

Salmonellosis in Man in Poland, 1957-66

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EPIDEMIOLOGIC data concerning salmonellosis in human beings in Poland during 1946-56 were published in 1961 (1). During this period 30 different serotypes of *Salmonella* were isolated in specimens from 13,500 persons. Nineteen of the 30 were recovered from clinically ill patients.

The activities of the National Salmonella Center, Gdansk, Poland, which included cooperation with field laboratories during the subsequent 10 years from 1957 through 1966, are presented in this report. The methods of cooperation and data collection were described in the previous paper (1). Most of the bacteriological investigations were carried out in field laboratories. These studies primarily concerned healthy persons who were employed or applying for employment in institutions which prohibited persons who excreted enteric pathogens from working for them.

During the 10-year period, about 28 million specimens from more than 8 million persons were examined. Samples were obtained from many of these persons several times each year. The National Salmonella Center received 16,412

cultures suspected of containing *Salmonella* from field laboratories for serotyping, 15,715 of which were confirmed as containing these organisms. Nearly half the cultures contained *Salmonella typhi*, *Salmonella paratyphi* A, *Salmonella paratyphi* B, or *Salmonella paratyphi* C, but data on these cultures are not included in this report.

A total of 56 *Salmonella* serotypes were isolated from 52,461 persons during the 10 years (table 1). Thirty-one of the 56 came from 33,640 persons with clinical illnesses and 55 from 18,821 healthy persons and persons whose medical histories were not known. The serotypes occurring most frequently in the persons who were ill were not the same as those occurring most frequently in the asymptomatic. The percentage of persons who were ill is based on the total number of persons culturally diagnosed (those ill plus those not ill). Perhaps these percentages may also serve as an index of pathogenicity for individual *Salmonella* serotypes. The given serotypes could be ranked according to their incidence, beginning with *Salmonella enteritidis* as the most pathogenic (89.4 percent) and *Salmonella give* as the least (6.7 percent). Of course, the proof of this hypothesis requires a more exact epidemiologic analysis with consideration of age groups, outbreaks (foci), and sporadic cases.

The serotypes that were infrequently encountered are summarized in the footnotes to table 1. Seventeen of the less common types were isolated from patients and 41 from other persons.

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More than one serotype was isolated from 18 persons with sporadic cases of *Salmonella* infection in the period 1957-66, only two of whom had been ill.

| <i>Salmonella</i> organisms isolated | Persons infected |
|---|------------------|
| <i>S. typhimurium</i> and <i>S. enteritidis</i> | 1 |
| <i>S. typhimurium</i> and <i>S. heidelberg</i> | 1 |
| <i>S. typhimurium</i> and <i>S. paratyphi</i> B and <i>S. brandenburg</i> | 1 |
| <i>S. typhimurium</i> and <i>S. anatum</i> | 2 |
| <i>S. typhimurium</i> and <i>S. give</i> | 2 |
| <i>S. brandenburg</i> and <i>S. bovis-morbificans</i> | 1 |
| <i>S. brandenburg</i> and <i>S. give</i> | 1 |
| <i>S. heidelberg</i> and <i>S. newington</i> | 1 |
| <i>S. derby</i> and <i>S. stanleyville</i> | 1 |
| <i>S. derby</i> and <i>S. anatum</i> | 1 |
| <i>S. derby</i> and <i>S. meleagridis</i> | 1 |
| <i>S. saint-paul</i> and <i>S. give</i> | 2 |
| <i>S. anatum</i> and <i>S. give</i> | 1 |
| <i>S. newington</i> and <i>S. new-brunswick</i> | 1 |
| <i>S. haifa</i> and <i>S. gallinarum-pullorum</i> | 1 |
| Total..... | 18 |

¹ Clinically ill.

The number and percent of ill and normal persons in the period 1957-66 are shown by infecting *Salmonella* serotypes in table 2. Isola-

tions from persons whose medical histories were unknown and from persons with miscellaneous types of infections are excluded. A drastic change in the prevalence of two serotypes occurred during the 10 years. The proportion of persons with infections caused by *S. enteritidis* increased from 7.4 percent of the total persons ill with *Salmonella* infections in 1957 to 80.5 percent in 1966; the proportion of those infected by *Salmonella typhimurium* decreased from 76.3 percent of the total to 15.6 percent. The prevalence of these two serotypes in otherwise healthy persons increased considerably. A slight decrease occurred in the percentage of ill persons infected with *Salmonella heidelberg*.

Salmonella kottbus was not reported in ill persons until 1961 although it had been found in normal persons in 1958. A considerable increase was noted from year to year in the number of isolations from normal persons of serotypes *Salmonella bovis-morbificans*, *Salmonella brandenburg*, *Salmonella anatum*, *S. give*, *S. heidelberg*, and *Salmonella derby*, but no similar increase was observed in symptomatic cases.

Table 1. *Salmonella* serotypes isolated from ill and normal persons, Poland, 1957-66

| Serotype | Number of persons infected | | | | Total |
|--|----------------------------|---------|------------------|---------|--------|
| | Ill | Percent | Not ill | Unknown | |
| <i>S. enteritidis</i> | 20,777 | 89.4 | 2,468 | 205 | 23,450 |
| <i>S. typhimurium</i> | 10,241 | 66.1 | 5,253 | 136 | 15,630 |
| <i>S. bovis-morbificans</i> | 571 | 42.0 | 789 | 11 | 1,371 |
| <i>S. dublin</i> | 433 | 79.2 | 114 | 8 | 555 |
| <i>S. cholerae-suis</i> ¹ | 269 | 85.1 | 47 | 11 | 327 |
| <i>S. newington</i> | 251 | 10.1 | 2,233 | 30 | 2,514 |
| <i>S. heidelberg</i> | 238 | 34.6 | 450 | 10 | 698 |
| <i>S. anatum</i> | 231 | 8.3 | 2,541 | 11 | 2,783 |
| <i>S. brandenburg</i> | 181 | 18.9 | 778 | 9 | 968 |
| <i>S. give</i> | 156 | 6.7 | 2,182 | 22 | 2,360 |
| <i>S. kottbus</i> | 55 | 13.4 | 356 | 9 | 420 |
| <i>S. derby</i> | 53 | 10.4 | 457 | 4 | 514 |
| <i>S. new-haw</i> | 38 | 26.6 | 105 | 2 | 145 |
| <i>S. saint-paul</i> | 24 | 23.1 | 80 | 2 | 106 |
| Others..... | ² 122 | 20.1 | ³ 486 | 12 | 620 |
| Total..... | 33,640 | 64.7 | 18,339 | 482 | 52,461 |

¹ *S. cholerae-suis* (diphaseic) was isolated from 51 patients and 24 other persons; *S. cholerae-suis* var. *kunzendorf* was isolated from 218 patients and 34 other persons.

² The following 17 types were isolated from patients: *S. abortus-equi*, *S. stanleyville*, *S. haifa*, *S. mission*, *S. bareilly*, *S. tennessee*, *S. muenchen*, *S. manhattan*, *S. rostock*, *S. gallinarum-pullorum*, *S. meleagridis*, *S. london*, *S. lexington*, *S. rosenthal*, *S. new-brunswick*, and *S. senftenberg*.

³ The following 41 types were isolated from persons

who were not ill: *S. bispebjerg*, *S. abortus-equi*, *S. abortus-bovis*, *S. stanley*, *S. reading*, *S. chester*, *S. kingston* var. *copenhagen*, *S. bredeney*, *S. stanleyville*, *S. haifa*, *S. mission*, *S. monteideo*, *S. potsdam*, *S. virchow*, *S. bareilly*, *S. hartford*, *S. tennessee*, *S. muenchen*, *S. manhattan*, *S. newport*, *S. blockley*, *S. chailey*, *S. hadar*, *S. rostock*, *S. panama*, *S. gallinarum-pullorum*, *S. butantan*, *S. meleagridis*, *S. nchanga*, *S. london*, *S. weltevreden*, *S. orion*, *S. lexington*, *S. cambridge*, *S. drypool*, *S. new-brunswick*, *S. binza*, *S. senftenberg*, *S. alachua*, *S. heves*, and *S. thiaroye*.

Table 2. Infecting *Salmonella* serotypes from ill

| Infected persons and serotypes | 1957 | | 1958 | | 1959 | | 1960 | | 1961 | |
|-----------------------------------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| | Num-ber | Per-cent | Num-ber | Per-cent | Num-ber | Per-cent | Num-ber | Per-cent | Num-ber | Per-cent |
| <i>Ill persons</i> | | | | | | | | | | |
| <i>S. enteritidis</i> | 78 | 7.4 | 196 | 17.4 | 37 | 4.2 | 162 | 12.5 | 153 | 10.3 |
| <i>S. typhimurium</i> | 800 | 76.3 | 724 | 64.2 | 694 | 78.5 | 956 | 73.9 | 921 | 62.2 |
| <i>S. bovis-morbificans</i> | 9 | .9 | 5 | .4 | 28 | 3.2 | 16 | 1.2 | 80 | 5.4 |
| <i>S. dublin</i> | 27 | 2.6 | 6 | .5 | 24 | 2.7 | 80 | 6.2 | 7 | .5 |
| <i>S. cholerae-suis</i> | 48 | 4.6 | 47 | 4.2 | 12 | 1.4 | 41 | 3.2 | 28 | 1.9 |
| <i>S. newington</i> | 11 | 1.0 | 48 | 4.3 | 20 | 2.3 | 11 | .8 | 54 | 3.6 |
| <i>S. brandenburg</i> | 2 | .2 | 0 | 0 | 15 | 1.7 | 10 | .8 | 80 | 5.4 |
| <i>S. anatum</i> | 33 | 3.1 | 9 | .8 | 2 | .2 | 4 | .4 | 10 | .7 |
| <i>S. give</i> | 0 | 0 | 46 | 4.1 | 10 | 1.1 | 0 | 0 | 49 | 3.3 |
| <i>S. heidelberg</i> | 26 | 2.5 | 28 | 2.5 | 34 | 3.8 | 5 | .4 | 17 | 1.1 |
| <i>S. kottbus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 1.7 |
| <i>S. derby</i> | 0 | 0 | 0 | 0 | 2 | .2 | 0 | 0 | 13 | .9 |
| <i>S. new-haw</i> | 5 | .5 | 4 | .3 | 5 | .6 | 2 | .1 | 9 | .6 |
| <i>S. saint-paul</i> | 8 | .8 | 13 | 1.1 | 1 | .1 | 0 | 0 | 0 | 0 |
| Other <i>Salmonella</i> | 1 | .1 | 2 | .2 | 0 | 0 | 6 | .5 | 35 | 2.4 |
| All types..... | 1,048 | 100.0 | 1,128 | 100.0 | 884 | 100.0 | 1,293 | 100.0 | 1,481 | 100.0 |
| <i>Normal persons</i> | | | | | | | | | | |
| <i>S. enteritidis</i> | 24 | 3.1 | 48 | 2.6 | 79 | 6.8 | 63 | 6.7 | 103 | 3.0 |
| <i>S. typhimurium</i> | 491 | 62.9 | 524 | 28.6 | 422 | 36.5 | 492 | 52.7 | 1,005 | 29.2 |
| <i>S. bovis-morbificans</i> | 15 | 1.9 | 22 | 1.2 | 78 | 6.7 | 32 | 3.4 | 211 | 6.1 |
| <i>S. dublin</i> | 10 | 1.3 | 16 | .9 | 15 | 1.3 | 13 | 1.4 | 10 | .3 |
| <i>S. cholerae-suis</i> | 5 | .6 | 4 | .2 | 3 | .3 | 0 | 0 | 5 | .2 |
| <i>S. newington</i> | 79 | 10.1 | 316 | 17.2 | 207 | 17.9 | 114 | 12.2 | 415 | 12.1 |
| <i>S. brandenburg</i> | 9 | 1.2 | 9 | .5 | 40 | 3.5 | 68 | 7.3 | 213 | 6.2 |
| <i>S. anatum</i> | 99 | 12.7 | 75 | 4.1 | 44 | 3.8 | 54 | 5.8 | 145 | 4.2 |
| <i>S. give</i> | 1 | .1 | 669 | 36.4 | 149 | 12.9 | 21 | 2.2 | 784 | 22.8 |
| <i>S. heidelberg</i> | 12 | 1.5 | 20 | 1.1 | 71 | 6.1 | 25 | 2.8 | 37 | 1.1 |
| <i>S. kottbus</i> | 0 | 0 | 1 | .1 | 4 | .3 | 15 | 1.6 | 204 | 5.9 |
| <i>S. derby</i> | 2 | .3 | 3 | .2 | 7 | .6 | 4 | .4 | 180 | 5.2 |
| <i>S. new-haw</i> | 6 | .8 | 11 | .6 | 15 | 1.3 | 5 | .5 | 14 | .4 |
| <i>S. saint-paul</i> | 13 | 1.7 | 39 | 2.1 | 0 | 0 | 4 | .4 | 5 | .2 |
| Other <i>Salmonella</i> | 14 | 1.8 | 77 | 4.2 | 23 | 2.0 | 24 | 2.6 | 106 | 3.1 |
| All types..... | 780 | 100.0 | 1,834 | 100.0 | 1,157 | 100.0 | 934 | 100.0 | 3,437 | 100.0 |

NOTE: Percentages may not add to 100.0 because of rounding.

This result seems to confirm the hypothesis that these six serotypes show a lesser degree of pathogenicity.

A total of 336 foodborne *Salmonella* infections were recognized clinically, by laboratory studies, or by both means, during this 10-year period (table 3). The percent of foodborne outbreaks attributed to salmonellae varied from about 14 to 34 percent of the total number of incidents, although no consistent trends in their occurrence were observed.

The majority of the *Salmonella* outbreaks involved less than 10 ill persons, although in 50 outbreaks 26 to 100 persons reportedly were involved and in 13 outbreaks, 101 to more than

500 persons (table 4). The six largest outbreaks affected 210, 222, 296, 380, 522, and 556 persons.

The population of Poland increased from 28,310,000 persons in 1957 to 31,551,000 in 1965. In 1957, the proportion that was rural was 54.7 percent and in 1965, 50.3 percent. The outbreaks and patients involved, by environment of residence and year, are shown in table 5. The predominance of incidents oscillated considerably between rural and urban populations with no definite trends, although 193, or 57.4 percent, of the outbreaks occurred in rural areas and 143, or 42.6 percent, in urban.

The average number of patients per outbreak was 20.3 in rural areas and 24.3 in the cities.

and normal persons, by year, Poland, 1957-66

| 1962 | | 1963 | | 1964 | | 1965 | | 1966 | | Total 1957-66 |
|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|------------------|
| Num- ber | Per- cent | Num- ber | Per- cent | Num- ber | Per- cent | Num- ber | Per- cent | Num- ber | Per- cent | |
| 921 | 31.8 | 2,006 | 59.9 | 4,163 | 78.6 | 6,968 | 80.2 | 6,093 | 80.5 | 20,777 |
| 1,710 | 58.9 | 1,057 | 31.6 | 885 | 16.7 | 1,315 | 15.1 | 1,179 | 15.6 | 10,241 |
| 51 | 1.8 | 32 | .9 | 18 | .3 | 310 | 3.6 | 22 | .3 | 571 |
| 68 | 2.3 | 57 | 1.7 | 113 | 2.1 | 8 | .1 | 43 | .5 | 433 |
| 22 | .8 | 35 | 1.0 | 20 | .4 | 11 | .1 | 5 | .1 | 269 |
| 32 | 1.1 | 20 | .6 | 32 | .6 | 8 | .1 | 15 | .2 | 251 |
| 31 | 1.1 | 24 | .7 | 7 | .1 | 1 | .01 | 11 | .1 | 181 |
| 4 | .1 | 54 | 1.6 | 7 | .1 | 31 | .3 | 77 | 1.0 | 231 |
| 25 | .9 | 13 | .4 | 3 | .1 | 6 | .1 | 4 | .1 | 156 |
| 14 | .5 | 12 | .4 | 0 | 0 | 3 | .03 | 99 | 1.3 | 238 |
| 7 | .2 | 2 | .1 | 1 | .01 | 16 | .2 | 4 | .1 | 55 |
| 10 | .3 | 21 | .6 | 3 | .1 | 2 | .02 | 2 | .02 | 53 |
| 1 | .03 | 0 | 0 | 7 | .1 | 1 | .01 | 4 | .1 | 38 |
| 1 | .03 | 0 | 0 | 0 | 0 | 1 | .01 | 0 | 0 | 24 |
| 4 | .1 | 17 | .5 | 36 | .7 | 10 | .1 | 11 | .1 | 122 |
| 2,901 | 99.9 | 3,350 | 100.0 | 5,295 | 99.9 | 8,691 | 99.9 | 7,569 | 100.2 | 33,640 |
| 115 | 7.4 | 193 | 8.1 | 376 | 26.2 | 602 | 33.0 | 865 | 28.7 | 2,468 |
| 550 | 35.5 | 427 | 18.0 | 415 | 28.9 | 496 | 27.2 | 431 | 14.3 | 5,253 |
| 133 | 8.6 | 78 | 3.3 | 57 | 4.0 | 53 | 2.9 | 110 | 3.6 | 789 |
| 14 | .9 | 13 | .5 | 13 | .9 | 4 | .2 | 6 | .2 | 114 |
| 4 | .3 | 4 | .2 | 4 | .3 | 15 | .8 | 3 | .1 | 47 |
| 261 | 16.8 | 315 | 13.3 | 228 | 15.9 | 94 | 5.2 | 204 | 6.7 | 2,233 |
| 118 | 7.6 | 256 | 10.8 | 18 | 1.2 | 12 | .6 | 35 | 1.2 | 778 |
| 83 | 5.4 | 558 | 23.6 | 116 | 8.1 | 353 | 19.3 | 1,014 | 33.6 | 2,541 |
| 148 | 9.5 | 241 | 10.2 | 100 | 7.0 | 46 | 2.5 | 23 | .8 | 2,182 |
| 18 | 1.2 | 34 | 1.4 | 7 | .5 | 16 | .9 | 210 | 6.9 | 450 |
| 20 | 1.3 | 19 | .8 | 26 | 1.8 | 49 | 2.7 | 18 | .6 | 356 |
| 47 | 3.0 | 120 | 5.1 | 12 | .8 | 27 | 1.5 | 55 | 1.8 | 457 |
| 6 | .4 | 7 | .3 | 16 | 1.1 | 15 | .8 | 10 | .3 | 105 |
| 9 | .6 | 6 | .3 | 3 | .2 | 0 | 0 | 1 | .03 | 80 |
| 23 | 1.5 | 98 | 4.1 | 45 | 3.1 | 43 | 2.4 | 33 | 1.1 | 486 |
| 1,549 | 100.0 | 2,369 | 100.0 | 1,436 | 100.0 | 1,825 | 100.0 | 3,018 | 99.9 | 18,339 |

The average number of persons involved in single-family outbreaks in both rural and urban areas was four to five. In other outbreaks not associated with specific environments but only with certain areas of towns, villages, or districts, an average of 56 persons per focus were involved in towns and 40 persons per focus in villages.

The lower number of patients in rural outbreaks may be explained partly by incomplete registration of patients in those areas. Nevertheless, the restaurants, canteens, shops, and ready-to-eat foods available to the urban population must be taken into account. Two of the six largest outbreaks (one involving 556 persons and the other 380) occurred in towns, and the other

four (with 522, 296, 222, and 210 persons affected) occurred in the country; however, the environments of the persons affected varied.

Reported outbreaks of *Salmonella* infections with infecting serotype, number of patients involved, and source of infection are shown in table 6. *S. typhimurium* accounted for 258 (76.8 percent) of all outbreaks. Only four other serotypes were involved in more than two outbreaks.

These types, with number and percent affected were as follows: *S. enteritidis*—44 (13.1 percent), *Salmonella dublin*—19 (5.6 percent), *Salmonella cholerae-suis* var. *kunzendorf*—5 (1.5 percent), and *S. heidelberg*—4 (1.2 percent). Of the six largest outbreaks, four were

caused by *S. typhimurium*, one by *S. bovis-morbificans*, and one by *S. enteritidis*. Outbreaks caused by *S. typhimurium* were evenly distributed between the urban and rural populations. Foci of *S. enteritidis* were slightly more predominant in the country. However, all five outbreaks of *S. cholerae-suis* var. *kunzen-dorf* occurred in the urban population.

It should be emphasized that the parts played by *S. typhimurium* and *S. enteritidis* in *Salmonella* food poisoning in Poland have remained constant for 20 years. The previous report (1) showed that in the years 1946-56, *S. typhimurium* was the cause of 74.5 percent and *S. enteritidis* of 15.0 percent of all *Salmonella* food poisoning outbreaks. These proportions are in accordance with the data in table 6. (*S. typhimurium*—76.8 percent and *S. enteritidis*—13.1 percent). The ratio of *S. typhimurium* to *S. enteritidis* in the food poisoning of

groups remained unchanged even though in the years 1962-66 the proportion of *S. enteritidis* infections increased about seven to eight times in relation to the total number of *Salmonella* infections (table 2). This observation seems to indicate that food poisoning outbreaks caused by *Salmonella* and sporadic cases involve separate mechanisms.

Meat and meat products were the predominant sources of infection in outbreaks in which a food source was known to be the cause (130, or 84.4 percent). Eggs were the source of infection in only one reported outbreak. Unfortunately, the source was not known in 54.2 percent of the outbreaks. The small proportion of patients per outbreak indicates that most of the occurrences were single-family outbreaks, in which the search for the source of infection is frequently inadequate.

During the same 10-year period, 752 *Salmo-*

Table 3. Outbreaks of food infections or intoxications according to bacterial etiology, by year, Poland, 1957-66

| Year | Total food infections and intoxications | Incidents of bacterial etiology | Incidents caused by <i>Salmonella</i> | | |
|----------------|---|---------------------------------|---------------------------------------|--------------------------------|--|
| | | | Number | Percent of bacterial outbreaks | Percent of total food infections and intoxications |
| <i>1957</i> | | | | | |
| Outbreaks..... | 91 | 87 | 24 | 27. 8 | 26. 3 |
| Patients..... | 2, 783 | 2, 736 | 352 | 12. 8 | 12. 6 |
| <i>1958</i> | | | | | |
| Outbreaks..... | 82 | 77 | 18 | 23. 3 | 21. 9 |
| Patients..... | 3, 105 | 3, 050 | 484 | 15. 8 | 15. 5 |
| <i>1959</i> | | | | | |
| Outbreaks..... | 124 | 107 | 20 | 18. 7 | 18. 1 |
| Patients..... | 3, 166 | 2, 860 | 412 | 14. 4 | 13. 0 |
| <i>1960</i> | | | | | |
| Outbreaks..... | 136 | 130 | 46 | 35. 4 | 33. 8 |
| Patients..... | 3, 435 | 3, 397 | 684 | 20. 1 | 19. 9 |
| <i>1961</i> | | | | | |
| Outbreaks..... | 122 | 109 | 29 | 26. 6 | 23. 7 |
| Patients..... | 3, 332 | 3, 245 | 401 | 12. 3 | 12. 0 |
| <i>1962</i> | | | | | |
| Outbreaks..... | 195 | 174 | 38 | 21. 8 | 19. 5 |
| Patients..... | 4, 519 | 4, 387 | 1, 238 | 28. 2 | 27. 3 |
| <i>1963</i> | | | | | |
| Outbreaks..... | 210 | 195 | 29 | 14. 8 | 13. 8 |
| Patients..... | 4, 519 | 4, 385 | 716 | 16. 3 | 15. 8 |
| <i>1964</i> | | | | | |
| Outbreaks..... | 184 | 171 | 38 | 22. 2 | 20. 6 |
| Patients..... | 3, 920 | 3, 819 | 669 | 17. 5 | 17. 0 |
| <i>1965</i> | | | | | |
| Outbreaks..... | 269 | 196 | 54 | 27. 5 | 23. 5 |
| Patients..... | 4, 932 | 4, 766 | 1, 695 | 35. 5 | 34. 5 |
| <i>1966</i> | | | | | |
| Outbreaks..... | 236 | 145 | 40 | 27. 6 | 16. 9 |
| Patients..... | 5, 196 | 4, 225 | 739 | 17. 5 | 14. 2 |

NOTE: 3 or more patients constitute an outbreak.

Table 4. *Salmonella* food intoxication incidents by number of persons involved and type of organism, Poland, 1957-66

| Number of persons involved | Number of outbreaks caused by— | | | | |
|----------------------------|-----------------------------------|-----------------------------------|------------------|--|---------------------------------------|
| | <i>S. typhi-</i> <i>murium</i> | <i>S. enteri-</i> <i>tidis</i> | <i>S. dublin</i> | <i>S. cholerae-</i> <i>suis</i> var. <i>kunzendorf</i> | <i>S. bovis</i> <i>morbificans</i> |
| 3..... | 56 | 13 | 3 | 1 | 0 |
| 4-5..... | 71 | 11 | 0 | 0 | 0 |
| 6-10..... | 47 | 8 | 4 | 0 | 0 |
| 11-25..... | 35 | 6 | 6 | 3 | 0 |
| 26-50..... | 27 | 4 | 5 | 1 | 0 |
| 51-100..... | 12 | 0 | 1 | 0 | 0 |
| 101-200..... | 6 | 1 | 0 | 0 | 0 |
| More than 200..... | 4 | 1 | 0 | 0 | 1 |

Table 5. *Salmonella* food intoxication outbreaks and number of patients involved in towns and rural districts, by year, Poland, 1957-66

| Year | Outbreaks in urban environment | | | | | Outbreaks in rural environment | | | | | Yearly total |
|----------------|--------------------------------|-------------------------------|-------|-------|-------------------------|--------------------------------|--|-------|-------|-------------------------|--------------|
| | Single family | Boarding schools, sanitoriums | Other | Total | Percent of yearly total | Single family | State farms and children's summer camp | Other | Total | Percent of yearly total | |
| <i>1957</i> | | | | | | | | | | | |
| Outbreaks..... | 6 | 3 | 0 | 9 | 37.5 | 4 | 6 | 5 | 15 | 62.5 | 24 |
| Patients..... | 39 | 72 | 0 | 111 | 31.5 | 22 | 142 | 77 | 241 | 68.5 | 352 |
| <i>1958</i> | | | | | | | | | | | |
| Outbreaks..... | 7 | 1 | 4 | 12 | 66.7 | 2 | 0 | 4 | 6 | 33.3 | 18 |
| Patients..... | 24 | 161 | 255 | 440 | 90.9 | 13 | 0 | 31 | 44 | 9.1 | 484 |
| <i>1959</i> | | | | | | | | | | | |
| Outbreaks..... | 7 | 0 | 4 | 11 | 55.0 | 3 | 1 | 5 | 9 | 45.0 | 20 |
| Patients..... | 27 | 0 | 284 | 311 | 75.5 | 21 | 14 | 66 | 101 | 24.5 | 412 |
| <i>1960</i> | | | | | | | | | | | |
| Outbreaks..... | 8 | 2 | 6 | 16 | 34.8 | 17 | 3 | 10 | 30 | 65.2 | 46 |
| Patients..... | 34 | 104 | 172 | 310 | 45.3 | 73 | 81 | 220 | 374 | 54.7 | 684 |
| <i>1961</i> | | | | | | | | | | | |
| Outbreaks..... | 9 | 2 | 2 | 13 | 44.8 | 7 | 0 | 9 | 16 | 55.2 | 29 |
| Patients..... | 33 | 36 | 69 | 138 | 34.4 | 36 | 0 | 227 | 263 | 65.6 | 401 |
| <i>1962</i> | | | | | | | | | | | |
| Outbreaks..... | 7 | 1 | 6 | 14 | 36.8 | 10 | 3 | 11 | 24 | 63.2 | 38 |
| Patients..... | 25 | 151 | 630 | 806 | 65.1 | 64 | 38 | 330 | 432 | 34.9 | 1,238 |
| <i>1963</i> | | | | | | | | | | | |
| Outbreaks..... | 6 | 2 | 6 | 14 | 48.3 | 8 | 1 | 6 | 15 | 51.7 | 29 |
| Patients..... | 20 | 51 | 410 | 481 | 67.2 | 40 | 37 | 158 | 235 | 32.8 | 716 |
| <i>1964</i> | | | | | | | | | | | |
| Outbreaks..... | 13 | 4 | 3 | 20 | 52.6 | 9 | 4 | 5 | 18 | 47.4 | 38 |
| Patients..... | 51 | 100 | 195 | 346 | 51.7 | 46 | 69 | 208 | 323 | 48.3 | 669 |
| <i>1965</i> | | | | | | | | | | | |
| Outbreaks..... | 10 | 3 | 3 | 16 | 29.6 | 21 | 4 | 13 | 38 | 70.4 | 54 |
| Patients..... | 43 | 152 | 108 | 303 | 17.9 | 122 | 145 | 1,125 | 1,392 | 82.1 | 1,695 |
| <i>1966</i> | | | | | | | | | | | |
| Outbreaks..... | 11 | 0 | 7 | 18 | 45.0 | 16 | 3 | 3 | 22 | 55.0 | 40 |
| Patients..... | 42 | 0 | 184 | 226 | 30.6 | 71 | 54 | 388 | 513 | 69.4 | 739 |
| <i>1957-66</i> | | | | | | | | | | | |
| Outbreaks..... | 84 | 18 | 41 | 143 | 42.6 | 97 | 25 | 71 | 193 | 57.4 | 336 |
| Patients..... | 338 | 827 | 2,307 | 3,472 | 47.0 | 508 | 580 | 2,830 | 3,918 | 53.0 | 7,390 |

NOTE: 3 or more patients constitute an outbreak.

nella isolations were obtained in the bacteriological laboratories of the National Veterinary Service and the National Health Service from foods of animal origin, other foods, animals, water, and sewage and were identified in the National Salmonella Center (table 7). Of these 752 isolations, 73 (9.7 percent) were associated with foodborne outbreaks of salmonellosis. Eighteen serotypes were involved, six of which were responsible for the majority of the reported infections from food (table 6).

A similar relationship appeared in the source

of the isolations from foods of animal origin, other foods, animals, water, and sewage (table 8) and the source of isolations in human outbreaks (table 6). The greatest number of isolations were obtained from cattle and pigs and the meat of these animals. Although *Salmonella gallinarum* and *Salmonella pullorum* accounted for most of the isolations from poultry, eggs, and egg products, no infections in human beings from these serotypes have been reported. *S. give*, found in animals and meat, has not been associated with outbreaks in man, but it has been

Table 6. *Salmonella* outbreaks by serotype and source of infection, Poland, 1957-66

| <i>Salmonella</i> serotype | Source of infection | | | | Total | |
|--|------------------------|------|-----------------|---------|--------|---------|
| | Meat and meat products | Eggs | Other products | Unknown | Number | Percent |
| <i>S. typhimurium</i> : | | | | | | |
| Outbreaks..... | ¹ 98 | 1 | ² 18 | 141 | 258 | 76.8 |
| Patients..... | 3,572 | 65 | 1,104 | 789 | 5,530 | 74.8 |
| <i>S. enteritidis</i> : | | | | | | |
| Outbreaks..... | 14 | 0 | ³ 3 | 27 | 44 | 13.1 |
| Patients..... | 885 | 0 | 27 | 126 | 1,038 | 14.0 |
| <i>S. dublin</i> : | | | | | | |
| Outbreaks..... | 12 | 0 | ⁴ 1 | 6 | 19 | 5.6 |
| Patients..... | 317 | 0 | 14 | 40 | 371 | 5.0 |
| <i>S. cholerae-suis</i> var. <i>kunzendorf</i> : | | | | | | |
| Outbreaks..... | 3 | 0 | 0 | 2 | 5 | 1.5 |
| Patients..... | 65 | 0 | 0 | 18 | 83 | 1.1 |
| <i>S. bovis-morbificans</i> : | | | | | | |
| Outbreaks..... | 1 | 0 | 0 | 0 | 1 | .3 |
| Patients..... | 296 | 0 | 0 | 0 | 296 | 4.1 |
| <i>S. heidelberg</i> : | | | | | | |
| Outbreaks..... | 1 | 0 | 0 | 3 | 4 | 1.2 |
| Patients..... | 15 | 0 | 0 | 10 | 25 | .3 |
| <i>S. haifa</i> : | | | | | | |
| Outbreaks..... | 0 | 0 | ⁵ 1 | 1 | 2 | .6 |
| Patients..... | 0 | 0 | 23 | 4 | 27 | .4 |
| <i>S. anatum</i> : | | | | | | |
| Outbreaks..... | 0 | 0 | 0 | 1 | 1 | .3 |
| Patients..... | 0 | 0 | 0 | 9 | 9 | .1 |
| <i>S. newington</i> : | | | | | | |
| Outbreaks..... | 0 | 0 | 0 | 1 | 1 | .3 |
| Patients..... | 0 | 0 | 0 | 6 | 6 | .1 |
| <i>S. group B</i> (unidentified): | | | | | | |
| Outbreaks..... | 1 | 0 | 0 | 0 | 1 | .3 |
| Patients..... | 5 | 0 | 0 | 0 | 5 | .1 |
| Total: | | | | | | |
| Outbreaks..... | 130 | 1 | 23 | 182 | 336 | 100.0 |
| Patients..... | 5,155 | 65 | 1,168 | 1,002 | 7,390 | 100.0 |
| Percent of total outbreaks..... | 38.7 | .3 | 6.8 | 54.2 | ----- | 100.0 |
| Percent of all patients..... | 69.8 | .9 | 15.8 | 13.5 | ----- | 100.0 |

¹ Includes outbreaks caused by duck meat.

² 7 outbreaks caused by cakes, 2 by ice cream, 7 by processed dishes, 1 by smoked fish, and 1 by sweet vanilla milk soup.

³ 1 outbreak caused by fish, 2 by processed dishes.

⁴ Caused by grease of animal origin.

⁵ Caused by a canteen meal.

NOTE: 3 or more patients constituted an outbreak.

Table 7. Isolations of *Salmonella* serotypes from foods of animal origin, other foods, animals, water, and sewage, by year, Poland, 1957-66

| <i>Salmonella</i> serotype | Number of isolations ¹ | | | | | | | | | | | Total iso- lations | | | | | | | | | | |
|--|-----------------------------------|------|------|------|------|------|------|------|------|------|-----|--------------------------|-----|---|----|---|----|----|-----|---|-----|----|
| | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | | | | | | | | | | | | |
| <i>S. cholerae-suis</i> ----- | 8 | 3 | 1 | 4 | 6 | 16 | 121 | 39 | 15 | 11 | 12 | 235 | 1 | | | | | | | | | |
| <i>S. typhimurium</i> ----- | 6 | 5 | 4 | 3 | 6 | 3 | 7 | 5 | 24 | 7 | 21 | 11 | 68 | 6 | 18 | 1 | 15 | 10 | 46 | 4 | 215 | 55 |
| <i>S. dublin</i> ----- | 2 | 1 | 4 | | 11 | 4 | 4 | 12 | | 8 | 2 | 14 | 2 | 6 | 3 | | 6 | | 6 | 1 | 70 | 6 |
| <i>S. enteritidis</i> ----- | 1 | 1 | 0 | | 2 | 2 | 2 | 4 | | 6 | 2 | 3 | 1 | 7 | 7 | 3 | 22 | | 6 | | 54 | 9 |
| <i>S. bovis-morbificans</i> --- | 1 | | 0 | | 0 | 0 | 1 | 0 | | 0 | | 1 | | 0 | 3 | 1 | 1 | | | | 7 | 1 |
| <i>S. give</i> ----- | 0 | | 19 | | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | | 0 | 0 | | 0 | | | | 20 | |
| <i>S. saint-paul</i> ----- | 0 | | 3 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | | 0 | | | | 3 | |
| <i>S. kottbus</i> ----- | 0 | | 1 | | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | | 0 | 0 | | 0 | | | | 2 | |
| <i>S. anatum</i> ----- | 0 | | 0 | | 1 | 0 | 0 | 0 | | 0 | 1 | 0 | | 0 | 0 | | 5 | | | | 7 | |
| <i>S. gallinarum-</i> <i>pullorum</i> ----- | 0 | | 0 | | 0 | 22 | 7 | 27 | | 18 | 11 | | | 3 | | | 20 | | | | 108 | |
| <i>S. brandenburg</i> ----- | 0 | | 0 | | 0 | 0 | 2 | 1 | | 0 | 2 | | | 2 | | | 1 | | | | 8 | |
| <i>S. derby</i> ----- | 0 | | 0 | | 0 | 0 | 1 | 0 | | 0 | 0 | | | 0 | | | 0 | | | | 1 | |
| <i>S. newport</i> ----- | 0 | | 0 | | 0 | 0 | 1 | 0 | | 0 | 0 | | | 0 | | | 3 | | | | 4 | |
| <i>S. newington</i> ----- | 0 | | 0 | | 0 | 0 | 0 | 2 | | 3 | 1 | | | 1 | | | 4 | | | | 11 | |
| <i>S. muenchen</i> ----- | 0 | | 0 | | 0 | 0 | 0 | 0 | | 1 | 0 | | | 0 | | | 0 | | | | 1 | |
| <i>S. senftenberg</i> ----- | 0 | | 0 | | 0 | 0 | 0 | 0 | | 1 | 0 | | | 2 | | | 0 | | | | 3 | |
| <i>S. new-haw</i> ----- | 0 | | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | | | 0 | | | 2 | | | | 2 | |
| <i>S. heidelberg</i> ----- | 0 | | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | | | 0 | | | 1 | 1 | | | 1 | 1 |
| Total----- | 18 | 7 | 34 | 4 | 24 | 3 | 41 | 7 | 70 | 7 | 186 | 15 | 149 | 9 | 60 | 1 | 49 | 14 | 121 | 6 | 752 | 73 |

¹ Italics show the number, among the yearly isolations to the left, that were associated with foodborne outbreaks of salmonellosis.

recovered sporadically from specimens from ill persons.

Summary

Detailed data were assembled and studied on the *Salmonella* infections diagnosed in 33,640 ill and 18,821 symptomless persons in Poland over the 10-year period 1957-66. The percent of isolations of individual serotypes from persons who became ill in relation to total isolations of the serotype from both the sick and well revealed the role of each serotype in causing symptomatic infections during this period.

The proportion of *Salmonella* food poisoning outbreaks in Poland caused by *Salmonella typhimurium* remained fairly constant over the years 1957-66, as well as over the preceding 10 years, as did the proportion of outbreaks caused by *Salmonella enteritidis*. *S. typhimurium* caused 74.5 percent of the outbreaks in the years 1946-56 and 76.8 percent in the years 1957-66. *S. enteritidis* caused 15.0 percent of the outbreaks in the earlier period and 13.1 percent in the period under study. However, in the years

1962-66, the proportion of *S. enteritidis* infections increased several times in relation to the total number of *Salmonella* infections. These results suggest that a different mechanism is involved in the spread of *S. enteritidis* infections from that operating in the spread of infections caused by other *Salmonella*.

The percentage of symptomatic infections caused by a given serotype in relation to the total infections, both symptomatic and asymptomatic, that the serotype has caused might serve as a basis for rating the degree of pathogenicity of individual serotypes. By this hypothesis, *S. enteritidis*, which caused illness in 89.4 percent of the persons in Poland it infected in the period 1957-66, would be ranked as most pathogenic of the serotypes studied; *Salmonella give*, which caused illness in 6.7 percent of those infected, would be ranked as least pathogenic.

REFERENCE

- (1) Buczowski, Z.: Salmonellosis of man diagnosed in the years 1946-56 in Poland. Bull Inst Mar Med Gdansk 12: 51-71 (1961).

Table 8. *Salmonella* isolations from foods of animal origin, other foods, animals, water, and sewage, by serotype and source, Poland, 1957-66

| Source of isolation | <i>Salmonella</i> types | | | | | | | | | | Total |
|--|-------------------------|-----------------------|-------------------------------|------------------|-----------------------|----------------|---------------------|---------------|--|--|-------|
| | <i>S. cholerae-suis</i> | <i>S. typhimurium</i> | <i>S. gallinarum-pullorum</i> | <i>S. dublin</i> | <i>S. enteritidis</i> | <i>S. give</i> | Others ¹ | | | | |
| Foods of animal origin: | | | | | | | | | | | |
| Cattle, beef, veal.... | 5 | 16 6 | 1 | 44 3 | 8 7 | 19 | 14 | 107 16 | | | |
| Swine, pork, bacon.... | 182 | 25 5 | 0 | 1 | 3 | 0 | 4 | 215 5 | | | |
| Sheep, mutton..... | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | | | |
| Rabbit..... | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | | | |
| Hare..... | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | | | |
| Wild hog..... | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | |
| Meat (meat dishes)... | 24 | 10 9 | 0 | 5 2 | 0 | 0 | 1 1 | 40 12 | | | |
| Processed meat (jellied meats, pâtés)..... | 0 | 20 19 | 0 | 0 | 0 | 0 | 3 1 | 23 20 | | | |
| Smoked meat (sausages, ham)... | 1 1 | 9 7 | 0 | 2 | 1 1 | 0 | 0 | 13 9 | | | |
| Animal fat..... | 0 | 0 | 0 | 1 1 | 0 | 0 | 0 | 1 1 | | | |
| Duck..... | 2 | 26 | 2 | 0 | 11 | 0 | 5 | 46 | | | |
| Goose..... | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 5 | | | |
| Chicken..... | 0 | 21 | 36 | 2 | 9 | 0 | 0 | 68 | | | |
| Smoked herring..... | 0 | 1 1 | 0 | 0 | 0 | 0 | 0 | 1 1 | | | |
| Other foods: | | | | | | | | | | | |
| Salad..... | 0 | 0 | 0 | 0 | 1 1 | 0 | 0 | 1 1 | | | |
| Eggs, frozen eggs, egg powder..... | 0 | 9 | 68 | 1 | 1 | 0 | 1 | 80 | | | |
| Ice cream..... | 0 | 2 2 | 0 | 0 | 0 | 0 | 0 | 2 2 | | | |
| Artificial baby food... | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | | | |
| Bone meal..... | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | | | |
| Fish meal..... | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | | | |
| Roll, macaroni..... | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 3 | | | |
| Cake..... | 0 | 6 6 | 0 | 0 | 0 | 0 | 0 | 6 6 | | | |
| Food not further specified..... | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 5 | | | |
| Other sources: | | | | | | | | | | | |
| Horse..... | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 4 | | | |
| Rat, mouse..... | 0 | 15 | 0 | 6 | 3 | 0 | 4 | 28 | | | |
| Dog..... | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 3 | | | |
| Fur animals (silver fox, nutria)..... | 16 | 32 | 0 | 4 | 2 | 0 | 2 | 56 | | | |
| Guinea hen..... | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | | | |
| Guinea pig..... | 0 | 1 | 0 | 0 | 8 | 0 | 0 | 9 | | | |
| Monkey..... | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | | | |
| Snake..... | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | | | |
| Canary..... | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | | | |
| Water..... | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 4 | | | |
| Sewage..... | 1 | 0 | 0 | 1 | 1 | 0 | 5 | 8 | | | |
| Pigeon..... | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | | | |
| Deer..... | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | |
| Puma..... | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | | | |
| Fox..... | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | | | |
| Nutria..... | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | | | |
| Total..... | 235 1 | 215 55 | 108 | 70 6 | 54 9 | 20 | 50 2 | 752 73 | | | |

¹ *S. saint-paul*, *S. derby*, *S. brandenburg*, *S. heidelberg*, *S. muenchen*, *S. newport*, *S. kotibus*, *S. bovis-morbificans*, *S. anatum*, *S. new-haw*, *S. newington*, and *S. senftenberg*.

NOTE: Italics show the number, among the isolations to the left, that were associated with foodborne outbreaks of salmonellosis.