

SALMONELLA EXCRETION BY TURTLES

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THE PET turtle as a potential source of salmonellosis has been pointed out (1, 2). The evidence is clear-cut—a pet turtle is brought into a home and within a few days one or more persons handling the turtle becomes ill. Upon investigation, the same *Salmonella* serotype is recovered from the patient and the turtle. Quite commonly, however, a turtle is in the home for several months before any person becomes ill. One wonders in such instances whether the turtle had the organism when it was brought into the home or whether it was infected from some source after it arrived.

To supply a logical basis for evaluation of these points, we attempted to determine if naturally infected pet turtles would have salmonellae in the feces for prolonged periods of time. As an adjunct to the study, we tried to quantitate the levels of *Salmonella* contamination in the typical environment of a pet turtle.

Materials and Methods

The animals studied were young dormant turtles (*Pseudemys scripta-elegans*) obtained from a commercial turtle breeder in March 1966. They had been hatched and refrigerated at the end of the preceding summer (1965). Since hatching the turtles had received neither food nor water. The original group of 100 turtles was divided into subgroups of 10 each, and each subgroup was kept in a separate shallow pan. Their diet consisted of lettuce rinsed in 10 percent hypochlorite solution to remove any possible *Salmonella* contamination, and the water used in the pans was from a chlorinated drinking water supply. The pans were sterilized

weekly, and the water was changed as often as every other day. Samples of water were cultured approximately every 2 weeks during the 27-week test period.

In an attempt to quantitate levels of contamination reached in a container with only a single turtle, one subgroup of 10 turtles was selected and each turtle was placed in a separate sterile pan containing 1,200 ml. of fresh water. Levels of contamination were checked by the most probable numbers method (3) at 24, 48, and 72 hours. The quantitation was stopped at 3 days, because it was felt that a typical owner would change the water that frequently for esthetic reasons. This experiment was repeated three times in 3 successive weeks. Standard methods of isolation and identification of salmonellae were used (4). Tetrathionate broth was used for enrichment, and brilliant green agar plates were used for primary isolation.

Results

The results of cultures from the 10 groups are summarized in table 1. Seven of the ten groups excreted salmonellae for most of the 27-week period. However, water samples from group C were consistently negative beginning at the 7th week, group G at the 9th week, and group D at the 15th week. *Salmonella* serotypes recovered at the start of the experiment were *Salmonella blockley*, *Salmonella eimsbuettel*, *Salmonella heidelberg*, *Salmonella livingstone*, and *Salmonella saint-paul*. On one occasion an *Arizona* organism was recovered. After 7 weeks only two serotypes, *S. blockley* and *S. heidelberg*, were recovered. From this point on, each positive container consistently yielded but one of these two serotypes. Of the seven groups of turtles still having *Salmonella* at the end of the test period, five yielded *S. blockley* and two *S. heidelberg*.

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Table 2 shows the results of studies on levels of contamination in a typical tank holding only one turtle. Variation in excretion rates from week to week for the same turtle was striking. For example, the water of the tank holding turtle I-9 was found to contain more than 1,100 organisms per 100 ml. during the first 2 weeks, but the water was essentially free of *Salmonella* in the third. As a rule, contamination tended to reach its peak by our measurements within 24 hours after a turtle was placed in the tank. The highest levels of contamination measured were in the water from a pan with more than 1,100 organisms, although measuring the exact levels were beyond the capacity of the test system.

Discussion

By the end of the test period, all the turtles were more than 1 year old. *Salmonella* excretion was evident in all 10 groups at least 9 months after hatching and in seven after a full year. In the pet turtle industry, there is no carryover from 1 year to the next; they are either sold because of a large demand or they die, since they have poor viability. It is apparent, therefore, from these results that naturally infected turtles can be expected to remain a hazard for the duration of their commercial suitability. Since turtles are usually not kept very long as pets, they can be expected to remain a hazard for the duration of their stay in a household.

It is impossible to equate contamination levels with any particular degree of risk of infection, but they surely represent a sizable potential inoculum to a young child, the usual victim. The

extreme variability in contamination levels explains why a child can handle a turtle with impunity 1 week and be infected by his pet the next.

Table 2. *Salmonella heidelberg* organisms per 100 ml. of water in containers with single turtle, most probable numbers method

Turtle number and day of sampling	First week	Second week	Third week
I-1:			
1-----	0	0	0
2-----	0	3.6	0
3-----	0	0	0
I-4:			
1-----	9	46	150
2-----	0	1,100	1,100
3-----	9	90	240
I-5:			
1-----	60	0	9
2-----	240	0	3.6
3-----	30	0	3.6
I-6:			
1-----	0	0	0
2-----	0	9	0
3-----	0	0	0
I-8:			
1-----	¹ > 1,100	240	36
2-----	> 1,100	> 1,100	1,100
3-----	> 1,100	> 1,100	460
I-9:			
1-----	> 1,100	> 1,100	0
2-----	> 1,100	> 1,100	3.6
3-----	> 1,100	> 1,100	0
I-10:			
1-----	> 1,100	0	0
2-----	150	0	0
3-----	15	0	0

¹ *Salmonellae* in excess of capacity of test system.

NOTE: The water sampled from containers of turtles I-2, I-3, and I-7 did not show *Salmonella* organisms.

Table 1. *Salmonellae* found in cultures of water samples from containers with 10 turtles for 27 weeks

Container	Week											
	1	3	5	7	9	11	15	17	20	22	25	27
A-----	+	+	+	+	+	+	+	+	+	+	+	+
B-----	+	+	+	+	+	+	+	+	+	+	+	+
C-----	+	+	+	+	+	+	+	+	+	+	+	+
D-----	+	+	+	+	+	+	+	+	+	+	+	+
E-----	+	+	+	+	+	+	+	+	+	+	+	+
F-----	+	+	+	+	+	+	+	+	+	+	+	+
G-----	+	+	+	+	+	+	+	+	+	+	+	+
H-----	+	+	+	+	+	+	+	+	+	+	+	+
I-----	+	+	+	+	+	+	+	+	+	+	+	+
J-----	+	+	+	+	+	+	+	+	+	+	+	+

The results of this study seem to indicate that merely retaining a turtle for a period of time will not necessarily eliminate the carrier state. Attempts to treat carrier turtles with antimicrobial agents have been unsuccessful (personal communication, V. D. Foltz, University of Kansas, July 1965). Thus attempts at control will have to be made earlier in the turtle's life cycle. One study has indicated transovarial passage of salmonellae in the turtle (5), but the serotype involved, *Salmonella rubislaw*, may be host adapted and thus a special case. A subsequent attempt to corroborate these results was unsuccessful, but it indicated that contamination of the soil on the banks of turtle ponds may serve as a significant source of contamination (unpublished data, A. F. Kaufmann, National Communicable Disease Center, June 1966). Possibly salmonellae from such a source contaminate the surface of a newly laid egg, subsequently penetrate the shell, and thereby infect the young turtle before it hatches. Further study is needed in this area, as it seems to offer the key to control of this problem.

Summary

A group of 100 turtles, naturally infected with salmonellae, was studied to see how long

they would excrete the organisms. Of 10 groups of turtles, all groups were excreting salmonellae 9 months after hatching, and six groups excreted salmonellae a full year after hatching. Quantitative examination of water in tanks holding single turtles was undertaken. Quantitative studies indicate that turtles are extremely variable in their rate of excretion—more than 1,100 organisms per 100 ml. of water may be found 1 week and virtually no organisms will be found the next week in the same tank containing the same turtle.

REFERENCES

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- (5) Kaufmann, A. F., and Morrison, Z. L. : An epidemiologic study of salmonellosis in turtles. *Amer J Epidem* 84: 364-370, September 1966.

Demonstration on Preventing Electric Shock

To educate consumers about the safe use of electricity, the Public Health Service's Injury Control Program has developed an electric shock prevention demonstration kit. The kit is a mockup of a house with inside walls facing the audience; it shows electrical circuits including wiring outside the structure. The kit illustrates basic facts about electricity, electrical systems, grounding electric cords, and appliances that are applicable to the home environment. The kit, available before the end of 1967, will be used by Public Health Service personnel in demonstrations before organizations and community groups and other gatherings interested in home accident prevention.

A need exists to expand consumer education and to encourage manufacturers to design safer appliances. It is hoped that a proper understanding of electricity will help decrease the yearly toll of 1,000 Americans killed by accidental electrical shock.



Federal Publications

Reported Tuberculosis Data, 1965. *PHS Publication No. 638; 1967; 44 pages; 30 cents.* Presents data and statistics on tuberculosis morbidity and mortality. Includes recent information about the status of the disease in the United States. Points out changes that have influenced recent trends. Pinpoints the variety of components that require consideration in assessing the applicability and effectiveness of local, State, or national tuberculosis control activities.

Occupational Characteristics of Disabled Workers, by Disabling Condition. Disability insurance benefit awards made in 1959-1962 to men under age 65. *PHS Publication No. 1531; 1967; 307 pages; \$1.75.* Presents data in two tables. Table 1 shows the number of awards by age at time of filing and by the primary disease or condition which resulted in the disability. Table 2 presents the same data associated with each occupational group. Table 2 also includes a calculated index value denoted as a proportionate morbidity ratio.

Refresher Programs for Inactive Professional Nurses—A Guide for Developing Courses of Study. *PHS Publication No. 1611; 50 pages; 25 cents.* Presents a guide to help health agencies and institutions retrain inactive nurses and to prepare them for active practice in 1 month. Deals mainly with the nursing care of medical-surgical patients. Focuses on changing patterns of nursing practice and current methods of diagnosis and therapy, including use of the newer drugs. Outlines the essential components of refresher training, but encourages health agencies and institutions to determine their own specific educational content to meet the nursing needs of patients in their communities. Emphasizes clinical practice as an in-

dispensable part of refresher training. Outlines six units of study: overview of the course material, review of previously acquired skills, current practice in caring for medical-surgical patients, management of complications attending medical-surgical conditions, new diagnostic tests, and team nursing. Includes a skill inventory questionnaire to help nurses assess their familiarity with recent nursing procedures and concepts, and sponsors of refresher courses to know what training materials and experiences they must provide. Contains a suggested 4-week plan for class instruction and related clinical practice. Also includes a bibliography of about 150 recent articles in nursing periodicals, an additional bibliography of 24 major nursing reference books, and recommended films to support classwork and clinical practice in each unit.

Health Statistics from the U.S. National Health Survey. National Center for Health Statistics.

VARIANCE AND COVARIANCE OF LIFE TABLE FUNCTIONS ESTIMATED FROM A SAMPLE OF DEATHS. *PHS Publication No. 1000, Series 2, No. 20; March 1967; 8 pages; 15 cents.*

CALIBRATION OF TWO BICYCLE ERGOMETERS USED BY THE HEALTH EXAMINATION SURVEY. *PHS Publication No. 1000, Series 2, No. 21; February 1967; 10 pages; 15 cents.*

THREE VIEWS OF HYPERTENSION AND HEART DISEASE. *PHS Publication No. 1000, Series 2, No. 22; March 1967; 43 pages; 35 cents.*

CHARACTERISTICS OF PERSONS WITH IMPAIRED HEARING, United States, July 1962-June 1963. *PHS Publication No. 1000, Series 10, No. 35; 64 pages; 45 cents.*

HEALTH CHARACTERISTICS BY GEOGRAPHIC REGION, LARGE METROPOLITAN AREAS, AND OTHER PLACES OF RESIDENCE, United States, July 1963-June 1965. *PHS Publication No. 1000, Series 10, No. 36; April 1967; 58 pages; 40 cents.*

SERUM CHOLESTEROL LEVELS OF ADULTS, United States, 1960-1962. *PHS Publication No. 1000, Series 11, No. 22; March 1967; 23 pages; 25 cents.*

DECAYED, MISSING, AND FILLED TEETH IN ADULTS, United States, 1960-1962. *PHS Publication No. 1000, Series 11, No. 23; February 1967; 47 pages; 35 cents.*

MEAN BLOOD HEMATOCRIT OF ADULTS, United States, 1960-1962. *PHS Publication No. 1000, Series 11, No. 24; April 1967; 36 pages; 30 cents.*

MARRIAGE STATISTICS ANALYSIS, United States, 1962. *PHS Publication No. 1000, Series 21, No. 10; January 1967; 29 pages; 30 cents.*

NATALITY STATISTICS ANALYSIS, United States, 1964. *PHS Publication No. 1000, Series 21, No. 11; February 1967; 38 pages; 35 cents.*

Nurses Serve in Hurricane Betsy. *PHS Publication No. 1071-I-7; 1967; 60 pages.* Contains personal accounts of nine nurses who served in various capacities in New Orleans during Hurricane Betsy. The collection was prepared for members of the nursing profession, including student nurses, to acquaint them with actual conditions and problems encountered by nurses who serve in hospitals, shelters, and other facilities and health agencies during and following a major disaster. It will also be of interest to others concerned with predisaster health planning and disaster assignments.

This section carries announcements of new publications prepared by the Public Health Service and of selected publications prepared with Federal support.

Unless otherwise indicated, publications for which prices are quoted are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington D.C. 20402. Orders should be accompanied by cash, check, or money order and should fully identify the publication. Public Health Service publications which do not carry price quotations, as well as single sample copies of those for which prices are shown, can be obtained without charge from the Public Inquiries Branch, Public Health Service, Washington, D.C. 20201.

The Public Health Service does not supply publications other than its own.

MOULDING, THOMAS (National Jewish Hospital): *The realized and unrealized benefits from chemotherapy for tuberculosis. Public Health Reports, Vol. 82, September 1967, pp. 753-758.*

Chemotherapy has greatly improved the control of tuberculosis. By using optimal drug regimens, close to 100 percent therapeutic success can be achieved among previously untreated patients. Even among patients with isoniazid-resistant organisms who are considered treatment failures, 80-90 percent sputum conversion can be attained by aggressive, but careful, use of the relatively toxic retreatment drugs. Such successful treatment protects

the public by interrupting the patient's transmission of the disease to other people. Wider application of these optimal drug regimens is needed.

Chemotherapy makes it possible to shorten hospitalization for tuberculosis. Enforced bed rest is no longer needed, and the patient rapidly becomes noninfectious. The difficulty with such shortened hospitalization, however, is that outpatients frequently interrupt their medication

before completing the necessary 2 years of chemotherapy. To obviate such interruptions, exceedingly tight supervision of tuberculous outpatients is required, along with high-quality convenient services and intensive patient education.

Many health departments are deficient in this area of outpatient treatment, which should be their activity of first priority in tuberculosis control. Establishment of better supervised outpatient programs would make it possible to shorten hospitalization safely, producing both marked savings for the taxpayers and far more humane treatment for the tuberculous patient.

RAY, C. GEORGE (University of Washington School of Medicine), SCIPLE, GEORGE W., HOLDEN, PRESTON, and CHIN, TOM D. Y.: *Acute, febrile CNS illnesses in an endemic area of Texas. Epidemiologic and serologic findings, 1965. Public Health Reports, Vol. 82, September 1967, pp. 785-793.*

Investigations of the 1965 outbreak of febrile central nervous system (CNS) disease in Hale County, Tex., an endemic area for western equine encephalitis (WEE), St. Louis encephalitis (SLE), and enterovirus infections, revealed that 46 cases had occurred. WEE infections were the cause of 24 percent of the cases, SLE was associated with 9

percent, and enteroviruses with 11 percent.

A study of 400 serum samples during October 1965 showed that 61 to 83 percent of the population had neutralizing antibodies to three enteroviruses which had been associated with illness during 1964 and 1965 (ECHO 9, ECHO 11, and Coxsackie B2).

Neutralizing antibodies to WEE

were found in 27 percent and to SLE in 18 percent of persons tested. The highest proportion of persons without WEE antibodies was in the age group 0 to 4 years, and there was a rapid rise in WEE antibody prevalence after 4 years of age. However, the percentage distribution of SLE antibodies was low among children under 10 years of age.

Rural dwellers had a higher prevalence of WEE and SLE than urban dwellers. WEE antibodies were detected more frequently among Latin Americans than other groups. No significant racial differences were noted with respect to SLE antibodies.

NISWANDER, JERRY D. (Public Health Service), and ADAMS, MORTON S.: *Oral clefts in the American Indian. Public Health Reports, Vol. 82, September 1967, pp. 807-812.*

Clinical records of 25,341 Indians born in 46 Public Health Service hospitals from July 1963 through June 1966 revealed 35 cases of cleft lip with or without cleft palate (an incidence of 1.38 per 1,000) and 15 cases of isolated cleft palate (an incidence of 0.59 per 1,000).

Sufficient data are not yet available for extensive examination of possible intertribal variation in the frequency of oral clefts. In this preliminary study, however, consider-

able variation was seen in the degree of Caucasian admixture, using the mother's statement of degree of Indian ancestry as well as her ABO blood group and Rh type.

Because of the previously reported high frequency of cleft lip and cleft palate in Montana Indians, this area was examined in more detail. The findings suggested that a major gene has reached high frequency among the Flathead tribe.

Comparison of the overall frequencies in various racial groups showed that cleft lip with or without cleft palate in the American Indian is intermediate between Caucasians and other Mongoloids (Japanese), but isolated cleft palate occurs in Indians with a frequency almost identical to that in Japanese but higher than in Caucasians. Considering the degree of Caucasian admixture in the present-day Indian population, these findings are compatible with what is known of the genetic basis for the two malformations.

CHIAZZE, LEONARD, Jr. (Georgetown University School of Medicine), and CIOCCO, ANTONIO: *Intracommunity variation in cancer incidence for Pittsburgh. Public Health Reports, Vol. 82, September 1967, pp. 759-770.*

Results of a survey of the incidence of cancer in Pittsburgh, Pa., for the years 1957-58 were compared with results of a similar survey in 1947. The city was divided into 15

residence classifications with definable demographic characteristics, and the total incidence of cancer among whites in each area was determined for both 1957-58 and

1947. Substantial temporal and spatial variation in incidence was observed. The rankings of the areas according to incidence rates were, on the whole, dissimilar in the two periods. Rankings of the areas according to selected demographic characteristics, on the other hand, remained about the same.

MARSHALL, CARTER L. (University of Kansas Medical School), MAESHIRO, MIEKO, and KORPER, SAMUEL P.: *Attitudes toward leprosy in the Ryukyu Islands. Public Health Reports, Vol. 82, September 1967, pp. 795-801.*

A questionnaire was administered to 1,023 Ryukyuan, and the results were analyzed by age, sex, and type of community (urban or rural). Factual knowledge of the nature of leprosy was widespread at all ages and in both sexes, regardless of type of community. It was well known that Hansen's disease is caused by germs, that it need not result in crippling, that early treatment is effective, and that leprosy is curable.

Nevertheless, large numbers of respondents believed that all patients will eventually become crippled, that all patients should be iso-

lated permanently, and that even the most casual association with patients is a risk to the person concerned. This punitive or "unfavorable" attitude toward leprosy was most common in the older age (31 years old and over) groups. Younger (10-30 years old) persons seemed less afraid of Hansen's disease and less committed to isolating and ostracizing patients with leprosy.

The disparity between attitudes and factual knowledge is regarded primarily as a problem of image substitution. Older persons have personally observed the crippled, de-

formed patients with leprosy, and they equate leprosy with deformity. Patients who escape deformity also escape identification as leprosy victims. Thus, older persons in the Ryukyus having never recognized a person without deformity as a patient with leprosy find it hard to accept the concept that leprosy is curable and does not invariably result in deformity.

Younger people do not have this conflict and tend to accept, without reservation, theoretical knowledge of leprosy acquired in school or through the news media. Perhaps the most promising approach to changing attitudes toward leprosy is widespread publicity about the unmarked patients who escaped deformity and thus represent obvious cures.

HILBERT, MORTON S. (University of Michigan School of Public Health), and KIRSCHNER, SEYMOUR L.: *Autoclave and free-flowing-steam systems for heat treatment of infant formula: a comparative study of effectiveness. Public Health Reports, Vol. 82, September 1967, pp. 813-821.*

A 3-week study was undertaken to compare the bacteriological results obtained in samples of 11 different infant formulas after heat treatment in free-flowing-steam equipment (212° F. for 30 minutes) with those obtained in similar samples after heat treatment in an autoclave (230° F. for 10 minutes). The study included four separate phases of investigation: (a) study of the operating characteristics of the two

systems, (b) comparison of the two systems in relation to viable microorganisms, (c) comparison of the two systems using highly contaminated formulas, and (d) differentiating problems other than microbiological with bottled formula.

Practical sterility was not obtained with either system. Under the operating conditions of the study, the free-flowing-steam procedure produced more samples positive for

viable microorganisms than the autoclave procedure. When samples of formula were highly contaminated in the laboratory, again the flowing-steam procedure produced more positive samples than the autoclave.

The study results indicated that periodic characterization of the equipment and calibration of the quantitating devices are essential in order to obtain the required time and temperature conditions.

Parameters such as nipple inversion and caramelization were found of no significance in differentiating between the two systems. With the flowing-steam equipment, however, the bottles of formula cooled faster than with the autoclave.



TAUBENHAUS, LEON J. (Boston Department of Health and Hospitals), and KIRKPATRICK, JOHN R.: *Analysis of a hospital ambulance service. Public Health Reports, Vol. 82, September 1967, pp. 823-827.*

An analysis was made of the ambulance attendant's record of every third trip made by the Boston City Hospital's ambulance service during the 10-week period December 1, 1965, to February 10, 1966. Of 1,296 trips, 432 were analyzed. This study revealed that the hospital's ambulance service played only a minor role in the transportation of emergency patients. Only 120 ambulance trips were emergencies, while 280 were nonurgent. More often than not, emergency service was provided by the police department.

The ambulance service did, however, play an important role in the medical care system. It provided an essential transportation link between various medical care facilities and the city hospital (one-fourth of all trips were between hospitals). In this way it supported an unofficial system of progressive patient care, making it possible for the general hospital to discharge patients who otherwise would have difficulty in leaving the hospital. It also served to create an important link between nursing homes and the hospital.

Patients brought to the hospital by the ambulance service were usually ill, even those not classified as emergency cases. Two-thirds of the 204 patients arriving by hospital ambulance were admitted to the hospital.

This study indicates the value of analyzing a hospital ambulance service. The information gained can be useful in planning for the purchase of ambulance equipment, as well as for the training of ambulance personnel. Likewise, this type of information can be used in planning for a more effective use of the ambulance service.

FERRI, ESTHER S. (Northeastern Radiological Health Laboratory), and CHRISTIANSEN, HOWARD: *Lead-210 in tobacco and cigarette smoke. Public Health Reports, Vol. 82, September 1967, pp. 828-832.*

Tests of six brands of cigarettes have shown that lead-210 is a component of mainstream smoke. These brands of cigarettes included two which were nonfiltered, and one each with a cellulose filter, a cellulose and charcoal filter, a cellulose and charcoal filter with the tobacco treated for the removal of "tars" and nicotine, and a cellulose filter with pipe tobacco.

In smoke from five brands, the lead-210 activity was about half the polonium-210 activity. Compared with average levels of lead-210 inhaled from air in normal breathing, the intake of lead-210 from four brands of cigarettes was double the lead-210 in air, and in two brands was about equal to the lead-210 in air.

A constant relationship between

levels of radioactivity, tar, and nicotine content of the smoke could not be demonstrated. Using a recent model established by the International Commission on Radiological Protection, dosages to the pulmonary compartment of the respiratory tract were calculated, for each of the six brands, for a person smoking 20 cigarettes per day. These results showed that the radiation dose to the lung from inhalation of lead-210 in smoke plus the subsequent daughter ingrowth was equal to the dose from polonium-210 in smoke.

KAUFMANN, ARNOLD F. (Public Health Service), FEELEY, JAMES C., and DeWITT, WALLIS E.: *Salmonella excretion by turtles. Public Health Reports, Vol. 82, September 1967, pp. 840-842.*

A group of 100 turtles, naturally infected with salmonellae, was studied to see how long they would excrete the organisms. Of 10 groups of turtles, all groups were excreting

salmonellae 9 months after hatching, and six groups excreted salmonellae a full year after hatching. Quantitative examination of water in tanks holding single turtles was

undertaken. Quantitative studies indicate that turtles are extremely variable in their rate of excretion—more than 1,100 organisms per 100 ml. of water may be found 1 week and virtually no organisms will be found the next week in the same tank containing the same turtle.