme. Some of the human untypable strains were resistant to ampicillin, chloramphenicol, streptomycin, sulphonamides, spectinomycin and tetracyclines (ACSSuSpT). This pattern of resistance (R-type) is similar to that of the multiresistant clone of *S.* Typhimurium provisional phage type U302 (PT U302), a type related to the multiresistant definitive phage type 104 (DT 104), the dominant *S.* Typhimurium phage type in England and Wales (Walker et al., 2001). In addition non-typable strains resistant to tetracyclines (R-type T) were also observed. The need to type these untypable strains became apparent and a new phage was adapted from the phage that defines PT U302. This new phage was introduced into the *S.* Typhimurium phage-typing scheme in 1997 and defines the former untypable strain as PT U310. During 1997 the LEP reported on seven human isolates of PT
U310; in 2000 this number had risen to 98. (Table 1). Between the first reports in 1997 and the end of 2000 the LEP reported on 134 human isolates of PT U310 and of these 119 (89%) were of R-type T and nine (7%) were of R-type ACSSuSpT.

Only two non-human isolations of PT U310 were reported in 1997. They were both resistant to tetracyclines and had been isolated in the Republic of Ireland. The first was from a pig and the second was of unknown source.

Isolations from foods have all had resistance to tetracyclines and include raw sausage, sausage rolls and tripe.

In 2000 there was an increase in the number of human infections with PT 310 of R-type T, particularly in Wales and the south of England. Although there were no isolations from foods the epidemiological evidence implicated pig products, particularly sausages and faggots (personal communication, CDSC Wales). Nine recently isolated strains of S. Typhimurium from abattoir pigs in England and Wales have been identified as PT U310, R-type T and in 2001 the LEP has reported on three isolates of U310 from pig products in England and Wales and three pig isolates of PT U310 from the Republic of Ireland. S. Typhimurium PT U310 R-type T appears to have a strong link with pig and pig products and with continued surveillance using the S. Typhimurium phage-typing scheme the spread of infection in both man and pigs will be monitored.

**Discussion:** The use of *S. Typhimurium* phage typing and antibiotic resistance markers in defining new types of *S. Typhimurium* and investigating the source and occurrence of human infection continues to be invaluable. These simple techniques over many years have been responsible for monitoring the detection and spread of many "incidents" of *Salmonella* in man and food producing animals. Early detection is essential to control and restrict salmonella epidemics. Further investigations are in progress to establish whether the *S. Typhimurium* PT U310 is related to PT U302 and the relationship between PT U310 R-type ACSSuSpT and PT U310 R-type T.
Table 1. *Salmonella* Typhimurium PT U310 Human, England and Wales 1997-2000

<table>
<thead>
<tr>
<th>Year</th>
<th>T</th>
<th>ACSSuSpT</th>
<th>ACKSSuSpT</th>
<th>ACSSuSpT Tm</th>
<th>ACSSuSPT Fu</th>
<th>SSuSp</th>
<th>Sensitive</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>1997</td>
<td>2</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>1998</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>1999</td>
<td>18</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>2000</td>
<td>96</td>
<td>1</td>
<td>1</td>
<td>-</td>
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<td>98</td>
</tr>
<tr>
<td>Total</td>
<td>119</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>2</td>
<td>134</td>
</tr>
</tbody>
</table>

A = ampicillin  
C = chloramphenicol  
K = kanamycin  
S = streptomycin  
Su = sulphonamides  
Tm = trimethoprim  
K = kanamycin  
Sp = spectinomycin  
Fu = furazolidone

**References**

Anderson, E.S., Ward, L.R., de Saxe, M.J. Bacteriophage-typing designations of *Salmonella* Typhimurium.