



A retrospective analysis of *Salmonella* serovars isolated from pigs in Great Britain between 1994 and 2010



Doris Mueller-Doblies*, Kathleen Speed, Robert H. Davies

Bacteriology Department, Animal Health and Veterinary Laboratories Agency Weybridge, New Haw, Addlestone, Surrey KT15 3NB, United Kingdom

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ABSTRACT

A retrospective study analysing *Salmonella* serovars and antimicrobial resistance data from pigs in Great Britain between 1994 and 2010 was performed. Data were obtained through scanning surveillance and compared with prevalence data from other livestock species as well as human data. During the study period, two serovars, *S. Typhimurium* and *S. Derby*, predominated in British pigs. The total number of *Salmonella* incidents has decreased steadily over the study period, from 360 incidents per year in 1994 to 172 incidents in 2010. *S. Typhimurium* has been the most common serovar every year, but the relative percentage went down over the past few years. During the same time period, monophasic strains of *S. Typhimurium* have increased in numbers and were accounting for as much as 25% of incidents in 2010, representing the second most common serovar in British pigs in 2010. Antimicrobial resistance data from *S. Typhimurium* isolates show that the percentage of isolates which are resistant to six or more antimicrobials has increased from 27.2% in 1994 to 58.3% in 2010 and that the percentage of isolates fully sensitive to the panel of antimicrobials tested was only 3.3% in 2010. *S. Typhimurium* isolates belonged mainly to phagetypes DT193 and U288 in 2010, and an increase can be seen in the number of isolates belonging to phage type DT193. DT104, which was the predominant phagetype during the 1990s, has gone down considerably and represented less than 5% of all *S. Typhimurium* isolates in 2010. Monophasic strains of *S. Typhimurium* belonged mainly to phagetype 193 with less than 20% belonging to phagetype 120.

The overall trend shows that the number of *Salmonella* incidents reported from British pigs has gone down considerably over the 17-year study period, but that the relative percentage of monophasic strains of *S. Typhimurium* has increased significantly. This trend seems to be in line with observations from other European countries, where an increase of this serovar can be seen both in livestock and in human patients. The increasing percentage of *Salmonella*-isolates which show multi-resistance is a matter of concern and has to be monitored carefully in order to assess any potential risks this may pose to human patients.

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1. Introduction

Salmonellosis is one of the major causes of gastroenteritis in the UK and worldwide. In 2010, 9685 cases of laboratory confirmed human salmonellosis were reported in the UK, and while England and Wales saw a fall of 9.6% from 2009, numbers in Scotland and Northern Ireland rose by 11.2% and 13.9% respectively (Anonymous, 2011).

* Corresponding author. Tel.: +44 1932 357814; fax: +44 1932 357595.
E-mail addresses: doris.mueller-doblies@ahvla.gsi.gov.uk,
dmdoblies@gmx.net (D. Mueller-Doblies).

Salmonella Enteritidis (SE) and *Salmonella* Typhimurium (ST) which have been the most prevalent serovars in people for many years, continued to be the most commonly reported in 2010, accounting for 28.9% and 22.8% of cases respectively.

The number of human salmonellosis cases in England and Wales caused by ST decreased by 46% between the years 2000 and 2004, but has been increasing steadily since 2004 (Anonymous, 2012b). For the whole of the UK, an increase of 4.6% of ST isolates was reported for the period 2009/10 (Anonymous, 2011).

Human cases of salmonellosis caused by ST have been linked to a number of sources including pig and pork products, and for 2010, it was estimated that 28% of human salmonellosis cases within the EU might be attributed to pigs (Anonymous, 2012a). Most recent data from the EU estimate that as many as 56.8% of human salmonellosis cases might be attributable to pigs (BIOHAZ, 2012). In a European baseline survey for the prevalence of *Salmonella* in slaughter pigs in 2006–07, the UK prevalence (21.2%) was higher than the EU average (10.3%). Pork and pork products were identified or strongly suspected as vehicles in five large outbreaks in Germany between 2001 and 2005, including *S. Goldcoast*, *S. Muenchen*, *S. Give* and *S. Bovismorbificans*, the biggest one comprising 487 confirmed cases (Jansen et al., 2007). Epidemiological studies in England and Wales (Smerdon et al., 2001), Scotland (Smith-Palmer et al., 2003), phage typing studies (Ward, 2003) and AMR studies (Threlfall et al., 2003) have all found associations between ST in live pigs or pork and human infection. However, it is not clear yet to what extent pigs contribute to the burden of salmonellosis in people in the UK, where slaughter and cooking practices may be partially protective, despite a high prevalence of infection in slaughter pigs.

Pigs may become infected at any stage in production, from the breeding and fattening farms through to transport and lairage, and carcasses and edible offal may become contaminated at slaughter (Duggan et al., 2010; Kirchner et al., 2011). Nucleus breeder and multiplier herds were shown to be a source of *Salmonella* for herds producing pigs for slaughter (Wales et al., 2009). Pigs can be infected by several serovars of *Salmonella* and the infection usually remains subclinical.

Over the last few years, monophasic strains of *Salmonella* Typhimurium with the antigenic formula *S.* 1,4,[5],12:i:- have increasingly been implicated in human disease worldwide (Mossong et al., 2007; Moreno Switt et al., 2009).

A study analysing *Salmonella* strains sent in on a voluntary basis to the German National Reference Centre showed that the number of *S.* 1,4,[5],12:i:- strains originating from people increased from 0.1% in 1999 to 14% in 2008 (Hauser et al., 2010). Within this study, it was also shown that strains from people, pigs and pork are highly related (Hauser et al., 2010). In England and Wales, cases of serovar 4,[5],12:i:- infections have risen from 47 in 2005 to 151 in 2009 (a 321% increase), and similar or even higher increases were reported from France and Italy (Hopkins et al., 2010). However, it is not clear if infections caused by monophasic *Salmonella* Typhimurium strains are more or less severe

than infections with other *S.* Typhimurium infections, and a study from the United States showed similar hospitalisation and death rates for *S.* 4,[5],12:i:- compared to *S.* Typhimurium (Jones et al., 2008). European data also do not suggest infections with the monophasic variants to be more severe than infections with biphasic *S.* Typhimurium strains (EFSA, 2010).

The EU baseline survey on the prevalence of *Salmonella* in slaughter pigs carried out in 2006–2007 showed that monophasic strains of ST were isolated from pigs in eight participating member states representing the fourth most prevalent serovar at EU level (EFSA, 2008).

Because of the potentially high impact of *Salmonella* originating from pigs and pork and the emergence of monophasic strains of ST in pigs, they should be regarded as an issue of considerable public health significance. This paper reports results from the scanning surveillance of pigs in Great Britain over a period of 17 years and puts them into context with data from other European countries as well as with trends seen in people during the same period of time.

2. Materials and methods

2.1. Statutory reporting of *Salmonella* isolates

In Great Britain, all *Salmonella* isolates from animals, their environment or animal feed stuffs have to be reported to the Competent Authority under the Zoonosis Order 1989 (see <http://www.legislation.gov.uk/ukxi/1989/285/made>, last accessed 06/02/2013). These reports are made to government veterinarians at the Animal Health and Veterinary Laboratories Agency (AHVLA) and the *Salmonella* isolates are submitted to the AHVLA Reference Laboratory for further identification, which includes serotyping, phage typing and analysis for resistance to a panel of 16 antimicrobials.

Salmonella isolates originate from a variety of sources and can be grouped, by reason for submission, into (i) scanning surveillance samples, (ii) samples taken under the Zoonoses Order, (iii) investigations of clinical disease and (iv) reason for submission not known.

To reduce bias caused by testing several isolates obtained from the same group of animals within a short period of time, not all isolates were included in this study but data were limited to so-called incidents. An incident is defined as a case in which a *Salmonella* has been isolated from animals or their environment, without any previous isolations of the same serotype or phage type in the same epidemiological group within the preceding 30 days. The 30-day period is used to standardise procedures, and analysis by incident gives a truer picture of the amount of *Salmonella* in the pig population as it minimises the bias where there are differences in the intensity of sampling.

In 2010, 84.4% of incidents originated from investigations of clinical disease, 8.1% originated from samples taken under the Zoonoses Order, 6.4% were taken under voluntary surveillance and for 1.2% of incidents, the reason was not known. The relative proportion of the different reasons for submission has been stable over the past few years (data not shown).

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