Farming antibiotic resistance: the influence of livestock within a current public health concern in the United States

Anna Solomon
Faculty Advisor: Dr. Jordan Covvey

Introduction

In the modern era of antibiotics, infections that meant certain death a hundred years ago became largely treatable. The ability to treat infectious diseases was a major medical advancement that meant longer life expectancies for people in the United States and around the world. However, a new healthcare issue has recently emerged: the rise of antibiotic resistance. While there are many contributing factors, this descriptive report focuses on the use of antibiotics in livestock within the United States and its influence on the development of resistance. Several studies on antibiotic-resistant bacteria originating in livestock are explored. Resistant microbes that evolve in animals spread far from the farms, travelling to human populations via waste, consumption of and contact with infected livestock. This has major implications in terms of hospital visits, death rates due to infection, and health care costs. Development of new antibiotics is not an effective solution to the problem, given how expensive they are to create and how little the return is for pharmaceutical companies. Thus, another solution must be explored. Prudent use of antibiotics in livestock is necessary to maintain the efficacy of antibiotics.

Methods

In this descriptive report, several different livestock-related antibiotic resistance infectious outbreaks are examined. These studies were chosen because they both connect the use of antibiotics in livestock to antibiotic resistance in human isolates and depict the medical and economic implications of these infections.

Results

Salmonella Heidelberg Outbreak of 2012

Case count: 634
States: 29
Hospitalizations: 34%

In June 2012, health officials in Washington and Oregon were alerted to an outbreak of Salmonella Heidelberg strains. PulseNet, a database developed by the CDC, was used to track cases related to the outbreak. Investigators found seven strains of Salmonella Heidelberg that were involved in the outbreak. The infection was traced back to Foster Farms, the largest poultry-production company in California. Isolates on the chicken matched those found in the human patients infected with the resistant-microbes. At the time, Foster Farms was still using medically-important antibiotics in their livestock for prevention and treatment of infections. These cases proved to be particularly virulent, causing sepsis in 15% of those affected as opposed to the average with Salmonella of 5%. Of the 58 isolates obtained from ill patients involved in the outbreak, 65% was resistant to one or more antibiotic and 35% were resistant to one or more antibiotics in at least three drug classes.

Even without a widespread, single-source resistant outbreak like this, Salmonelle costs and annual 5631 million dollars in healthcare in the United States.

Livestock-related ExPEC Infections

What are ExPECs?

Extraintestinal Pathogenic Escherichia coli (ExPEC) strains contain acquired genes that cause infections outside the gastrointestinal tract in both healthy and immunocompromised or otherwise vulnerable patients. In some cases, ExPECs cause urinary tract infections (UTIs) that migrate to the abdominal cavity, bones, lungs, brain, and spine. These conditions can prove to be extremely costly.

Where do ExPECs originate?

Dr. James Johnson and his team of researchers set out to identify the origin of ExPECs. To do this, they obtained fecal samples from 622 adults recently-admitted adults in four rural hospitals throughout Wisconsin and Minnesota. They also bought and tested 180 retail poultry products from four communities and 40 recently slaughtered chickens from local farms that did not use antibiotics. They found that 331 (70 human, 261 animal) isolates were resistant to antibiotics. Of those, 27% were classified as ExPECs. Johnson and his team also determined that the drug-resistant human isolates were more similar to drug-resistant poultry isolates than to drug-susceptible human isolates, which is consistent with foodborne transmission of poultry-source organisms to humans. In a later study, Johnson and his team analyzed 175 E. coli isolates originating in chicken from the 2013 Consumer Reports national survey. Of those isolates, 25 were ExPECs, with each demonstrating higher virulence (severity of disease) and resistance scores than non-ExPECs. Furthermore, they found that organic-labeled chickens (did not use antibiotics) had lower resistance scores than non-organic isolates.

Estimated frequency and associated annual costs in the US of selected extraintestinal infection syndromes due to E. coli

<table>
<thead>
<tr>
<th>Infection Syndrome</th>
<th>Estimated frequency of cases</th>
<th>Estimated frequency of cases caused by ExPECs</th>
<th>Estimated direct costs (US dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncomplicated cystitis in premenopausal women</td>
<td>6.8 million</td>
<td>4.8 ± 7.6 million</td>
<td>1 billion</td>
</tr>
<tr>
<td>Uncomplicated gonococcal pharyngitis</td>
<td>260,000</td>
<td>225,000</td>
<td>175 million</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>54,100-21,400</td>
<td>15,000</td>
<td>75-120 million</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1,710,000</td>
<td>21,675</td>
<td>1.1-2.8 million</td>
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</tbody>
</table>

Persons infected by outbreak of Salmonella Heidelberg outbreak strains, by state

Discussion

The importance of these studies cannot be overlooked by those in the farm industry, health care professionals, or lawmakers. Use of antibiotics in livestock, whether it be for growth promotion, prevention, or treatment, leads to the creation of antibiotic-resistant microbes that can and do infect human populations. These infections are both costly and deadly. This report shows that even non-life-threatening illnesses such as UTIs can be extremely costly and lead to infections that are much more severe in the long run. It is not enough, or even possible, to simply develop a new antibiotic when resistance is developed against those already in use. The pharmaceutical companies cannot keep up with microbial evolution. Therefore, prudent use of antibiotics is of the utmost importance. Agriculture must relinquish use of antibiotics that are used in human medicine and those that are related to medicinally important antibiotics.

References


